FINAL
Paper 14

Strategic Financial Management

Study Notes
SYLLABUS 2022

The Institute of Cost Accountants of India
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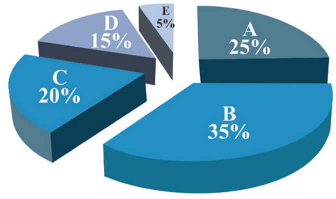
PAPER 14: STRATEGIC FINANCIAL MANAGEMENT

Syllabus Structure:

The syllabus comprises the following topics and study weightage:

Module No.	Module Description	Weight
	Section A : Investment Decisions	**25%**
1	Investment Decisions, Project Planning and Control	10%
2	Evaluation of Risky Proposal for Investment Decisions	10%
3	Leasing Decisions	5%
4	Securitization	
	Section B: Security Analysis and Portfolio Management	**35%**
5	Introduction	5%
6	Equity and Bond Valuation and Evaluation of Performance	15%
7	Mutual Funds	
8	Portfolio Theory and Practice	15%
9	Asset Pricing Theories	
10	Portfolio Performance Evaluation and Portfolio Revision	
11	Efficient Market Hypothesis	
	Section C: Financial Risk Management	**20%**
12	Risks in Financial Market	20%
13	Financial Derivatives - Instruments for Risk Management	
	Section D: International Financial Management	**15%**
14	The International Financial Environment	5%
15	Foreign Exchange Market	10%
16	Foreign Exchange Risk Management	
	Section E: Digital Finance	**5%**
17	Digital Finance	5%



Learning Environment

Subject Title	**STRATEGIC FINANCIAL MANAGEMENT**
Subject Code	**SFM**
Paper No.	**14**
Course Description	The subject Strategic Financial Management deals with three key areas of strategic decision making with respect to financial resources, namely, long term investment decisions, management of investment portfolio and management of risk in national and internal operations. It provides a detailed understanding of various alternatives approaches of capital budgeting and project appraisal under a deterministic environment and complements the discussion with detail coverage of different techniques for incorporating the uncertainty element in project evaluation. The subject provides a detail account of the alternative approaches towards security analysis and portfolio performance evaluation and portfolio revision. It also provides a detail coverage on various risk management techniques including use of derivatives with an added emphasis on risk management in international operations. In addition to the above, the subject gives an overview of the components of a digital finance ecosystem and highlights the interaction among them.
CMA Course Learning Objectives (CMLOs)	1. Interpret and appreciate emerging national and global concerns affecting organizations and be in a state of readiness for business management. a. Identify emerging national and global forces responsible for enhanced/varied business challenges. b. Assess how far these forces pose threats to the status-quo and creating new opportunities. c. Find out ways and means to convert challenges into opportunities 2. Acquire skill sets for critical thinking, analyses and evaluations, comprehension, syntheses, and applications for optimization of sustainable goals. a. Be equipped with the appropriate tools for analyses of business risks and hurdles. b. Learn to apply tools and systems for evaluation of decision alternatives with a 360-degree approach. c. Develop solutions through critical thinking to optimize sustainable goals. 3. Develop an understanding of strategic, financial, cost and risk-enabled performance management in a dynamic business environment. a. Study the impacts of dynamic business environment on existing business strategies. b. Learn to adopt, adapt and innovate financial, cost and operating strategies to cope up with the dynamic business environment. c. Come up with strategies and tactics that create sustainable competitive advantages. 4. Learn to design the optimal approach for management of legal, institutional, regulatory and ESG frameworks, stakeholders' dynamics; monitoring, control, and reporting with application-oriented knowledge. a. Develop an understanding of the legal, institutional and regulatory and ESG frameworks within which a firm operates. b. Learn to articulate optimal responses to the changes in the above frameworks. c. Appreciate stakeholders' dynamics and expectations, and develop appropriate reporting mechanisms to address their concerns. 5. Prepare to adopt an integrated cross functional approach for decision management and execution with cost leadership, optimized value creations and deliveries. a. Acquire knowledge of cross functional tools for decision management. b. Take an industry specific approach towards cost optimization, and control to achieve sustainable cost leadership. c. Attain exclusive knowledge of data science and engineering to analyze and create value.

Subject Learning Objectives [SLOB(s)]	1. To obtain in-depth knowledge on application of various techniques of project evaluation under a deterministic environment as well as techniques of incorporating the element of uncertainty in project appraisal. (CMLO 2a, 2b) 2. To develop detailed understanding of how to make strategic choices in long term investment decisions such as own or lease and making optimal allocation of limited funds. (CMLO 3c) 3. To equip oneself with the knowledge of application of various techniques in security evaluation, building a portfolio, measuring its performance and making revisions to optimise the returns. (CMLO 3a) 4. To develop detail understanding of the sources and impact of risks to which an organisation is exposed to in a dynamic business environment at national and international level and the techniques for managing the same to sustain competitive advantages. (CMLO 3b, 3c) 5. To obtain an overview of various components of digital finance to better understand the interrelationship among them. (CMLO 1a, b, c)
Subject Learning Outcomes (SLOC) and Application Skills (APS)	**SLOCs:** 1. Students will be able to perform project appraisals, allocation of limited funds among competing projects and making strategic choices in long term investment decisions. 2. They will be able to identify the risks associated with various functional areas of the organisation and evaluate the alternative risk management techniques. 3. They will be able to build profitable portfolios and evaluate their performance continuously to identify if any revision is warranted. **APSs:** 1. They will develop necessary skill to prepare project appraisal reports and guide the management in selecting the appropriate one. 2. They will be able to prepare risk reports to be submitted to the management to facilitate strategic decision making relating to the functional areas of the organisation. 3. They will be able to prepare periodic portfolio performance reports to facilitate portfolio revision decisions.

Module wise Mapping of SLOB(s)			
Module No.	**Topics**	**Additional Resources (Research articles, books, case studies, blogs)**	**SLOB Mapped**
Section A: Investment Decisions			
1	Investment Decisions, Project Planning and Control	Capital Budgeting Techniques Among The Fortune 500: A Rationale Approach - Burns and Walker https://www.emerald.com/insight/content/doi/10.1108/eb018643/full/html	1. To obtain in-depth knowledge on application of various techniques of project evaluation under a deterministic environment as well as techniques of incorporating the element of uncertainty in project appraisal.
2	Evaluation of Risky proposal for Investment decisions	Capital-Budgeting Decisions Involving Combinations of Risky Investments – J C Van Horne https://pubsonline.informs.org/doi/abs/10.1287/mnsc.13.2.b84	
3	Leasing Decisions	The Leasing Decision: A Comparison of Theory and Practice – Drury and Braund https://www.tandfonline.com/doi/abs/10.1080/00014788.1990.9728876	

Section B: Security Analysis and Portfolio Management			
4	Securitization	Introduction to Securitization – Fabozzi, Kothari https://books.google.co.in/books?hl=en&lr=&id=DReWAAAAQBAJ&oi=fnd&pg=PT6&dq=securitization&ots=SwP5p0u-NO&sig=jBrJi0h0HwyTa3zCfGO18pJ5Zxo&redir_esc= y#v=onepage&q=securitization&f=false	2. To develop a detailed understanding on how to make strategic choices in long term investment decisions such as own or lease and making optimal allocation of limited funds.
5	Introduction to Security Analysis	Fundamental and technical analysis: substitutes or complements? – Bettman, Sault and Schultz https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-629X.2008.00277.x	To equip oneself with the knowledge of application of various techniques in security evaluation, building a portfolio, measuring its performance and making revisions to optimise the returns.
6	Equity and Bond Valuation and Evaluation of Performance	Convertible Bond Valuation: An Empirical Test – R. King https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1475-6803.1986.tb00435.x	
7	Mutual Funds	The Origins of Mutual Funds – Rouwenhorst https://papers.ssrn.com/sol3/papers.cfm?abstract_id=636146	
8	Portfolio Theory and Practice	The Markowitz Contribution to Portfolio Theory – Witt & Dobbins https://www.emerald.com/insight/content/doi/10.1108/eb013433/full/html	
9	Asset Pricing Theories	The Capital Asset Pricing Model: Some Empirical Tests – Jensen, Black & Scholes https://papers.ssrn.com/sol3/papers.cfm?abstract_id=908569	
10	Portfolio Performance Evaluation and Portfolio Revision	A Note on Ambiguity in Portfolio Performance Measures – Peterson & Rice https://www.jstor.org/stable/2327098	
11	Efficient Market Hypothesis	Information efficiency in the stock markets in India – Sarkar https://shodhganga.inflibnet.ac.in/handle/10603/156663	

Section C: Financial Risk Management			
12	Risks in Financial Market	Financial Market Risks during the COVID-19 Pandemic – Haroon et al. https://www.tandfonline.com/doi/abs/10.1080/1540496X.2021.1873765	To develop a detail understanding of the sources and impact of risks to which an organisation is exposed to in a dynamic business environment at national and international level and the techniques for managing the same to sustain competitive advantages.
13	Financial Derivatives - Instruments for Risk Management	Derivatives and Risk Management – Fabozzi https://jpm.pm-research.com/content/25/5/16.abstract	
Section D : International Financial Management			
14	The International Financial Environment	Innovation in the International Financial Markets – Dufey & Giddy https://link.springer.com/article/10.1057/palgrave.jibs.8490577	
15	Foreign Exchange Market	Foreign Exchange Market Structure, Players and Evolution – King et al. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1935858	
16	Foreign Exchange Risk Management	Management of foreign exchange risk: a review article – Jacque https://www.sciencedirect.com/science/article/pii/B9780408108416500294	
Section E : Digital Finance			
17	Digital Finance	Impact of digital finance on financial inclusion and stability – Ozili https://www.sciencedirect.com/science/article/pii/S2214845017301503	To obtain an overview of various components of digital finance to better understand the interrelationship among them.

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SECTION - A

INVESTMENT DECISIONS

Investment Decisions, Project Planning and Control

1

This Module Includes:

1.1 Measuring Cash Flows, Discounted Cash Flow Technique for Project Evaluation

1.2 NPV and IRR - Conflict and Resolution, The Modified Internal R`ate of Return (MIRR), Comparing Projects with Unequal Lives, The Concept of Abandonment Value, Modified Accelerated Cost Recovery System (MACRS)

1.3 Inflation Adjusted Cash Flow Forecasting in Capital Budgeting

1.4 Capital Rationing for Divisible and Non – divisible Projects (with Application of Integer Programming)

1.5 Social Cost Benefit Analysis

Investment Decisions, Project Planning and Control

SLOB Mapped against the Module

1. To obtain in-depth knowledge on application of various techniques of project evaluation under a deterministic environment as well as techniques of incorporating the element of uncertainty in project appraisal. (CMLO 2a, 2b)
2. To develop detailed understanding of how to make strategic choices in long term investment decisions such as own or lease and making optimal allocation of limited funds. (CMLO 3c)

Module Learning Objectives:

After studying this module, the students will be able to –

- Develop a theoretical understanding of various techniques of project evaluation.
- Understand the reasons behind the conflict between NPV and IRR and various methods to resolve the same.
- Know the technique for inflation adjusted cash flow forecasting and capital budgeting.
- Learn the technique for capital rationing for divisible and non-divisible projects.
- Understand the relevance of social cost and benefit analysis in capital budgeting.

Introduction 1

Financial management aims at procuring the funds in the most economic and prudent manner and optimum utilization of the same in order to maximize value of the firm. Accordingly, the broad areas of decisions concerning financial management are: investment decisions, financing decisions and dividend decisions.

The investment decisions may relate to long-term investment or short-term investment. The long-term investment decisions are related to investment in long-term assets or projects for generating future benefits. Such decisions are popularly known as capital budgeting decisions. In accounting, any expenditure for earning future income over a long period of time is known as capital expenditure. Therefore, long term investment decisions are also known as capital expenditure decisions.

Such decisions may relate to the new investments in case of a newly established firm or an existing firm, e.g., purchase of a new machinery, setting up of a new plant, taking up a new project, etc. Apart from new investments, there may be investments for replacement or modernization or expansion programme. Investment may also be required for diversification into new product lines, new market etc.

Long term investment decisions are considered as the most important decisions in financial management. These decisions involve substantial amount of investment to be blocked for a sufficiently larger timespan, the returns are uncertain and there is possibility of incurring huge amount of losses if such decisions are required to be reversed. In other worlds, such decisions involve a largely irreversible commitment of resources with long term implications having its huge impact on the future growth and profitability of the firm. This is why, long term investment decisions require, at the planning stage, a detail evaluation of the financial viability of the project by appropriate evaluation techniques. In addition, a detailed analysis of marketing, technical, economic (social cost benefit) and ecological aspects of different alternative investment opportunities is required to be conducted. Market analysis focuses on the demand for the proposed products or services desired to be provided through the investment proposal, expected market share, etc. Technical analysis considers the preliminary tests, layout of the factory, availability of inputs, etc. Social Cost Benefit analysis focuses on the possible impact of the investment proposal from the societal point of view. Ecological analysis or Environmental analysis considers the impact of the proposed investment on the environment. Many projects like power project, projects relating to chemical, leather processing etc., may have significant environmental implications, hence, the assessment of the likely damage caused by such projects on the environment and cost of controlling or restoring such damages should also form part of the analyses.

Once the investment is made towards commissioning a project or setting up of manufacturing facilities, process of periodical performance review should be started with a view to compare the actual performance with the planned or projected performance and initiate control procedure.

Measuring Cash Flows, Discounted Cash Flow Technique for Project Evaluation

1.1

1.1.1 Estimation of Project Cash Flow

Financial analysis of long-term investment decisions basically involves estimating cost of the asset / project and benefits receivable therefrom over the economic life of the asset or project. Estimating cost is relatively easier as it is conventionally incurred in the current period only, but estimating benefits is very difficult as it relates to future period involving risk and uncertainty.

For estimating benefits, two alternatives are available – (i) Cash Inflow and (ii) Accounting Profit. The cash flow approach is considered as superior to accounting profit approach as cash flows are theoretically better measure of net economic benefits associated with the long-term investments. Moreover, as cost of investment is represented by cash outflows, benefit out of such investment is better represented through cash inflows. The difference between the two measures – cash flow and accounting profit – arises because of inclusion of some non-cash items, e.g., depreciation, in determining accounting profit. Moreover, accounting profit differs depending on the accounting policies, procedures, methods (e.g., method of depreciation, method of inventory valuation) adopted by the organisation.

The cash flows associated with a proposal may be classified into: (i) Initial Cash Flow, (ii) Subsequent Cash Flow and (iii) Terminal Cash Flow.

(i) Initial Cash Flow: Any long-term investment decision will involve large amount of initial cash outlay. It reflects the cash spent for acquiring the asset, known as initial cash outflow. For estimating the initial cash outflow, the following aspects are taken into consideration.

(a) The cost of the asset, installation cost, transportation cost and any other incidental cost, i.e., all the costs to be incurred for the asset in order to bring it to workable condition, are to be taken into consideration.

(b) Sunk cost which has already been incurred or committed to be incurred, and hence, which has no effect on the present or future decision, will be ignored as it is irrelevant cost for the decision. For example, a plot of land which is owned by the firm and lying idle is the sunk cost, hence, the cost of such plot of land will not be considered for estimating the initial cost, but if it has any alternative use, the opportunity cost of such alternative use is the relevant cost and such opportunity cost will have to be considered. On the other hand, if a new plot of land is required to be purchased for the proposal, the cost of such plot of land is the relevant cost and will form part of initial investment.

(c) Investment decisions relating to replacement of an existing asset usually involve salvage value of the old item which is considered as cash inflow and is subtracted from the cash outflow relating to the installation of the new asset. Therefore, tax on gain on sale of asset has to be added and tax on loss on sale has to be subtracted in order to determine initial cash outflow.

(d) Change in working capital requirement due to the new investment decision is also required to be considered to determine the initial cash flow. If additional working capital is required, it will increase the initial cash outflow. On the other hand, in a replacement situation, if requirement of working capital is decreased, such decrease in working capital requirement will reduce the total initial cash outflow.

Initial Cash Outflow:

Cost of the new asset including installation, transportation and other incidental costs related to the asset

(+/-) Change in working capital requirement (Addition for increase, Subtraction for decrease)

(–) Salvage value of the old asset (in case of replacements of old asset)

(–) Tax savings for loss on sale of asset (if the block ceases to exist due to sale of old asset), or

(+) Tax payable for profit on sale of asset (if the block ceases to exist due to sale of old asset)

(ii) Subsequent Cash Flow

In conventional cash flow, cash outflow occurs at the initial period and a series of cash inflows occur in the subsequent periods. On the other hand, non-conventional cash flow involves intermittent cash outflows in the subsequent periods also for major repairing, additional working capital requirement, etc. Therefore, apart from estimating initial cash flow, subsequent cash flows are also required to be estimated. For estimating future cash inflows, i.e., cash inflows of the subsequent periods, the following aspects need to be considered.

(a) Cash inflows are to be estimated on an after-tax basis.

(b) Depreciation being a non-cash item is to be added back to the amount of profit after taxes.

(c) Interest being a financial charge will be excluded for estimating cash inflow for investment decisions (Interest Exclusion Principal). However, interest (on debt capital) is taken into consideration for determining weighted average cost of capital which is used for discounting the cash inflows to arrive at its present value.

Net Cash Inflow after Taxes (CFAT):

Net Sales Revenue

Less: Cost of Goods Sold

Less: General Expenses (other than Interest)

Less: Depreciation

Profit before Interest and Taxes (PBIT or EBIT)

Less: Taxes

Profit after Taxes (excluding Interest) [PAT]

Add: Depreciation

Net Cash Inflow after Taxes

In short, CFAT = EBIT (1 – t) + Depreciation [where, t is income tax rate]

Note: If PAT is taken from accounting records, which is arrived at after charging Interest, 'Interest Net of Taxes' is to be added back along with the amount of Depreciation, i.e., PAT after charging Interest

Add: Depreciation

Add: Interest Net of Taxes (i.e., Total Interest – Tax on Interest)

Net Cash Inflow after Taxes

Consider the following illustration.

Illustration 1

	₹	₹
Net Sales Revenue		10,00,000
Less: Cost of Goods Sold	5,00,000	
Less: Operating Expenses	2,00,000	
Less: Depreciation	1,00,000	8,00,000
PBIT or EBIT		2,00,000
Less: Interest		50,000
PBT or EBT		1,50,000
Less: Tax (30%)		45,000
PAT		1,05,000
Net Cash Inflow after Taxes:		₹
EBIT		2,00,000
Less: Tax (30%)		60,000
		1,40,000
Add: Depreciation		1,00,000
Net Cash Inflow after Taxes		2,40,000

Alternatively,

	₹	₹
PAT		1,05,000
Add: Depreciation		1,00,000
		2,05,000
Add: Interest Net of Taxes:		
Total Interest	50,000	
Less: Tax on Interest (30%)	15,000	35,000
Net Cash Inflow after Taxes		2,40,000

(iii) **Terminal Cash Flow:**

At the end of the economic life of the asset or at the time of termination of the project, usually some additional cash inflows occur in addition to the operating cash inflows, viz., salvage value of the asset, release of working capital (the working capital that is introduced at the beginning will no longer be required at the end of the life of the asset or at the termination of the project). Moreover, tax impact on gain or loss on sale of the asset if the block of asset ceases to exist may also lead to some equivalent cash inflow or outflow.

Terminal Cash Inflow:

Salvage or Scrap Value

(+) Tax Savings on Loss on Sale of Asset; or

(-) Tax Burden on Gain on Sale of Asset

(+) Release of Working Capital

1.1.2 Importance of Relevant Cost Analysis for Projects

Relevant costs or revenues are those expected future costs or revenues that differ among alternative courses of action. It is a future cost/revenue that would arise as a direct consequence of the decision under review and it differs among the alternative courses of action.

Relevant cost analysis or relevant costing is used for various managerial decisions like:

- Make or buy decision
- Accepting or rejecting a special order
- Continuing or discontinuing a product line
- Using scarce resources optimally, etc.

In the context of investment decisions, incremental cash flows are considered as relevant. The sunk costs, which have already been incurred, or committed costs which are committed to be incurred in future, are considered as irrelevant, as it will have no impact on whatever decisions are taken. However, the opportunity costs, imputed costs, out of pocket costs, avoidable costs and differential costs are relevant.

Consider the following illustration.

Illustration 2

A company is considering replacement of one of its old machines, purchased three years ago at a cost of ₹5,00,000 with a life of 5 years. It follows straight line method of depreciation. Annual revenue from the sale of the product manufactured using the machine is ₹5,50,000 and the annual operating cost is ₹4,00,000. The current salvage value of the machine is ₹1,00,000. The cost of the new machine is ₹3,00,000 and its salvage value at the end of its life 2 years is nil. The annual operating cost of the new machine is estimated at ₹2,30,000 and the revenue is expected to be same as to that of the old machine.

Relevant Costs and Revenues are shown below:

Particulars	Old	New	Difference	Relevant or not
Revenue (For next two years) *	11,00,000	11,00,000	Nil	Not Relevant
Book Value of Old Machine at the end of three years	2,00,000	--	--	Not relevant (Sunk Cost)
Current Salvage Value	1,00,000	--	1,00,000	Relevant
Cost of the new machine	--	3,00,000	(3,00,000)	Relevant
Operating Cost (2 years)	8,00,000	4,60,000	3,40,000	Relevant

*(as the old machine with a life of 5 years is being considered for replacement after 3 years)

1.1.3 Discounted Cash Flow Technique for Project Evaluation

For financial appraisal of the project / investment proposals different techniques are used. These methods or techniques can broadly be categorized into two groups – Non-Discounted Cash Flow Methods and Discounted Cash Flow.

Non-Discounted Cash Flow methods consider the cash flows over the life of the projects similarly. In other words, here it is assumed that cash flows in different time periods do not have any time value and hence are directly additive. These methods are again divided into two groups –

1. Accounting or Average Rate of Return (ARR)
2. Payback Period:
    a. Traditional Payback Period
    b. Payback Profitability
    c. Payback Reciprocal

As against the Non-Discounted Cash Flow methods, **Discounted Cash Flow** methods assume that cash flow over different time periods are not directly additive as they involve time value of money. Hence, before making any analysis, one has to convert them into cash flows at the same parlance i.e. either compounded cash flows or discounted cash flows. Since conceptually the latter is more realistic, these methods first convert the cash flows into their present values and then conduct the analysis.

Depending upon a few other project specific considerations these methods can be as follows:

1. Discounted Pay Back Period
2. Net Present Value (NPV)
3. Profitability Index or Benefit Cost Ratio
4. Adjusted Net Present Value (ANPV)
5. Internal Rate of Return (IRR)
6. Modified NPV
7. Modified IRR

Non-Discounted Cash Flow Methods

1. Accounting or Average Rate of Return Method:

Accounting or average rate of return method Accounting or Average Rate of Return (ARR) method measures the average annual net income out of the project (incremental income) as a percentage of the investment. After calculation of ARR, the same is compared with a predetermined or minimum required rate of return or cut-off rate set up by the management. The project is accepted if the ARR is higher than the minimum desired ARR.

ARR can be calculated as follows:

$$\text{Accounting or Average Rate of Return (ARR)} = \frac{\text{Average Annual Profit after Tax}}{\text{Average Investment}} \times 100$$

Where, Average annual profit after tax =

Total profit after depreciation and tax of the whole life of the project /Project Life (in years)

Where equal amount of depreciation is charged every year,

Average Investment = Half of the Depreciable Part (Cost – Salvage Value) + Non-Depreciable Part (Salvage Value).

In other cases, average investment is to be determined taking the book value of the investment of different years separately and average is to calculated accordingly.

- **Decision Rules:**

  1. **Acceptance/Rejection Decision:** A project is accepted if it generates returns higher than the target/cut off ARR.

  2. **Mutually Exclusive Decision:** The project which gives the highest ARR over the minimum required rate of return, is acceptable.

Consider the following illustration.

Illustration 3

A project costing ₹10 lakhs having a life of 5 years is expected to generate Profit before tax and depreciation of ₹2,50,000; ₹3,00,000; ₹3,50,000; ₹4,00,000 and ₹5,00,000 respectively. Assume 33.99% tax and 30% depreciation on WDV Method. Compute ARR.

Solution:

Computation of ARR

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Average
PBDT	2,50,000	3,00,000	3,50,000	4,00,000	5,00,000	3,60,000
Less: Depreciation	3,00,000	2,10,000	1,47,000	1,02,900	72,030	1,66,386
EBT / PBT	(50,000)	90,000	2,03,000	2,97,100	4,27,970	1,93,614
Less: Tax @ 33.99%	-	#13,596	69,000	1,00,984	1,45,467	65,809
EAT / PAT	(50,000)	76,404	1,34,000	1,96,116	2,82,503	1,27,805

Average Investment

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Beginning	10,00,000	7,00,000	4,90,000	3,43,000	2,40,100
Depreciation	3,00,000	2,10,000	1,47,000	1,02,900	72,030
End	7,00,000	4,90,000	3,43,000	2,40,100	1,68,070
Average	8,50,000	5,95,000	4,16,500	2,91,550	2,04,085

So, ARR = $\frac{\text{Average Annual Profit after Tax}}{\text{Average Investment}} \times 100 = \frac{1,27,805}{4,71,427} \times 100 = 27.11\%.$

\# Note: Unabsorbed depreciation of Yr. 1 is carried forward and set-off against profits of Yr. 2. Tax is calculated on the balance of profits

= 33.99% (₹90,000 – ₹50,000) = ₹13,596.

- **Advantages**

  a. It is simple to understand.

  b. It is easy to operate and compute.

  c. Income throughout the project life is considered.

  d. In this method the net income after depreciation is used, therefore it is theoretically sound.

- **Limitations**

  a. It does not consider cash inflows (CFAT), which is important in project evaluation rather than PAT.

  b. It ignores time value of money, which is important in capital budgeting decisions.

2. Payback Period Method:

(a) Traditional Payback Period: This is a traditional or non-time value adjusted technique based on cash flow rather than profit. In other words, here numerical values of benefits i.e., cash flow are added over the years directly i.e., without discounting them.

- **Definition of Pay Back Period (PBP):**

Pay-back period is the period required by the firm to recover the original investment from the net cash flows of an investment project. It is basically an application of the 'break-even' concept to investment.

- **Determination of PBP:**

i) When annual cash inflows are uniform:

PBP = Cost of Investment/Annual Cash flow.

Illustration 4

A project requires an initial investment of ₹3,00,000. It yields annual cash inflow of ₹60,000 for 8 years. You are required to find out the pay-back period of the project.

Solution:

PBP = Cost of Investment/Annual Cash flow. = 300000/60000 = 5 Years.

ii) When the annual cash inflows are not uniform:

Here PBP is determined at that point of time when cumulative cash flow becomes equal to the initial investment.

$$\text{PBP} = \text{Base Year} + \frac{\text{Investment Amount - Cumulative Cash Inflow till Base Year}}{\text{Cumulative Cash Inflow for Next Year - Cumulative Cash Inflow till Base Year}}$$

Illustration 5

A project requires an initial investment of ₹3,00,000. It yields cash inflow of ₹60,000, ₹50,000, ₹70,000, ₹75,000, ₹90,000, ₹60,000 for next 6 years. You are required to find out the pay-back period of the project.

Solution:

Calculation of payback period-

Years	Cash Inflows (₹)	Cumulative Cash Inflows (₹)
1	60,000	60,000
2	50,000	1,10,000
3	70,000	1,80,000
4	75,000	2,55,000
5	90,000	3,45,000
6	60,000	4,05,000

In 4 years ₹ 2,55,000 are recovered.

$$\therefore \text{ PBP} = 4 \text{ years} + \frac{3,00,000 - 2,55,000}{3,45,000 - 2,55,000}$$

$$\text{PBP} = 4 \text{ years} + 0.5$$

$$= 4.5 \text{ years.}$$

- **Decision Rules:**

1. **Acceptance/ Rejection Decision:**

   A project is accepted only if the PBP is lower than the target PBP set by the management.

2. **Mutually Exclusive Decision:**

   The project with least PBP should be accepted.

- **Some Critical Issues:**

Though PBP method, as a traditional or non-time value adjusted method, is considered to be a better method than Accounting Rate of Return, it may mislead the decision maker in a number of situations.

For example, if the projects differ significantly in terms of the investment size, then it is very likely that the larger project will have higher PBP than the smaller one. In that case PBP may mislead while choosing between mutually exclusive projects. This dilemma is due to the size difference of the projects.

Similarly, if the projects differ in terms of life, then again accepting a project with lower PBP may not be a wise decision, if the other one is having a longer life after PBP where the profit potential is likely to be better.

In order to overcome the above limitations, traditional PBP method should not be used blindly but should be supplemented by some other criteria.

Two important extensions of traditional PBP are suggested therefore.

(a) Payback Reciprocal: It is the reciprocal of Payback Period, i.e., 1÷ Pay Back Period.

Therefore,

$$\text{Payback Reciprocal} = \frac{\text{Average Annual Net Cash Inflow after Taxes (i.e. CFAT p.a)}}{\text{Initial Investment}}$$

Higher the payback reciprocal, better is the project.

The Payback Reciprocal is considered to be an approximation of the Internal Rate of Return, if- (i) The life of the project is at least twice the payback period and (ii) The project generates equal amount of the annual cash inflows.

Illustration 6

A project with an initial investment of ₹50 Lakh and life of 10 years, generates CFAT of ₹10 Lakh per annum. Calculate the Payback Reciprocal.

Solution:

The Payback Reciprocal will be ₹10 Lakhs ÷ ₹50 Lakhs = 1/5 or 20%.

(b) Post Payback Profitability: This variant of traditional PBP method is meant for providing an additional support in decision making in case the two projects that differ significantly in terms of their life. This is because, traditional PBP only takes care of the risk involved. In such a case, a project with relatively higher PBP which is rejected on such ground under traditional PBP method, may have more life left post payback and may earn higher overall profit to the organisation.

Illustration 7

A project requires an initial investment of ₹2,00,000. It yields annual cash inflow of ₹40,000 for 8 years. You are required to find out the pay-back profitability of the project.

Solution:

Payback Profitability = 40,000 × 8 – 2,00,000 = ₹1,20,000

Discounted Cash Flow Methods

One of the major limitations of ARR or Pay Back method of investment appraisal techniques is that they do not take into consideration time value of money. Time value of money refers to the phenomena that money received now and that received in a future period cannot have the same worth because of a number of factors including uncertainty involved in future events, opportunity costs, deferment of present consumption etc. Hence benefits or costs in whatever form (profit or cash flow) belonging to two different time periods are never additive unless they are converted into similar parlance (either future value or present value). As a result, non-discounted cash flow methods like ARR and Payback Period may often mislead the decision maker.

This is why experts suggest time adjusted or discounted cash flow techniques which essentially require discounting all future benefits and costs before aggregating them to arrive at any conclusion.

1. Discounted Payback Period:

Discounted Payback Period (DPBP) is the payback period calculated on the basis of discounted cash flows, i.e., present value of cash flows, over the life of the project. This is determined based on the same principles as in case of Traditional Payback Period with the improvement over the consideration of time value of money.

The procedure for computation of Discounted Payback Period is as follows:

Step 1: Determine the Total Cash Outflow of the project. (Initial Investment)

Step 2: Determine the Cash Inflow after Taxes (CFAT) for each year.

Step 3: Determine the present value of net cash inflow after taxes (CFAT)

= CFAT of each year × PV Factor for that year.

Step 4: Determine the cumulative present value of DCFAT of every year.

Step 5: Find out the Discounted Payback Period as the time at which cumulative DCFAT equals Initial Investment. This is calculated on "time proportion basis".

Illustration 8

X Ltd. is considering a project with following cash flow pattern.

Year	1	2	3	4	5
CFAT (₹)	10,000	15,000	20,000	25,000	20,000

Initial investment of the project is ₹ 60,000 and cost of capital is 10% p.a. Calculate DPBP.

Solution:

Calculation for DPBP

Year	CFAT (₹)	PVIF @ 10%	PV of CFAT	Cumulative of CFAT
1	10,000	0.909	9090	9090
2	15,000	0.826	12390	21480
3	20,000	0.751	15020	36500
4	25,000	0.683	17075	53575
5	20,000	0.621	12420	65995

Cumulative Discounted Cash Flow exceeds the initial investment of ₹ 60,000 in the year 5. Therefore, payback period is after 4 years before completion of the 5th year.

$$\text{DPBP} = 4 \text{ years} + \frac{60{,}000 - 53{,}575}{65{,}995 - 53{,}575}$$

DPBP = 4 years + 0.52

DPBP = 4.52 years

- **Decision Rules:**

    a. Acceptance/rejection Decision: The project is accepted if its DPBP is lower than the target value or cut-off value decided by the management.

    b. Mutually Exclusive Decision: Among a number of competing projects satisfying the cut-off DPBP, the project with the least DPBP is ultimately selected.

2. Net Present Value Method:

Technically, NPV is defined as the excess of present value of cash inflows in any investment project over and above the present value of cash outflows in that project.

In other words, NPV = PV of Cash Inflows – PV of Cash Outflows.

Symbolically, NPV $=\sum_{t=1}^{n}\frac{CI_t}{(1+K)^t}-\sum_{t=1}^{n}\frac{CO_t}{(1+K)^t}$ where, CI_t = Cash inflow for the period t; CO_t = Cash Outflow for the period t and K = Appropriate discounting rate.

Thus, NPV basically signifies the profitability of the project in present value terms.

Following table summarizes the steps of calculating NPV.

Steps	Projects with Non-conventional Cash Flow Structure	Projects with Conventional Cash Flow Structure
1.	Determine the cash inflows and outflows associated with the project (CI and CO)	
2.	Identify the appropriate discounting rate (preferably the cost of capital)	
3.	Calculate the present value of all cash inflows i.e., $\sum_{t=1}^{n}\frac{CI_t}{(1+K)^t}$	
4.	Calculate the present value of all cash outflows i.e. $\sum_{t=1}^{n}\frac{CO_t}{(1+K)^t}$	Calculate the total cash outflow at the beginning of the project (CO_0 i.e. I_0)
5.	Determine NPV = Step 3 – Step 4	
	i.e., NPV $=\sum_{t=1}^{n}\frac{CI_t}{(1+K)^t}-\sum_{t=1}^{n}\frac{CO_t}{(1+K)^t}$	NPV $=\sum_{t=1}^{n}\frac{CI_t}{(1+K)^t}-I_0$

- **Decision Rules:**

    1. Acceptance/Rejection Decision: Since, NPV basically denotes the time value adjusted profitability of a project, a project is accepted if its NPV is positive and rejected if the NPV is negative.

    2. Mutually Exclusive Decision: In case of mutually exclusive projects (where one out of two or more projects is to be selected), the projects are first ranked based on their respective NPV and then the project with highest NPV is selected.

Illustration 9

Z Ltd. has two projects under consideration A & B, each costing ₹60 lakhs. The projects are mutually exclusive. Life for project A is 4 years & project B is 3 years. Salvage value NIL for both the projects. Tax Rate 33.99%. Cost of Capital is 15%.

Cash Inflow (₹ in Lakhs)

At the end of the year	Project A	Project B	P.V. @ 15%
1	60	100	0.870
2	110	130	0.756
3	120	50	0.658
4	50	-	0.572

Solution:

Computation of Net Present Value of the Project A. (₹ lakhs)

Particulars	Yr. 1	Yr. 2	Yr. 3	Yr. 4
1. Cash Inflows	60.00	110.00	120.00	50.00
2. Depreciation	15.00	15.00	15.00	15.00
3. PBT (1-2)	45.00	95.00	105.00	35.00
4. Tax @ 33.99%	15.30	32.29	35.70	11.90
5. PAT (3-4)	29.70	62.71	69.30	23.10
6. Net Cash Inflows (PAT + Depreciation)	44.70	77.71	84.30	38.10
7. Discounting Factor	0.870	0.756	0.658	0.572
8. P.V of Net Cash Inflows	38.89	58.75	55.47	21.79
9. Total P.V. of Net Cash Inflows				174.9
10. P.V. of Cash Out Flow (Initial Investment)				60.00
Net Present Value (9-10)				114.9

Computation of Net Present Value of the Project B (₹ lakhs)

Particulars	Yr. 1	Yr. 2	Yr. 3
1. Cash Inflows	100.00	130.00	50.00
2. Depreciation	20.00	20.00	20.00
3. PBT (1-2)	80.00	110.00	30.00
4. Tax @ 33.99%	27.19	37.39	10.20
5. PAT (3-4)	52.81	72.61	19.80
6. Net Cash Inflows (PAT + Depreciation)	72.81	92.61	39.80
7. Discounting Factor	0.870	0.756	0.658
8. P.V of Net Cash Inflows	63.345	70.013	26.188
9. Total P.V. of Net Cash Inflows			159.546
10. P.V. of Cash Out Flow (Initial Investment)			60.00
11. Net Present Value (9-10)			99.546

As Project A has a higher Net Present Value, it has to be taken up.

- **Advantages**

  a. It considers the time value of money. Hence it satisfies the basic criterion for project evaluation.

  b. Unlike payback period, all cash flows (including post-payback returns) are considered.

  c. NPV constitutes addition to the wealth of Shareholders and thus focuses on the basic objective of financial management.

  d. Since all cash flows are converted into present value (current rupees), different projects can be compared on NPV basis. Thus, each project can be evaluated independent of others on its own merit.

- **Disadvantages**

  a. It involves complex calculations in discounting and present value computations.

  b. It involves forecasting cash flows and application of discount rate. Thus, accuracy of NPV depends on accurate estimation of these two factors which may be quite difficult to forecast in practice.

  c. NPV and project ranking may differ at different discount rates, causing inconsistency in decision-making.

  d. It ignores the difference in initial outflows i.e., size of different proposals while evaluating mutually exclusive projects.

  e. Similarly, comparing projects with different lifespan may not be appropriate under NPV criterion.

3. **Profitability Index:** Net Present Value, as a criterion for project appraisal, often becomes inappropriate when the competing projects have similar lifespan but significantly different initial outlay. This is because NPV is an absolute measure and hence does not recognize the size difference (difference in the size of investment or cash outflow) between two competing projects.

   Thus, a refinement of NPV is suggested in form of a new method, called Profitability Index (PI) method. PI is defined as the ratio between the present value of cash inflow to the present value of cash outflow or investment.

   That is to say, $PI = \dfrac{\text{Present Value of Cash Inflow}}{\text{Present Value of Cash Outflow}}$ (for non-conventional cash flow) or,

   $$= \frac{\text{Present Value of Cash Inflow}}{\text{Initial Outlay}} \quad \text{(for conventional cash flow)}$$

   Thus, basically PI calculates the present value of cash inflow or benefit per rupee of present value of cash outflow (or initial outlay) or cost. This is why it is also called Benefit-Cost Ratio.

   Illustration 10

   K Ltd. is considering a new project with an initial outlay of ₹70,000. The project has a lifespan of four years with cash inflows of ₹25,000, ₹30,000, ₹18,000 and ₹16,000 for year 1, 2, 3 and 4 respectively. Calculate the profitability index for the project if the cost of capital is 10% p.a.

Solution:

Calculation for PV of Cash Inflow

Year	CFAT (₹)	PVIF@ 10%	PV of CFAT (₹)
1	25,000	0.909	22,725
2	30,000	0.826	24,780
3	18,000	0.751	13,518
4	16,000	0.683	10,928
		Total PV of CFAT	71,951

So, $PI = \frac{\text{Present Value of Cash Inflow}}{\text{Initial Outlay}} = \frac{71951}{70000} = 1.028$

- **Decision Rules**

  a) **Acceptance/Rejection Decision:** A project is accepted if its PI is more than one and rejected if the PI is less than one. For a project with PI equals to one, the decision maker remains indifferent.

  For example, in illustration 10, the investment project is having a PI of 1.028. Hence the project may be accepted.

  b) **Mutually Exclusive Decision:** In case of mutually exclusive projects, the projects are first ranked based on their respective PI and then the project with highest PI is selected.

Consider the following illustration.

Illustration 11

A company provides you the following information relating to two mutually exclusive projects.

Particulars	Project 1	Project 2
PV of Cash Inflow (₹)	75,000	1,40,000
Initial Outlay (₹)	60,000	1,20,000
Life (Years)	5	5

Advise the company regarding the selection. Will NPV method be appropriate in this case?

Solution:

Calculation for PI and NPV and respective ranking.

Particulars	Project 1	Project 2
PV of Cash Inflow (₹)	75,000	1,40,000
Initial Outlay (₹)	60,000	1,20,000
Life (Years)	5	5
$PI = \frac{\text{Present Value of Cash Inflow}}{\text{Initial Outlay}}$	1.25	1.17
Ranking based on PI	I	II
NPV = PV of Cash Inflow – Initial Outlay	15,000	20,000
Ranking based on NPV	II	I

Since PI is higher for Project 1, it offers higher benefit per rupee of investment. Hence it is recommended.

It may be worth mentioning that, NPV will not be appropriate as project 2, though offers higher NPV also have higher initial outlay. Hence the absolute value of NPV is not comparable at all.

- **Advantages:**

  a. This method considers the time value of money.

  b. It is a better project evaluation technique than Net Present Value and helps in ranking projects where Net Present Value is positive.

  c. It focuses on maximum return per rupee of investment and hence is useful in case of investment in divisible projects, when availability of funds is restricted.

- **Disadvantages:**

  a. In case a single large project with high Profitability Index is selected, possibility of accepting several small projects which together may have higher NPV than the single project, is excluded.

  b. Situations may arise where a project with a lower profitability index selected may generate cash flows in such a way that another project can be taken up one or two years later, the total NPV in such case being more than the one with a project with highest Profitability Index.

  c. In case of more than one proposal, which are mutually exclusive, with different investment patterns or values, profitability index alone cannot be used as a measure for choosing.

4. Adjusted Net Present Value Method:

For determining NPV, weighted average cost of capital is used as the discounting factor, based on the assumption that every project is financed by the same proportions of debt and equity as found in the capital structure of the firm. A project may be financed by a higher proportion of debt capital and such a project is likely to get the benefit of leveraging as well. In other words, the interest tax shield on such project can be quite substantial. The impact of debt financing can be incorporated using Adjusted Net Present Value Method (ANPV) with an adjustment of tax aspects of debt financing with the Base Case NPV.

Base Case NPV is the NPV under the assumption that the project is all-equity financed.

Adjusted NPV = Base case NPV + NPV of Tax Shields arising out of financing decisions associated with the project. PV of floatation cost of equity, if any, should be deducted in the above formula.

Thus, the steps in calculating ANPV are as follows:

Step 1: Calculate Base Case NPV = PV of Cash Flows at Cost of Equity – Initial Investment

Step 2: Calculate PV of tax savings from debt financing = (Debt × Interest Rate × Tax Rate) × PVIFA (K_d, n)

Step 3: Calculate PV of floatation cost of equity

Step 4: Step 1 + Step 2 – Step 3

The decision rule for adjusted net present value is the same as net present value.

Consider the following illustration.

Illustration 12

A firm is considering a project requiring ₹50 lakh of investment. Expected cash flow is ₹10 lakh per annum for 8 years. The rate of return required by the equity investors from the project is 15%. The firm is able to raise ₹24 lakh of debt finance carrying 14% interest for the project. The principal amount of debt is repayable in equal annual instalments over the eight-year period – the first to be paid at the end of the first year. The tax rate is 40%. Calculate ANPV and advise.

Solution:

Calculation of Base Case NPV:

Base case NPV = 10,00,000 × PVIFA (15%, 8) – 50,00,000

= 10,00,000 × 4.4873 – 50,00,000 = (–) ₹5,12,700

Equity Finance ₹ 26 lakh, Debt Finance ₹ 24 lakhs.

Calculation of PV of tax savings from debt financing: (₹ in lakhs)

Year	O/S Debt at the beginning	Interest @ 14%	Tax Shield = Interest × 40%	PVIF @ 14%	PV of Tax Shield
1	24	3.36	1.344	0.877	1.179
2	21	2.94	1.176	0.769	0.9043
3	18	2.52	1.008	0.675	0.6804
4	15	2.1	0.840	0.592	0.497
5	12	1.68	0.672	0.519	0.349
6	9	1.26	0.504	0.456	0.230
7	6	0.84	0.336	0.399	0.134
8	3	0.42	0.168	0.351	0.059
Total					4.0327

Equity Issue Cost is assumed to be 5%. Therefore, to get ₹ 26 lakh,

Total equity issue = ₹26/0.95 = ₹27.37 lakh

So, floatation cost representing the cost of underwriting, brokerage, etc. for the issue

= 27.37 – 26 = ₹1.37 lakhs

Adjusted NPV = (–) 5,12,700 + 4,03,270 –1,37,000 = (–) ₹2,46,430

Since the ANPV is negative the project is not acceptable.

5. Internal Rate of Return (IRR) Method:

Internal Rate of Return (IRR) is the rate of discount at which the sum of Discounted Cash Inflows equals the Discounted Cash Outflows. It is the discount rate which makes Net Present Value of the project equals to zero.

In other words, IRR refers to that discount rate (i), such that

Present value of cash inflows = Present value of cash outflows

Or, Present value of cash inflows – Present value of cash outflows = 0

Or, NPV = 0

Similarly, at IRR, PI = 1.

Note: The method by which IRR is determined suggests that the IRR represents the reinvestment rate at which cash inflows are reinvested, i.e., IRR is the reinvestment rate of cash inflows. The IRR of different project proposals is expected to be different, but it may not be realistic to assume that rate of return from reinvesting the cash inflows of different projects by a particular firm will be different. It may be noted in this connection that the reinvestment rate in case of NPV is assumed to be cost of capital.

- **Decision Rules**

  a. **Acceptance/Rejection Decision:** A project is accepted if its IRR is higher than the cost of capital.

  b. **Mutually Exclusive Decision:** In case of mutually exclusive projects, the project with highest IRR is selected.

- **Procedure for computation of IRR:**

  Step 1: Determine the present value of cash outflows and cash inflows using cost of capital (K) as the discounting factor. The rationale behind use of K as the discounting factor to start with is that, the NPV can be easily determined. If NPV is less than zero (i.e., P.V. of cash inflows is equal to P.V. of cash outflows), no further calculation is necessary because it indicates that IRR is less than K, so the project is not acceptable. On the other hand, if NPV is greater than zero, i.e., P.V. of cash inflows are more than the present value of cash outflows, the discount rate has to be increased in order to reduce the present value of cash inflows so as to make it equal or close to the present value of cash outflow. If increase in discount rate results in negative NPV, the rate of discount has to be decreased in order to increase the present value of cash inflows. The process of increase and decrease in discount rate is continued till the present value of cash inflow either equals to or becomes very close to the present value of present value of cash outflow.

  Alternatively, a guidance rate may be calculated for using it as the starting discounting rate as shown in the Illustration below.

  Step 2: Identify the two discount rates for which the NPV is little more than and slightly less than zero.

Step 3: Compute the change in NPV over the two selected discount rates.

Step 4: On proportionate basis (or using simple interpolation method), compute the discount rate at which NPV is Zero.

Illustration 13

Consider the following information in respect of a project.

Particulars	₹
Project Cost	1,10,000
Cash Inflows:	
Year 1	60,000
Year 2	20,000
Year 3	10,000
Year 4	50,000

Calculate the Internal Rate of Return.

Solution:

Internal Rate of Return will be calculated by the trial-and-error method. Here, the cash flow is not uniform. Thus, to have an approximate idea about such rate we can calculate the guidance rate to start with. It represents the same relationship of investment and cash inflows as in case of payback period calculation. Therefore, it is known as fake payback period:

F = I/C

Where F = Fake payback period I = Original investment

C = Average Cash inflow per annum

Factor for the project = 1,10,000/35,000 = 3.14 (also known as Fake Pay Back Period)

The factor will be located from the table "P.V. of an Annuity of ₹1" representing number of years corresponding to estimated useful life of the asset.

The approximate value of 3.14 is located against 10% in 4 years in the PVIFA table.

Applying 10% as the discount rate, it has been found that NPV is ₹2,720. To make it zero, the present value of cash inflows is to be reduced. Therefore, a higher discount rate, 12% has been used in the next step and the NPV has been negative (– ₹1,560). So, NPV is positive at 10% and negative at 12%. It indicates that NPV is zero at a discount rate which is more than 10% but less than 12%.

Year	Cash Inflows (₹)	P.V. @ 10%	Discounted Figures (₹)	P.V. @ 12%	Discounted Figures (₹)
1	60,000	0.909	54,540	0.893	53,580
2	20,000	0.826	16,520	0.797	15,940
3	10,000	0.751	7,510	0.712	7,120

4	50,000	0.683	34,150	0.636	31,800
P.V. of Inflows			1,12,720		1,08,440
Less: Initial Investment			1,10,000		1,10,000
NPV			2,720		(1,560)

$$\text{IRR} = 10\% + \frac{12\% - 10\%}{2720 - (-1560)} \times 2720$$

IRR = 10% + 1.28%

IRR = 11.28%

Since, IRR of the project is higher than the cost of capital, the project is acceptable.

- **Advantages**

  a. Time value of money is taken into account.

  b. All cash inflows of the project, arising at different points of time are considered.

  c. Decisions can be easily taken by comparing IRR with the cost of capital. All projects having IRR above the Cost of Capital will be automatically accepted.

- **Disadvantages**

  a. It is tedious to compute.

  b. Decision making becomes difficult in case of Multiple IRRs

  c. It may conflict with NPV in case of difference in inflow/ outflow patterns, or size of investment, or life of the alternative proposals.

  d. The presumption that all the future cash inflows of a proposal are reinvested at a rate equal to the IRR may not be practically valid.

- **Multiple IRR**

In case of projects with non-conventional cashflow, there may be multiple IRRs.

Consider the following illustration.

Illustration 14

Calculate the IRR of a project having following cash flow structure over its four years lifespan.

Year	0	1	2	3	4
Cash Flow (₹)	-2,000	1,600	2,000	2,600	-4,400

Here negative cash flow in year 0 and 4 indicates initial and subsequent investment (cash outflow) in the project.

Solution:

In the given situation IRR can be calculated from the following equation,

$$\frac{-2000}{(1+r)^0} + \frac{1600}{(1+r)^1} + \frac{2000}{(1+r)^2} + \frac{2600}{(1+r)^3} + \frac{-4400}{(1+r)^4} = 0 \text{ where } r = \text{IRR}$$

Solving the equation, we can get IRR = 6.6% and 36.55%.

Thus, here the project has two IRRs.

Selecting projects with multiple IRRs may appear to be quite difficult. In case cost of capital is lower than the lower IRR, the project is obviously acceptable as the project will generate positive NPV. Similarly, if the cost of capital is higher than the higher IRR, the project is obviously rejected as the NPV, in such a case, bound to be negative. A real problem appears if the cost of capital lies in between the two IRRs.

In such a case, using Modified Internal Rate of Return (MIRR) method which produces a single IRR even in case of a project with non-conventional cash flow pattern, is suggested.

6. Modified Internal Rate of Return:

Traditional IRR suffers from two important limitations. Firstly, IRR assumes that the future project cash flows will be reinvested at IRR itself for the remaining life of the project which is not justified. As a result of its faulty assumption regarding the reinvestment rate, IRR produces too much optimistic result for any project. Secondly, in case of non-conventional cash flow projects i.e., projects with cash outflow in multiple periods, there may be more than one IRR. Such a result may create confusion in making any decision.

In order to avoid the above two limitations, a new method known as Modified Internal Rate of Return (MIRR) method is suggested. MIRR is defined as the discounting rate which equates the present value of the aggregate future value of all cash inflows compounded at the cost of capital with the initial investment.

The steps for calculating MIRR are as follows –

(i) Calculate the future value of each cash inflow from the project by using cost of capital as the compounding rate.

(ii) Calculate the aggregate future value (may be called terminal value)

(iii) Calculate initial investment (in case of conventional cash flow project) or present value of all cash outflow (in case of non-conventional cash flow project).

(iv) Determine the discounting rate that equates the present value of the aggregate future value with the initial investment or present value of all cash outflow. Such rate will be the MIRR.

A direct formula for MIRR can be obtained as follows –

$$\text{Aggregate PV of cash outflow or Initial Investment} = \frac{\text{Aggregate FV of Cash Inflow}}{(1 + \text{MIRR})^n} \text{ (Here, n = project life).}$$

$$\text{Therefore, MIRR} = \sqrt[n]{\frac{\text{Aggregate Future Value of Cash Inflow}}{\text{Aggregate Present Value of Cash Outflow}}} - 1 \text{ (For Non-conventional cash flow) or,}$$

$$\text{MIRR} = \sqrt[n]{\frac{\text{Aggregate Future Value of Cash Inflow}}{\text{Initial Investment}}} - 1 \text{ (For conventional cash flow).}$$

Illustration 15

From the following information calculate the MIRR of the project.

Initial Outlay ₹1,00,000, cost of capital 12% p.a. Life of the project 5 years.

Cash inflows from the project are ₹20,000, ₹30,000, ₹40,000, ₹50,000 and ₹30,000.

Solution:

Calculation of aggregate future value

Year	CFAT (₹)	Years for Investment	FVIF@12%	FV (₹)
1	20,000	4	1.5735	31,470
2	30,000	3	1.4049	42,147
3	40,000	2	1.2544	50,176
4	50,000	1	1.12	56,000
5	30,000	0	1	30,000
				2,09,793

Now, MIRR = $\sqrt[n]{\dfrac{\text{Aggregate Future Value of Cash Inflow}}{\text{Initial Investment}}} - 1$

Or, MIRR = $(209793/100000)^{1/5} - 1$

Or, MIRR = $(2.09793)^{1/5} - 1$

Or, MIRR = 1.15973 – 1

Or, MIRR = 0.15973 i.e., 15.97%

Note: the rule for selection remains the same as the traditional IRR method.

7. Modified NPV Method:

Both NPV and IRR methods are often criticized due to the assumption of a constant reinvestment rate. While NPV method assumes that future cash flows will be reinvested at the minimum required rate of return i.e., cost of capital, IRR method assumes that they will be reinvested at IRR itself. However, in practice it is hardly possible to reinvest future cash flows at an agreed upon rate. In order to overcome such limitation a new method is suggested. This is known as Modified Net Present Value (MNPV) method or Terminal Value method. Under this method future cash flows are first compounded at the estimated reinvestment rate for the rest of the life of the project. The aggregate future value of all cash inflows is then discounted at an appropriate rate of return (generally cost of capital) to determine the present value. Finally, this present value is compared against the initial outlay for final selection.

Steps to be followed: The steps to be followed under Terminal Value approach are –

a) Calculate the future value of each cash inflow by compounding them at the estimated reinvestment rate for the remaining lifespan of the project.

b) Calculate the aggregate of all future values thus obtained. This is called terminal value.

c) Calculate the present value of terminal value obtained above by using an appropriate discounting rate, preferably the cost of capital.

d) Compare the present value as obtained above with the initial outlay or present value of cash outflow of the project to calculate MNPV to be used for final selection.

Consider the following illustration.

Illustration 16

A company is contemplating an investment project of 4 years with an initial outlay of ₹1,20,000. The cash inflows estimated from the project are ₹30,000, ₹40,000, ₹30,000, and ₹36,000. The estimated rates at which the above cash flows will be reinvested are:

Year End	1	2	3	4
Reinvestment Rate (%)	8	9	10	9

The cost of capital is 10% p.a. Analyze the viability of the project under terminal value method.

Solution:

Calculation for Terminal Value

Year	Cash Inflows (₹)	Re-investment Rate	Years of Reinvestment	FVIF	Future Value (₹)
1	30,000	8%	3	1.26	37,800
2	40,000	9%	2	1.1881	47,524
3	30,000	10%	1	1.1	33,000
4	36,000	9%	0	1	36,000
				Terminal Value	1,54,324

So, Present Value of Terminal Value = Terminal Value × PVIF (Cost of capital, Years)

= ₹ 1,54,324 × PVIF (10%, 4)

= ₹ 1,54,324 × 0.683

= ₹ 1,05,403

So, Modified NPV = 1,05,403 – 1,20,000 = ₹ – 14,597.

Since the MNPV is negative, the project is not acceptable.

- **Decision Rules:**

  a) **Acceptance/Rejection Decision:** Under MNPV method a project is accepted if the present value of aggregate future value of cash inflows (or terminal value) is more than the initial outlay and vice-versa.

  b) **Mutually Exclusive Decision:** In case of mutually exclusive projects, the project that offers the highest MNPV is ultimately selected.

NPV and IRR - Conflict and Resolution, MIRR, Comparing Projects with Unequal Lives, The Concept of Abandonment Value, MACRS

1.2

1.2.1 Conflict between NPV and IRR

Though in case of a single independent project application of both NPV and IRR methods always choose the same project, while evaluating mutually exclusive projects, the results sometimes lead to conflict. In other words, the project which is acceptable under NPV may not be so under IRR and vice-versa.

Such conflict may arise because of three reasons:

a) Difference in the timing of cash flow or cash flow pattern of alternative projects, known as time disparity in cash flow.

b) Difference in the life expectancy of the alternative projects known as life disparity.

c) Difference in the investment size (size of cash outflow) of the alternative projects known as scale or size disparity.

These are disussed below with the help of numerical illustrations:

a) Time Disparity in Cash Flows:

Time disparity in cash flows essentially implies that the cash flow patterns of the competing projects are significantly different. In other words, though the total cash flow is more or less similar, they accrue differently. In case of one project early cashflows are higher while for the other cash flow during the later period of the project are higher. In such a situation there may be difference in the ranking based on NPV and that based on IRR.

Illustration 17

PQR Ltd is considering two projects X and Y. The cash flows associated with the project are as follows:

	Project I	Project II
	₹	₹
Investment	2,20,000	2,20,000
Year 1	62,000	1,42,000
Year 2	80,000	80,000
Year 3	1,00,000	82,000
Year 4	1,40,000	40,000

Cost of capital 10% p.a.

Evaluate the projects under NPV and under IRR method.

Solution:

The results of NPV and IRR can be summarized as follows –

	Project I	Project II
NPV (₹)	73,158	64,135
Ranking based on NPV	1	2
IRR (appx.)	22.61%	25.99%
Ranking based on IRR	2	1

From the above table it is clear that the results of NPV and IRR are contradictory. Here, both the projects have similar lifespan and also similar investment size. So, the source of conflict is the timing of cash flow or the pattern of cash flow.

- **Resolution of the Conflict (Modified IRR and Modified NPV)**

  The conflict between NPV and IRR due to time disparity may be resolved using Modified version of NPV or IRR (MNPV or MIRR) as follows.

  Using reinvestment rate of 14% (as assumed),

  $TV_I = 62000\ (1 + .14)^3 + 80000\ (1 + .14)^2 + 100000\ (1 + .14)^1 + 140000\ (1 + .14)^0 = 4{,}49{,}824$

  $TV_{II} = 142000\ (1 + .14)^3 + 80000\ (1 + .14)^2 + 82000\ (1 + .14)^1 + 40000\ (1 + .14)^0 = 4{,}47{,}827$

  $MNPV(I) = \{449824 \div (1 +.10)^4\} – 220000 = 87{,}235$

  $MNPV(II) = \{447827 \div (1 +.10)^4\} – 220000 = 85{,}871$

  $MIRR(I) = (449824 \div 220000)^{1/4} – 1 = 19.58\%$

  $MIRR(II) = (447827 \div 220000)^{1/4} – 1 = 19.44\%$

  Thus, under both the MIRR and MNPV, project I is acceptable.

  Note: For theoretical discussion on MIRR, follow the previous explanations.

b) Life Disparity:

Another source of conflict may be the life disparity i.e., different project lifespan. That is to say, while one is a long duration project, the other is a relatively short duration project.

Illustration 18

XYZ Ltd is considering two investment projects A and B. Project A has a life of only one year whereas project B has a lifespan of 3 years. The cash flows associated with the project are as follows:

Year	Project A (₹)	Project B (₹)
1	7,50,000	2,00,000
2	–	2,00,000
3	–	7,00,000

Both the projects require initial investment of ₹ 5,00,000 and cost of capital is 12% p.a. Evaluate the projects under NPV and IRR.

Solution:

The results of NPV and IRR can be summarized as follows –

Particulars	Project A	Project B
NPV (₹)	1,69,750	3,36,400
Ranking based on NPV	II	I
IRR	50%	40%
Ranking based on IRR	I	II

From the above table it is clear that the results of NPV and IRR are contradictory. Since investment size of the projects is same, the source of conflict is the life of the projects.

Resolution of Conflict (Equivalent Annual Benefit i.e., EAB Approach for Projects with Unequal Lives)

The conflict between NPV and IRR due to life disparity can resolved by using Equivalent Annual Benefit (EAB) or Equivalent Annual Cost (EAC) method.

Equivalent Annual Benefit (EAB) or Equivalent annual cost (EAC) is the annual cost of owning, operating, and maintaining an asset over its entire life. Apart from resolving the conflict between NPV and IRR for mutually exclusive projects, this method can be used whenever two projects with unequal live are compared under NPV method.

EAB = NPV × Capital Recovery Factor or NPV ÷ PVIFA

Here, Capital Recovery Factor is the inverse of PVIFA.

In the context of our example, EAB approach may be followed as follows.

PVIFA for project A = $\frac{1}{1.12^1}$ = 0.893

PVIFA for project B = (0.893 + 0.797 + 0.712) = 2.402

So, Capital recovery Factor (Project A) = 1 ÷ 0.893 = 1.12

And Capital recovery Factor (Project B) = 1 ÷ 2.402 = 0.416

So, EAB (Project A) = 169750 × 1.12 = ₹ 1,90,000

EAB (Project B) = 336400 × 0.416 = ₹1,39,882

Based on EAB, Project A is better.

c) Scale or Size Disparity:

Since IRR is a relative measure and NPV is an absolute measure, conflict in ranking may also arise in case the projects differ significantly in their investment size.

Illustration 19

ABC Ltd is considering two investment projects X and Y. The cash flows associated with the project is as follows.

Year	Project X (₹)	Project Y (₹)
1	4,000	14,000
2	4,000	14,000
3	4,000	14,000
4	4,000	14,000
5	4,000	14,000

Initial investment for project X is ₹10,000 whereas that for project B is ₹40,000. If cost of capital is 10%, evaluate the two projects based on NPV and IRR.

Solution:

Calculation for NPV of the projects

Particulars	Project X	Project Y
1. Annual CFAT (₹)	4,000	14,000
2. PVIFA (10%, 5 Years)	3.79	3.79
3. Total PV (1 × 2)	15,160	53,060
4. Initial Investment	10,000	40,000
5. NPV (3 – 4)	5,163	13,071

Using the normal trial and error approach, we get,

IRR (A) = 50%

IRR (B) = 40%

So, the results can be summarized as follows –

Particulars	Project X	Project Y
NPV (₹)	5,163	13,071
Ranking based on NPV	II	I
IRR	29%	22%
Ranking based on IRR	I	II

From the above table it is clear that the results of NPV and IRR are contradictory. Since lifespan of the projects is same but the projects differ in terms of size or scale, the source of conflict is the scale or size of the project.

Resolution of Conflict (Differential Cash Flow Approach)

The conflict between NPV and IRR due to size disparity can resolved using incremental approach as follows:

Differential Cash Outflows = 40,000 – 10,000 = ₹30,000,

Differential Net Cash Inflows = 14,000 – 4,000 = ₹10,000 p.a.

We know that IRR is the discount rate at which Present Value of Cash Inflows are equal to the Present Value of Cash Outflows.

So, 30,000 = 10,000 × PVIFA (x%, 5 years)

PVIFA (x%, 5 years) = 3

Or, x = 19.86%

So, IRR of incremental cashflow = 19.86%. Since, it is higher than the cost of capital (10%), the project with higher cash flow p.a. should be selected.

1.2.2 Comparing Projects with Unequal Lives

If the mutually exclusive projects have differing lives and the projects can be replaced (or replicated) repeatedly when they wear out, the appraisal becomes more complicated. This is because, the analysis of a one-time investment differs significantly from that of an investment chain (in which the asset is replaced regularly in the future).

There are two logically equivalent ways of comparing mutually exclusive projects in a replacement chain. They are the least common multiple of lives approach and the equivalent annual annuity approach.

(a) Equivalent Annual Annuity (EAA) Approach: Equivalent Annual Annuity is defined as the annuity payment (series of equal annual payments over the project' s life) that is equivalent in value to the NPV. This is also known as Equivalent Annual Cost or Equivalent Annual Benefit (Refer to Illustration 16). Among the competing projects, the project with highest EAA is accepted.

(b) Least Common Multiple (LCM) of Lives Approach: For the least common multiple of lives approach, the analyst extends the time horizon of analysis so that the lives of both projects will divide exactly into the horizon. For example, if there are two projects – S and L with lifespan of 2 years and 3 years respectively, the least common multiple of 2 and 3 will be 6. Thus, the two-year project would be replicated three times over the six - year horizon and the three - year project would be replicated two times over the six - year horizon. The NPV thus calculated will be compared for decision making.

Refer to Illustration 18.

NPV of Project A = ₹1,69,750 (1 Year Project)

NPV of Project B = ₹ 3,36,400 (3 Year Project)

Thus, the LCM = 3. Hence, within a 3-year time horizon, project A can be repeated 3 times while project B can be repeated only once. This means receiving ₹1,69,750 NPV from Project A at the end of year 1, 2, and 3. The PV of these NPVs at 12% cost of capital = 1,69,750 × 0.893 + 1,69,750 × 0.797 + 1,69,750 × 0.712 = ₹4,07,740. This is higher than the NPV of the three-year project. Hence, if reputation is allowed, project A is better than project B.

1.2.3 Abandonment Value

Abandonment value is the value of a project or asset if it were immediately liquidated or sold. This is why abandonment value is also known as liquidation value of an asset. The general rule for deciding to discontinue the product is that if the product's salvage value is greater than the net present value (NPV) of its expected cash flows, the project is abandoned. There is no denying the fact that if any project is not profitable, it is better to discontinue the same. Since, there is every possibility that the expected cash flows of the project may change over the life of the asset. Hence, the company should also estimate the future abandonment values in the initial investment phase.

The consideration of abandonment value in project evaluation comes under Real Option Analysis in Capital Budgeting (This has been discussed in greater details in Module 2). Thus, a project under NPV method is accepted if NPV with abandonment is positive and higher than the NPV without abandonment option. Alternatively, abandonment can be considered as a put option and its value can be calculated using option valuation methodology.

The value thus determined should be added to the NPV without abandonment option to get the total NPV and if the same is positive, the project may be accepted.

Consider the following illustration.

Illustration 20

X Ltd. is considering a capital project with the following characteristics:

The initial outlay is ₹5,00,000.

Project life is 6 years.

Annual after-tax operating cash flows have a 50 percent probability of being ₹80,000 for the four years and a 50 percent probability of being ₹1,40,000.

Salvage value at project termination is 0.

The required rate of return is 12 percent.

In one year, after realizing the first-year cash flow, the company has the option to abandon the project and receive the salvage value of ₹4,00,000.

a. Compute the project NPV assuming no abandonment.

b. What is the optimal abandonment strategy? Compute the project NPV using that strategy.

Solution:

a. NPV assuming no abandonment

NPV (Low Cash Flow) = –500000 + 80000 × PVIFA (12%, 6)

= –5,00,000 + 80,000 × 4.111 = (–) ₹1,71,120

NPV (High Cash Flow) = –500000 + 140000 × PVIFA (12%, 6)

= –5,00,000 + 1,40,000 × 4.111 = ₹75,540

NPV of the project without abandonment option = 0.50 × (–) 171120 + 0.50 × 75540 = (–) ₹47,790

Since, NPV is negative, the project should be rejected.

b. NPV assuming abandonment option

Low cash flow and abandonment after 1 year:

NPV = –500000 + 80000 × PVIF (12%, 1) + 400000 × PVIF (12%, 1)

= –500000 + 80000 × 0.893 + 400000 × 0.893

= (–) ₹71,360

Whereas, NPV for Low cash flow and continue = (–) ₹1,71,120

This is the preferred option as NPV without abandonment leads to an NPV of (–) ₹1,71,120.

High cash flow and abandonment after 1 year:

NPV = –500000 + 140000 × PVIF (12%, 1) + 400000 × PVIF (12%, 1)

= –500000 + 140000 × 0.893 + 400000 × 0.893 = (–) ₹17,780

Whereas, NPV for High cash flow and Continue = ₹75,540

So, the latter is the preferred option.

Hence, NPV with abandonment option = (–) 17780 × 0.50 + 75540 × 0.50 = ₹28,880

Since NPV is higher with abandonment option, the project should be accepted.

Inflation Adjusted Cash Flow Forecasting in Capital Budgeting

1.3

1.3.1 Concept of Inflation

The term 'Inflation' refers to the increase in general price level of goods and services. Due to such increase in price level, purchasing power of money decreases. As a result, more money is required to acquire same quantity of goods and services or less quantity can be procured with the same amount of money. For example, a person can purchase 5 kg of apple with ₹700 at present, i.e., at ₹140 per kg. If rate of inflation is 5%, the price per kg will be ₹147 and the person would require ₹735 to buy the same quantity (5 kg) of apples, or would get less than 5 kg (₹700/₹147 = 4.76 kg), of apple for ₹700. The causes of inflation are generally attributed to increase in aggregate demand due to increase in private and government spending (Demand Pull Inflation) or drop in aggregate supply of goods and services due to natural disasters, increase in the price of inputs, etc., for which cost increases (Supply Shock Inflation or Cost Push Inflation).

Rate of inflation is measured by observing the change in the price of a specified number of goods and services in an economy over a period of time, usually based on data collected by government agencies and an index is determined to indicate the inflation rate. Some of the widely used measures of inflation include: Consumer Price Index (CPI), Producer Price Index (PPI), Wholesale Price Index (WPI), Commodity Price Index, etc.

1.3.2 Impact of Inflation on Investment Analysis

Investment Analysis will be unrealistic if the impact of inflation is not properly incorporated. Since, the cash flows of future periods over the life of the project are considered for the analysis and price level does not remain same over such period (usually price level increases over time, i.e., inflationary situation), the nominal value of cash flow estimates will not reflect the real purchasing power resulting in the distortion in the capital budgeting decisions. In order to reflect the true picture, cash flows should be adjusted to accommodate the effect of the inflation. The process of adjustment for inflation is as follows.

Nominal or Money Cash Flows are discounted with the Inflation Rate (IR) to arrive at the Real Cash Flows. Real Cash Flows are discounted with the Real Discount Rate (RDR) to get the Present Value.

Alternatively, Nominal Cash Flows may be discounted with the Nominal Discount Rate (NDR) directly to get the Present Value.

So, either a two-stage process – (i) finding out the real cash flow by discounting the nominal cash flow with the inflation rate and (ii) discounting real cash flows with the real discount rate to get the present value of the real cash flows – or a single stage process may be followed to get the present value of real cash flows by directly discounting the money / nominal cash flows with the nominal discount rate which incorporates both the inflation rate and real discount rate as shown below.

Real Cash Flows = Nominal Cash Flows of the Period 't' ÷ $(1 + \text{Inflation Rate})_t$

Present Value of Real Cash Flows = Real Cash Flows of the period 't' as calculated above ÷ $(1+ \text{RDR})_t$

Alternatively,

Present Value of Real Cash Flows = Nominal Cash Flows of the period 't' ÷ $(1+ \text{NDR})_t$

It may be noted that Nominal or Money Cash Flows are the actual amount expected to arise in future while Real Cash Flows are the nominal cash flows expressed in terms of real values representing purchasing power. Therefore, it is prudent to use the real cash flows for analysis instead of money or nominal cash flows.

1.3.3 Relationship between NDR and RDR

The relationship between NDR and RDR can be expressed in form of the following equation:

1 + Nominal Discount Rate = (1 + Real Discount Rate) (1 + Inflation Rate)

or, NDR = (1 + RDR) (1 + IR) – 1

It may be observed from the above equation that Nominal Discount Rate contains two elements – Real Discount Rate and Inflation Rate. Real Discount Rate helps maintaining the shareholders wealth and Inflation Rate is the compensation for giving up the purchasing power today for a purchasing power in future.

Illustration 21

The following information is available:

Initial Outlay ₹24 lakh. Life 4 years. Annual PBDT ₹10 lakh. Income Tax Rate 40%. Inflation Rate 5%. Real Discount Rate (Cost of Capital 10%).

In absence of Inflation:

Year	PBDT	Depreciation	PBT	Tax	PAT	Cash Flow
0						– 24,00,000
1 – 4	10,00,000	6,00,000	4,00,000	1,60,000	2,40,000	8,40,000

Calculate NPV before and after adjustment of inflation and comment on the viability of the project.

Solution:

In absence of Inflation, NPV will be as follows:

PV of Cash Inflows = 8,40,000 × (0.9091 + 0.8264 + 0. 7513 + 0.6830)	= ₹26,62,632
Less: PV of Cash Outflows (Initial Outlay)	= ₹24,00,000
NPV	= ₹ 2,62,632

As the NPV is positive, the project is acceptable.

With 5% Inflation, Nominal Cash Inflow will be discounted with Inflation Rate for finding out the Real Cash Flow and thereafter Real Cash Inflow will be discounted with Real Discount Rate to get the present value.

	Year 1	2	3	4
Nominal Cash Inflow after Tax (₹):	8,40,000	8,40,000	8,40,000	8,40,000
Real Cash Inflow	8,00,000	7,61,905	7,25,624	6,91,070
[(Nominal Cash Inflow / (1+ Inflation Rate)]				
PV of Real Cash Inflow	7,27,273	6,29,674	5,45,172	4,72,010

[(Real Cash Flow / (1+ Real Discount Rate, K)]

Total PV of Real Cash Inflows:	₹ 23,74,129
PV of Cash Outflow (Initial Outlay):	₹ 24,00,000
NPV	₹ (–) 25,871

The project is not acceptable as NPV is negative.

Alternatively, the Nominal Cash Inflows may be discounted with the Nominal Discount Rate.

Nominal Discount Rate = 1 – (1+IR) (1+RDR)

NDR = 1 – (1+0.05) (1+0.10) = 1 – 1.155 = 0.155 or 15.5%

PV of Real Cash Inflows = $8{,}40{,}000 \times [(\frac{1}{1.155})^1 + (\frac{1}{1.155})^2 + (\frac{1}{1.155})^3 + (\frac{1}{1.155})^4]$ = ₹ 23,74,176

NPV (after considering inflation) = ₹ (23,74,176 – 24,00,000) = ₹ (–) 25,824

[Note: Two results are same, difference between two figures (₹25,871 & ₹25,824) is due to approximation of discounting factors.]

The project is not acceptable as NPV is negative.

Capital Rationing for Divisible and Non-divisible Projects (with Application of Integer Programming)

1.4

CAPITAL RATIONING

There may be situations where a firm has a number of independent projects that yield a positive NPV or having IRR more than its cut off rate, PI more than 1, i.e., the projects are financially viable, hence, acceptable. However, the most important resource in investment decisions, i.e. funds, are not sufficient enough to undertake all the projects. In such a case, the projects are selected in such a way so that NPV becomes maximum in order to maximize wealth of shareholders. Investment planning in such situation is Capital Rationing.

There are two possible situations of Capital Rationing

(i) Generally, firms fix up maximum amount that can be invested in capital projects, during a given period of time, say a year. This budget ceiling imposed internally is called as Soft Capital Rationing or Internal Capital Rationing.

(ii) There may be a market constraint on the amount of funds available for investment during a period. This inability to obtain funds from the market, due to external factors is called Hard Capital Rationing or External Capital Rationing.

Different proposals may be classified into two categories: DIVISIBLE and INDIVISIBLE

In case of divisible projects, part acceptance of the project is possible.

Indivisible projects are either to be accepted in its entirety or to be rejected, i.e., part acceptance is not possible.

For divisible projects, PI approach help in selecting the proposals providing the highest NPV.

For indivisible projects, through trial and error methods, best combination of the projects with the highest NPV may be ascertained.

For Divisible Projects

Rank the projects following PI and arrange them in descending order. Go on selecting the projects till the fund is available.

For Indivisible Projects

Determine all the feasible combination of the projects and rank them according to total NPV of the combinations. Select the combination with the highest NPV.

Example:

X Ltd. has a capital budget of ₹ 1.5 crore for the year. From the following information relating to six independent proposals, select the projects if (i) the projects are divisible and (ii) the projects are indivisible.

Proposal	Investments (₹)	NPV (₹)
A	70,00,000	30,00,000
B	25,00,000	16,00,000
C	50,00,000	20,00,000
D	20,00,000	10,00,000
E	55,00,000	45,00,000
F	75,00,000	-25,00,000

If the projects are divisible

Projects are ranked according to PI and arranged in descending order.

Proposal	Investments (₹)	PV of Inflows (NPV+I)	PI	Rank	NPV (₹)
A	70,00,000	1,00,00,000	100/70 = 1.43	(4)	30,00,000
B	25,00,000	41,00,000	41/25 = 1.64	(2)	16,00,000
C	50,00,000	70,00,000	70/50 = 1.4	(5)	20,00,000
D	20,00,000	30,00,000	30/20 = 1.5	(3)	10,00,000
E	55,00,000	1,00,00,000	100/55 = 1.8	(1)	45,00,000
F	75,00,000	50,00,000	50/75 = 0.67		-25,00,000

Proposal	Investments (₹)	Cum. Investments (₹)	NPV (₹)	Cum. NPV (₹)
E	55,00,000	55,00,000	45,00,000	45,00,000
B	25,00,000	80,00,000	16,00,000	61,00,000
D	20,00,000	1,00,00,000	10,00,000	71,00,000
A*	70,00,000	1,70,00,000	30,00,000	92,42,857*
C	50,00,000	2,20,00,000	20,00,000	

* only ₹ 50,00,000 can be invested in Project A, i.e., 5/7 th of the total investment can be made. Proportionate NPV is 5/7 x ₹ 30,00,000 = ₹ 21,42,857.

* So selected projects are E, B, D and 5/7 th part of A

If the projects are indivisible

If the projects are indivisible

Feasible Sets	Investments (₹)	NPV (₹)
EBDC	1,50,00,000	91,00,000
EBA	1,50,00,000	91,00,000
BAC	1,45,00,000	66,00,000
DAC	1,40,00,000	60,00,000
EBC	1,30,00,000	81,00,000

Either EBDC or EBA, which provides the maximum NPV, may be undertaken.

Illustration 22

X Ltd. has ₹ 20,00,000 allocated for capital budgeting purposes. The following proposals are available:

Projects	Initial Outlay (₹)	Total PV (₹)
A	6,00,000	7,32,000
B	3,00,000	2,85,000
C	6,00,000	8,40,000
D	9,00,000	10,62,000
E	4,00,000	4,80,000
F	8,00,000	8,40,000

Which of the above investments should be undertaken? Assume that the projects are divisible.

Solution:

Calculation for NPV, Profitability Index and Ranking

Projects	Initial Outlay	Total PV	PI	Ranking	NPV
(1)	(2)	(3)	(4)=(3)/(2)	(5)	(6)=(3) – (2)
A	6,00,000	7,32,000	1.22	2	1,32,000
B	3,00,000	2,85,000	0.95	6	-15,000
C	6,00,000	8,40,000	1.4	1	2,40,000
D	9,00,000	10,62,000	1.18	4	1,62,000
E	4,00,000	4,80,000	1.2	3	80,000
F	8,00,000	8,40,000	1.05	5	40,000

Selection of the projects based on PI ranking.

Ranking	Projects	Initial Outlay (₹)	Cumulative Initial Outlay (₹)	NPV (₹)
1	C	6,00,000	6,00,000	2,40,000
2	A	6,00,000	12,00,000	1,32,000
3	E	4,00,000	16,00,000	80,000
4	D	4,00,000 (Balancing Figure)	20,00,000	72,000* $\left(1,62,000 \times \frac{4,00,000}{9,00,000}\right)$
Total		20,00,000		5,24,000

Note: * Project D has been accepted in part as the funds available after accepting project E is not sufficient to accept D in full. NPV has been calculated proportionately.

Social Cost Benefit Analysis 1.5

While evaluating investment proposals, more emphasis is given on the return on investment as the firms usually face the limitations or scarcity of funds. However, the impact of investment proposals from the larger social point of view is considered in Social Cost Benefit Analysis (SCBA). The social costs and benefits of a project differ from the costs incurred and benefits earned in monetary terms primarily due to market imperfections, externalities, taxes, concern for savings and redistribution, merit and demerit goods. As the focus of SCBA is on the social costs and benefits of the projects, the perspectives and parameters provided by the macro level plans often serve as the basis of SCBA. The purpose of SCBA to supplement and strengthen the existing techniques of financial analysis.

Need for Social Cost Benefit Analysis (SCBA)

(i) Monetary Cost Benefit Analysis fails to consider the external effects of a project, which may be positive like development of infrastructure or negative like pollution and imbalance in environment.

(ii) Taxes and subsidies are monetary costs and gains, but these are only transfer payments from social point of view and therefore irrelevant.

(iii) Market prices used to measure costs and benefits in project analysis, do not represent social values due to imperfections in market.

(iv) SCBA is essential for measuring the redistribution effect of benefits of a project as benefits going to poorer section are more important from social point of view than one going to sections which are economically better off.

(v) Projects, manufacturing life necessities like medicines, or creating infrastructure like construction of road or electricity generation are more important than projects for manufacture of liquor and cigarettes. Thus, merit wants are important appraisal criterion for SCBA.

Relevance of Social Cost Benefit Analysis for Private Enterprises

(i) SCBA is one of the most important criteria for taking up any project by the Government enterprises. For example, if government wants to take up a project relating to expansion of road for which Hawkers are to be removed, it has to consider the rehabilitation of the hawkers and cost involved therein. SCBA is important for private corporations also which have a moral responsibility to undertake socially desirable projects.

(ii) If the private sector includes social cost benefit analysis in its project evaluation techniques, it will ensure that it is not ignoring its own long-term interest, since projects that are socially beneficial and acceptable are expected to survive in the long run. Therefore, SCBA is important for private enterprises also.

Methodology of SCBA

Two principal approaches for SCBA are: (i) UNIDO (United Nations Industrial Development Organisation) approach and (ii) Little-Mirrlees (L-M) approach. The L-M approach has considerable similarity with the UNIDO approach. However, there are certain important differences as well. The Financial Institutions like ICICI, IDBI, and IFCI evaluate the project proposals primarily from the financial point of view and also incorporate the larger social aspect in their analyses. These institutions follow the simplified version of L-M approach with some minor variation.

Additional Illustrations

1. Following are the data on a capital project being evaluated by the management of X Ltd.

	Project M
	₹
Annual cost saving	4,00,000
Useful life	4 years
I.R.R.	15%
Profitability Index (PI)	1.064
NPV	?
Cost of capital	?
Cost of project	?
Payback	?
Salvage value	0

Find the missing values considering the following table of discount factor only:

Discount factor	15%	14%	13%	12%
1 year	0.869	0.877	0.885	0.893
2 years	0.756	0.769	0.783	0.797
3 years	0.658	0.675	0.693	0.712
4 years	0.572	0.592	0.613	0.636
	2.855	2.913	2.974	3.038

Solution:

Cost of Project M

At 15% I.R.R., the sum total of cash inflows = Cost of the project i.e., Initial cash outlay Given:

Annual cost saving	₹ 4,00,000
Useful life	4 years
I.R.R.	15%

Now, considering the discount factor table @ 15% cumulative present value of cash inflows for 4 years is 2.855. Therefore, Total of cash inflows for 4 years for Project M is (₹4,00,000 × 2.855) = ₹11,42,000

Hence cost of project is = ₹11,42,000

Payback period of the Project M

Payback period = $\frac{\text{Cost of the project}}{\text{Annual cost saving}} = \frac{11,42,000}{4,00,000}$ = 2.855 or 2 years 11 months approximately.

Cost of Capital

If the profitability index (PI) is 1, cash inflows and outflows would be equal. In this case, (PI) is 1.064. Therefore, cash inflows would be more by 0.064 than outflow.

Profitability index (PI) = $\frac{\text{Discounted Cash inflows}}{\text{Cost of the project}}$

or, 1.064 = $\frac{\text{Discounted Cash inflows}}{11,42,000}$

or, Discounted Cash inflows = 1.064 × ₹11,42,000 = ₹12,15,088

Hence, Discounted cash inflows = ₹12,15,088

Since, Annual cost saving is ₹4,00,000, hence, cumulative discount factor for 4 years

= ₹12,15,088 / 4,00,000 = 3.037725 or 3.038

Considering the discount factor table at discount rate of 12%, the cumulative discount factor for 4 years is 3.038. Hence, the cost of capital is 12%.

Net present value of the project.

NPV = Total present value of cash inflows – Cost of the project

= ₹12,15,088 – ₹11,42,000 = ₹73,088.

2. Nine Gems Ltd. has just installed Machine – R at a cost of ₹2,00,000. The machine has a five-year life with no residual value. The annual volume of production is estimated at 1,50,000 units, which can be sold at ₹6 per unit. Annual operating costs are estimated at ₹2,00,000 (excluding depreciation) at this output level. Fixed costs are estimated at ₹3 per unit for the same level of production.

Nine Gems Ltd. has just come across another model called Machine – S capable of giving the same output at an annual operating cost of ₹1,80,000 (exclusive of depreciation). There will be no change in fixed costs. Capital cost of this machine is ₹2,50,000 and the estimated life is for five years with nil residual value.

The company has an offer for sale of Machine – R at ₹1,00,000, but the cost of dismantling and removal will amount to ₹30,000. As the company has not yet commenced operations, it wants to sell Machine – R and purchase Machine –S.

Nine Gems Ltd. will be a zero-tax company for seven years in view of several incentives and allowances available. The cost of capital may be assumed at 15%. P.V. factors for five years are as follows:

Year	P.V. Factors
1	0.8696
2	0.7561
3	0.6575
4	0.5717
5	0.4972

(i) Advise whether the company should opt for the replacement.

(ii) Will there be any change in your view, if Machine-R has not been installed but the company is in the process of selecting one or the other machine?

Support your view with necessary workings.

Solution:

(i) Replacement of Machine – R:

Incremental cash out flow

	Particulars	₹	₹
(i)	Cash outflow on Machine – S		2,50,000
	Less: Sale value of Machine – R Less: Cost of dismantling and removal	1,00,000 30,000	70,000
	Net outflow		1,80,000
	Incremental cash flow from Machine –S		
	Annual cash flow from Machine – S [(1,50,000×₹6)–(1,50,000× ₹3) – 1,80,000]		2,70,000
	Annual cash flow from Machine – R [(1,50,000×₹6)– (1,50,000×₹3) – 2,00,000]		2,50,000
	Net incremental cash in flow		20,000

Present value of incremental cash inflows = ₹20,000 × (0.8696 + 0.7561 + 0.6575 + 0.5717 + 0.4972)
= ₹20,000 × 3.3523 = ₹67,046

NPV of Machine – S = ₹67,046 – ₹1,80,000 = (–) ₹1,12,954.

₹2,00,000 spent on Machine – R is a sunk cost and hence it is not relevant for deciding the replacement.

Decision: Since Net present value of Machine –S is in the negative, replacement is not advised.

If the company is in the process of selecting one of the two machines, the decision is to be made on the basis of independent evaluation of two machines by comparing their Net present values.

(ii) Independent evaluation of Machine– R and Machine –S

Particulars	Machine– R	Machine– S
Units produced	1,50,000	1,50,000
Selling price per unit (₹)	6	6
Sale value	9,00,000	9,00,000
Less: Operating Cost (exclusive of depreciation)	2,00,000	1,80,000
Contribution	7,00,000	7,20,000
Less: Fixed cost	4,50,000	4,50,000
Annual Cash flow	2,50,000	2,70,000
Present value of cash flows for 5 years	8,38,075	9,05,121
Cash outflow	2,00,000	2,50,000
Net Present Value	6,38,075	6,55,121

As the NPV of Cash in flow of Machine-S is higher than that of Machine-R, the choice should fall on Machine-S.

Note: As the company is a zero tax company for seven years (Machine life in both cases is only for five years), depreciation and the tax effect on the same are not relevant for consideration.

3. S Engineering Company is considering to replace or repair a particular machine, which has just broken down. Last year this machine costed ₹2,00,000 to run and maintain. These costs have been increasing in real terms in recent years with the age of the machine. A further useful life of 5 years is expected, if immediate repairs of ₹1,90,000 are carried out. If the machine is not repaired it can be sold immediately to realize about ₹50,000 (Ignore loss/gain on such disposal).

   Alternatively, the company can buy a new machine for ₹4,90,000 with an expected life of 10 years with no salvage value after providing depreciation on straight line basis. In this case, running and maintenance costs will reduce to ₹1,40,000 each year and are not expected to increase much in real term for a few years at least. S Engineering Company regard a normal return of 10% p.a. after tax as a minimum requirement on any new investment. Considering capital budgeting techniques, which alternative will you choose? Take corporate tax rate of 50% and assume that depreciation on straight line basis will be accepted for tax purposes also. Given cumulative present value of ₹1 p.a. at 10% for 5 years ₹3.791, 10 years ₹6.145.

   Solution:

   Evaluation of proposal to repair existing machine or buy a new machine for M/s S. Engineering Company

   (i) To repair existing machine:

Particulars	Amount (₹)
Present value of after-tax cash outflows	
Cost of repairs immediately net of tax 95,000 (50% of 1,90,000)	
Equivalent annual cost for 5 years = $\frac{95{,}000}{3.791}$	25,059
Running and maintenance cost per annum net of tax (50% of 2,00,000)	1,00,000
Total net equivalent cash outflows p.a.	1,25,059

   (ii) To buy a new machine:

Particulars	Amount (₹)
Present value of after-tax cash outflows	
Purchase cost of new machine	4,90,000
Less: Sale Proceeds of old machine	50,000
	4,40,000
Equivalent annual cost for 10 years = $\frac{4{,}40{,}000}{6.145}$	71,603
Tax saving of depreciation (4,90,000/10) × 50%	(24,500)
Running and maintenance cost p.a. net of tax (50% of 1,40,000)	70,000
Total net equivalent cash outflows p.a.	1,17,103

   Since, net equivalent cash outflows p.a. for buying a new machine ₹1,17,103 is less than net equivalent cash outflows of ₹1,25,059 for repairing of an existing machine. Therefore, it is advisable that the company should go for buying a new machine.

Alternative Solution:

(i) To repair an existing machine:

Particulars	Amount (₹)
Present value of after-tax cash outflow	
Cost of repairs immediately net of tax (1,90,000 × 50%)	95,000
Running and maintenance cost for 5 years (2,00,000 × 50% × 3.791)	3,79,100
Total net present value of after-tax cash outflows for 5 years	4,74,100
Hence, net equivalent cash outflows p.a. = 474100/3.791	1,25,059

(ii) To Buy new machine

Particulars	Amount (₹)	Amount (₹)
Present value of after-tax cash outflow		
Purchase cost of new machine	4,90,000	
Less: Sale proceeds of old machine	50,000	4,40,000
Tax benefit on depreciation p.a. (4,90,000/10) × 50%	(24,500)	
Running and maintenance cost p.a. (50% of 1,40,000)	70,000	
	45,500	
Net cash outflows for 10 years (45,500 × 6.145)		2,79,598
Total net present value of after-tax cash outflows for 10 years		7,19,598
Hence, net equivalent cash outflow p.a. = 719598/6.145		1,17,103

Since, net equivalent cash outflows p.a. for buying a new machine ₹1,17,103 is less than net equivalent outflows of ₹1,25,509 for repairing of an existing machine. Therefore, it is advisable that the company should go for buying a new machine.

4. ABC Company Ltd. has been producing a chemical product by using machine Z for the last two years. Now the management of the company is thinking to replace this machine either by X or by Y machine. The following details are furnished to you:

Particulars	Z (₹)	X (₹)	Y (₹)
Books value	1,00,000	-	-
Resale value now	1,10,000	-	-
Purchase price	-	1,80,000	2,00,000
Annual fixed costs (including depreciation)	92,000	1,08,000	1,32,000
Variable running costs (including labour) per unit	3	1.50	2.50
Production per hour (unit)	8	8	12

You are also provided with the following details:

Selling price per unit	₹ 20
Cost of materials per unit	₹ 10
Annual operating hours	2,000
Working life of each of the three machines (as from now)	5 years
Salvage value of machines Z ₹ 10,000, X ₹ 15,000, Y ₹ 18,000	

The company charges depreciation using straight line method. It is anticipated that an additional cost of ₹8,000 per annum would be incurred on special advertising to sell the extra output of machine. Assume tax rate of 40% and cost of capital 10%. The present value of ₹1 to be received at the end of the year at 10% is as under:

Year	1	2	3	4	5
Present value	0.909	0.826	0.751	0.683	0.621

Required: Using NPV method, you are required to analyse the feasibility of the proposal and make recommendations.

Solution:

ABC Company Ltd.

Computation of yearly cash inflow

Machine	**Z (₹)**	**X (₹)**	**Y (₹)**
Sales (units)	16,000	16,000	24,000
Selling price per unit	20	20	20
Sales: (A)	3,20,000	3,20,000	4,80,000
Less: Costs			
Variable running costs	48,000	24,000	60,000
Material cost	1,60,000	1,60,000	2,40,000
Annual fixed cost	92,000	1,08,000	1,32,000
Additional cost (Special advertising)	-	-	8,000
Total costs: (B)	3,00,000	2,92,000	4,40,000
Profit before tax: (A) – (B)	20,000	28,000	40,000
Less: Tax @ 40%	8,000	11,200	16,000
Profit after tax	12,000	16,800	24,000
Add: Depreciation	20,000	33,000	36,400
Cash inflow	32,000	49,800	60,400

Computation of cash inflow in 5th year

Machine	Z (₹)	X (₹)	Y (₹)
Cash in flow	32,000	49,800	60,400
Add: Salvage value of machines	10,000	15,000	18,000
Cash inflow	42,000	64,800	78,400

Computation of Net Present Value

Year	Machine	Z		X		Y	
	Discounting factor	Cash inflow	P.V. of cash inflow	Cash inflow	P.V. of cash inflow	Cash inflow	P.V. of cash inflow
		₹	₹	₹	₹	₹	₹
1	0.909	32,000	29,088	49,800	45,268	60,400	54,904
2	0.826	32,000	26,432	49,800	41,135	60,400	49,890
3	0.751	32,000	24,032	49,800	37,400	60,400	45,360
4	0.683	32,000	21,856	49,800	34,013	60,400	41,253
5	0.621	42,000	26,082	64,800	40,241	78,400	48,686
			1,27,490		1,98,057		2,40,094
Less: Purchase price			1,10,000		1,80,000		2,00,000
Net present value			17,490		18,057		40,094

Recommendation:

The net present value is higher in the case of Machine Y. Therefore, it is advisable that the company should replace machine Z with machine Y.

However, as the cost of investment is not the same for all machines, it would be better to base the decision on profitability index which is as under:

$$P.I = \frac{\text{PV of cash inflow}}{\text{PV of cash outflow}}$$

$$\text{Machine Z} = \frac{127490}{110000} = 1.159$$

$$\text{Machine X} = \frac{198057}{180000} = 1.10$$

$$\text{Machine Y} = \frac{240094}{200000} = 1.20$$

Since the profitability index of machine Y is the highest therefore machine Z should be replaced by machine Y.

5. Complex Ltd., an infrastructure company is evaluating a proposal to build, operate and transfer a section of 20 kms. of road at a project cost of ₹400 crores to be financed as follows:

   Equity Shares Capital ₹100 crores, loans at the rate of interest of 15% p.a. from financial institutions ₹300 crores. The Project after completion will be opened to traffic and a toll will be collected for a period of 15 years from the vehicles using the road. The company is also required to maintain the road during the above 15 years and after the completion of that period, it will be handed over to the Highway authorities at zero value. It is estimated that the toll revenue will be ₹100 crores per annum and the annual toll collection expenses including maintenance of the roads will amount to 5% of the project cost. The company considers to write off the total cost of the project in 15 years on a straight-line basis. For Corporate Income-tax purposes the company is allowed to take depreciation @ 10% on WDV basis. The financial institutions are agreeable for the repayment of the loan in 15 equal annual instalments – consisting of principal and interest.

   Calculate Project IRR and Equity IRR. Ignore Corporate taxation. Explain the difference in Project IRR and Equity IRR.

Solution:

Computation of Project IRR (₹ in crore)

Project IRR is computed by using the following equation: $CO_0 = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t}$

Where,

CO_0 = Cash outflow at time zero

CF_t = Net cash inflow at different points of time

n = Life of the project and

r = Rate of discount (IRR)

Now,

CO_0 = ₹ 400

CF_t = ₹80 p.a. for 15 years (Refer to working note (i))

Therefore,

₹ 400 crores = ₹80 × PVIFA (r%, 15)

The value of IRR of the project:

1. An approximation of IRR is made on the basis of cash flow data. A rough approximation may be made with reference to the payback period. The payback period in the given case is 5 years (i.e., 400/80). From the PVIFA table the closest figures are given in rate 18% (5.092) and the rate 19% (4.876). This means the IRR of the project is expected to be between 18% and 19%.

2. The estimate of IRR cash inflow of the project for both these rates is as follows:

   At 18% = ₹80 × PVIFA (18%, 15 years)

   = ₹80 × 5.092 = ₹ 407.36

   at 19% = ₹80 × PVIFA (19%, 15 years)

   = ₹80 crores × 4.876 = ₹ 390.08 crore

3. The exact IRR by interpolating between 18% and 19% is worked out as follows:

   $$IRR = 18\% + \frac{(407.36 - 400)}{(407.36 - 390.08)} \times 1\% = 18.43\%$$

   Therefore, the IRR of the project is 18.43%.

Working Notes:

(i) Net cash inflow of the project

Cash inflow	₹ in crore
Toll revenue	100 crores p.a. for 15 years
Cash outflow	₹ in crore
Toll collection expenses including maintenance of the roads (5% of ₹ 400 crores)	20 crores p.a. for 15 years
Net cash inflow	80 crores p.a. for 15 years

Note: Since corporate taxes is not payable. The impact of depreciation need not be considered.

Computation of Equity IRR

Equity IRR is computed by using the following equation:

Cash inflow at zero date from equity shareholders = $\sum \frac{\text{Cash inflow available for equity shareholders}}{(1+r)^n}$

Where,

r = Equity IRR

n = Life of the project

Here, Cash inflow at zero date from equity shareholders = ₹100 crores

Cash inflow for equity shareholders = ₹28.69 crores p.a. (Refer to working note).

Therefore: ₹100 crores = $\sum \frac{₹28.69}{(1+r)^n}$

The value of equity IRR of the project is calculated as follows:

An approximation of IRR is made on the basis of cash flow data. A rough approximation may be made with reference to the payable period. The payback period in the given case is 3.484 (100/28.69)

From the PVIFA table at 28% the cumulative discount factor for 1 –15 years is 3.484. Therefore, the equity IRR of project is 28%.

(ii) Equated annual instalment (i.e., principal + interest) of loan from financial institution:

Amount of loan from financial institution (₹ in crore)	₹ 300
Rate of interest	15% p.a.
No. of years	15
Cumulative discount factor for 1-15 years	5.847

Hence, equated yearly instalment will be ₹300 crores/5.847 i.e., ₹51.31crore.

(iii) Cash inflow available for equity shareholders

Net cash inflow of the project [Refer to working note (i)]	₹ 80.00
Equated yearly instalment of the project [Refer to working note (ii)]	₹ 51.31
Cash inflow available for equity shareholders	₹ 28.69

Difference in Project IRR and Equity IRR:

The project IRR is 18.4% whereas Equity IRR is 28%. This is attributed to the fact that XYZ Ltd. is earning 18.4% on the loan from financial institution but paying only 15%. The difference between the return and cost of funds from financial institution has enhanced equity IRR. The 3.4% (18.4% - 15%) earnings on ₹300 crores goes to equity shareholders who have invested ₹100 crore i.e.,

3.4% × ₹300/₹100 = 10.2% is added to the project IRR is equity IRR of 28%.

6. X Ltd. an existing profit-making company, is planning to introduce a new product with a projected life of 8 years. Initial equipment cost will be ₹120 lakhs and additional equipment costing ₹10 lakhs will be needed at the beginning of third year. At the end of the 8 years, the original equipment will have resale value equivalent to the cost of removal, but the additional equipment would be sold for ₹1 lakhs. Working Capital of ₹15 lakhs will be needed. The 100% capacity of the plant is of 4,00,000 units per annum, but the production and sales-volume expected are as under:

Year	Capacity in percentage
1	20
2	30
3-5	75
6-8	50

A sale price of ₹100 per unit with a profit-volume ratio of 60% is likely to be obtained. Fixed Operating Cash Cost are likely to be ₹16 lakhs per annum. In addition to this the advertisement expenditure will have to be incurred as under:

Year	1	2	3-5	6-8
Expenditure in ₹ lakhs each year	30	15	10	4

The company is subject to 40% tax, straight-line method of depreciation, (permissible for tax purposes also) and taking 15% as appropriate after-tax Cost of Capital, should the project be accepted?

Solution:

(a) Computation of initial cash outlay (₹ in lakhs)

Equipment Cost (at year 0)	120
Working Capital (at year 0)	15
	135

Calculation of cash inflows

Year	1	2	3-5	6-8
Sales (in units)	80,000	1,20,000	3,00,000	2,00,000
	₹	₹	₹	₹
Contribution @ ₹ 60 p.u.	48,00,000	72,00,000	1,80,00,000	1,20,00,000
Fixed cost	16,00,000	16,00,000	16,00,000	16,00,000
Advertisement	30,00,000	15,00,000	10,00,000	4,00,000
Depreciation	15,00,000	15,00,000	16,50,000	16,50,000
Profit/(loss)	(13,00,000)	26,00,000	1,37,50,000	83,50,000
Less: Tax @ 40%	5,20,000	(10,40,000)	(55,00,000)	(33,40,000)
Profit/(loss) after tax	(7,80,000)	15,60,000	82,50,000	50,10,000
Add: Depreciation	15,00,000	15,00,000	16,50,000	16,50,000
Cash Inflow	7,20,000	30,60,000	99,00,000	66,60,000

Computation of PV of Cash Inflow (₹)

Year	CIF (₹)	PV Factor @ 15%	(₹)
1	7,20,000	0.8696	6,26,112
2	30,60,000	0.7561	23,13,666
3	99,00,000	0.6575	65,09,250
4	99,00,000	0.5718	56,60,820

5	99,00,000	0.4972	49,22,280
6	66,60,000	0.4323	28,79,118
7	66,60,000	0.3759	25,03,494
8	66,60,000	0.3269	21,77,154
WC	15,00,000	0.3269	4,90,350
SV	(1,00,000)	0.3269	(32,690)
			2,80,49,554
		PV of COF_0	1,35,00,000
	Additional Investment = ₹ 10,00,000 × 0.7561		7,56,100
		NPV	1,37,93,454

Recommendation: Accept the project in view of positive NPV.

7. A & Co. is contemplating whether to replace an existing machine or to spend money on overhauling it. A & Co. currently pays no taxes. The replacement machine costs ₹1,00,000 now and requires maintenance of ₹10,000 at the end of every year for eight years. At the end of eight years, it would have a salvage value of ₹20,000 and would be sold. The existing machine requires increasing amounts of maintenance each year and its salvage value fall each year as follows:

Year	Maintenance (₹)	Salvage (₹)
Present	0	40,000
1	10,000	25,000
2	20,000	15,000
3	30,000	10,000
4	40,000	0

The opportunity cost of capital for A & Co. is 15%. When should the company replace the machine?

(Notes: Present value of an annuity of ₹1 per period for 8 years at interest rate of 15%: 4.4873; present value of ₹1 to be received after 8 years at interest rate of 15%: 0.3269).

Solution:

A & Co.

Equivalent cost of (EAC) of new machine

		₹
(i)	Cost of new machine now	1,00,000
	Add: P.V. of annual repairs @ ₹10,000 per annum for 8 years (₹10,000 × 4.4873)	44,873
		1,44,873
	Less: P.V. of salvage value at the end of 8 years (₹20,000 × 0.3269)	6,538
		1,38,335
	Equivalent annual cost (EAC) (₹1,38,335/4.4873)	30,828

Equivalent Cost (EAC) of keeping the machine

Present value (P.V)	I Year (₹)	II Year (₹)	III Year (₹)	IV Year (₹)
Value Present	40,000	25,000	15,000	10,000
Add: P.V of annual maintenance (Annual Maintenance/1.15)	8,696	17,391	26,087	34,783
Total	48,696	42,391	41,087	44,783
Less: P.V. of salvage value at the end of the year (P.V./1.15)	21,739	13,043	8,696	Nil
	26,957	29,348	32,391	44,783
	1.15	1.15	1.15	1.15
Equivalent Annual Cost (EAC)	31,000	33,750	37,250	51,500

Advice: The company should replace the old machine immediately because the Equivalent Annual Cost (EAC) of the new machine at ₹30,828 is lower than the cost of using the existing machine in first year, second year, third year and fourth year.

8. S Ltd. has ₹10,00,000 allocated for capital budgeting purposes. The following proposals and associated profitability indexes have been determined as follows:

Project	Amount (₹)	Profitability Index
1	3,00,000	1.22
2	1,50,000	0.95
3	3,50,000	1.20
4	4,50,000	1.18
5	2,00,000	1.20
6	4,00,000	1.05

Which of the above investments should be undertaken? Assume that projects are indivisible and there is no alternative use of the money allocated for capital budgeting.

Solution:

Statement showing ranking of projects on the basis of Profitability Index

Project	Amount	P.I.	Rank
1	3,00,000	1.22	1
2	1,50,000	0.95	5
3	3,50,000	1.20	2
4	4,50,000	1.18	3
5	2,00,000	1.20	2
6	4,00,000	1.05	4

Assuming that projects are indivisible and there is no alternative use of the money allocated for capital budgeting on the basis of P.I., the S Ltd., is advised to undertake investment in projects 1, 3 and 5. However, among the alternative projects the allocation should be made to the projects which adds most to the shareholders wealth.

The NPV method, by its definition, will always select such projects.

Statement showing NPV of the projects

Project	Amount (₹)	P.I.	Cash inflows of project (₹)	N.P.V. of Project (₹)
(i)	(ii)	(iii)	(iv) = [(ii) × (iii)]	(v) = [(iv) – (ii)]
1	3,00,000	1.22	3,66,000	66,000
2	1,50,000	0.95	1,42,500	(-)7,500
3	3,50,000	1.20	4,20,000	70,000
4	4,50,000	1.18	5,31,000	81,000
5	2,00,000	1.20	2,40,000	40,000
6	4,00,000	1.05	4,20,000	20,000

The allocation of funds to the projects 1, 3 and 5 (as selected above on the basis of P.I.) will give N.P.V. of ₹1,76,000 and ₹1,50,000 will remain unspent.

However, the N.P.V. of the projects 3, 4 and 5 is ₹1,91,000 which is more than the N.P.V. of projects 1, 3 and 5. Further, by undertaking projects 3, 4 and 5 no money will remain unspent. Therefore, S Ltd. is advised to undertake investments in projects 3, 4 and 5.

9. A product is currently manufactured on a machine that is not fully depreciated for tax purposes and has a book value of ₹70,000. It was purchased for ₹2,10,000 twenty years ago. The cost of the product are as follows:

Particulars	Unit Cost (₹)
Direct Labour	28.00
Indirect labour	14.00
Other variable overhead	10.50
Fixed overhead	17.50
	70.00

In the past year 10,000 units were produced. It is expected that with suitable repairs the old machine can be used indefinitely in future. The repairs are expected to average ₹75,000 per year.

An equipment manufacturer has offered to accept the old machine as a trade in for a new equipment. The new machine would cost ₹4,20,000 before allowing for ₹1,05,000 for the old equipment. The Project costs associated with the new machine are as follows:

Particulars	Unit Cost (₹)
Direct Labour	14.00
Indirect labour	21.00
Other variable overhead	7.00
Fixed overhead	22.75
	64.75

The fixed overhead costs are allocations for other departments plus the depreciation of the equipment. The old machine can be sold now for ₹50,000 in the open market. The new machine has an expected life of 10 years and salvage value of ₹20,000 at that time. The current corporate income tax rate is assumed to be 50%. For tax purposes cost of the new machine and the book value of the old machine may be depreciated in 10 years. The minimum required rate is 10%. It is expected that the future demand of the product will stay at 10,000 units per year. The present value of an annuity of ₹1 for 9 years @ 10% discount factor = 5.759. The present value of ₹1 received at the end of 10th year @ 10% discount factor is = 0.386. Should the new equipment be purchased?

Solution:

Evaluation of replacement decision under NPV Method

Step 1: Calculation of PV of net cash outflow

Cost of new machine	4,20,000
Less: Exchange price for old machine	1,05,000
	3,15,000
Add: Tax on profit on exchange [1,05,000 – 70,000 = 35,000×50%] =	17,500
Net Investment =	3,32,500

Step 2: Calculation of PV of incremental operating cash inflows for 10 years

	Existing	New	Incremental
Number of units	10,000	10,000	–
	₹	₹	₹
Variable cost per unit	52.5	42	10.5
Variable Cost	5,25,000	4,20,000	1,05,000
Repairs	75,000	--	75,000
Depreciation	7,000	40,000	(33,000)
[2,10,000 – 70,000]/20			
[4,20,000 – 20,000]/10			
Total Savings before tax			1,47,000
Less: Tax at 50%			73,500
Savings after tax			73,500
Add: Depreciation			33,000
CFAT			1,06,500

Note: The allocations from other department are irrelevant for decision making.

Step 3: Calculation of terminal cash inflows

Salvage value of machine = ₹20,000

Step 4: Calculation of NPV:

Operating cash inflow from 1 to 9 years [1,06,500 × 5.759]	= 6,13,334
PV of cash inflow for 10th year (1,06,500 + 20,000) × 0.386	= 48,829
PV of total cash inflow	= 6,62,163
Less: Outflow	= 3,32,500
NPV	= 3,29,663

Comment: Since NPV is positive, it is advised to replace the machine.

Note: Since the exchange value is greater than open market value, the open market value is irrelevant.

10. Techtronics Ltd., an existing company, is considering a new project for manufacture of pocket video games involving a capital expenditure of ₹600 lakhs and working capital of ₹150 lakhs. The capacity of the plant is for an annual production of 12 lakh units and capacity utilisation during the 6-year working life of the project is expected to be as indicated below.

Year	Capacity utilization (%)
1	$33^1/_3$ %
2	$66^2/_3$ %
3	90 %
4-6	100 %

The average price per unit of the product is expected to be ₹200 netting a contribution of 40%. Annual fixed costs, excluding depreciation, are estimated to be ₹480 lakhs per annum from the third year onwards; for the first and second year it would be ₹240 lakhs and ₹360 lakhs respectively. The average rate of depreciation for tax purposes is $33^1/_3$% on the capital assets. No other tax reliefs are anticipated. The rate of income-tax may be taken at 50%.

At the end of the third year, an additional investment of ₹100 lakhs would be required for working capital.

The company, without taking into account the effects of financial leverage, has targeted for a rate of return of 15%. You are required to indicate whether the proposal is viable, giving your working notes and analysis.

Terminal value for the fixed assets may be taken at 10% and for the current assets at 100%. Calculation may be rounded off to lakhs of rupees. For the purpose of your calculations, the recent amendments to tax laws with regard to balancing charge may be ignored.

Solution:

Evaluation of Expansion decision under NPV method

Step 1: ₹ In lakhs

Calculation of PV of cash outflow

Cost of fixed asset at [t = 0] = 600 × 1 = ₹600

Cost of working capital at [t = 0] = 150 × 1 = ₹150

Additional WC required at [t = 3] = 100 × PVF (3yrs 15%) = (100 × 0.66) = ₹66

PV of cash outflow = ₹ 816

Step 2:

Calculation of PV of operating cash inflow for six years (working notes) = ₹826 lakhs

Step 3:

		₹ In lakhs
Calculation of PV of terminal cash inflow		
Salvage value of fixed assets [600 × 10/100]		= 60
Less: Tax on profit at 50% [60-53] × 50/100	= 3.5(rounded off)	= 4
Add: WC recovered [100%] [100 + 150]		= <u>250</u>
		= <u>306</u>

Its present value = 306 × PVF (6 years 15%) = 306 × 0.432 = ₹132 lakhs

Step 4:

Calculation of NPV		₹ In lakhs
PV of total cash inflows	[Recurring + Terminal i.e., 826 + 132]	= ₹958
Less: Outflow		= ₹816
NPV		= ₹142

Comment: As NPV is positive, it is advised to implement the new project.

Working Notes:

1. Calculation of Operating Cash Inflows

Year	Production	Contribution	Fixed expenses	Depreciation (WDV)	PBT	PAT	CIAT	PV at 15%	PV
1	400	320	240	200	(120)	(60)	140	0.870	121.80
2	800	640	360	133	147	74	207	0.756	156.49
3	1080	864	480	89	295	148	237	0.658	155.95
4	1200	960	480	59	421	210	269	0.572	153.87
5	1200	960	480	40	440	220	260	0.497	129.22
6	1200	960	480	26	454	227	253	0.432	109.29
PV of operating cash inflows for 6 years									826.62

Solved Case Study

A large profit-making company is considering the installation of a machine to process the waste produced by one of its existing manufacturing processes to be converted into a marketable product. At present, the waste is removed by a contractor for disposal on payment by the company of ₹50 lakhs per annum for the next four year. The contract can be terminated upon installation of the aforesaid machine on payment of a compensation of ₹30 lakhs before the processing operation starts. This compensation is not allowed as deduction for tax purposes.

The machine required for carrying out the processing will cost ₹200 lakhs to be financed by a loan repayable in 4 equal instalments commencing from the end of year 1. The interest rate is 16% per annum. At the end of the 4th year, the machine can be sold for ₹20 lakhs and the cost of dismantling and removal will be ₹15 lakhs.

Sales and direct costs of the product emerging from waste processing for 4 years are estimated as under:

			₹ in lakhs	
Year	1	2	3	4
Sales	322	322	418	418
Material consumption	30	40	85	85
Wages	75	75	85	100

Other expenses	40	45	54	70
Factory overheads	55	60	110	145
Depreciation (as per income-tax rules)	50	38	28	21

Initial stock of materials required before commencement of the processing operations is ₹20 lakhs at the start of year 1. The stock levels of materials to be maintained at the end of year 1, 2 and 3 will be ₹55 lakhs and the stocks at the end of year 4 will be nil. The storage of materials will utilize space which would otherwise have been rented out for ₹10 lakhs per annum. Labour costs include wages of 40 workers, whose transfer to this process will reduce idle time payments of ₹15 lakhs in year 1 and ₹10 lakhs in year 2. Factory overheads include apportionment of general factory overheads except to the extent of insurance charges of ₹30 lakhs per annum payable on this venture. The company's tax rate is 35%.

Present value factors for four years are as under:

Year	1	2	3	4
Present value factors	0.870	0.756	0.658	0.572

Advise the management on the desirability of installing the machine for processing the waste. All calculations should form part of the answer.

Solution:

Statement of Incremental Profit (₹ in lakhs)

Particulars	Years			
	1	2	3	4
Sales: (A)	322	322	418	418
Material consumption	30	40	85	85
Wages	60	65	85	100
Other expenses	40	45	54	70
Factory overheads (Insurance)	30	30	30	30
Loss of rent	10	10	10	10
Interest	32	24	16	8
Depreciation (as per income tax rules)	50	38	28	21
Total cost: (B)	252	252	308	324
Incremental profit: (C) = (A) – (B)	70	70	110	94
Tax (35% of (C))	24.5	24.5	38.5	32.9

Statement of Incremental Cash Flows (₹ in lakhs)

Particulars	Years				
	0	1	2	3	4
Material stocks	(20)	(35)	-	-	-
Compensation for contract	(30)	-	-	-	-
Contract payment saved	-	50	50	50	50

Tax on contract payment	-	(17.5)	(17.5)	(17.5)	(17.5)
Incremental profit	-	70	70	110	94
Depreciation added back	-	50	38	28	21
Tax on profits	-	(24.5)	(24.5)	(38.5)	(32.9)
Loan repayment	-	(50)	(50)	(50)	(50)
Profit on sale of machinery (net)	-	-	-	-	5
Total incremental cash flows	(50)	43	66	82.0	69.60
Present value factor	1.00	0.870	0.756	0.658	0.572
Net present value of cash flows	(50)	37.410	49.896	53.956	39.811

Net present Value = ₹181.073 – ₹50 = ₹131.073 lakhs.

Advice: Since the net present value of cash flows is ₹131.073 lakhs which is positive the management should install the machine for processing the waste.

Notes:

1. Materials stock increase are taken in cash flows.
2. Idle-time wages have also been considered.
3. Apportioned factory overheads are not relevant only insurance charges of this project are relevant.
4. Interest calculated at 16% based on 4 equal instalments of loan repayment.
5. Sale of machinery – Net income after deducting removal expenses taken. Tax on capital gains ignored.
6. Saving in contract payment and income tax there on considered in the cash flows.

Exercise

Theoretical Questions

Multiple Choice Questions

1. Which of the following statements is/are true?

   a. NPV is not useful for evaluating mutually exclusive projects.

   b. The result of the NPV technique is not affected by the discount rate used.

   c. Benefit-cost ratio helps in evaluating the projects which differ in initial outlays.

   d. The advantage of NPV criteria is that it remains the same for all possible reinvestment rates of intermediate cash flows.

2. Terminal value of the projects' cash inflows means

   a. The sum of the future cash flows after a particular period of time

   b. The present value of the projects' future cash inflows

   c. The sum of the reinvested values of the cash inflows up to the end of the project life

   d. The sum of the reinvested values of the cash inflows up to the end of the project life minus initial outlay

3. Which of the following statements is/are true?

   a. If BCR takes a value of one, it means that the NPV is positive.

   b. While BCR is a ratio of present value of benefits to initial investment, the profitability index is the ratio of net present value to initial investment.

   c. While BCR can take negative values, NBCR cannot take negative values.

   d. BCR criteria is used to rank the projects in the order of decreasingly efficient use of capital when the capital budget is limited.

4. IRR can be viewed as

   a. Desired rate of return for the investment proposed

   b. Rate of return earned on the initial investment

   c. The discount rate at which the capital is procured

   d. Rate of return earned on the intermediate cash flows of the project

5. Which of the following techniques is the most suitable, when NPV and IRR lead to inconsistent ranking due to life disparity between two or more projects?

   a. Modified Net Present Value.

   b. Modified Internal Rate of Return.

   c. Uniform Annual Equivalent Cost/Benefit.

   d. Discounted Payback Period.

Answer:

1	2	3	4	5
c	c	d	b	c

State True or False

1. Cash inflows are to be estimated on an after-tax basis.
2. The conflict between NPV and IRR due to life disparity may be resolved using Modified version of NPV or IRR.
3. Monetary Cost Benefit Analysis fails to consider the external effects of a project, which may be positive like development of infrastructure or negative like pollution and imbalance in environment.
4. Nominal Cash Flows may be discounted with the Real Discount Rate (RDR) directly to get the inflation adjusted Present Value.
5. IRR assumes that the future project cash flows will be reinvested at IRR itself for the remaining life of the project.

Answer:

1	2	3	4	5
True	False	True	False	True

Fill in the Blanks

1. NPV is defined as the excess of present value of ___________in any investment project over and above the present value of _________in that project.
2. At IRR, NPV is ________.
3. When NPV is zero, PI is _____.
4. Multiple IRR situation is observed in case of ____________ cash flow.
5. To handle project interdependence issues in capital rationing, ___________ should be used.

Answer:

1	cash inflows, cash outflows	2	zero
3	one	4	non-conventional
5	integer linear programming		

Short Essay Type Questions

1. How can the problems of traditional PBP method be overcome?
2. How will you treat salvage value and working capital investment in NPV method?
3. How is IRR related to NPV and PI method?
4. What are the possible reasons of conflict between IRR and NPV?
5. What is the need for Social Cost Benefit Analysis?

Essay Type Questions

1. Write a Short Note on: Multiple IRR.
2. How will you resolve the conflict between IRR and NPV in case of mutually exclusive projects?
3. What is MIRR? How does it overcome the limitations of IRR?
4. What is Modified NPV method? How is it better than the NPV method?
5. What is the relevance of SCBA for private enterprises? What are the two approaches of SCBA?

Practical Problems

Multiple Choice Questions

1. The following information is available in case of an investment proposal:

   NPV at discounting rate of 10% = ₹ 1250 and NPV at discounting rate of 11% = ₹ (-) 200. The IRR of the proposal is_________________

   a. 11.86%
   b. 10.86%
   c. 9.87%
   d. 11.96%

2. The Profitability Index of a project is 1.28 and its cost of investment is ₹ 2,50,000. The NPV of the project is ___________

   a. ₹ 75,000
   b. ₹ 80,000
   c. ₹ 70,000
   d. ₹ 65,000

3. From the following information calculate the MIRR of the project.

   Initial Outlay ₹50,000, cost of capital 12% p.a., Life of the project 4 years, Aggregate future value of cash flows ₹1,04,896.50.

   a. 20.35%
   b. 21.53%
   c. 31.25%
   d. 12.25%

4. The IRR of a project is 10%. If the annual cash flow after tax is ₹1,30,000 and project duration is 4 years, what is the initial investment in the project?

   a. ₹ 4,10,000
   b. ₹ 4,12,100
   c. ₹ 3,90,000
   d. ₹ 4,05,000

5. The NPV of a 4-year project is ₹ 220 lakh and PVIFA at 12% for 4 years is 3.037. The Equivalent Annual Benefit of the project is ___________

   a. ₹ 72.43 lakh
   b. ₹ 94.74lakh
   c. ₹ 66.96 lakh
   d. ₹ 76.65 lakh

Answer:

1	2	3	4	5
b	c	a	b	a

Comprehensive Numerical Problems

1. An oil company proposes to install a pipeline for transport of crude from wells to refinery. Investments and operating costs of the pipeline vary for different sizes of pipelines (diameter). The following details have been conducted:

(a) Pipeline diameter (in inches)	3	4	5	6	7
(b) Investment required (₹ lakhs)	16	24	36	64	150
(c) Gross annual savings in operating costs before depreciation (₹ lakhs)	5	8	15	30	50

The estimated life of the installation is 10 years. The oil company's tax rate is 50%. There is no salvage value and straight-line rate of depreciation is followed.

Calculate the net savings after tax and cash flow generation and recommend therefrom, the largest pipeline to be installed, if the company desires a 15% post-tax return. Also indicate which pipeline will have the shortest payback. The annuity PV factor at 15% for 10 years is 5.019.

[Answer: Pipeline diameter of 6 inches has shortest payback period; Pipeline of 6 inches diameter has highest NPV and it is recommended for installation]

2. A particular project has a four-year life with yearly projected net profit of ₹10,000 after charging yearly depreciation of ₹ 8,000 in order to write-off the capital cost of ₹32,000. Out of the capital cost ₹20,000 is payable immediately (Year 0) arid balance in the next year (which will be the year 1 for evaluation). Stock amounting to ₹6,000 (to be invested in year 0) will be required throughout the project and for debtors a further sum of ₹8,000 will have to be invested in year 1. The working capital will be recouped in year 5. It is expected that the machinery will fetch a residual value of ₹2,000 at the end of 4th year. Income tax is payable @ 40% and the Depreciation equals the taxation writing down allowances of 25% per annum. Income tax is paid after 9 months after the end of the year when profit is made. The residual value of ₹2,000 will also bear tax @ 40%. Although the project is for 4 years, for computation of tax and realisation of working capital, the computation will be required up to 5 years.

Taking discount factor of 10%, calculate NPV of the project and give your comments regarding its acceptability.

[Answer: NPV = ₹10,910; Proposal should be accepted]

3. A company is considering a cost saving project. This involves purchasing a machine costing ₹7,000, which will result in annual savings on wage costs of ₹1,000 and on material costs of ₹400.

The following forecasts are made of the rates of inflation each year for the next 5 years:

Wages costs 10%, Material costs 5%, General prices 6%

The cost of capital of the company, in monetary terms, is 15%.

Evaluate the project, assuming that the machine has a life of 5 years and no scrap value.

Answer: NPV = (-) ₹1,067]

4. A Ltd. is considering the question of taking up a new project which requires an investment of ₹200 lakhs on machinery and other assets. The project is expected to yield the following gross profits (before depreciation and tax) over the next five years: (₹ lakhs)

Year	1	2	3	4	5
Gross profit	80	80	90	90	75

The cost of raising the additional capital is 12% and the assets have to be depreciated at 20% on 'written down value' basis. The scrap value at the end of the five-year period may be taken as zero. Income-tax applicable to the company is 50%.

Calculate the net present value of the project and advise the management whether the project has to be implemented. Also calculate the Internal Rate of Return of the project.

[Answer: NPV = ₹19.31 lakhs; IRR = 15.6%]

5. United Industries Ltd. has an investment budget of ₹100 lakhs for 2021-22. It has short listed two projects A and B after completing the market and technical appraisals. The management wants to complete the financial appraisal before making the investment. Further particulars regarding the two projects are given below:

(₹ lakhs)

Particulars	A	B
Investment required	100	90
Average annual cash inflow before depreciation and tax (estimate)	28	24

Salvage value - Nil for both projects.

Estimate life - 10 years for both projects.

The company follows straight line method of charging depreciation. Its tax rate is 50%. You are required to calculate: (a) Payback period and (b) I.R.R. of the two projects.

[Answer: Payback period = 5.26 years and 5.45 years; IRR = 13.78% and 12.87%]

6. Swastik Ltd. manufacturers of special purpose machine tools, have two divisions which are periodically assisted by visiting teams of consultants. The management is worried about the steady increase of expense in this regard over the years. An analysis of last year's expenses reveals the following: (₹)

Consultants' remuneration	2,50,000
Travel and conveyance	1,50,000
Accommodation expenses	6,00,000
Boarding charges	2,00,000
Special allowances	50,000
	12,50,000

The management estimates accommodation expenses to increase by ₹2,00,000 annually.

As part of a cost reduction drive, Swastik Ltd. are proposing to construct a consultancy centre to take care of the accommodation requirements of the consultants. This centre will additionally save the company ₹50,000 in boarding charges and ₹2,00,000 in the cost of Executive Training Programmes hitherto conducted outside the company's premises every year.

The following details are available regarding the construction and maintenance of the new centre:

(a) Land at a cost of ₹8,00,000 already owned by the company, will be used.

(b) Construction cost ₹15,00,000 including special furnishings.

(c) Cost of annual maintenance ₹1,50,000.

(d) Construction cost will be written off over 5 years being the useful life.

Assuming that the write-off of construction cost as aforesaid will be accepted for tax purposes, that the rate of tax will be 50% and that the desired rate of return is 15%, you are required to analyse the feasibility of the proposal and make recommendations. The relevant Present Value Factors are:

Year	1	2	3	4	5
PV Factor	0.87	0.76	0.66	0.57	0.50

[Answer: NPV = ₹10.95 lakhs]

7. GFM produces two products - a main product Cp and a co-product Dg. For their main product Cp there is a 100% buy back arrangement with their foreign collaborators. Recently GFM doubled their capacity and with this their production capacity for the co-product Dg increased to 10,000 MT per annum. Fortunately, there was an unprecedented increase in demand for Dg and price too has increased significantly to ₹1,000 per tonne.

   However, with delicensing and liberalisation, more and more units for manufacturing Cp and Dg are being set up in the country. GFM, therefore, anticipates stiff competition for Dg from next financial year. For maintaining sales at current level (i.e., 10,000 MT per year) GFM will have to drop the price by ₹50 per MT every year for the next 5 years when prices are likely to stabilise at pre-boom level of ₹750 per MT.

   The Vice-President (Marketing) who, sensing this situation, has just completed a market study, suggests that the Company revive and earlier project for converting Dg into Dp grade and starting with 1,000 MT from next year increase production of Dp in stages of 1,000 MT every year by correspondingly reducing Dg. The Production Manger estimates that the additional variable cost for Dp will be ₹200 per MT. V.P. (Marketing) feels that Dp can be sold at ₹1,500 per MT but in the first two years a discounted price of ₹1,400 in year 1 and ₹1,450 in year 2 will have to be fixed. With partial conversion into Dp, the drop in price of Dg can also be contained at ₹25 MT instead of ₹50 envisaged. Production facilities for Dp involves a capital outlay of ₹50 lakhs.

   Present the projected sales volume and price of products Dg and Dp for the next 5 years under two alternatives.

   If GFM normally appraises investments @ 12% p.a. and if cash beyond 5 years from investment are ignored advise whether Dp should be produced.

[Answer: NPV of incremental cashflow = ₹12.03 lakhs; conversion of Dg into Dp is advisable.]

References:

1. Pandey, I M; Essentials of Financial Management; Pearson Publication
2. Chandra, P.; Financial Management – Theory and Practice; McGraw Hill
3. Khan and Jain; Financial Management – Text, Problems and Cases; McGraw Hill
4. Brigham and Houston; Fundamentals of Financial management; Cengage

Evaluation of Risky Proposals for Investment Decisions 2

This Module includes:

2.1 Risk Analysis in Capital Budgeting - Certainty Equivalent Approach, Risk Adjusted Discount Rate, Expected NPV, Standard Deviation of NPV and Use of Normal Distribution, Decision Tree Analysis, Options in Capital Budgeting

2.2 Sensitivity Analysis

2.3 Scenario Analysis

2.4 Monte Carlo Simulation

Evaluation of Risky Proposals for Investment Decisions

SLOB Mapped against the Module

1. To obtain in-depth knowledge on application of various techniques of project evaluation under a deterministic environment as well as techniques of incorporating the element of uncertainty in project appraisal. (CMLO 2a, 2b)
2. To develop detailed understanding of how to make strategic choices in long term investment decisions such as own or lease and making optimal allocation of limited funds. (CMLO 3c)

Module Learning Objectives:

After studying this module, the students will be able to -

- Understand certainty equivalent approach, risk adjusted discount rate, expected NPV and standard deviation, decision tree analysis in capital budgeting.
- Learn sensitivity analysis, scenario analysis and Monte Carlo Simulation techniques to deal with uncertainty in capital budgeting.

Risk Analysis in Capital Budgeting - Certainty Equivalent Approach, Risk Adjusted Discount Rate, Expected NPV, Standard Deviation of NPV and Use of Normal Distribution, Decision Tree Analysis, Options in Capital Budgeting

2.1

Introduction

While making an investment decision, a financial manger may face three alternative situations relating to the possible states of nature. Accordingly, there can be:

1. Decision making under Complete Certainty
2. Decision making under Complete Uncertainty; and
3. Decision making under Risk.

Decision making under complete certainty implies that the manager is fully aware of all the states of nature (i.e., possible events not under the control of the firm) available and expected payoffs from the strategies under considerations for each state of nature. Since all the outcomes are fully known here, the manager can construct a pay-off matrix for all states of nature and can select the best possible strategy with the maximum pay-off.

While dealing with risk and uncertainties in capital investment decisions, a financial manager, resorts to various alternative techniques based on the principle stated above. Some of the important techniques are:

1. Certainty Equivalent Approach
2. Risk Adjusted Discount Rate
3. Expected NPV and Standard Deviation
4. Decision Tree Analysis

In addition to the above, some advance risk analysis techniques are also used such as –

1. Sensitivity Analysis
2. Scenario Analysis
3. Simulation Approach

These techniques are discussed in detail as follows.

2.1.1 Certainty Equivalent Approach

Under this approach, the estimated cash flows over the life of the proposed project, i.e., risky cash flows, are converted to their certainty equivalent. Certainty equivalent of estimated cash flow will indicate the cash flows that are likely to be received with almost certainty (certain cash flows or riskless cash flows) and the certain cash flows are derived through multiplying the estimated risky cash flows of the future periods by Certainty Equivalent Co-efficient of the respective periods.

CE Co-efficient = Riskless cash flow / Risky cash flow

Riskless or Certain Cash Flows of period 't' = Estimated or risky cash flows of period 't' (CF_t)× CE Co-efficient of period 't'(α_t)

Symbolically, Riskless Cashflow = $\alpha_t\ CF_t$

The CE Co-efficient (α_t) is a fractional amount that assumes a value between 0 and 1 and there is an inverse relationship between the degree of risk and the value of co-efficient.

NPV is calculated with present value of risk less or certain cash flows using risk free rate.

Therefore, NPV = $- CF_0 + \sum_{t=1}^{n} \frac{\alpha_t CF_t}{(1+i)^t}$

- CF_0 is the Cash outlay at the initial period (i.e. period '0')
- CF_t are the risky or uncertain cash inflows from year 1 to year n
- α_t is the Certainly Equivalent Co-efficient for period t.
- i is the risk free rate.
- n is the total number of periods

If NPV is positive, the project is acceptable.

It may be observed that the major difference between the RADR and CE methods is that the RADR method adjusts for risk in the discount rate while the CE method adjusts the cash flows for risk and then discounts at a risk-free rate of interest.

2.1.2 Risk Adjusted Discount Rate

The rationale, underlying this method is that all the projects undertaken by a firm should not be discounted at the same rate. The rate should be so chosen for each project that it reflects the risk characteristics of the project. If the risk of the project is similar to the existing projects, the weighted average cost of capital is used as the discounting rate. But, if the project involves higher or lower risk, a higher or lower discounting rate should be used for adjusting the risk involved. Such a revised discounting rate is called Risk Adjusted Discount (RAD) Rate.

The Risk Adjusted Discount rate (RAD), therefore, consists of three exponents. The risk-free rate of discount, the premium for the normal risk of the firm and the premium (whether positive and negative) for the extra or below normal risk of the project.

Symbolically, RAD (say, i) = r + u + a

Where, r = risk free rate

u = the premium for normal risk of the firm

a = the premium for the abnormal or subnormal risk of the project compared to the normal risk of the firm.

The first two components, taken together, constitute the weighted average cost of capital. In an uncertain environment, due to increase in the discount rate, present value of cash flows will be less and will reduce the value of NPV or IRR, etc. This conservative estimate of benefits will take care of risk and uncertainties.

The additional risk premium may be decided upon by the firm on a case-to-case basis, or a blanket rate may be decided for each class of investments. For example, a firm may decide the discount rates for various categories of investments as follows:

Category of Investment	Discount rate
Replacement investments	Cost of capital + 2%
New projects	Cost of capital + 4%
Research and development investments	Cost of capital + 5%

Consider the following Illustration.

Illustration 1

A firm is considering a replacement investment. The firm feels that the suitable discount rate for investment is cost of capital + 2%. Firm's cost of capital is 13%. The cash flows as projected by the company's analyst are as follows:

Initial outflow is ₹14 lakhs and expected cash inflow for 1-5 years is ₹2.54 lakhs and from 6-10 years is ₹3.14 lakhs. Calculate the NPV of the project.

Solution:

NPV = -14 + 2.54 × PVIFA (15%, 5) + 3.14 × PVIFA (15%, 6-10)

= -14 + 2.54 × PVIFA (15%, 5) + 3.14 × PVIFA (15%, 5) × PVIF (15%, 5)

= -14 + 2.54 × 3.352 + 3.14 × 3.352 × 0.497

= (-) ₹0.255 lakhs

Since, NPV is negative, the project should not be accepted.

Note: Risk Adjusted Discounting rate = cost of capital + 2% = 13% + 2% = 15%

2.1.3 Expected NPV and Standard Deviation

Hillier Model

H. S. Hillier argues that the uncertainty or the risk associated with a capital expenditure proposal is shown by the standard deviation of the expected cash flows. In other words, the more certain a project is, lesser would be the deviation of various cash flows from the mean cash flows.

Hillier argues that working out the standard deviation of the various ranges of possible cash flows would be helpful in the process of taking cognizance of uncertainty involved with future projects.

Accordingly, Hillier developed a model to evaluate long term investment proposals based on the expected Net Present Value and the standard deviation of the Net present value of the project which can be calculated using the expected cashflows and standard deviations of cash flows.

The steps involved are as follows:

Step 1: Calculate the expected cashflows and S.D of cashflows for each year of the project based on the probability distribution of cashflows for the respective year.

Expected cashflows ($\bar{A}_t$) = $\sum P_i CF_i$ where 'i' refers to the states of nature and i = 0, 1…, n.

S.D of cash flows = $\sqrt{\sum P_i(CF_i - \overline{CF})^2}$

Illustration 2

Pioneer Projects Ltd. is considering accepting one of two mutually exclusive projects M & N. For the first year the cash flow and probabilities are estimated as under:

Project M		Project N	
Probability	**Cash flow (₹)**	**Probability**	**Cash flow (₹)**
0.10	12,000	0.10	8,000
0.20	14,000	0.25	12,000
0.40	16,000	0.30	16,000
0.20	18,000	0.25	20,000
0.10	20,000	0.10	24,000

Calculate the expected cashflows and standard deviation of cashflows.

Solution:

Calculation of expected cashflows and standard deviation of cashflows for Project M ('000)

Probablity	Cash flows (X)	EV = P × X	X - ∑EV	(X - ∑EV)^2	(X - ∑EV)^2 × Probablity
0.10	12	1.2	-4	16	1.6
0.20	14	2.8	-2	4	0.8
0.40	16	6.4	0	0	0
0.20	18	3.6	2	4	0.8
0.10	20	2.0	4	16	1.6
		∑EV = 16.0			Variance = 4.8

Standard Deviation (σ) $= \sqrt{4.8} = 2.19$

Calculation of expected cashflows and standard deviation of cashflows for Project N ('000)

Probablity	Cash flows (X)	EV = P × X	X - ∑EV	(X - ∑EV)^2	(X - ∑EV)^2 × Probablity
0.10	8.0	0.8	-8	64	6.4
0.25	12.0	3.0	-4	16	4.0
0.30	16.0	4.8	0	0	0
0.25	20.0	5.0	4	16	4.0
0.10	24.0	2.4	8	64	6.4
		∑EV = 16.0			Variance = 20.8

Standard Deviation (σ) $= \sqrt{20.8} = 4.56$

Note: The above illustration shows the calculation of expected cashflows and standard deviation of cashflows for the projects only for the first year. In the similar way, the calculation of expected cashflows and standard deviation of cashflows for all the other years in the life of the projects must also be calculated.

Step 2: Calculate the Expected NPV and Standard Deviation of NPV

The calculation of expected NPV is very simple. It is the excess of the present value of expected cashflows over the initial investment in the project. Symbolically,

$$\text{Expected NPV (NPV)} = \sum_{t=1}^{n} \frac{A_t}{(1+i)^t} - I$$

Where, A_t = the expected cash flows

i = the risk-free discount rate

n = life of the project

The calculation of standard deviation of NPV depends on the association between the expected cashflows. There can be three possible associations between the expected cashflows over time:

(a) Perfectly Correlated Cashflows:

If the cashflows are perfectly correlated, the S.D of NPV is calculated as follows:

$$\sigma\text{ (NPV)} = \sum_{t=1}^{n} \frac{\sigma_t}{(1+i)^t}$$

Where, σ_t = standard deviation of the cashflows

Illustration 3

The cashflows of a project are perfectly correlated. The project involves an initial cash outlay of ₹20,000. The mean or expected value and standard deviation of the cashflows are as follows:

Year	1	2	3	4
Exp. Cashflow (₹)	10,000	6,000	8,000	6,000
S.D of Cashflow (₹)	3,000	2,000	4,000	1,200

Risk free rate of interest is 6%. Calculate the expected NPV and S.D of NPV.

Solution:

Calculation of expected NPV and S.D of NPV **(Figure in ₹)**

Year	Exp. C/F	SD of C/F	PVIF @ 6%	PV of C/F	PV of S. D
1	10,000	3,000	0.943	9,430	2,829
2	6,000	2,000	0.890	5,340	1,780
3	8,000	4,000	0.840	6,720	3,360
4	6,000	1,200	0.792	4,752	951
Total PV of C/F Less: Initial investment				26,242 20,000	8,920
			NPV	6,242	

So, expected NPV = ₹6,242

Standard deviation of NPV = ₹8,920

(b) Uncorrelated Cashflows:

If the cashflows are uncorrelated, the S.D of NPV is calculated as follows:

$$\sigma\,(\text{NPV}) = \left[\sum_{t=1}^{n} \frac{\sigma_t^2}{(1+i)^{2t}}\right]^{\frac{1}{2}}$$

Illustration 4

Refer to the previous illustration, calculate the expected NPV and S.D of NPV assuming that the cashflows are uncorrelated.

Solution:

Expected NPV = ₹6,242 (refer to the previous illustration).

Calculation of SD of NPV (Figure in ₹)

Year	SD of C/F	PVIF @ 6%	PV of S. D	(PV of S. D)^2
1	3,000	0.943	2,829	80,03,241
2	2,000	0.890	1,780	31,68,400
3	4,000	0.840	3,360	1,12,89,600
4	1,200	0.792	951	9,04,401
Total				2,33,65,642

So, SD of NPV = $\sqrt{23365642}$ = ₹4,833

(c) Moderately Correlated Cashflows (positive or negative)

In reality cashflows are neither perfectly correlated nor uncorrelated, rather they are moderately correlated (with positive or negative correlation). In such cases expected NPV and the standard deviation of NPV cannot be determined in the above two approaches. They are to be based on conditional probabilities and joint probabilities.

Conditional probability is the probability of the event occurring given that the event preceding it has occurred. P(B/A) indicates the probability of the occurrence of B given the occurrence of A.

Joint probability of, say, three events, that is, the probability of all the three events occurring simultaneously. So, P (A, B, C) is the product of the conditional probabilities of the three events, that is P (A) × P (B/A) × P (C/ B, A).

Illustration 5

The information relating to cash flows and probabilities are given below.

Year 1		Year 2		Year 3	
NCF (₹)	Initial Probability	NCF (₹)	Conditional Probability	NCF (₹)	Conditional Probability
20,000	0.35	20,000	0.40	25,000	0.20
				30,000	0.80
		30,000	0.60	35,000	0.30
				40,000	0.70
30,000	0.65	55,000	0.20	45,000	0.50
				55,000	0.50
		65,000	0.80	60,000	0.60
				70,000	0.40

Assuming an initial investment of ₹1,00,000, calculate the expected NPV and the standard deviation of NPV.

Solution:

Here, we need to calculate the joint probabilities associated with each possible stream of cashflows as follows:

(Figure in ₹)

Year 1		Year 2		Year 3		Joint Probability
NCF (₹)	Initial Probability	NCF (₹)	Conditional Probability	NCF (₹)	Conditional Probability	
20,000	0.35	20,000	0.40	25,000	0.20	0.028*
				30,000	0.80	0.112
		30,000	0.60	35,000	0.30	0.063
				40,000	0.70	0.147
30,000	0.65	55,000	0.20	45,000	0.50	0.065
				55,000	0.50	0.065
		65,000	0.80	60,000	0.60	0.312
				70,000	0.40	0.208

*0.028 = 0.35 × 0.40 × 0.20 [cash flow ₹20,000(1st year) – ₹20,000 (2nd year) – ₹25,000 (3rd year)]

Cash Flow Stream	NPV	Joint Probability	NPV × Joint Prob.	(NPV – Exp. NPV)^2 × Joint Prob.
1.	$\frac{20000}{(1.06)^1}+\frac{20000}{(1.06)^2}+\frac{25000}{(1.06)^3}-100000=-42340$	0.028	-1185.52	96005724
2.	$\frac{20000}{(1.06)^1}+\frac{20000}{(1.06)^2}+\frac{30000}{(1.06)^3}-100000=-38340$	0.112	-4271.68	333348944
3.	$\frac{20000}{(1.06)^1}+\frac{30000}{(1.06)^2}+\frac{35000}{(1.06)^3}-100000=-25040$	0.063	-1577.52	107228325
4.	$\frac{20000}{(1.06)^1}+\frac{30000}{(1.06)^2}+\frac{40000}{(1.06)^3}-100000=-20840$	0.147	-3063.48	201849905
5.	$\frac{30000}{(1.06)^1}+\frac{55000}{(1.06)^2}+\frac{45000}{(1.06)^3}-100000=19755$	0.065	1284.075	814208.887
6.	$\frac{30000}{(1.06)^1}+\frac{55000}{(1.06)^2}+\frac{55000}{(1.06)^3}-100000=28155$	0.065	1830.075	9265469.89
7.	$\frac{30000}{(1.06)^1}+\frac{65000}{(1.06)^2}+\frac{60000}{(1.06)^3}-100000=41255$	0.312	12871.56	195612781
8.	$\frac{30000}{(1.06)^1}+\frac{65000}{(1.06)^2}+\frac{70000}{(1.06)^3}-100000=49655$	0.208	10328.24	232582156
Total		Exp. NVP	16215.75	1174267896

Expected NPV = ₹16,215.75

S.D of NPV = $\sqrt{1174267896}$ = ₹34,268

Step 3: Finally, alternative investment proposals should be compared using Coefficient of Variation which is equal to $\frac{\text{S.D. of NPV}}{\text{Mean of Expected NPV}}$

Illustration 6

Consider the following information regarding two projects X and Y.

(Figure in ₹)

Particulars	X	Y
Expected NPV	12,000	14,000
S.D of NPV	4,800	5,800

Advise on the selection of the project in terms of riskiness.

Solution:

Calculation of Coefficient of Variation

(Figure in ₹)

Particulars	X	Y
Expected NPV	12,000	14,000
S.D of NPV	4,800	5,800
Coefficient of Variation = $\frac{\text{S.D. of NPV}}{\text{Mean of Expected NPV}}$	0.4	0.414

Since, the coefficient of variation is higher for Project Y, it is riskier than Project X. Hence, Project X with lower risk may be preferred.

Use of Normal Probability Distribution (NPD)

Once the expected NPV and S.D of NPV is calculated, the probability of occurrence of any value of NPV is calculated assuming that the NPV follows the normal distribution. Accordingly, it is possible to calculate the probability of the project NPV taking a value higher than, lower than or in between specified value(s).

Basically, NPD is a smooth, symmetric, continuous bell-shaped curve. It can be used to analyse the risk element in capital budgeting.

Illustration 7

Refer to our previous illustration no. 6. Suppose, we are interested to calculate the probability that NPV of the project will be at least ₹20,000. The same can be calculated as follows

Solution:

$$P\,(NPV \geq 50000) = P\left(\frac{\text{NPV - Expected NPV}}{\text{S.D of NPV}} \geq \frac{20000-16215.75}{34268}\right) = P\,(Z \geq 0.11) = 1 - \frac{\text{Profit}}{\text{P/V Ratio}}\,(0.11)$$

$$= 1 - (0.5 + 0.4602) = 0.0398 = 3.98\%$$

Note: For $\frac{\text{Profit}}{\text{P/V Ratio}}$ (0.11), please refer to standard normal distribution table.

Illustration 8

A project has expected NPV value of ₹800 and S.D. of NPV of ₹400. The management wants to determine the probability of the NPV under the following ranges.

(i) Zero or less

(ii) Greater than zero

(iii) Between the range of ₹500 and ₹900

(iv) Between the range of ₹300 and ₹600

Solution:

(i) P (NPV ≤ 0)

$$= P\left(\frac{\text{NPV- expected NPV}}{\text{S.D. of NPV}} \leq \frac{0-800}{400}\right)$$

$$= P\,(Z \leq -2) = (-2) = 1 - (2) = 1 - (0.50 + 0.4772) = 0.0228 \text{ or } 2.28\%$$

(ii) P (NPV ≥ 0)

$$= P\left(\frac{\text{NPV- expected NPV}}{\text{S.D. of NPV}} \geq \frac{0-800}{400}\right)$$

$= P (Z \geq - 2) =1 - P (Z \leq - 2) = 1- \frac{\text{Profit}}{\text{P/V Ratio}} (-2) = \frac{\text{Profit}}{\text{P/V Ratio}} (2) = (0.50 + 0.4772) = 0.9772$ or 97.72%

(iii) When NPV = 500; Z = (500 – 800) / 400 = - 300/400 = - 3/ 4 = - 0.75

When NPV = 900; Z = (900 – 800) / 400 = 100/400 = 1/ 4 = 0.25

Table Value of 0.75 = .2734 and 0.25 = .0987; so, $\frac{\text{Profit}}{\text{P/V Ratio}} (0.25) = 0.5987$ and $\frac{\text{Profit}}{\text{P/V Ratio}} (0.75) = 0.7734$

P (NPV between 500 & 900)

$= P (500 \leq NPV \leq 800)$

$= P (-0.75 \leq Z \leq 0.25)$

$= \frac{\text{Profit}}{\text{P/V Ratio}} (0.25) - (-0.75)$

$= \frac{\text{Profit}}{\text{P/V Ratio}} (0.25) – [1- (0.75)]$

= 0.5987 – [1 – 0.7734]

= 0.5987 – 0.2266 = 0.3721 = 37.21%

(iv) Table Value of 1.25 = 0.3944 and 0.50 = 0.1915; so, $\frac{\text{Profit}}{\text{P/V Ratio}} (1.25) = 0.8944$ and $\frac{\text{Profit}}{\text{P/V Ratio}} (0.50) = 0.6915$

P (NPV between 300 & 600)

$= P (300 \leq NPV \leq 600)$

$= P (-1.25 \leq Z \leq -0.50)$

$= \frac{\text{Profit}}{\text{P/V Ratio}} (-0.5) - \frac{\text{Profit}}{\text{P/V Ratio}} (-1.25)$

$= [1- \frac{\text{Profit}}{\text{P/V Ratio}} (0.5)] – [1- \frac{\text{Profit}}{\text{P/V Ratio}} (1.25)]$

= 0.3085 – 0.1056

= 0.2029 = 20.29%

2.1.4 Decision Tree Analysis

Decision Tree Analysis is a useful tool for analysis of investment proposals incorporating project flexibility. The decision-tree method analyses investment opportunities involving a sequence of decisions over time. Various decision points are defined in relation to subsequent chance events. The Expected NPV for each decision point is computed based on the series of NPVs and their probabilities that branch out or follow the decision point in question. In other words, once the range of possible decisions and chance events are laid out in tree-diagram form, the NPVs associated with each decision are computed by working backwards on the diagram from the expected cash flows defined for each path on the diagram. The optimal decision path is chosen by selecting the highest expected NPV.

The following is an illustration on a decision tree relating to an investment proposal.

Illustration 9

A firm has an investment proposal, requiring an outlay of ₹40,000. The investment proposal is expected to have 2 years' economic life with no salvage value. In year 1, there is a 0.4 probability that cash inflow after tax will be ₹25,000 and 0.6 probability that cash inflow after tax will be ₹30,000. The probabilities assigned to cash inflows after tax for the year 2 are as follows:

The Cash inflow year 1	₹ 25,000		₹30,000	
The Cash inflow year 2		**Probability**		**Probability**
	₹ 12,000	0.2	₹ 20,000	0.4
	₹ 16,000	0.3	₹ 25,000	0.5
	₹ 22,000	0.5	₹ 30,000	0.1

The firm uses a 12% discount rate for this type of investment.

Required:

(i) Construct a decision tree for the proposed investment project.

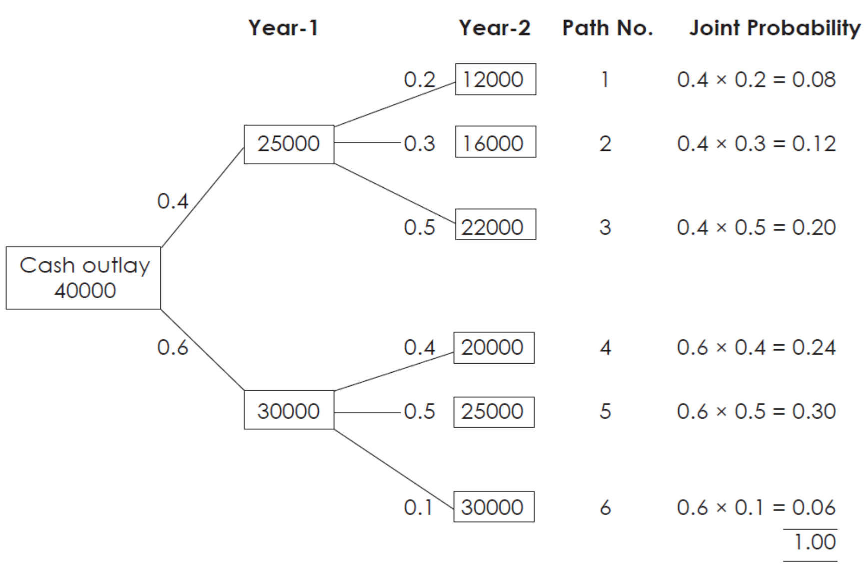
(ii) What net present value will the project yield if worst outcome is realized? What is the probability of occurrence of this NPV?

(iii) What will be the best and the probability of that occurrence?

(iv) Will the project be accepted?

Solution:

Decision Tree



(i) The decision tree given above shows that there are six possible outcomes each represented by a path. The net present value of each path at 12% discount rate is given below: (Fig in ₹)

Path	(Cash inflow year 1 × discount factor year 1)	(Cash inflow year 2 × discount factor year 2)	Total Cash inflow	Cash outflow	Net present value
	(a)	(b)	(c) = (a) + (b)	(d)	(e) = (c) – (d)
			₹	₹	₹
1	(₹ 25,000 × 0.8929) = 22,323	(₹ 12,000 × 0.7972) = 9,566	31,889	40,000	-8,111
2	(₹ 25,000 × 0.8929) = 22,323	(₹ 16,000 × 0.7972) = 12,755	35,078	40,000	-4,922
3	(₹25,000 × 0.8929) = 22,323	(₹22,000 × 0.7972) = 17,538	39,861	40,000	-139
4	(₹ 30,000 × 0.8929) = 26,787	(₹ 20,000 × 0.7972) = 15,944	42,731	40,000	2,731
5	(₹ 30,000 × 0.8929) = 26,787	(₹ 25,000 × 0.7972) = 19,930	46,717	40,000	6,717
6	(₹ 30,000 × 0.8929) = 26,787	(₹ 30,000 × 0.7972) = 23,916	50,703	40,000	10,703

Statement showing the expected Net Present Value

Path	Net present value @ 12% (Refer above) (₹)	Joint probability (Refer above)	Expected Net present Value (₹)
	(a)	(b)	(a) × (b)
1	- 8,111	0.08	- 648.88
2	- 4,922	0.12	- 590.64
3	-139	0.20	-27.80
4	2,731	0.24	655.44
5	6,717	0.30	2,015.10
6	10,703	0.06	642.18
			2,045.40

(ii) If the worst outcome is realized the Net present value which the project will yield is ₹8,111 (negative). The probability of occurrence of this Net present value is 8%.

(iii) The best outcome will be path 6 when Net present value is higher i.e., ₹10,703 (positive). The probability of occurrence of this Net present value is 6%.

(iv) Yes, the project will be accepted since the Expected Net Present Value is positive.

Illustration 10

A firm has an investment proposal, requiring an outlay of ₹80,000. The investment proposal is expected to have two years economic life with no salvage value. In year 1, there is a 0.4 probability that cash inflow after tax will be ₹50,000 and 0.6 probability that cash inflow after tax will be ₹60,000. The probability assigned to cash inflow after tax for the year 2 are as follows:

The cash inflow year 1	₹ 50,000		₹ 60,000	
The cash inflow year 2		Probability		Probability
	₹24,000	0.2	₹40,000	0.4
	₹32,000	0.3	₹ 50,000	0.5
	₹44,000	0.5	₹ 60,000	0.1

The firm uses 8% discount rate for this type of investment.

Required:

(i) Construct a decision tree for the proposed investment project and calculate the expected net present value (NPV).

(ii) What net present value will the project yield, if worst outcome is realized? What is the probability of occurrence of this NPV?

(iii) What will be the best outcome and the probability of that occurrence?

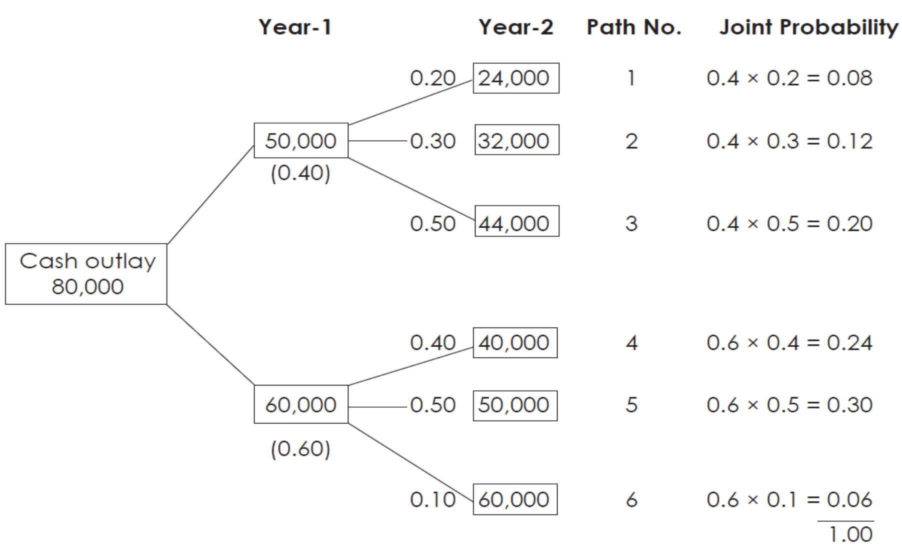
(iv) Will the project be accepted?

(Note: 8% discount factor 1 year 0.9259; 2 year 0.8573)

Solution:

The decision tree diagram is presented in the chart, identifying various paths and outcomes, and the computation of various paths/outcomes and NPV of each path are presented in the following tables:

(i) The Net Present Value (NPV) of each path at 8% discount rate is given below:



The Net Present Value (NPV) of each path at 8% discount rate is given below:

Path	Year 1 Cash Flows (₹)	Year 2 Cash Flows (₹)	Total Cash Inflows (PV) (₹)	Cash Outflows (₹)	NPV (₹)
1	50,000×.9259 = 46,295	24,000×.8573 = 20,575	66,870	80,000	(-) 13,130
2	50,000×.9259 = 46,295	32,000×.8573 = 27,434	73,729	80,000	(-) 6,271
3	50,000×.9259 = 46,295	44,000×.8573 = 37,721	84,016	80,000	4,016
4	60,000×.9259 = 55,554	40,000×.8573 = 34,292	89,846	80,000	9,846
5	60,000×.9259 = 55,554	50,000×.8573 = 42,865	98,419	80,000	18,419
6	60,000×.9259 = 55,554	60,000×.8573 = 51,438	1,06,992	80,000	26,992

Statement showing Expected Net Present Value

Path	NPV (₹)	Joint Probability	Expected NPV (₹)
1	(-) 13,130	0.08	(-)1,050.40
2	(-) 6,271	0.12	(-)752.52
3	4,016	0.20	803.20
4	9,846	0.24	2,363.04
5	18,419	0.30	5,525.70
6	26,992	0.06	1,619.52
			8,508.54

Conclusions:

(ii) If the worst outcome is realized the project will yield NPV of (-) ₹13,130. The probability of occurrence of this NPV is 8% and a loss of (-) ₹ 1,050.40 (path 1).

(iii) The best outcome will be path 5 when the NPV is at ₹18,419. The probability of occurrence of this NPV is 30% and an expected profit of ₹5,525.70.

(iv) The project should be accepted because the expected NPV is positive at ₹8,508.54 based on joint probability.

2.1.5 Options in Capital Budgeting – Real Options

Traditional capital budgeting theory argues that investments should be made when the net present value (NPV) of an investment equals or exceeds zero. It also assumes that the investment must be made either now or never. However, such an investment approach fails to consider that management can revise its strategies in response to unexpected market and technological developments which may cause cash flows to deviate from their original expectations. In other words, it fails to capture management's flexibility in adapting its decisions to evolving market and technological uncertainty. The notion of real options was developed from the idea that one can view firms' discretionary investment opportunities as a call option on real assets, similar to financial call option which provides decision rights on financial assets. Again, the firm may have the option to abandon a project during its life. This amounts to a put option on the remaining cash flows associated with the project.

By analogy, a real option provides the firm the right, but not the obligation, to take some action in the future. The option is "real" because the underlying assets are usually physical and human assets rather than financial securities. The commonality in applying option-pricing models for real assets and for financial securities is that the future is uncertain. In an uncertain environment, having the flexibility to decide what to do after some of that uncertainty is resolved has value. A key feature is that the real option creates economic value by generating future decision rights – specifically, by offering management the flexibility to act upon new information such that the upside economic potential is retained while the downside losses are contained.

Generally, real options in capital budgeting are of the following types:

a. **Option to expand** is the option to make an investment or undertake a project in the future to expand the business operations (a fast-food chain considers opening new restaurants).

b. **Option to abandon** is the option to cease a project or an asset to realize its salvage value (a manufacturer can opt to sell old equipment).

c. **Option to wait** is the option of deferring the business decision to the future (a fast-food chain considers opening new restaurants this year or in the next year).

d. **Option to contract** is the option to shut down a project at some point in the future if conditions are unfavorable (a multinational corporation can stop the operations of its branches in a country with an unstable political situation).

e. **Option to switch** is the option to shut down a project at some point in the future if the conditions are unfavorable and resume it when the conditions are favorable (an oil company can shut down the operation of one of its plants when oil prices are low and resume operation when prices are high).

Sensitivity Analysis

2.2

Sensitivity analysis in the context of capital budgeting decisions refers to the analysis of impact of changes in the underlying variables or parameters on the decisions regarding acceptance or rejection of the investment proposal. If NPV method is followed for financial appraisal, the changes in the factors or variables or parameters on the basis of which NPV is determined (i.e., Cash Outlay, Cash Inflow, Discounting Factor, Life of the Project) are taken into consideration for sensitivity analysis. While analyzing the sensitivity, change in each of the variables is considered one by one and other variables are taken as constant, that means, when impact of changes in cash inflow is considered, the other elements, viz., cash outflow, discount rate, life of the project, are taken as remaining unchanged (changing one variable at a time, keeping other variables unchanged). Similarly, when changes in discount rate is considered, other elements, i.e., cash outlay, cash inflow and life of the project, are taken as remaining unchanged and so on. The objective of the sensitivity analysis is to measure the impact of changes in the parameters on the decision criteria and identify the key factors or parameters having more adverse impact on the decision criteria, hence, require more attention.

In other words, sensitivity is the term used to describe the process where each estimated element of a project's cash flow is taken in turn (holding all other estimates constant) to see the extent to which it can vary before the project's positive expected net present value (ENPV) is reduced to zero, as zero NPV is the tolerance limit. Therefore, if the estimated element varies by more than this amount, then the decision advice given by the original estimate of the project's NPV will be reversed. So, it may be said that sensitivity analysis measures to what extent the changes in the underlying variables of the measurement criteria, e.g., NPV, can be tolerated for acceptance of the project. For example, if NPV is ₹2,00,000, the project will remain acceptable even if the initial investment increases up to ₹2,00,000, beyond which NPV will be negative and the project will be unacceptable. If the original estimated cost of the project is ₹10,00,000, it can be said that tolerance limit of increase in cost will be 20%, i.e., if cost increases by more than 20% of the original estimate, the project will not be acceptable. It may be noted that while measuring the impact of changes in cost (cash outlay), it has been assumed that other elements like cash inflow, discounting factor, life of the project are remaining unchanged.

Consider the following illustration.

Illustration 11

Given, Investment ₹1,00,000, Life 3 years, Annual Cash Inflows ₹2,00,000, Annual Cash Outflows ₹1,50,000, Appropriate Discount Rate 10%. Calculate NPV and conduct a sensitivity analysis on the relevant factors.

Solution:

Expected NPV = -1,00,000 + (2,00,000 – 1,50,000) (0.909 + 0.826 + 0.751) = ₹24,300

Taking each of the estimated factors in turn (and holding all others as constant at their initial estimated values), we shall examine the degree of variation necessary to reduce the ENPV of ₹24,300 to Zero.

Investment: Let the investment be ₹ X

- X + 50000 (0.909 + 0.826 + 0.751) = 0

X = 50000 (0.909 + 0.826 + 0.751) = 1,24,300

So, the investment can be as high as ₹1,24,300 before the appraisal advice to invest becomes incorrect. In other words, if the original estimate increases by more than ₹24,300 or 24.30%, the NPV will be negative.

Life: Let the life be X years.

- 100000 + 50000 × PVIFA (10%, X) = 0

PVIFA (10%, x) = 100000 / 50000 = 2

Now, PVIFA (10%, 2) = 1.74 and PVIFA (10%, 3) = 2.49 [i.e., (0.909 + 0.826 + 0.751)]

Using simple interpolation, we get X = 2.35 years.

So, if the life of the asset decreases by more than 0.65 years or 21.67%, the NPV will be negative.

Net Cash Flow (NCF): Let the annual NCF be ₹ X

- 100000 + X (0.909 + 0.826 + 0.751) = 0

or, 2.486 X = 100000

or, X = 100000/2.486 = 40225

Decrease in NCF that can be tolerated = 50,000 – 40225 = ₹ 9,775

Percentage change = (9775/50,000) × 100 = 19.55%

So, if the NCF decreases by more than 9775 or 19.55%, the NPV will be negative

Discount Rate: Let the discount rate be X%

-100000 + 50000 × PVIFA (X%, 3) = 0

PVIFA (X%, 3) = 100000 / 50000 = 2

From Table,

PVIFA (20%, 3) = 2.11 and PVIFA (25%, 3) = 1.95

Using simple interpolation, we get, X = 0.234 or 23.4%

Discount rate can be increased from 10% to 23.4% or it can tolerate an increase of 134% in discount rate before NPV becomes zero.

The summarized result of the sensitivity analysis is shown below:

Element or Variable	Sensitivity
Initial Investment	24.30%
Net Cash Inflow	19.55%
Life	21.67%
Discount Rate	23.40%

Scenario Analysis

2.3

Scenario analysis is a what-if analysis in which a model's output is calculated for a number of scenarios. Scenario analysis is most commonly used in finance to estimate the expected value of an investment in a number of situations (such as best-case scenario, base case scenario and worst-case scenario).

Scenario analysis of an investment would involve the following steps:

a) Finding the base case output at the most likely value for each input. For example, when calculating net present value, use the most likely value for discount rate, cash flows growth, tax rate, etc.

b) Finding the value of the output at the best possible value for each input. In case of calculating net present value, use the lowest possible discount rate, highest possible growth rate, lowest possible tax rate, etc. This is the best-case scenario.

c) Finding the value of the output at the worst possible value for each input. For a net present value calculation, it would mean the highest possible discount rate, lowest possible cash flow growth rate, highest possible tax rate, etc. This is the worst-case scenario.

This gives us a range for output values.

Consider the following illustration.

Illustration 12

Spark Ltd. is a company that specializes in building tracks for high-speed trains. The company is the process of bidding for a new interstate train project. The chief bidding engineer has come up with a net present value estimate of ₹814.5 Crore. His inputs include the company's weighted average cost of capital of 8%, cash inflows of ₹2,000 crore which are expected at the end of 3rd year, annual expenditures for year 1, 2 and 3 of ₹300 crore per year. As the chief investment officer, you have made the following predictions:

For the best-case scenario, you predicted a WACC of 6.5%, cash inflows of ₹2,100 crore at the end of 2nd year and cash outflows of ₹400 crore at the end of 1st year and ₹500 crore at the end of second year. For the worst-case scenario, you predicted a WACC of 9%, cash inflows of ₹1,200 crore at the end of 4th year and cash outflows of ₹200 crore at the end of each year for 4 years. The initial investment is 0 in all scenarios.

Find the best-case scenario and worst-case scenario.

Solution:

The summary of different scenarios are as follows:

Particulars	Base-Case	Best Case	Worst Case
WACC	8%	6.5%	9%
Cash Inflow	₹2000 crore at the end of 3rd year	₹2100 crore at the end of 2nd year	₹1,200 crore at the end of 4th year
Cash Outflow	₹300 crore per year for first 3 years	₹400 crore at the end of 1st year and ₹500 crore at the end of 2nd year	₹200 crore at the end of each year for 4 years

NPV with the most likely figure (base-case) = ₹814.5 Crore (given)

NPV under best-case scenario = $\frac{-400}{(1+6.5\%)^1}+\frac{2100-500}{(1+6.5\%)^2}-0$ = ₹1,035 crore

NPV under worst-case scenario = - 200 × PVIFA (9%, 4) + $\frac{1200}{(1+9\%)^4}-0$ = ₹202 Crore

From this scenario analysis, we find that the net present value of the project is expected to be between ₹202 crore and ₹1,035 crore with the most likely figure to be ₹814.5 crore.

Thus, NPV is likely to vary within the range ₹202 crores to ₹1,035 crore.

Scenario Analysis vs. Sensitivity Analysis

The difference between the two methods is that sensitivity analysis examines the effect of changing just one variable at a time while scenario analysis assesses the effect of changing all the input variables at the same time.

In other words, sensitivity analysis determines how sensitive the dependent variable is, if there's a variation in the independent variable. On the other hand, scenario analysis entails making several premises about different independent variables and then examining how the outcome changes.

Monte Carlo Simulation 2.4

In sensitivity analysis, the impact on NPV of change in one of the variables is examined. Here, for studying the impact of each variable all other factors have either been assumed to be constant, or their expected values are used, but if the decision maker wants to know the expected value of the NPV taking into account each possible value of all the factors that affect it, sensitivity is not the method to be used as the number of alternatives for which NPV may have to be calculated will be very high.

To overcome these difficulties in sensitivity analysis, the simulation approach has been developed. Simulation or Monte Carlo simulation, as it is generally referred to, has been found to be a useful technique in evaluation of capital investments under conditions of risk. It is a flexible operations research tool that can handle any problem if the structure and the logic of the problem can be specified.

In simple words, simulation is an imitation of a real-world system using a mathematical model that captures the characteristic features of the system as it encounters random events in time. It can also be defined as the method of solving decision-making problems by designing, constructing and operating a model of the real system.

The basic principle in simulation is that since risk arises out of events which cannot be fixed into a pattern, that is random events, a model can be developed in which all factors excepting the random factors are fixed, and the impact of the random factors on the output can be studied by generating the random events artificially. It should be noted that though the occurrence of the events is not known, it should be possible to fix the occurrence of the event in some probability distribution.

Using simulation, the manager or decision maker should:

1. Determine "probabilistic" variables.
2. Define probability distributions for these variables.
3. Check for correlation across variables.
4. Run the simulation.
5. Decide on the best possible course of action.

Advantages of Simulation

Simulation is one of the widely accepted techniques of risk analysis. It offers the following advantages.

a) Simulation models con handle any problem which fits into the following description:
   - (i) The behaviour of the variables affecting the problem can be described using a probability distribution.
   - (ii) The interrelationship between the variables can be mathematically expressed.
   - (iii) The operation of the system can be described using a mathematical model.

(b) The model formulated for simulation. can be used to perform 'sensitivity analysis' or 'What IF analysis' to study the impact of one of the variables. This can be done by fixing all other variables excepting the one intended to be studied.

c) Simulation models are highly flexible and once developed, can be modified for use in different conditions.

d) Simulation can be used to study problems which are too risky or difficult to study in the real-life situation, such as the possibility that the proposed project will fail or whether the proposed computerized system of service is good enough to satisfy the customer.

Additional Illustrations

1. A company is considering two mutually exclusive projects X and Y. Project X costs ₹3,00,000 and Project Y ₹3,60,000. You have been given below the net present value, probability distribution for each project:

Project X		Project Y	
NPV Estimate (₹)	Probability	NPV Estimate (₹)	Probability
30,000	0.1	30,000	0.2
60,000	0.4	60,000	0.3
1,20,000	0.4	1,20,000	0.3
1,50,000	0.1	1,50,000	0.2

Compute the expected net present value of Projects X and Y.

(i) Compute the risk attached to each project i.e., Standard Deviation of each probability distribution.

(ii) Which project do you consider riskier and why?

(iii) Compute the profitability index of each project.

Solution:

Project X

NPV Estimate (N_i) (₹)	Probability (P_i)	NPV Estimate × Probability ($N_i \times P_i$) (₹)	Deviation from Expected NPV i.e., ₹90,000 (₹)	Square of the deviation (₹)	Square of the deviation × Probability (₹)
30,000	0.1	3,000	– 60,000	3,60,00,00,000	36,00,00,000
60,000	0.4	24,000	– 30,000	90,00,00,000	36,00,00,000
1,20,000	0.4	48,000	30,000	90,00,00,000	36,00,00,000
1,50,000	0.1	15,000	60,000	3,60,00,00,000	36,00,00,000
		Expected NPV = 90,000			1,44,00,00,000

Project Y

NPV Estimate (N_i) (₹)	Probability (P_i)	NPV Estimate × Probability ($N_i \times P_i$) (₹)	Deviation from Expected NPV i.e., ₹90,000 (₹)	Square of the deviation (₹)	Square of the deviation × Probability (₹)
30,000	0.2	6,000	– 60,000	3,60,00,00,000	72,00,00,000
60,000	0.3	18,000	– 30,000	90,00,00,000	27,00,00,000
1,20,000	0.3	36,000	30,000	90,00,00,000	27,00,00,000
1,50,000	0.2	30,000	60,000	3,60,00,00,000	72,00,00,000
		Expected NPV = 90,000			1,98,00,00,000

The expected NPV of projects X and Y is ₹90,000.

(i) Standard deviation of NPV for project X = $\sqrt{1440000000}$ = ₹37,947

Standard deviation of NPV for project X = $\sqrt{1980000000}$ = ₹44,497

(ii) Coefficient of variation = $\dfrac{\text{Standard Deviation}}{\text{Expected NPV}}$

For project X: Coefficient of variation = 37947/90000 = 0.42

For project Y: Coefficient of variation = 44497/90000 = 0.4944 i.e., 0.50

Therefore, Project Y is riskier since it has a higher coefficient of variation.

(iii) Profitability Index = $\dfrac{\text{Discounted cash inflow}}{\text{Discounted cash outflow}}$

For project X: Profitability Index = (90000 + 300000)/ 300000 = 1.30

For project Y: Profitability Index = (90000 + 360000)/ 360000 = 1.25

2. Determine the risk adjusted net present value of the following projects:

Particulars	A	B	C
Net cash outlays (₹)	1,00,000	1,20,000	2,10,000
Project life	5 years	5 years	5 years
Annual cash inflow (₹)	30,000	42,000	70,000
Coefficient of variation	0.4	0.8	1.2

The company selects the risk-adjusted rate of discount on the basis of the co-efficient of variation:

Coefficient of variation	Risk adjusted rate of discount	Present value factor 1 to 5 years at risk adjusted rate of discount
0.0	10%	3.791
0.4	12%	3.605
0.8	14%	3.433
1.2	16%	3.274
1.6	18%	3.127
2.0	22%	2.864
More than 2.0	25%	2.689

Solution:

Statement showing the determination of the risk adjusted net present value

Projects	Net cash outlays	Coefficient of variation	Risk adjusted discount rate	Annual cash inflow	PV factor 1-5 years at risk adjusted rate of discount	Discounted cash inflow	Net present value
	₹			₹	₹	₹	₹
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)=(v)×(vi)	(viii)=(vii)-(ii)
A	1,00,000	0.4	12%	30,000	3.605	1,08,150	8,150
B	1,20,000	0.8	14%	42,000	3.433	1,44,186	24,186
C	2,10,000	1.20	16%	70,000	3.274	2,29,180	19,180

3. Skylark Airways is planning to acquire a light commercial aircraft for flying class clients at an investment of ₹50,00,000. The expected cash flow after tax for the next three years is as follows:

Year I		Year II		Year III	
CFAT	Probability	CFAT	Probability	CFAT	Probability
14,00,000	0.1	15,00,000	0.1	18,00,000	0.2
18,00,000	0.2	20,00,000	0.3	25,00,000	0.5
25,00,000	0.4	32,00,000	0.4	35,00,000	0.2
40,00,000	0.3	45,00,000	0.2	48,00,000	0.1

The Company wishes to take into consideration all possible risk factors relating to an airline operation. The company wants to know:

(i) The expected NPV of this venture assuming independent probability distribution with 8 per cent risk free rate of interest.

(ii) The possible deviation in the expected value.

(iii) State the importance of standard deviation of the present value distribution in Capital Budgeting decisions?

Solution:

(i) Expected NPV (₹ in lakhs)

Year I			Year II			Year III		
CFAT	P	CF×P	CFAT	P	CF×P	CFAT	P	CF×P
14	0.1	1.4	15	0.1	1.5	18	0.2	3.6
18	0.2	3.6	20	0.3	6.0	25	0.5	12.5
25	0.4	10.0	32	0.4	12.8	35	0.2	7.0
40	0.3	12.0	45	0.2	9	48	0.1	4.8
$\overline{x}$ or $\overline{CF}$		27.0	$\overline{x}$ or $\overline{CF}$		29.3			$\overline{x}$ or $\overline{CF}$ 27.9

Expected CF (₹)	PV factor @ 8%	Discounted CF (₹)
27	0.9259	25.00
29.3	0.8573	25.12
27.9	0.7938	22.15
	PV of cash inflow	72.27
	Less: Cash outflow	50.00
	NPV	**22.27**

(ii) Possible deviation in the expected value **Year I**

$(x-\overline{x})$	$(x-\overline{x})^2$	P	$P \times (x-\overline{x})^2$
14 – 27 = -13	169	0.1	16.9
18 – 27 = -9	81	0.2	16.2
25 – 27 = -2	4	0.4	1.6
40 – 27 = 13	169	0.3	50.7
			85.4

$$\sigma_1 = \sqrt{85.4} = 9.241$$

Year II

$(x-\overline{x})$	$(x-\overline{x})^2$	P	$P \times (x-\overline{x})^2$
15-29.3 = -14.3	204.49	0.1	20.449
20-29.3 = -9.3	86.49	0.3	25.947
32-29.3 = 2.7	7.29	0.4	2.916
45-29.3 = 15.7	246.49	0.2	49.298
			98.61

$$\sigma_2 = \sqrt{98.61} = 9.930$$

Year III

$(x-\overline{x})$	$(x-\overline{x})^2$	P	P x $(x-\overline{x})^2$
18-27.9 = -9.9	98.01	0.2	19.602
25-27.9 = -2.9	8.41	0.5	4.205
35-27.9 = 7.1	50.41	0.2	10.082
48-27.9 = 20.1	404.01	0.1	40.401
			74.29

$$\sigma_3 = \sqrt{74.29} = 8.619$$

Standard deviation about the expected value (assuming uncorrelated cash flows):

$$\sigma = \sqrt{\frac{85.4}{(1.08)^2} + \frac{98.61}{(1.08)^4} + \frac{74.29}{(1.08)^6}} = 13.8749$$

(iii) Standard deviation is a statistical measure of dispersion; it measures the deviation from a central number i.e., the mean.

In the context of capital budgeting decisions, especially where we take up two or more projects giving somewhat similar mean cash flows, by calculating standard deviation in such cases, we can measure in each case the extent of variation. It can then be used to identify which of the projects is least risky in terms of variability of cash flows.

A project, which has a lower coefficient of variation will be preferred if sizes are heterogeneous.

Besides this, if we assume that probability distribution is approximately normal, we are able to calculate the probability of a capital budgeting project generating a net present value less than or more than a specified amount.

4. Cyber Company is considering two mutually exclusive projects. Investment outlay of both the projects is ₹5,00,000 and each is expected to have a life of 5 years. Under three possible situations their annual cash flows and probabilities are as under:

		Cash Flow	
Situation	**Probabilities**	**Project A**	**Project B**
Good	0.3	6,00,000	5,00,000
Normal	0.4	4,00,000	4,00,000
Worse	0.3	2,00,000	3,00,000

The cost of capital is 9 per cent, which project should be accepted? Explain with workings.

Solution:

Project A

Expected Net Cash flow (ENCF) = 0.3(6,00,000) + 0.4(4,00,000) + 0.3(2,00,000) = 4,00,000

$\sigma^2 = 0.3(6{,}00{,}000 - 4{,}00{,}000)^2 + 0.4(4{,}00{,}000 - 4{,}00{,}000)^2 + 0.3(2{,}00{,}000 - 4{,}00{,}000)^2$

$\sigma^2 = 24{,}00{,}00{,}00{,}000$

$\sigma = 1{,}54{,}919.33$

ENPV = 4,00,000 × 3.890 = 15,56,000

NPV = 15,56,000 – 5,00,000 = 10,56,000

Project B

ENCF = 0.3 (5,00,000) + 0.4 (4,00,000) + 0.3 (3,00,000) = 4,00,000

$\sigma^2 = 0.3(5,00,000 - 4,00,000)^2 + 0.4(4,00,000 - 4,00,000)^2 + 0.3(3,00,000 - 4,00,000)^2$

$\sigma^2 = 6,00,00,00,000$

$\sigma = 77,459.66$

ENPV = 4,00,000 × 3.890 = 15,56,000

NPV = 15,56,000 – 5,00,000 = 10,56,000

Recommendation:

NPV in both projects being the same, the project should be decided on the basis of standard deviation and hence project 'B' should be accepted having lower standard deviation, means less risky.

5. A company is considering Projects X and Y with following information:

Project	Expected NPV (₹)	Standard deviation
X	1,06,000	75,000
Y	2,40,000	1,35,000

Which project will you recommend based on the above data?

(i) Explain whether your opinion will change, if you use coefficient of variation as a measure of risk.

(ii) Which measure is more appropriate in this situation and why?

Solution:

(i) On the basis of standard deviation project X be chosen because it is less risky than Project Y having higher standard deviation.

(ii) CV_x = SD/ ENPV = 75,000/106000 = 0.71

CV_y = 135000/240000 = 0.5626

On the basis of Co-efficient of Variation (C.V.) Project X appears to be riskier and Y should be accepted.

(iii) However, the NPV method in such conflicting situation is best because the NPV method is in compatibility with the objective of wealth maximisation in terms of time value.

6. The Globe Manufacturing Company Ltd. is considering an investment in one of the two mutually exclusive proposals – Projects X and Y, which require cash outlays of ₹3,40,000 and ₹3,30,000 respectively. The certainty-equivalent (C.E.) approach is used in incorporating risk in capital budgeting decisions. The current yield on government bond is 10% and this be used as the riskless rate. The expected net cash flows and their certainty-equivalents are as follows:

	Project X		Project Y	
Year-end	Cash flow (₹)	C.E.	Cash flow (₹)	C.E.
1	1,80,000	0.8	1,80,000	0.9
2	2,00,000	0.7	1,80,000	0.8
3	2,00,000	0.5	2,00,000	0.7

Present value factors of ₹ 1 discounted at 10% at the end of year 1, 2 and 3 are 0.9091, 0.8264 and 0.7513 respectively.

Required:

(i) Which project should be accepted?

(ii) If risk adjusted discount rate method is used, which project would be analysed with a higher rate?

Solution:

(i) Statement showing Net Present Value of Project X

Year-end	Cash flow (₹)	C.E.	Adjusted Cash flow (₹)	Present value factor at 10%	Total present value (₹)
	(a)	(b)	(c) = (a) × (b)	(d)	(e) = (c) × (d)
1	1,80,000	0.8	1,44,000	0.9091	1,30,910
2	2,00,000	0.7	1,40,000	0.8264	1,15,696
3	2,00,000	0.5	1,00,000	0.7513	75,130
					3,21,736
Less: Initial investment					3,40,000
Net Present Value					(18,264)

Statement showing the Net Present Value of Project Y

Year-end	Cash flow (₹)	C.E.	Adjusted Cash flow (₹)	Present value factor 10%	Total present value (₹)
	(a)	(b)	(c) = (a) × (b)	(d)	(e) = (c) × (d)
1	1,80,000	0.9	1,62,000	0.9091	1,47,274
2	1,80,000	0.8	1,44,000	0.8264	1,19,002
3	2,00,000	0.7	1,40,000	0.7513	1,05,182
					3,71,458
Less: Initial investment					3,30,000
Net present value					41,458

Decision: Since the net present value of project Y is positive, the project Y should be accepted.

(ii) Since the certainty-equivalent (C.E.) Co-efficient of project X is lower than project Y, project X is riskier than project Y. Therefore, if risk adjusted discount rate method is used then project X would be analysed with a higher rate.

7.

Particulars		Profit if there is strong demand	Profit/(loss) if here is weak demand
Option A	(₹)	4,000	(1,000)
Option B	(₹)	1,500	500
Probability of demand		0.3	0.7

a. What would be the decision based on expected values? If no information about demands were available?

b. What is the value of perfect information about demand?

Solution:

a. If there were no information to help with the decision, the project with the higher EV of profit would be selected.

Probability	Project A		Project B	
	Profit	EV	Profit	EV
0.3	4,000	1,200	1,500	450
0.7	(1,000)	(700)	500	350
1.0		500		800

Analysis: Project B would be selected. This is clearly the better option if demand turns out to be weak. However, if demand were to turn out to be strong, Project A would be more profitable. There is a 30% chance that this could happen.

b. Perfect information will indicate for certain whether demand will be weak or strong. If demand is forecasted 'weak' Project B would be selected. If demand is forecasted as 'strong', Project A would be selected, and perfect information would improve the profit from ₹1,500, which would have been earned by selecting B to ₹4,000.

Forecast demand	Probability	Project chosen	Profit	EV of profit
Weak	0.7	B	500	350
Strong	0.3	A	4,000	1,200
EV of profit with perfect information				1,550

The Value of Perfect Information derives from the 0.3 probability that if demand is going to be strong, the information would reveal this fact, and the decision is changed from 'choose B' to 'choose A' thereby earning ₹2,500 more profit. The EV of the Value of Perfect Information is therefore 0.3 × ₹2,500 = ₹750. Another way of making this same calculation is as follows:

(₹)

EV of profit without Perfect Information (i.e., choose B all the time)	800
EV of profit with Perfect Information	1,550
Value of Perfect Information	750

Analysis: Provide that the information does not cost more than ₹ 750 to collect, it would be worth having.

8. A manager is trying to decide which of the three mutually exclusive projects to undertake. Each of the projects could lead to varying net profits which are classified as outcomes I, II and III. The manager has constructed the following pay-off table or matrix (a conditional profit table).

Net profit if outcome turns out to be:

Project	I	II	III
A (₹)	50,000	65,000	80,000
B (₹)	70,000	60 ,000	75,000
C (₹)	90,000	80,000	55,000
Probability	0.2	0.6	0.2

Which project should be undertaken?

Solution:

If the project with the highest EV of profit were chosen, this would be project C. (₹)

Outcome	Probability	Project A EV	Project B EV	Project C EV
I	0.2	10,000	14,000	18,000
II	0.6	39,000	36,000	48,000
III	0.2	16,000	15,000	11,000
	1.0	65,000	65,000	77,000

However, if the maximum criterion were applied, the assessment would be as follows:

Project Selected	The worst outcome that could happen	Profit (₹)
A	I	50,000
B	II	60,000
C	III	55,000

Analysis: By choosing B, we are 'guaranteed' a profit of at least ₹ 60,000, which is more than we would get from project A or C if the worst outcome were to occur for them. The decision would therefore be to choose project B.

9. A manager is trying to decide which of the three mutually exclusive projects to undertake. Each of the projects could lead to varying net profits which are classified as outcomes I, II and III. The manager has constructed the following pay-off table or matrix (a conditional profit table).

Net profit if outcome turns out to be:

Outcomes		Project		
(Net profit)	Probability	A	B	C
I (Worst)	0.2	50,000	70,000	90,000
II (Most likely)	0.5	85,000	75,000	1,00,000
III (Best)	0.3	1,30,000	1,40,000	1,10,000

Which project should be undertaken? Which project is profitable, if minimax regret rule is applicable?

Solution:

If the project with the highest EV of profit were chosen, this would be project C. (₹)

Outcome	Probability	Project A EV	Project B EV	Project C EV
I (Worst)	0.2	10,000	14,000	18,000
II (Most likely)	0.5	42,500	37,500	50,000
III (Best)	0.3	39,000	42,000	33,000
	1.0	91,500	93,500	1,01,000

A table of regrets can be compiled, as follows, showing the amount of profit that might be foregone for each project, depending on whether the outcome is I, II or III.

Outcome	Project		
	A	B	C
I (Worst)	[90,000 – 50,000] = 40,000	[90,000 – 70,000] = 20,000	[90,000 – 90,000] = 0
II (Most likely)	[1,00,000 - 85,000] = 15,000	[1,00,000 - 75,000] = 25,000	[1,00,000 – 1,00,000] = 0
III (Best)	[1,40,000 - 1,30,000]=10,000	[1,40,000 – 1,40,000] = 0	[1,40,000 – 1,10,000]=30,000

Analysis: The maximum regret is 40,000 with project A, 25,000 with B and 30,000 with C. The lowest of these three maximum regrets is 25,000 with B, and so project B would be selected if the minimax regret rule is used.

Note: The minimax regret rule aims to minimize the regret from making the wrong decision. Regret is the opportunity lost through making the wrong decision.

10. Infoway Ltd. is considering the purchase of an automatic packing machine to replace the 2 machines which are currently used to pack Product X. The new machine would result in reduced labour costs because of the more automated nature of the process and in addition, would permit production levels to be increased by creating greater capacity at the packing stage with an anticipated rise in the demand for Product X, it has been estimated that the new machine will lead to increased profits in each of the next 3 years. Due to uncertainty in demand however, the annual cash flows (including savings) resulting from purchase of the new machine cannot be fixed with certainty and have therefore, been estimated probabilistically as follows:

Annual cashflows: (₹ ‘000)

Year 1	Probability	Year 2	Probability	Year 3	Probability
10	0.3	10	0.1	10	0.3
15	0.4	20	0.2	20	0.5
20	0.3	30	0.4	30	0.2
		40	0.3		

Due to the overall uncertainty in the sales of Product X, it has been decided that only 3 years cash flows will be considered in deciding whether to purchase the new machine. After allowing for the scrap value of the existing machines, the net cost of the new machine will be ₹42,000. The effects of taxation should be ignored.

Required:

(a) Ignoring the time value of money, identify which combinations of annual cash flows will lead to an overall negative net cash flow, and determine the total probability of this occurring.

(b) On the basis of the average cash flow for each year, calculate the net present value of the new machine given that the company's cost of capital is 15%. Relevant discount factors are as follows:

Year	Discount factor
1	0.8696
2	0.7561
3.	0.6575

(c) Analyse the risk inherent in this situation by simulating the net present value calculation. You should use the random number given at the end of the illustration in 5 sets of cash flows. On the basis of your simulation results what is the expected net present value and what is the probability of the new machine yielding a negative net present value?

	Set 1	Set 2	Set 3	Set 4	Set 5
Year 1	4	7	6	5	0
Year 2	2	4	8	0	1
Year 3	7	9	4	0	3

Solution:

(a) If the total cash flow in years 1, 2 and 3 is less than ₹42,000, the net cash flow will be negative. The combinations of cash flow with total less than ₹42,000 are given in table below:

Cash flow (₹'000)

Year 1	Probability	Year 2	Probability	Year 3	Probability	Total	Joint Probability
10	0.3	10	0.1	10	0.3	30	0.3 × 0.1 × 0.3 = 0.009
10	0.3	10	0.1	20	0.5	40	0.3 × 0.1 × 0.5 = 0.015
10	0.3	20	0.2	10	0.3	40	0.3 × 0.2 × 0.3 = 0.018
15	0.4	10	0.1	10	0.3	35	0.4 × 0.1 × 0.3 = 0.012
20	0.3	10	0.1	10	0.3	40	0.3 × 0.1 × 0.3 = 0.009
							Total = 0.063

The probability of a negative cash flow is 0.063

(b) Expected cash flow = Σ [Cash flow × Probability]

		(₹'000)
Year 1 EV	= (10×0.3) + (15×0.4) + (20×0.3)	15
Year 2 EV	= (10×0.1) + (20×0.2) + (30×0.4) + (40×0.3)	29
Year 3 EV	= (10×0.3) + (20×0.5) + (30×0.2)	19

P.V. of the cash = (15×0.8696) + (29×0.7561) + (19×0.6575) = ₹47,463

The net present value of the new machine = 47,463 – 42,000 = ₹5,463

(c) Allocated random number ranges to the cash flows for each year.

	Cashflow (₹ 000)	Probability	Random number
Year 1	10	0.3	0 - 2
	15	0.4	3 - 6
	20	0.3	7 - 9
Year 2	10	0.1	0
	20	0.2	1 - 2
	30	0.4	3 - 6
	40	0.3	7 - 9
Year 3	10	0.3	0 - 2
	20	0.5	3 - 7
	30	0.2	8 - 9

We can now carry out the simulation. (₹ '000)

	Year 1			Year 2			Year 3			
Number	Random	Cash	DCF	Random	Cash	DCF	Random	Cash	DCF	Net PV
1	4	15	13.044	2	20	15.122	7	20	13.150	-0.684
2	7	20	17.392	4	30	22.683	9	30	19.725	17.800
3	6	15	13.044	8	40	30.244	4	20	13.150	14.438
4	5	15	13.044	0	10	7.561	0	10	6.575	-14.820
5	0	10	8.696	1	20	15.122	3	20	13.150	-5.032
									Total	11.702

The average net present value of the cash flow = 11,702/5 = ₹2,340.40

Three out of the five simulations produced negative NPV, therefore, we estimate the probability of a negative NPV as 3/5=0.6. Since the simulation is small, the estimates are unlikely to be reliable.

Solved Case Study

Supreme Logistics Co. is evaluating an investment proposal which has uncertainty associated with the three important aspects: original cost, useful life and annual net cash flows. The three probability distributions for these variables are shown below:

Original Cost		Useful life		Annual Net Cash Inflows	
Value	Probability	Period	Probability	Value	Probability
₹ 60,000	0.30	5 years	0.40	₹ 10,000	0.10
₹ 70,000	0.60	6 years	0.40	₹ 15,000	0.30
₹ 90,000	0.10	7 years	0.20	₹ 20,000	0.40
				₹ 25,000	0.20

The company wants to perform five simulation runs of this project's life. The firm's cost of capital is 15% and the risk- free rate is 6%; for simplicity it is assumed that these two values are known with certainty and will remain constant over the life of the project.

To simulate the probability distribution of original cost, useful life and annual net cash inflows, the following are the sets of random numbers:

09, 84, 41, 92, 65; 24, 38, 73, 07, 04; and 07, 48, 57, 64, 72 respectively each of the five simulation runs.

Conduct the simulation to calculate the NPV of the project.

Solution:

To simulate the probability distribution corresponding to original cost, useful life and annual net cash inflows, we assign an appropriate set of random numbers as shown in the following table:

Original cost

Value (₹)	Probability	Cumulative Probability	Random Numbers
60,000	0.30	0.30	00-29
70,000	0.60	0.90	30-89
90,000	0.10	1.00	90-99

Useful Life

Period	Probability	Cumulative Probability	Random Number
5	0.40	0.40	00-39
6	0.40	0.80	40-79
7	0.20	1.00	80-99

Net Cash Inflows

Value (₹)	Probability	Cumulative Probability	Random Numbers
10,000	0.10	0.10	00-09
15,000	0.30	0.40	10-39
20,000	0.40	0.80	40-79
25,000	0.20	1.00	80-99

The five simulation runs are now performed and the results are tabulated below:

Simulation Worksheet

Simulation Run	Original Cost		Useful life		Annual net cash inflows	
	Random Number	Value (₹)	Random Number	Period (years)	Random Number	Value (₹)
1	09	60,000	24	5	07	10,000
2	84	70,000	38	5	48	20,000
3	41	70,000	73	6	57	20,000
4	92	90,000	07	5	64	20,000
5	65	70,000	04	5	72	20,000

Now let us calculate NPV for run 1 to run 5.

Run 1

(1) Period	(2) Cash flows	(3) PV factor @ 6%	Present Value (4) = (2) × (3)

0	-60,000	1.000	-60,000
1	10,000	0.943	9,430
2	10,000	0.890	8,900
3	10,000	0.840	8,400
4	10,000	0.792	7,920
5	10,000	0.747	7,470

Net Present Value = ₹ -17,880

Run 2

(1) Period	(2) Cash flows	(3) PV factor @ 6%	Present Value (4) = (2) × (3)
0	-70,000	1.000	-70,000
1	20,000	0.943	18,860
2	20,000	0.890	17,800
3	20,000	0.840	16,800
4	20,000	0.792	15,840
5	20,000	0.747	14,940

NPV = ₹14,240

Run 3

Period	Cash flows
0	-70,000
1	20,000
2	20,000
3	20,000
4	20,000
5	20,000
6	20,000

Therefore, NPV = (20,000 × PV of annuity factor for 6 years @ 6%) – 70,000

= (₹ 20,000 × 4.917) – ₹70,000

= ₹ (98,340 – 70,000) = ₹ 28,340

Run 4

Period	Cash flows
0	-90,000
1	20,000
2	20,000
3	20,000
4	20,000
5	20,000

Therefore, NPV = (₹ 20,000 × PV of annuity factor for 5 years @ 6%) – ₹90,000

= ₹ (20,000 × 4.212) – ₹ 90,000

= ₹ (84,240 – 90,000) = ₹ -5760

Run 5

Period	Cash flows
0	-70,000
1	20,000
2	20,000
3	20,000
4	20,000
5	20,000

Therefore, NPV = (₹ 20,000 × PV of annuity factor for 5 years @ 6%) – ₹70,000

= ₹ (20,000 × 4.212) – ₹ 70,000

= ₹ (84,240 – 70,000) = ₹14,240.

Exercise

Theoretical Problems

Multiple Choice Questions

1. If the cash flows over the life of the project are perfectly correlated, the Standard Deviation is determined using the formula ________

   A. $SD = \frac{\sum \sigma^2}{(1+i)^2}$

   B. $SD = \frac{\sum \sigma}{(1+i)^2}$

   C. $SD = \frac{\sum \sigma^2}{(1+i)}$

   D. $SD = \sum \frac{\sigma_t}{(1+i)^t}$

2. Which of the following is/are not true regarding the risk adjusted investment appraisal techniques?

   i. In the certainty equivalent method, if there is high degree of correlation between the cash flows for the entire project life the certainty equivalent coefficient is taken as one for all the years.

   ii. In sensitivity analysis, the impact of the changes in one or more variables on the criterion of merit is studied.

   iii. Simulation does not produce an optimal solution but the user of the technique has to generate all possible combinations of conditions and constraints to choose the optimal solution.

   A. Only (ii) above.

   B. Only (iii) above.

   C. Both (i) and (ii) above

   D. Both (i) and (iii) above

3. Coefficient of variation

   A. Is an absolute measure of risk

   B. Is a relative measure of risk

   C. Is given by mean expected return by standard deviation

   D. Is given by the product of mean expected return and standard deviation

Answer:

1	2	3
D	C	D

State True or False

1. Risk is a scenario that falls in between 'complete certainty' and 'complete uncertainty'.
2. The Certainty Equivalent Coefficient (CEC) ranges between 0 and 0.5.
3. H. S. Hillier argues that the uncertainty or the risk associated with a capital expenditure proposal is shown by the Range of the expected cash flows.
4. A real option provides the firm the right, but not the obligation, to take some action in the future.
5. Sensitivity analysis in the context of capital budgeting decisions refers to the analysis of impact of changes in the underlying variables or parameters on the decisions regarding acceptance or rejection of the investment proposal.
6. Scenario analysis assesses the effect of changing one of the input variables at a time.

Answer:

1	2	3	4	5	6
True	False	False	True	True	False

Fill in the Blanks

1. __________is the option to cease a project or an asset to realize its salvage value.
2. The three possible scenarios are best-case scenario, ________and worst-case scenario.
3. ____________is a smooth, symmetric, continuous bell-shaped curve.
4. __________is an imitation of a real-world system using a mathematical model that captures the characteristic features of the system as it encounters random events in time.
5. A real option provides the firm the_______, but not the obligation, to take some action in the future.

Answer:

1	Option to abandon	2	base case scenario
3	Normal Probability Distribution	4	Simulation
5	right		

Short Essay Type Questions

1. How will you distinguish certainty, uncertainty and risk?
2. What do you mean by certainty equivalent coefficient? How is it used?
3. What is risk adjusted discount rate? What are its components?
4. State the formulas for calculating the standard deviation of project cashflows in three different correlation assumptions.
5. How is scenario analysis different from sensitivity analysis?

Essay Type Questions

1. How is sensitivity analysis used in capital budgeting?
2. How is scenario analysis used in capital budgeting?
3. How is Monte Carlo Simulation used in capital budgeting?
4. How will you use Normal probability Distribution in capital budgeting?

Practical Problems

Multiple Choice Questions

1. If nominal discounting rate is 15%, inflation rate is 5%, then real discounting rate will be ___________

   A. 9.52%

   B. 9.25%

   C. 10.25%

   D. 10.52%

2. If project cost = ₹ 12,000, Annual cash flow = ₹ 4,500 Cost of capital = 14%, life = 4 years, PVIFA (14%, 4) = 2.9137, then the sensitivity with respect to the project cost is

   A. 9.27%

   B. 10.27%

   C. 9.72%

   D. 10.72%

3. The following information is available with respect to Project X

NPV Estimate (₹)	30,000	60,000	1,20,000	1,50,000
Probability	0.1	0.4	0.4	0.1

   The expected NPV will be _____________

   A. ₹ 1,00,000

   B. ₹75,000

   C. ₹90,000

   D. ₹1,20,000

4. If expected NPV = ₹ 1,20,000 and S.D = ₹30,000, then coefficient of variation will be _____________

   A. 25%

   B. 20%

   C. 30%

   D. 50%

5. Given, expected value of profit without perfect information = ₹1,600 and expected value of perfect information = ₹300, then expected value of profit with perfect information will be ________

   A. ₹1,300

   B. ₹1,900

   C. ₹950

   D. None of the above

Answer:

1	2	3	4	5
A	A	C	A	B

Comprehensive Numerical Problems

1. Diamond industries is considering investment in specialized moulds which cost ₹1.00 lakh, with a life of 2 years, after which there is no expected value. The possible incremental cash flows (post-tax) are:

Year I		Year II	
Cash flow (₹)	**Probability**	**Cash flow (₹)**	**Probability**
60,000	0.20	50,000	0.20
70,000	0.50	60,000	0.50
80,000	0.30	70,000	0.30

The risk-free rate of return required by the company is 10%.

Required:

a. Assume that the cash flows are perfectly correlated. Calculate the expected net present value and the standard deviation of the net present value of the probability distribution of possible net present values.

b. If the NPV were normally distributed what is the probability of the investment providing a negative net present value?

c. If the cash flows were independent what would be the probability of the NPV being negative?

[Answer: Expected NPV = ₹14,958 and S.D = ₹12,149; 10.93%; 4.09%]

2. Calculate the Expected NPV and S.D (NPV) for the moderately correlated cash flows which are expected to be generated by a certain project which are shown in the table below

Year 1		Year 2		Year 3	
Net cash flow (₹)	**Initial probability**	**Net cash flow (₹)**	**Probability**	**Net cash flow (₹)**	**Probability**
50,000	0.6	50,000	0.8	40,000	0.70
				35,000	0.30
		75,000	0.2	80,000	0.50

				70,000	0.50
80,000	0.4	85,000	0.6	85,000	0.60
				95,000	0.40
		1,10,000	0.4	1,05,000	0.35
				1,15,000	0.65

The initial outlay for the project is ₹1,50,000 and the risk-free interest rate is 6%.

[Answer: ₹27,667; ₹56,807]

3. Rama Chemicals is considering an investment project. The estimated life of the project is 3 years. The cost of the project is ₹15,000. The projected cash flows are given below.

Year 1		Year 2		Year 3	
Net cash flow (₹)	**Initial probability**	**Net cash flow (₹)**	**Probability**	**Net cash flow (₹)**	**Probability**
6,000	0.3	4,00	0.2	6,000	0,3
5,000	0.4	6,000	0.6	10.000	0.4
14,000	0.3	12,000	0.2	14,000	0.3

The cash flows are independent and the post-tax risk-free discount rate is 6%. You are required to analyze the project for Rama Chemicals.

Required:

a. Calculate the expected net present value.

b. Calculate the probability of NPV being zero or less.

[Answer: ₹6,995; 8.85%]

4. A company is trying to choose between two investment proposals A and B. Project A has a standard deviation of ₹6,500 while Project B has a standard deviation of ₹7,200. The finance manager wishes to know which investment to choose, given each of the following combinations of the expected values;

(i) Project A and Project B both have expected net present value of ₹15,000. (ii) Project A has expected NPV of ₹18,000 while for Project B it is ₹22,000.

[Answer: (i) Since expected NPV are similar, the project with lower S.D is recommended (i.e., Project A); COV for Project A 0.361 and for B 0.327 and hence Project B is recommended]

5. From the following project details calculate the sensitivity of the (a) Project cost, (b) Annual cash flow, and (c) Cost of capital. Which variable is the most sensitive?

Project cost	₹ 12,000	Annual cash flow	₹ 4,500
Life of the project	4 years	Cost of capital	14%

The annuity factor at 14% for 4 years is 2.9137 and at 18% for 4 years is 2.6667.

[Answer: (a) 9.27%; (b) 8.48%; (c) 29%]

References:

1. Pandey, I M; Essentials of Financial Management; Pearson Publication
2. Chandra, P.; Financial Management – Theory and Practice; McGraw Hill
3. Khan and Jain; Financial Management – Text, Problems and Cases; McGraw hill
4. Brigham and Houston; Fundamentals of Financial management; Cengage

Leasing Decisions 3

This Module includes:

3.1 Lease Financing – Evaluation of Lease vs. Buy Options

3.2 Break-Even Lease Rental Determination and Implicit Rate

3.3 Cross Border Leasing, Sale and Lease Back

Leasing Decisions

SLOB Mapped against the Module

1. To obtain in-depth knowledge on application of various techniques of project evaluation under a deterministic environment as well as techniques of incorporating the element of uncertainty in project appraisal. (CMLO 2a, 2b)
2. To develop detailed understanding of how to make strategic choices in long term investment decisions such as own or lease and making optimal allocation of limited funds. (CMLO 3c)

Module Learning Objectives:

After studying the chapter, the students will be able to -

- Understand the meaning of lease financing.
- Evaluate lease vs. buy options.
- Determine the break-even lease rental and implicit rate.
- Understand the meaning of cross border lease and sale and leaseback arrangements.

Lease Financing – Evaluation of Lease vs Buy Options

3.1

3.1.1 Concept of Lease

A lease is basically an agreement between two parties, commonly known as lessor and lessee, whereby the lessor conveys to the lessee the right to use an asset for an agreed period of time in return for a payment or series of payments.

3.1.2 Parties Associated with Lease

As mentioned above, a lease agreement has two parties associated with it – **the lessor** and **the lessee.** A lessor is the owner of the asset who conveys the right to use the asset to lessee. A lessee, on the other hand, is the person who makes either lump-sum or periodic payments to continue to use the asset. The period for which such a right is conveyed by the lessor to the lessee is called the lease period.

In some cases, a lessee may again lease out entire or a part of the asset to another person. Such another person is termed as a **sub-lessee.** A sub-lease agreement is basically another lease agreement where original lesser assumes the role of a lesser.

3.1.3 Types of Leases

Leases can broadly be classified into Finance Lease and Operating Lease. A finance lease is a lease that transfers substantially all the risks and rewards incidental to ownership of an asset. Thus, in such a lease, the lease period covers substantial life of the asset and hence the lease is found to be of long term in nature. Moreover, the payment towards lease rental covers substantial, if not all, the cost of obtaining the asset by the lessor i.e., owner. On the other hand, an operating lease does not transfer substantially all the risks and rewards incidental to ownership.

In short, while operating lease is merely a rental, financial lease is a disguised purchase.

3.1.4 Advantages of Leasing Transaction

(i) Advantages to the Lessor

(a) **Full Security:** Lessor's interest is fully secured as he is always the owner of the asset and can take repossession of the asset, if the Lessee defaults.

(b) **Tax Benefits:** Tax Relief is available by way of depreciation. If the lessor is in high tax bracket, he can lease out assets with high depreciation rates and thus reduce his tax liability substantially. Besides, the rentals can be suitably structured to pass on some tax benefit to the assessee. Generally, assets that are leased out carry a higher depreciation rate.

(c) **High Profits:** Because of a higher depreciation charge, there is a quicker capital recovery and also higher profitability since rate of return is more than what is available in case of lending business.

(d) **Trading on Equity:** Lessors may have very low equity and use substantial amount of borrowed funds and deposits for their business. Thus, they carry out their operation with great financial leverage. Hence, the return on equity is very high.

(ii) Advantages to the Lessee

(a) Source of Financing: Leasing is a source of financing provided by the lessor to the lessee. The lessee may use the asset against payment of lease rental without purchasing the asset. Therefore, the amount which would have been required for purchasing the asset may be used for other purposes.

(b) No Dilution of Ownership: Leasing provides finance without diluting the ownership or control of the promoters, unlike equity or debt financing.

(c) No Loss of Control: In case of Institutional Financing (Bank and Other Term Lending Institutions), the lender may have restrictive conditions in the sanction letter such as representation in the Board, conversion of debt into equity, payment of dividend, etc. Such restrictions are not present in case of lease financing. This enhances the independence of the firm in its operations.

(d) Tax Benefits: Since the entire lease rental is treated as an expenditure, cost of the asset is amortized rapidly under this option, and hence there is huge tax savings, when compared to similar outflow under borrow and procure option.

(e) Less Risk: Risk of obsolescence rests with the lessor, and the Lessee always has the option of replacing the asset with latest technology, by opting for a different asset or lessor.

(f) Sale and Leaseback: By employing sale and lease back arrangement, the lessee may overcome a financial crisis by immediately arranging financial resources (to be discussed in detail later in this Module).

3.1.5 Limitations of Leasing

(a) Restrictions on Use: The lessor generally imposes certain restrictions on the leased assets. The Lessee may not be permitted to make additions on alterations to suit his needs.

(b) High Pay-out: A Financial Lease may entail a higher pay out obligation, if the equipment is not found useful subsequently, and the lessee opts for premature termination of the Lease arrangement.

(c) No Ownership for Lessee: In most circumstances, the Lessee does not become the owner of the asset, and is thus deprived of the residual value of the asset.

3.1.6 Lease vs. Buy Option

Evaluation of a Lease vs. Buy Option

There is no denying the fact that lease will never entail ownership of asset to the lessee. However, in case of a finance lease that transfers substantially all the risks and rewards incidental to ownership of an asset, such issue may not be that significant as the lessee continues to enjoy all the benefits associated with the asset for almost the entire lifetime of the asset. Hence, the issue that concerns most is the cost. In order to make a comparative analysis all the relevant cash flows are required to be identified. In addition, any tax savings shall also be taken into consideration. Following is a summary of all the cash flows and tax shields associate with the two options.

Buy (Though Loan)	Lease
⅄ PV of instalments against the loan taken to buy the asset. ⅄ Interest tax shield ⅄ Depreciation tax shield ⅄ Present value of residual value of asset to be deducted.	⅄ Present value of after-tax lease rentals ⅄ Present value of any maintenance cost

Consider the following illustration.

Illustration 1

Excel Transport needs a truck for which it is considering the following two options:

(i) Buy the asset for ₹3,00,000 by borrowing the amount @12% interest and repaying the same together with interest in 4 equal annual instalments.

(ii) Acquiring the asset on lease with a payment of annual lease rentals of ₹90,000 per annum for 4 years.

The firm follows straight line method of depreciation and is under the income tax bracket of 30%. Life of the asset is 4 years.

Which option – lease or buy, should the firm opt for?

Solution:

Applicable discount rate = 12(1-0.3) = 8.4% p.a.

Lease Option:

Present value of after-tax lease rentals = 90,000 × (1-0.3) × PVIFA (8.4%, 4 years) = 63,000 × 3.28 = ₹2,06,640

Buy Option

Annual instalment = 3,00,000 ÷ PVIFA (12%, 4) = 3,00,000 ÷ 3.037 = ₹98,782

Calculation of interest tax shield (in ₹)

Opening outstanding	Interest @ 12%	Instalment	Principal	Closing Outstanding	Tax savings on Interest	PVIF @ 8.4%	PV of tax savings
3,00,000	36,000	98,782	62,782	2,37,218	10,800	0.9225	9,963
2,37,218	28,466	98,782	70,316	1,66,902	8,540	0.8510	7,268
1,66,902	20,028	98,782	78,754	88,148	6,008	0.7851	4,717
88,148	10,634	98,782	88,148	0	3,190	0.7242	2,310
Total							24,258

Calculation of depreciation tax shield (in ₹)

Depreciation	Tax savings	PVIF @ 8.4%	PV of tax savings
75,000	22,500	0.9225	20,756
75,000	22,500	0.8510	19,148
75,000	22,500	0.7851	17,665
75,000	22,500	0.7242	16,295
			73,864

Present value of cash flow under buy option

Particulars	₹
Present value of instalments (98,782 × 3.2828)	3,24,282
Less: Interest tax shield	24,258
Less: Depreciation tax shield	73,864
Total	2,26,160

Since the present value of net cash outflow under leasing option is lower than that of buy option, leasing is preferable over buy option.

Alternative Approach of Calculation (Buy Option) (in ₹)

Year	Instalment	Interest @ 12%	Tax Savings on Interest	Depreciation	Tax Savings on Dep.	NCF	PVIF @ 8.4%	PV of NCF
1	98,782	36,000	10,800	75,000	22,500	65,482	0.9225	60,407
2	98,782	28,466	8,540	75,000	22,500	67,742	0.8510	57,648
3	98,782	20,028	6,008	75,000	22,500	70,274	0.7851	55,172.11
4	98,782	10,634	3,190	75,000	22,500	73,092	0.7242	52,933
								2,26,160

Since the present value of net cash outflow under leasing option is lower than that of buy option, leasing is preferable to buy option.

Impact of Lease on Financial Statements

Any acquisition of assets under lease vis-à-vis an outright purchase by loan will have significant difference in impact on both Profit and Loss Account and Balance Sheet of the Lessee especially in case of operating lease. The following illustration shows the differential impact of a lease transaction vis-à-vis outright buy transaction financed by loan.

Break-Even Lease Rental Determination and Implicit Rate

3.2

3.2.1 Concept of Break-even Lease Rental

While evaluating a lease-or-buy option, a lessee often looks for a lease rental for which both the lease and the buy option will yield equal amount of cash outflow. Such a lease rental is known as break even lease rental. In other words, the break-even lease rental is the rental at which the lessee remains indifferent to a choice between leasing and buying. Thus, it is the maximum amount of lease rental that the lessee is willing to pay. Therefore, if the actual amount of lease rental is less than or equal to the break-even lease rental, the lessee will accept the lease. Otherwise, the same will be rejected.

To put it symbolically, it is the lease rental (L) for which,

PV of after-tax lease rental (L)

= PV of cash outflow under buy (through loan) option

= PV of Instalments – PV of Interest tax shield – PV of depreciation tax shield – PV of salvage value.

From the view point of a lessor, however, the concept of break-even lease rental is different. Here, break-even lease rental is the minimum lease rental that lessor can accept. In other words, it is the lease rental for which the NPV is zero.

To put it symbolically, it is the lease rental (L) for which,

PV of after-tax lease rental (L) = Cost of the asset - PV of depreciation tax shield - PV of salvage value.

Consider the following illustrations.

Illustration 2: BELR from the point of view of a lessee

Excel Transport needs a truck for which it is considering the following two options:

(i) Buy the asset for ₹3,00,000 by borrowing the amount @12% interest and repaying the same together with interest in 4 equal annual instalments.

(ii) Acquiring the asset on lease with a payment of annual lease rentals for 4 years.

The firm follows straight line method of depreciation and is under the income tax bracket of 30%. Life of the asset is 4 years.

What is the maximum amount the lessee will be willing to pay for accepting the lease?

Solution:

Refer to Illustration 1 for detail calculation.

Present value of cash flow under buy option

Particulars	₹
Present value of instalments (98,782 × 3.2828)	3,24,282
Less. Interest tax shield	24,258
Less. Depreciation tax shield	73,864
Total	2,26,160

Let the break-even lease rental is ₹ X.

Applicable discount rate = 12(1-0.3) = 8.4% p.a.

So, Present value of after-tax lease rental

= ₹X × (1- tax rate) × PVIFA (8.4%, 4 years)

= ₹X × (1- 0.30) × 3.2828

= ₹2.29796X

Conditionally, 2.29796X = 2,26,160

So, X = 98,417

So, the maximum amount the lessee will be willing to pay for accepting the lease (i.e., BELR) is ₹98,417.

Illustration 3: BELR from the point of view of a lessor

ABC finance, a leasing company, has been approached by a prospective customer intending to acquire a machine whose Cash Down price is ₹6 crores. The customer, in order to leverage his tax position, has requested a quote for a four-year lease with rentals payable at the end of each year but in a diminishing manner such that they are in the ratio of 4: 3: 2: 1. Depreciation can be assumed to be on straight line basis and ABC Finance's marginal tax rate is 30%. The target rate of return for ABC Finance on the transaction is 10% p.a. The asset has no salvage value.

Solution:

Applicable discount rate = 10 (1-0.3) = 7.0% p.a.

Cost of the asset = ₹6 crores.

Depreciation under SLM = ₹6 crores ÷ 4 years = ₹1.5 crores.

PV of depreciation tax shield

= ₹1.5 crores × 0.30 × PVIFA (7%, 4 years)

= ₹1.5 crores × 0.30 × 3.387

= ₹1.52415 crores

Let the amount to be quoted by ABC Finance (i.e., break-even lease rental) is ₹X for fourth year.

So, Present value of after lease rental revenue will be:

Year	Post-tax Rental	PVIF @7%	PV of post-tax rental
1	4X × (1-0.3)	0.935	2.618X
2	3X × (1-0.3)	0.873	1.8333X
3	2X × (1-0.3)	0.816	1.1424X
4	X × (1-0.3)	0.763	0.5341X
Total		3.387	6.1278X

Conditionally, 6.1278X = 6,00,00,000 – 1,52,41,500

or, X = 73,04,171

So, the lease rentals to be quoted are ₹2,92,16,684, ₹2,19,12,513, ₹1,46,08,342 and ₹73,04,171

3.2.2 Leveraged Lease and Break-Even Lease Rental

Leveraged lease refers to a lease agreement wherein the lessor acquires an asset partially financed by the financial institutions and lease out the same to the lessee for the agreed lease payments. The lessee transfers the lease rentals directly to an escrow account maintained with the financial institution by the lessor. The financial institution charges the loan instalments (principal as well as interest) from the proceeds available in the escrow account and balance amount if any gets transferred to the account of the lessor.

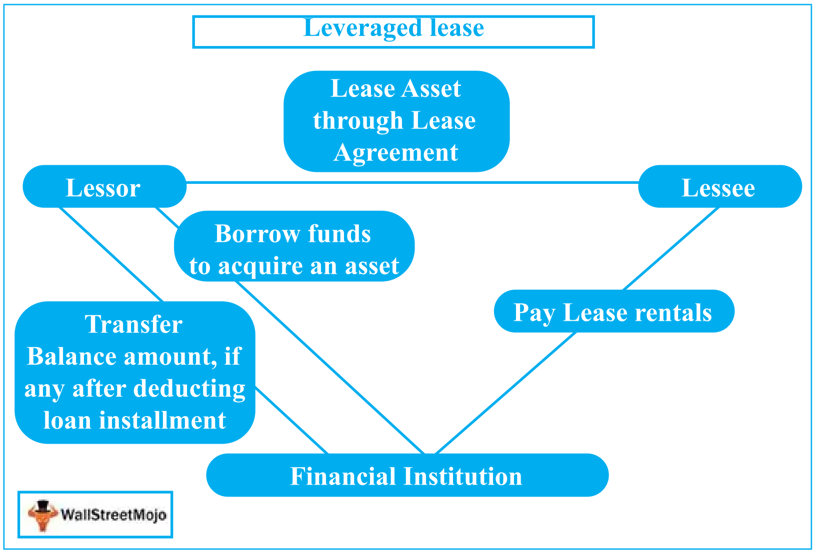


Figure 3.1: Leveraged Lease Process

In case of Leveraged Lease, the lessor must determine the minimum lease rental (or BELR) to recover the equity portion (financed by own fund) of the cost of asset by the net cash flow (i.e., lease rental less loan instalment).

Consider the following illustration.

Illustration 4: BELR in case of Leveraged Lease

P Ltd has taken a plant on lease, valued at ₹40 crore**.** The lease arrangement is in the form of a leveraged lease. K Ltd. is the equity participant and the H Ltd. is the loan participant. They invested fund in the ratio of 1:4. The loan from H Ltd. carries a fixed rate of interest of 15 percent, payable in 6 equated annual instalments. The lease term is 6 years, with lease rental payable annually in arrear.

(a) Compute the equated annual instalment from the point of view of H Ltd.

(b) If the lease rate is unknown, and H Ltd.'s pre-tax yield is 20 percent, what is the minimum lease rent that must be quoted?

Solution:

Cost of asset = ₹40 crores

Debt-equity ratio = 1:4

Loan raised = ₹40 × 4/5 = ₹32 crores

Rate of interest = 15% p.a.

(a) Let the equated annual instalment = ₹ X

Conditionally, X ×PVIFA (15%, 6 years) = 32

or, 3.7845X = 32

or, X = 32/3.7845

or, X = 8.4555423 Crore = ₹8,45,55,423

So, the equated annual instalment is ₹8,45,55,423.

(b) Let the lease rental be ₹ Y

Equity component of the cost of asset = ₹ 40 × 1/5 = ₹8 crores

So, Net cash flow = Lease rental - Loan instalment = ₹(Y - 8,45,55,423)

Conditionally, (Y - 8,45,55,423) × PVIFA (20%, 6 years) = 8,00,00,000

or, (Y - 8,45,55,423) × 3.3255 = 8,00,00,000

or, Y - 8,45,55,423 = 2,40,56,533

or, Y = 10,86,11,956

So, the minimum lease rent that must be quoted by H Ltd. is ₹10,86,11,956.

3.2.3 Alternative Lease Rental Structures

Against any lease, the lease rents are payable on periodical basis over the specified lease period. The lease rentals should be structured in such a way that it will create a win-win opportunity for both lessor and lessee. In a competitive environment, the lessee will look for a lease finance where the lease rentals are lowest while the lessor must recover his principal amount invested as well as the desired return on investment to ensure sustainability.

Following are some popular lease rent structures used by businesses:

a) **Equal Periodic Plan -** In this plan, the periodic lease rent payable is divided into equal amounts by applying the annuity factor for the specified period of lease at a predetermined interest rate taken as the discount rate.

b) **Stepped-up Plan -** Under this plan, the periodic lease rent will go on increasing with a specified rate of increase.

c) **Stepped-down Plan -** Under this plan, the periodic lease rent will go on decreasing with a specified rate of decrease.

d) **Balloon Payment Plan -** In this plan, the periodic lease rent payable in the initial period would be less, fixed up in such a way to meet the nominal amount comparative to the cost of investment, the rest of the amount is payable in lump sum during the ending periods of the lease.

e) **Deferred Payment Plan -** Under this plan, the lease rent need not be paid for the initial specified period. However, the same is payable in the subsequent periods, in equal annual amounts which will recover the cost of financing for the deferred payment period also.

Consider the following illustration.

Illustration 5

The following data are furnished by the SIGMA LEASING LTD. (SLL):

Investment cost	₹ 99 lakhs
Lease term	3 years
Residual value	NIL
Pre-tax required rate of Annual Return	22%

The SLL seeks your advise in determining the annual lease rental under the following rental structures:

a) Equated

b) Stepped (annual increase of 12%)

c) Ballooned (annual rental of ₹ 15 lakhs for year 1 and 2)

d) Deferred (deferment period of 1 year)

You are required to compute the annual rentals under four rental structures. Show your workings.

Solution:

Calculation of annual lease rents under different lease rental structures

(a) Equated Lease Rent

Let X be the equated lease rent p.a.

At 22%,

PV of cash inflows = outflows

X PVAF (3 YRS 22%) = 99,00,000

X (2.0422) = 99,00,000

X = 99,00,000 / 2.0422

X = 48,47,713

(b) Stepped lease rent

Stepped lease rent is a lease rent which increases at a fixed percentage over the earlier or preceding year lease rent.

Let X be the lease rent in year 1.

PV of cash inflows:

Year	Lease Rent	PVF"22%	PV
1	X	0.8196	0.8196X
2	1.12X	0.6719	0.7525X
3	$(1.12)^2$X[]	0.5507	0.6908X
PV of total CIAT for 3 years			2.2629X

At 22% Return,

PV of Cash Inflows = Investment

2.263X = 99,00,000

X = 99,00,000 / 2.263

X = 43,44,724

Year	Lease Rent
1	43,74,724
2	48,99,691
3	54,87,654

(c) Calculation of ballooned lease rent

Ballooned lease rent is a lease rent under which major part of rentals are collected in a lumpsum amount at the end of lease period.

Let X be the third year lease rent

Year	Lease Rent	PVF"22%	PV
1	15,00,000	0.8196	12,29,400
2	15,00,000	0.6719	10,07,850
3	X	0.5507	0.5507X

At 22% required return,

PV of cash inflows = Investment

0.5507X + 22,37,250 = 99,00,000

0.5507X = 76,62,750

X = 76,62,750 / 0.5507

X = 1,39,14,563

(d) Deferred Lease Rent

Under deferred lease rental structure, the lessor does not collect any lease rentals during the deferment period to accommodate the gestation period.

Let X be the annual lease rent for year2 and year3 to earn 22% return.

PV of cash inflows

Year	Lease Rent	PVF”22%	PV
1	-	0.8196	
2	X	0.6719	0.6719X
3	X	0.5507	0.5507X
			1.2226X

At 22% required return,

PV of cash inflows = outflows

1.2226X = 99,00,000

X = 99,00,000 / 1.2226

X = 80,97,497

Cross Border Leasing, Sale and Lease Back

3.3

3.3.1 Cross Border Leasing

Concept of Cross Border Leasing

Cross-border leasing is a leasing arrangement where lessor and lessee are situated in different countries. Cross-border leasing can be considered as an alternative to equipment loans to foreign buyers, the only difference being the documentation, down payments, payment streams, and lease-end options as offered under Equipment Loans. Operating leases may be feasible for exports of large equipment with a long economic life relative to the lease term.

This type of arrangement is extremely useful when the tax rates are relatively high in the lessor's country along with liberal depreciation rules and either very flexible or very formalistic rules governing tax ownership. The tax savings of the lessor are passed through to the lessee as a lower cost of finance.

Objectives of Cross Border Leasing:

(a) **Overall Cost of Financing:** A major objective of cross-border leases is to reduce the overall cost of financing through utilization of tax depreciation allowances by the lessor in order to reduce its taxable income. The tax savings are passed through to the lessee as a lower cost of finance. The basic prerequisites are relatively high tax rates in the lessor's country, liberal depreciation rules and either very flexible or very formalistic rules governing tax ownership.

(b) **Security:** The lessor is often able to utilize non-recourse debt to finance a substantial portion of the equipment cost. The debt is secured, among other things, by a mortgage on the equipment and by an assignment of the right to receive payments under the lease.

(c) **Accounting Treatment:** Depending on the structure, in some countries, the lessor can utilize very favourable "Leveraged Lease" Financial Accounting treatment for the overall transaction.

(d) **Repossession:** In some countries, it is easier for a lessor to repossess the leased equipment following a default by Lessee because the lessor is an owner and not a mere secured lender.

Advantages of Cross Border Leasing

(a) **Double Dip Lease:** Cross-border leasing has been widely used to arbitrage the difference in the tax laws of different countries. This is possible since each country applies differing rules for determining whether the party acting as lessor under a cross-border lease is the "owner" of the leased asset for tax purposes which enables him to claim tax allowances.

Example: In the United States the criteria is that the lessor possesses substantially all attributes of economic ownership of the leased asset. In the European Union, Formalistic Property law concepts focus primarily on the location of legal title, although these countries usually also require that the lessor have some attributes of economic ownership or, at least, that the lessee have only a minimal economic interest in the equipment. In these cases, with sufficiently long leases (often 99 years), an asset can end up with two effective owners, one each in different countries, this is often referred to as a double-dip lease.

(b) Financing Infrastructure: Cross-border leasing has been in practice as a means of financing infrastructure development in emerging nations. Cross-border Leasing may have significant applications in Financing Infrastructure development in emerging nations in the areas of rail and air transport equipment, telephone and telecommunications, equipment, and assets incorporated into power generation and distribution systems and other projects that have predictable revenue streams

3.3.2 Sale and Lease Back Agreement

Under this type of lease agreement, the lessee first purchases the equipment of his choice and then sells it to the lessor firm. The lessor in turn leases out the asset to the same lessee. The main advantage of this method is that the lessee can be rest assured about the quality of the asset and can convert the sale into a lease arrangement after he has the possession of the asset. He can exercise this option even in the case of an existing asset used by him for some time to get a lumpsum cash released from the asset which he can put into some alternative use. The lessor gets the tax benefit for depreciation. This method of financing an asset is also popular when the lessee is in liquidity problems, he can sell the asset to a leasing company and take it back on lease. The fund released therefrom will improve the liquidity position of the lessee and he will continue to use the asset without parting with it.

In a cross-border lease, sometimes, the original owner of an asset is not subject to taxation in any country and therefore not able to claim depreciation. Hence, the transaction often involves an entity selling an asset (such as sewerage system or power plant) to an investor (who can claim depreciation), and long-term leasing it right back.

Additional Illustrations

1. Fair finance, a leasing company, has been approached by a prospective customer intending to acquire a machine whose Cash Down price is ₹3 crores. The customer, in order to leverage his tax position, has requested a quote for a three-year lease with rentals payable at the end of each year but in a diminishing manner such that they are in the ratio of 3: 2: 1. Depreciation can be assumed to be on straight line basis and Fair Finance's marginal tax rate is 35%. The target rate of return for Fair Finance on the transaction is 12%.

   Calculate the lease rents to be quoted for the lease for three years.

   Solution:

   Capital sum to be placed under Lease

Particulars	₹ in lakhs
Cash Down price of machine	300.00
Less: PV of depreciation tax shield [100 × 0.35 × PVIFA (12%, 3 years) = 35 × 2.4018]	84.06
	215.94

If the normal annual lease rent per annum is x, then cash flow will be:

Year	Post-tax cash flow	P.V. of post-tax cash flow
1	3x × (1 – .35) = 1.95x	1.95 × (1/1.12) = 1.7411x
2	2x × (1 – .35) = 1.3x	1.30 × [(1/(1.12)^2] = 1.0364x
3	x × (1 – .35) = 0.65x	0.65 × [1/(1.12)^3] = 0.4626x
		= 3.2401x

Therefore 3.2401 x = 215.94

or, x = ₹66.6409 lakhs

Year-wise rentals are as follows: (₹ in lakhs)

Year 1	3 × 66.6409 lakhs	199.9227
Year 2	2 × 66.6409 lakhs	133.2818
Year 3	1 × 66.6409 lakhs	66.6409

2. ABC Company Ltd. is faced with two options as under in respect of acquisition of an asset valued ₹1,00,000/-

Either

(a) to acquire the asset directly by taking a Bank Loan of ₹1,00,000/- repayable in 5 year-end instalments at an interest of 15%.

OR

(b) to lease in the asset at yearly rentals of ₹320 per ₹1,000 of the asset value for 5 years payable at year end. The following additional information are available.

(a) The rate of depreciation of the asset is 15% W.D.V.

(b) The company has an effective tax rate of 50%.

(c) The company employs a discounting rate of 16%.

You are to indicate in your report which option is more preferable to the Company. Restrict calculation over a period of ten years

The present value of one Rupee due at the end of each year is

End of year	1	2	3	4	5	6	7	8	9	10
Present Value	0.86207	0.74316	0.64066	0.55229	0.47611	0.41044	0.35313	0.30503	0.26295	0.22668

Solution:

ABC Company Ltd

Appraisal of Buying Decision: PV of Cash Out Flows (Fig in ₹)

Year	Principal repayment	Interest	Outflow	Tax savings on dep.	Tax savings on int.	Net cash out flow	PV factor @ 16%	Present value
1	20,000	15,000	35,000	7,500	7,500	20,000	0.86207	17,241.4
2	20,000	12,000	32,000	6,375	6,000	19,625	0.74316	14,584.5
3	20,000	9,000	29,000	5,420	4,500	19,080	0.64066	12,223.8
4	20,000	6,000	26,000	4,606	3,000	18,394	0.55229	10,158.8
5	20,000	3,000	23,000	3,915	1,500	17,585	0.47611	8,372.4
6	-	-	-	3,328	–	(3,328)	0.41044	(1,366)
7	-	-	-	2,829	–	(2,829)	0.35313	(999.0)
8	-	-	-	2,405	–	(2,405)	0.30503	(733.6)
9	-	-	-	2,044	–	(2,044)	0.26295	(537.5)
10	-	-	-	1,737	–	(1,737)	0.22668	(393.7)
								58,551.1

Net present value of outflows ₹58,551.1.

(b) Appraisal of Leasing Decision: Present Value of Cash outflows under Lease Alternative

Lease rent per year is 320/1,000 × 1,00,000 = ₹32,000

Year	Lease rent (₹)	Tax savings (₹)	Net out flow (₹)	PVCF @ 16%	Present value (₹)
1-5	32,000	16,000	16,000	3.27429	52,390

PVCF = Present Value of Cashflow

From "a" and "b", it is advised to lease, Since the net cash outflow is lower under Lease alternative.

However, it is not wise to compare the two projects with different life periods. So, consider equivalent annual cash outflows, which is calculated as follows,

Leasing : ₹52,390/3.27429 = ₹16,000

Buying : ₹58,552/4.83252 = ₹12,115.

So, it is advised to buy the asset.

3. Elite Builders has been approached by a foreign embassy to build for it a block of six flats to be used as guest houses. As per the terms of the contract, the foreign embassy would provide Elite Builders the plans and the land costing ₹25 lakhs. Elite Builders would build the flats at their own cost and lease them to the foreign embassy for 15 years. At the end of which the flats will be transferred to the foreign embassy for a nominal value of ₹8 lakh. Elite Builders estimates the cost of constructions as follows:

   Area per flat, 1,000 sq. feet; Construction cost, ₹400 per sq. feet; Registration and other costs, 2.5 per cent of cost of construction; Elite Builders will also incur ₹4 lakhs each in years 14 and 15 towards repairs.

   Elite Builders proposes to charge the lease rentals as follows:

Years	Rentals
1 - 5	Normal
6 – 10	120 per cent of normal
11 - 15	150 per cent of normal

   Elite builders present tax rate averages at 35 per cent which is likely to be the same in future. The full cost of construction and registration will be written off over 15 years at a uniform rate and will be allowed for tax purposes.

   You are required to calculate the normal lease rental per annum per flat. For your exercise you may assume:

   (a) Minimum desired return of 10 per cent,

   (b) Rentals and repairs will arise on the last day of the year, and,

   (c) Construction, registration and other costs will be incurred at time = 0.

   Solution:

   Calculation of present value of Cash outflow: (Figure in ₹)

Cost of construction 400 × 1,000 × 6			24,00,000
Registration and other costs @ 2.5%			60,000
Cost of Repairs	4,00,000		
(-) Tax savings @ 35%	1,40,000		
	2,60,000		

At t_{14} = Present value = 2,60,000 × 0.26333		68,466	
At t_{15} = present value = 2,60,000 × 0.23939		62,241	1,30,707
			25,90,707 (Rounded of to 25,90,700)

Let 'X' be Normal lease rent per 6 flats per annum. P/V of Recurring Cash Inflow for 15 years.

Particulars	1-5 years	6-10 years	11-15 years
Lease Rent p.a.	X	1.2 X	1.5 X
Depreciation (24,60,000/15)	164,000	164,000	164,000
PBT	X-164,000	1.2X-164000	1.5X-164,000
PAT 65 %	0.65X-106600	0.78X-106600	0.975X-106600
CIAT = PAT + Dep.	0.65X + 57400	0.78X + 57400	0.975X + 57400
PVCF	3.7908	2.3538	1.4615
PV	2.464X + 217592	1.836X + 135108	1.425X + 83890

Leasing Decision: Total PV = 5.725 X + 436590

P/V of Terminal Cash Inflows:	₹
Nominal value of flats after 15 years	8,00,000
Less: Tax on Profit [8,00,000 × 35%]	2,80,000
Total	5,20,000
PV = 5,20,000 × 0.239	1,24,280

At 10% Rate of Return: P/V of Cash Inflows = P/V of Cash outflows

5.725X + 4,36,590 + 1,24,280 = 25,90,700

Or, X = 3,54,555.

Lease Rent per Flat = 3,54,555/6 = ₹59,092.50

4. The Sharda Beverages Ltd has taken a plant on lease, valued at ₹20 crore. The lease arrangement is in the form of a leveraged lease. The Kuber Leasing Limited is the equity participant and the Hindusthan Bank Ltd. (HBL) is the loan participant. They fund the investment in the ratio of 2:8. The loan from HBL carries a fixed rate of interest of 19 percent, payable in 6 equated annual instalments. 'The lease term is 6 years, with lease rental payable annually in arrear.

   a) Compute the equated annual instalment from the point or view - of HBL.

   b) If the lease rate is unknown, and HBL's per-tax yield is 25 percent, what is the minimum lease rent that must be quoted'?

Solution:

Cost of the asset	₹20 cr	
Debt Equity ratio	2: 8	
Loan raised	(20 × 8/10) =	₹16cr
Rate of interest	19%	

(a) Computation of annual instalment

$X \times PVCF_{6yr,\ 19\%} = ₹16$ cr.

$X = ₹16$ cr/3.4098

$X = 4,69,23,573$

So, equated annual instalment is ₹4,69,23,573

(b) Let the lease rent be X

Net outflow = Lease rent – Loan instalment = X – 46923573

Then,

$(X - 46923573)\ PVCF_{6yr,\ 25\%} = 40000000$

$X = 6,04,76,463$

Minimum lease rental to be quoted is ₹6,04,76,463.

5. Basic Information:

(i) Asset related: Cost ₹120 lacs; Depreciation 40%; Useful life 4 years; Residual value after three years ₹25.92 lacs.

(ii) Leasing: Full pay out; Three-year lease; Lease Quote ₹434 per ₹1,000; Payment annually in arrears.

(iii) Borrow and buy Three-year loan; Interest rate 15%; Quantum to be determined, such that annual repayment of principal will be equal to annual lease rental payment.

(iv) Other: Tax Rate is 40%, and opportunity cost of capital is 11%.

Based on information given above, determine the preferred option as between leasing and buying.

Solution:

Appraisal of Leasing decision

Benefits of leasing (₹ in lakhs)

1.	Saving in Investment	120.00
2.	PV of tax shield on lease rentals	50.91
		170.91

Cost of leasing (₹ in lakhs)

Present Value of lease rentals	118.91
PV of tax shield on depreciation	31.70
PV of tax shield on Interest	12.54
PV of terminal cash inflows (25.92 × 0.7312)	18.95
	182.10

Net advantage of leasing = ₹(170.91 -182.1) lakhs = ₹(11.19) lakhs. Hence, it is better to purchase the asset than to lease.

Working Notes:

1. Calculation of PV of lease rentals

Lease rent per year = 434/1000 × 120 = ₹ 52.08 lakhs

Present value lease rent = 52.08 × $PVCF_{3yr,\ 15\%}$ = ₹118.91 lakhs

2. Present value of tax shield on lease rentals (₹ in lakhs)

Year	Lease rental	Tax saving	PV @ 11%	Present value
1	52.08	20.83	0.9009	18.7657
2	52.08	20.83	0.8116	16.9056
3	52.08	20.83	0.7312	15.2308

Total = ₹50.9100 lakhs

3. Present value of depreciation tax shield (₹ in lakhs)

Year	Book value	Depreciation	Tax savings	PV @11%	Present value
1	120	48	19.20	0.9009	17.2972
2	72	28.8	11.52	0.8116	9.3496
3	43.2	17.28	6.91	0.7312	5.0526
4	25.92	10.368	4.147	0.6587	2.7316

4. Calculation of interest tax shield (₹ in lakhs)

Year	O/ S loan	Interest	Installment	Principal	Tax saving	PV @ 11%	Present value
1	118.91	17.835	52.08	34.245	7.134	0.9009	6.427
2	84.655	12.698	52.08	39.382	5.079	0.8116	4.122
3	45.263	6.817	52.08	45.263	2.726	0.7312	1.995
						Total	12.54

Present value of terminal cash inflows = 25.92 × 0.7312 = ₹18.95 lakhs Present value of lease rental = ₹118.91 lakhs

Interest rate @ 15%; No of instalments = 3

Instalment amount = 118.91/PVCF $_{3yr,\ 15\%}$ = ₹52.08 lakhs

6. HB Finance Ltd is considering to enter the computer leasing business. Mainframe computers can be purchased for ₹2,00,000 each and, in turn, be leased out at ₹50,000 per year for 8 years with the initial payment occurring at the end of first year. You may ignore taxes and depreciation.

   a) Estimate the annual before tax expenses and internal rate of return (IRR) for the company.

   b) What should be the yearly lease payment charged by the company in order to earn a 20 percent annual compounded rate of return before expenses and taxes?

   c) Assume that the firm uses the straight-line method of depreciation, there is no salvage value, the annual expenses are ₹20,000, and the tax rate is 35%. Calculate the yearly lease payment in order to enable the firm to earn 20 percent after tax annual compound rate of return.

d) Further, assume that computer has a resale value of ₹40,000. Determine the revised lease rental to enable the firm to earn 20 per cent.

Solution:

(a) Cost of the Asset ₹ 2,00,000

Life 8 years

Lease rent ₹ 50,000 p.a.

(50,000) $PVCF_{8yr, IRR}$ = ₹2,00,000

$PVCF_{8yr, IRR}$ = 4

IRR = 18.63%

(b) Calculation of yearly lease rent to be charged to earn 20% return

Let the yearly lease rent be X

So, X × $PVCF_{8yr, 20\%}$ = 200000

or, X = 200000 / 3.8372

or, X = ₹52120

(c) Let X be the yearly lease rent

Computation of cash inflows per annum

Lease rent	X
(-) annual expenses	20,000
(-) Depreciation	25,000
PBT	X - 45,000
PAT @ (1-35%)	0.65X – 29,250
CIAT	0.65X – 4,250

Cash inflows after tax

Present value for 8years @ 20% = (0.65X – 4250) × 3.8372 = 2,00,000

Yearly lease rent X = ₹86,725

(d) Present value of cash outflows

Cost of computer 2,00,000

Present value of recurring cash inflows

Lease rent	X
(-) annual expenses	20,000
(-) Depreciation	20,000

PBT	X – 40,000
PAT @ (1-35%)	0.65X - 26,000
CIAT	0.65X- 6000
Present value for 8years @ 20%	= (0.65X-6,000) × 3.872

Present value of terminal cash inflows:

Resale value = ₹40,000

Its present value (40,000 × 0.23257)= ₹9,303

At 20%,

Inflows = Outflows

(0.65x – 6,000) × 3.8372 + 9303 = 2,00,000;

Revised lease rent, X = ₹85,687.

7. Beta Ltd is considering the acquisition of a personal computer costing ₹50,000. The effective life of the computer is expected to be five years. The company plans to acquire the same either by borrowing ₹50,000 from its bankers at 15% interest p.a. or on lease. The company wishes to know the lease rentals to be paid annually, which match the loan option. The following further information is provided to you:

a) The principal amount of loan will be paid in five annual equal instalments.

b) Interest, lease rentals, principal repayment are to be paid on the last day of each year.

c) The full cost of the computer will be written off over the effective life of computer on a straight-line basis and the same will be allowed for tax purposes

d) The company's effective tax rate is 40% and the after-tax cost of capital is 9%

e) The computer will be sold for ₹1,700 at the end of the 5th Year. The commission on such sales is 9% on the sale value.

You are required to compute the annual lease rentals payable by Beta Ltd, which will result in indifference to the loan option.

Solution:

Computation of Net Cash outflow if the Asset is Purchased by Borrowing

Year	Principal repayment (₹)	Interest (₹)	Installment (₹)	Tax savings on interest (₹)	Tax savings on dep (₹)	Net cash outflow (₹)	PV @ 9%	Present value (₹)
1	10,000	7,500	17,500	3,000	4,000	10,500	0.91743	9,633
2	10,000	6,000	16,000	2,400	4,000	9,600	0.84168	8,080
3	10,000	4,500	14,500	1,800	4,000	8,700	0.77218	6,718
4	10,000	3,000	13,000	1,200	4,000	7,800	0.70843	5,526
5	10,000	1,500	11,500	600	4,000	6,900	0.64993	4,485

Present Value of Total outflow of cash		₹34,442
Less: Present value of terminal cash inflows:		
Sale value of asset	₹ 1,700	
(-) Commission	₹ 153	₹ 1,547
(-) Tax on profit @ 40%		₹ 619
		₹ 928
Its Present value ₹ (928 × 0.64993)		₹ 603
Net cash outflow = 34,442 – 603		= ₹33,839

Since we are required to find the annual lease rental payable, which will result in indifference to loan option. The present value of net cash outflow will be the same in each case.

Computation of break-even lease rent:

Let X be the break-even lease rent

Present value of cash inflows:

Lease rent		₹ X
(-) Tax saving	(X @ 40%)	₹ 0.4X
Lease rent after tax per year	₹ 0.6X	

Present value of lease rental for five years = (0.6X) × (3.8896) = 33,839

or, X = ₹14,500.

So, the required annual lease rental is ₹14,500.

8. ABC leasing Ltd. is in the process of making out a proposal to lease certain equipment. The cost of the equipment is ₹10,00,000 and the period of lease is 10 years. The following additional information is available. You are required to determine the equated annual rent to be charged for the proposal.

   a) The ma chine can be depreciated fully over the 10 years on straight-line basis

   b) The current effective tax rate is 40% and expects to go down to 30% from the beginning of the 6 th year of the lease.

   c) It is the normal objective to make a 10% post-tax return in its lease pricing

   d) Lease management fee of 1% of the value of the assets is usually collected from the lessees upon signing of the contract of lease, to cover the overhead costs related to processing of the proposal.

   e) Annual lease rents are collected at the beginning of every year.

   Solution:

   Present value of cash outflow:

   Cost of equipment ₹10,00,000

   Let X be the equated annual lease rent

Present value of lease rentals after tax (Figures in ₹)

Year	Lease rent	Tax	Net cash inflows	PV @ 10%	Present value
0	X	-	X	1.0000	X
1-5	X	0.4X	0.6X	3.7908	2.2745X
6-9	X	0.3X	0.7X	1.9680	1.3776X
10	0	0.3X	(0.3X)	0.3855	(0.1158X)

Present value of total recurring cash inflows = 4.5364X

Calculation of tax shield on depreciation (Figures in ₹)

Year	Depreciation	Tax benefit	PV @ 10 %	Present value
1-5	1,00,000	40,000	3.7908	1,51,600
6-10	1,00,000	30,000	2.3540	70,620
				2,22,220

At 10%, Inflows = Outflows

Or, 1000000 = 4.5364X + 222220

X = 1,71,453.

Therefore, equated annual rent is ₹1,71,453.

Solved Case Study

PQR Ltd. is considering to acquire an additional computer to supplement its time-share computer services to its clients. It has two options:

(i) To purchase the computer for ₹22 lakhs.

(ii) To lease the computer for three years from a leasing company for ₹5 lakhs as annual lease rent plus 10% of gross time-share service revenue. The agreement also requires an additional payment of ₹6 lakhs at the end of the third year. Lease rents are payable at the year-end, and the computer reverts to the lessor after the contract period.

The company estimates that the computer under review will be worth ₹10 lakhs at the end of third year.

Forecast Revenues are:

Year	1	2	3
Amount (₹ in lakhs)	22.5	25	27.5

Annual operating costs excluding depreciation/lease rent of computer are estimated at ₹9 lakhs with an additional ₹1 lakh for start-up and training costs at the beginning of the first year. These costs are to be borne by the lessee. Your company will borrow at 16% interest to finance the acquisition of the computer. Repayments are to be made according to the following schedule:

Year end	1	2	3
Principal (₹ in ’000)	500	850	850
Interest (₹ in ’000)	352	272	136

The company uses straight line method (SLM) to depreciate its assets and pays 50% tax on its income. The management approaches you to advice. Which alternative would be recommended and why?

Note: The PV factor at 8% and 16% rates of discount are:

Year	1	2	3
8%	0.926	0.857	0.794
16%	0.862	0.743	0.641

Solution:

Working Notes:0

a) Depreciation: ₹ (22,00,000 – 10,00,000)/3 = ₹ 4,00,000 p.a.

b) Effective rate of interest after tax shield: 0.16 × (1 - 0.50) = 0.08 or 8%.

c) Operating and training costs are common in both alternatives hence not considered while calculating NPV of cash flows.

Calculation of NPV

1. Alternative I: Purchase of Computer

Particulars	Year 1	Year 2	Year 3
	₹	₹	₹
Instalment Payment			
Principal	5,00,000	8,50,000	8,50,000
Interest	3,52,000	2,72,000	1,36,000
Total (A)	8,52,000	11,22,000	9,86,000
Tax shield @ 50%;			
Interest payment	1,76,000	1,36,000	68,000
Depreciation	2,00,000	2,00,000	2,00,000
Total (B)	3,76,000	3,36,000	2,68,000
Net Cash outflows (A – B)	4,76,000	7,86,000	7,18,000
PV fa ctor at 8%	0.926	0.857	0.794
PV of Cash outflows	4,40,776	6,73,602	5,70,092
Total PV of Cash outflows:			16,84,470
Less: PV of salvage value (₹10 lakhs × 0.794)			7,94,000
Net PV of cash outflows			8,90,470

2. Alternative II: Lease of the Computer

Particulars	Year 1	Year 2	Year 3
	₹	₹	₹
Lease rent	5,00,000	5,00,000	5,00,000
10% of gross revenue	2,25,000	2,50,000	2,75,000
Lump sum payment	-	-	6,00,000
Total Payment	7,25,000	7,50,000	13,75,000
Less: Tax shield @ 50%	3,62,500	3,75,000	6,87,500
Net Cash outflows	3,62,500	3,75,000	6,87,500
PV of Cash outflows @ 8%	3,35,675	3,21,375	5,45,875
Total PV of cash outflows			**12,02,925**

Recommendation:

Since the Present Value (PV) of net cash outflow of Alternative I is lower, the company should purchase the computer.

Exercise

Theoretical Questions

Multiple Choice Questions

1. The major advantage of leasing is that it _________.

   A. provides flexible financing

   B. provides lower payments

   C. avoids risks of obsolescence.

   D. All of the above

2. A finance lease is an agreement between an owner of an asset and a user of that asset wherein the:

   A. usual risks and benefits of ownership are transferred to the user;

   B. legal title to property is transferred to the lessee when the first lease payment is made;

   C. ownership passes to the lessor on inception date of the lease;

   D. substantially all of the risks and benefits of ownership remain with the lessor.

3. A way to analyse whether debt or lease financing would be preferable is to:

   A. compare the net present values under each alternative, using the cost of capital as the discount rate.

   B. compare the net present values under each alternative, using the after-tax cost of borrowing as the discount rate.

   C. compare the payback periods for each alternative.

   D. compare the effective interest costs involved for each alternative.

4. Which of following clearly define the Leasing services?

   A. One party agrees to rent property owned by another party

   B. It guarantees the lessee, also known as the tenant, use of the asset

   C. It guarantees the lessor, regular payments from the lease

   D. All of the above.

5. The type of lease that includes a third party, a lender, is called as which of the following?

   A. Sale and leaseback

   B. Leveraged Lease

   C. Direct leasing arrangement

   D. Operating lease

6. A project has a 10% discounted pay back of 2 years with annual after tax cash inflows commencing from year end 2 to 4 of ₹ 400 lacs. How much would have been the initial cash outlay which was fully made at the beginning of year 1? (Use p.v. factors only up to 3 decimal places.)

   A. ₹ 400 lacs

   B. ₹ 452 lacs

   C. ₹ 633.80 lacs

   D. ₹ 497.20 lacs

7. A project is expected to yield an after tax cash inflow at the end of year 2 of ₹ 150 lacs and has a cost of capital of 10%. Inflation is expected at 3% p.a. While computing the NPV of t the project, this cash flow will be taken as the following:

   A. $\dfrac{\dfrac{150}{1.03}}{(1.1)^2}$

   B. $\dfrac{\dfrac{150}{(1.03)^2}}{(1.1)^2}$

   C. $\dfrac{150}{(111.33\%)^2}$

   D. $\dfrac{150\,(1.03)^2}{(1.11)^2}$

8. A company has ₹7 crore available for investment. It has evaluated its options and has found that only four investment projects given below have positive NPV. All these investments are divisible and get proportional NPVs.

Project	Initial Investment (₹ crore)	NPV (₹ crore)	PI
W	6.00	1.80	1.30
X	3.00	0.60	1.20
Y	2.00	0.50	1.25
Z	2.50	1.50	1.60

   Which investment projects should be selected?

   A. Project W in full and X in part

   B. Project Z in full and W in part

   C. Project W in full and Z in part

   D. Project Z and Y in full and X in part

9. Duhita Ltd. intends to buy an equipment. Quotes are obtained for two different makes A and B as given below: Cost (₹ Million) Estimate life (years) A 4.5, 10 B 6.00, 15 Ignoring the operations and maintenance costs which will be almost the same for A and B, which one would be cheaper? The company's cost of capital is 10% [Given: PVIFA (10%, 10 yrs.) = 6.1446 and PVIFA (10%, 15 years) = 7.6061]

   A. A will be cheaper

   B. B will be cheaper

   C. Cost will be the same

   D. They are not comparable and therefore nothing can be said about which is cheaper.

10. Given for a project: Annual Cash inflow = ₹80,000, Useful life = 4 years Undiscounted Pay-Back period = 2.855 years What is the cost of the project?

    A. ₹ 1,12,084

    B. ₹ 2,28,400

    C. ₹ 9,13,600

    D. None of the above

11. Initial investment of a project is ₹ 25 lakh. Expected annual cash flows are ₹ 6.5 lakh for 10 years Cost of capital is 15%. The annuity factor for 15% for 10 years is 5.019. The Profitability Index of the project will be

    A. 1.305

    B. 3.846

    C. 0.26

    D. 0.7663

12. A company is considering four projects A, B, C and D with the following information:

	Project A	Project B	Project C	Project D
Expected NPV (₹)	60,000	80,000	70,000	90,000
Standard deviation (₹)	4,000	10,000	12,000	14,000

    Which project will fit the requirement of low risk appetite?

    A. Project A

    B. Project B

    C. Project C

    D. Project D

13. M uses 12% as nominal required rate of return to evaluate its new investment projects. It has recently been decided to protect shareholders' interest against loss of purchasing power due to inflation. If the expected inflation rate is 5%, the real discount rate will be

    A. 6.67%

    B. 6%

    C. 17.6%

    D. 7%

14. Z Ltd. invests ₹ 20 lacs in a project with life 5 years and no salvage value. Tax rate is 50% and straight line depreciation is used. The uniform expected cash flows after tax and before depreciation shield are:

    The payback period is

Year End	1	2	3	4	5
Cash flows after tax (₹ lacs)	4	5	6	6	7

    A. 3 years

B. 3 years and 11 months

C. 2 years and 11 months

D. 2 years and 6 months

15. The value of beta of a security does not depend on

    A. standard deviation of the security

    B. standard deviation of the market

    C. correlation between the security and the market

    D. risk free rate

16. A project has a 10% discounted pay back of 2 years with annual after tax cash inflows commencing from year end 2 to 4 of ₹400 lakhs. How much would have been the total project cash outlay which was made in two installments equally at the beginning and end of year 1?

    A. ₹381.81 lakhs

    B. ₹347.11 lakhs

    C. ₹346.15 lakhs

    D. ₹330.58 lakhs

17. The following is true in a capital budgeting exercise with discounted cash flow technique:

    A. When there is capital rationing, Net Present Value is better than the Internal Rate of Return.

    B. The Net Present Value highlights the significant minus cash flows occurring between the inflows when the incomes are being generated more than the Internal Rate of Return.

    C. When there are mutually exclusive proposals of different scales, the Internal Rate of Return is better than the NPV.

    D. The internal rate of return assumes that the cash flows are reinvested at the requiredrate of return.

18. The following is not a disadvantage of pay-back period as an evaluation measure forselecting a project:

    A. Before the pay- back period, the mix of cash flows can be rearranged to get the sameresult

    B. It does not consider the magnitude of cash flows after the payback period.

    C. It can give a conflicting decision compared to the net present value method

    D. A company that is cash-poor gauges the early recovery of funds invested.

19. Annual Cost Saving ₹4,00,000 Useful life 4 years Cost of the Project ₹11,42,000. The Pay back period would be

    A. 2 years 8 months

    B. 2 years 11 months

    C. 3 years

    D. 1 year 10 months

20. There are 4 investments

	X	Y	Z	U
The Standard deviation is	37,947	44,497	42,163	41,997
Expected net present value (₹)	90,000	1,06,000	1,00,000	90,000

Which investment has the highest risk?

A. X

B. Y

C. Z

D. U

21. If the cost of an investment is ₹ 25,000 and it results in a net cash inflow of ₹1,800 per annum forever, the Net Profitability Index of the investment is ___________(assume a discount rate of 8%)

A. 0.9

B. (-) 0.1

C. 1.11

D. 0.8

22. A project has the following cash flows:

If discount rate is 20%, then the NPV of the project is________

A. 11.75

B. 12.34

C. 12.74

D. 11.50

23. A project with an initial investment of ₹100 lakhs and life of 10 years generates cash flows after tax (CFAT) of ₹20 lakh per annum. The Payback Reciprocal is ___________

A. 25%

B. 20%

C. 10%

D. 30%

24. The NPV of a 5 year project is ₹250 lakh and PVIFA at 10% for 5 years is 3.79. The Equivalent Annual Benefit of the project is ___________

A. ₹65.96 lakh

B. ₹947.5lakh

C. ₹56.96 lakh

D. ₹96.65 lakh

25. For an investment project, the following information is available.

    Annual Cost Savings = ₹4,00,000; IRR = 15%; Useful life = 4 years; PVIFA (15%, 4) = 2.85.

    Initial investment = ₹1,14,000, The Discounted Payback Period is __________

    (a) 2.85 years

    (b) 2.89 years

    (c) 3.54 years

    (d) 2.95 years

26. The following information is available in case of an investment proposal:

    NPV at discounting rate of 10% = ₹1250 and NPV at discounting rate of 11% = ₹ (-) 200. The IRR of the proposal is_________________

    (a) 11.86%

    (b) 10.86%

    (c) 9.87%

    (d) 11.96%

27. The Profitability Index of a project is 1.28 and its cost of investment is ₹2,50,000. The NPV of the project is ___________

    (a) ₹75,000

    (b) ₹80,000

    (c) ₹70,000

    (d) ₹65,000

28. From the following information calculate the MIRR of the project.

    Initial Outlay ₹50,000, cost of capital 12% p.a., Life of the project 4 years, Aggregate future value of cash flows ₹1,04,896.50.

    (a) 20.35%

    (b) 21.53%

    (c) 31.25%

    (d) 12.25%

29. The IRR of a project is 10%. If the annual cash flow after tax is ₹1,30,000 and project duration is 4 years, what is the initial investment in the project?

    (a) ₹4,10,000

    (b) ₹4,12,100

    (c) ₹3,90,000

    (d) ₹4,05,000

30. The NPV of a 4 year project is ₹220 lakh and PVIFA at 12% for 4 years is 3.037. The Equivalent Annual Benefit of the project is ___________

(a) ₹66.52 lakh

(b) ₹94.74lakh

(c) ₹66.96 lakh

(d) ₹76.65 lakh

31. The Gross Profitability Index of a project is 1.52 and its NPV is ₹52,000, The cost of investment of the project is ___________

(a) ₹ 1,10,000

(b) ₹ 1,00,000

(c) ₹ 95,000

(d) ₹ 1,05,000

32. If Annual CFAT is ₹ 5,40,000, Project life is 4 years and initial cost is ₹ 19,80,000, what is the Payback Profitability of the project?

(a) ₹ 1,60,000

(b) ₹ 1,95,000

(c) ₹ 1,80,000

(d) ₹ 1,20,000

Answer:

1	2	3	4	5	6	7	8	9	10
D	A	B	D	B	B	B	B	A	B
11	12	13	14	15	16	17	18	19	20
A	A	A	B	D	C	A	D	B	D
21	22	23	24	25	26	27	28	29	30
A	C	B	A	A	B	C	A	B	D
31	32								
B	C								

State True or False

1. A lease agreement has two parties associated with it – the lessor and the lessee.

2. A lessee may again lease out entire or a part of the asset to another person. Such another person is termed as a super lessee.

3. Leases can broadly be classified into Finance Lease and Operating Lease.

4. Operating lease is merely a rental, financial lease is a disguised purchase.

5. A finance lease is a lease that does not transfers substantially all the risks and rewards incidental to ownership of an asset.

Answer:

1	2	3	4	5
True	False	True	True	False

Fill in the Blanks

1. Under ___________ plan the periodic lease rent will go on increasing with a specified rate of increase.

2. Under _______ plan, the lease rent need not be paid for the initial specified period.

3. Cross-border leasing is a leasing arrangement where lessor and lessee are situated in _________ countries.

4. A leveraged lease involves a lessor, a lessee and a __________.

5. At ______________ buying and leasing options are equally preferable.

Answer:

1	Step-up	2	Deferred payment
3	different	4	lender
5	break-even lease rental		

Short Essay Type Questions

1. What are the two major types of leases? Discuss.
2. What is cross border leasing? What are its advantages?
3. Write a short note on: Sale and Leaseback
4. Write a short note on: Leveraged Lease

Practical Problems

Comprehensive Practical Problems

1. A firm has the choice of buying a piece of equipment at a cost of ₹1,00,000 with borrowed funds at a cost of 18% p.a. repayable in five annual instalments of ₹32,000, or to take on lease the same on an annual rental of ₹32,000. The firm is in the tax-bracket of 40%.

Assume:

(i) The salvage value of the equipment at the end of the period is zero.

(ii) The firm uses straight line depreciation.

Discounting factors are:

@ 9%	0.917	0.842	0.772	0.708	0.650
@ 11%	0.901	0.812	0.731	0.659	0.593
@ 18%	0.847	0.718	0.609	0.516	0.437

Which alternative do you recommend?

[Answer: PV of advantage of owning = ₹1050; Owning is recommended]

2. PQR. Ltd. is considering the possibility of purchasing a multipurpose machine which cost ₹10 lakhs. The machine has an expected life of 5 years. The machine generates ₹6 lakhs per year before depreciation and tax, and the management wishes to dispose the machine at the end of 5 years which will fetch ₹1 lakh. The depreciation allowable for the machine is 25% on written down value and the company's tax rate is 50%. The company approached a NBFC for a five-year lease for financing the asset which quoted a rate of ₹28 per thousand per month. The company wants you to evaluate the proposal with purchase option. The cost of capital of the company is 12% and for lease option it wants you to consider a discount rate of 16%.

**[Answer: Net Present Value: Purchase option = ₹4,31,000;
Lease = ₹4,33,000; Lease is recommended]**

3. XYZ Ltd. is considering a proposal to acquire an equipment costing ₹5,00,000. The expected effective life of the equipment is 5 years. The company has two options - either to acquire it by obtaining a loan of ₹5 lakhs at 12% interest p.a. or by lease. The following additional information is available:

(i) the principal amount of loan will be repaid in 5 equal yearly instalments.

(ii) the full cost of the equipment will be written off over a period of 5 years on straight line basis and it is to be assumed that such depreciation charge will be allowed for tax purpose.

(iii) the effective tax rate for the company is 40% and the after-tax cost of capital is 10%.

(iv) the interest charge, repayment of principal and the lease rentals are to be paid on the last day of each year.

You are required to work out the amount of lease rental to be paid annually, which will match the loan option.

[Answer: Required lease rental is ₹1,38,277]

4. Welsh Limited is faced with a decision to purchase or acquire on lease a mini car. The cost of the mini car is ₹1,26,965. It has a life of 5 years. The mini car can be obtained on lease by paying equal lease rentals annually. The leasing company desires a return of 10% on the gross value of the asset. Welsh Limited can also obtain 100% finance from its regular banking channel. The rate of interest will be 15% p.a. and the loan will be paid in five annual equal instalments, inclusive of interest. The effective tax rate of the company is 40%. For the purpose of taxation, it is to be assumed that the asset will be written off over a period of 5 years on a straight-

line basis.

(a) Advise Welsh Limited about the method of acquiring the car.

(b) What should be the annual lease rental to be charged by the leasing company to match the loan option?

For your exercise use the following discount factors:

Discount Rate	Year 1	Year 2	Year 3	Year 4	Year 5
10%	0.91	0.83	0.75	0.68	0.62
15%	0.87	0.76	0.66	0.57	0.49
9%	0.92	0.84	0.77	0.71	0.65

[Answer: (a) PV of cash outflow under lease = ₹81,719; under debt financing = ₹87,335; Lease is recommended; (b) Required lease rental = ₹34,906]

5. The FFM Ltd. is in the tax bracket of 35% and discounts its cash flows at 16%. In the acquisition of an asset worth ₹10,00,000, it is given two offers - either to acquire the asset by taking a bank loan @ 15% p.a. repayable in five yearly instalments of ₹2,00,000 each plus interest or to lease-in the asset at yearly rentals of ₹3,24,000 for five years. In both cases, the instalment is payable at the end of the year. Applicable rate of depreciation is 15% using 'written down value' (WDV) method.

   You are required to suggest the better alternative.

[Answer: PV of cash outflow: Under Lease = ₹6,89,505; Under Buy = ₹7,31,540; Leasing is recommended]

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1. Pandey, I M; Essentials of Financial Management; Pearson Publication
2. Chandra, P.; Financial Management – Theory and Practice; McGraw Hill
3. Khan and Jain; Financial Management – Text, Problems and Cases; McGraw hill
4. Brigham and Houston; Fundamentals of Financial management; Cengage

Securitization 4

This Module Includes:

4.1 Definition and Concept and Benefits of Securitization

4.2 Participants in Securitization

4.3 Mechanism and Problems of Securitization

4.4 Securitization Instruments

Securitization

SLOB Mapped against the Module

1. To obtain in-depth knowledge on application of various techniques of project evaluation under a deterministic environment as well as techniques of incorporating the element of uncertainty in project appraisal. (CMLO 2a, 2b)
2. To develop detailed understanding of how to make strategic choices in long term investment decisions such as own or lease and making optimal allocation of limited funds. (CMLO 3c)

Module Learning Objectives:

After studying the chapter, the students will be able to -

- Understand the meaning and benefits of securitization and know about the participants involved in securitization.
- Appreciate the mechanism of securitization and the limitations associated with it.
- Know about various securitized instruments.

Definition and Concept and Benefits of Securitization

4.1

Introduction

The development of securitization as a financial instrument along withderivatives mark thetransformation of global financial markets. From the traditional form of financial intermediation, markets are rapidly growing into financial commoditization.Lending relationships are being converted into investment products at greatpace and efficiency in many countries, with resultant benefits for the systemas a whole.

4.1.1 Definition and Concept of Securitization

"Securitization" in its widest sense implies every process that converts a business relation into a transaction. To be specific, it refers to the sale of assets, which generate cash flows, from the institution that owns them, to another company (termed as Special Purpose Vehicle) that has been specifically set up for the purpose, and the issuing of notes (preferably interest-bearing bonds) by this second company. These notes are backed by the cash flows from the original assets.

Financial engineering techniques employed by investment banks today enable bonds to be created from any type of cash flow. The most typical such flows are those generated by high-volume loans such as residential mortgages and car and credit card loans, which are recorded as assets on bank or financial house balance sheets. In a securitization, the loan assets are packaged together, and their interest payments are used to service the new bond issue. In addition to the more traditional cash flows from mortgages and loan assets, investment banks underwrite bonds secured with flows received by leisure and recreational facilities, such as health clubs, and other entities, such as nursing homes. Bonds securitizing mortgages are usually treated as a separate class, termed mortgage-backed securities, or MBSs. Those with other underlying assets are known as asset-backed securities, or ABSs. The type of asset class backing a securitized bond issue determines the method used to analyze and value it.

In the words of Sundaresan (1997, page 359), securitization is "a framework in which some illiquid assets of a corporation or a financial institution are transformed into a package of securities backed by these assets, through careful packaging, credit enhancements, liquidity enhancements, and structuring."

Thus, securitization may be defined as the process in which certain types of assets are pooled so that they can be repackaged into interest-bearing securities. The interest and principal payments from the assets are passed through to the purchasers of the securities.

4.1.2 Growth of Securitization

Securitization, in its primitive form, can be traced back to farm railroad mortgage bonds of the 1860s. A number of other examples were found in form of the mortgage-backed bonds of the 1880s and securitisation of mortgages before the 1929 crash. However, the modern era of securitisation began in 1970. That was when the Department of Housing and Urban Development created the first modern residential mortgage-backed security when the Government National Mortgage Association (Ginnie Mae or GNMA) issued the first residential mortgage-backed security, which pooled mortgage loans and allowed them to be used as collateral for securities sold into the secondary market. The stated purpose was to channel investment capital from global investors to provide access to capital for affordable housing. In 1971 Freddie Mac issued the first conventional loan securitisation. In 1977 Bank of America issued the first private label residential mortgage pass-through bond. Throughout the 1970s bankers and lawyers developed increasingly sophisticated securitisation structures. This was aided significantly when, in 1986, Congress passed the Tax Reform Act that included the Real Estate Mortgage Investment Conduit provisions (REMIC) that enabled greater flexibility in structuring bond classes with varying maturities and risk profiles. In the mid-1980s the first securitisations of automobile loans and bank credit card receivables were done. Commercial banks developed the first asset-backed commercial paper conduits (ABCPs) in the 1980s. During the 1980s UK banks began structuring residential mortgage securitisations. During the late 1980s and the 1990s the securitisation market exploded. This was aided in the United States by the REMIC legislation and changes in SEC rules, and fuelled by the growth of money market funds, investment funds and other institutional investors, such as pension funds and insurance companies looking for product. In the 1990s commercial mortgages began to be securitised. Outside the US, countries including the UK and Japan adopted laws that allowed for securitisation. The first securitisations of sub-prime residential mortgages were done in the early 1990s. During the next decade the growth in the volume of sub-prime mortgages that were securitised was huge.

4.1.3 Benefits of Securitization

The driving force behind securitization has been the need for banks to realize value from the assets they hold on their balance sheet. Typically, these assets are residential mortgages, corporate loans, and retail loans such as credit card loans. A financial institution securitizes part of its balance sheet for three main reasons:

a. Funding the assets that it owns

b. Balance sheet capital management

c. Risk management and credit risk transfer.

These are discussed below.

a. Funding the assets that is owns

Banks can use securitization to (1) support rapid asset growth, (2) diversify their funding mix and reduce cost of funding, and (3) reduce maturity mismatches. Banks aim to optimize their funding between a mix of retail, interbank, and wholesale sources. Securitization is a prime component in this mix. Securitization also helps a bank to reduce its funding costs. This is because the securitization process separates the credit rating of the originating institution from the credit rating of the issued notes. Typically, most of the notes issued by special purpose vehicles (SPVs) will be more highly rated than the bonds issued by the originating bank directly. Finally, bank often funds long-term assets, such as residential mortgages, with short-asset liabilities, such as bank account deposits or interbank funding. This funding “gap” can be mitigated via securitization, as the originating bank receives funding from the sale of the assets, and the economic maturity of the issued notes frequently matches that of the assets.

b. Balance sheet capital management

Banks use securitization to improve balance sheet capital management. Securitization provides (1) regulatory capital relief, in some cases (depending on the form of the transaction), (2) "economic" capital relief, and (3) diversified sources of funding.

c. Risk Management and Credit risk transfer

Once assets have been securitized, the credit risk exposure on these assets for the originating bank is reduced considerably. This is because assets have been sold to the SPV. Securitization can also be used to remove nonperforming assets from banks' balance sheets. This will remove credit risk as well as a potentially negative sentiment from the balance sheet apart from freeing up regulatory capital as before. Further, if any of the securitized NPA starts performing again, or there is a recovery value obtained from defaulted assets, the originator will receive any surplus profit made by the SPV.

Securitization is beneficial from the view point of investors also. The potential attractions include:

a. Ability to diversify into sectors of exposure that might not be available in the regular bond markets (for example, residential mortgages or project finance loans).

b. Access to different (and sometimes superior) risk-reward profiles.

c. Access to sectors that are otherwise not open to them.

Participants in Securitization

4.2

A typical Securitization involves the following parties:

a. **Originator:** An originator actually creates a securitized asset. This entity generates (originates) or owns the defined or identifiable cash flow (that is, an income stream from receivables). An example of an originator with assets that can be securitized is a retail bank which may securitize mortgages, automobile loans, credit card receivables, trade receivables etc.

b. **Arranger:** An originator usually appoints a financial institution to design and set up the securitization structure. It is known as arranger. It determines the risk profile of the receivables to create different tranches of security, sets up an SPV and also designs credit enhancement and liquidity support.

c. **Special Purpose Vehicle:** This is an entity established by the Originator to specifically purchase the assets and realize their off-balance-sheet treatment for legal and accounting purposes. This is generally established in form of a trust or a company and is, as far as legally possible, bankruptcy remote from the originator. The newly incorporated SPV (also called the issuer) issues securities to investors to fund the purchase of the isolated receivables from the originator.

d. **Investors:** In a securitization process, typically, financial institutions, insurance companies, pension funds, hedge funds, companies, high net worth individuals are the investors. Investors purchase the securities issued by the SPV according to their risk/return preferences.

e. **Servicers:** SPV appoints the servicer to administer and collect the underlying receivables in the capacity of SPV's agent for a servicing fee stipulated under the servicing agreement.

f. **Rating Agencies:** Rating agencies rate the securities to indicate whether the SPV has a strong or weak capacity to pay interest and principal. They act as the ultimate appraiser of the underlying pool of collateral.

g. **Enhancement Providers:** They provides credit enhancements to the asset-backed securities. Credit enhancement is used to improve the liquidity, marketability, appeal, and safety of the underlying cash flows (interest and principal) of a new instrument in the capital market. This enhancement is provided internally by (i) underwriters or dealers that agree to buy the entire subordinated tranche or (ii) banks or insurers that provide unconditional guarantees which the SPV can draw if debtors default.

h. **Regulators:** They issues various regulations that guides and regulates the securitization process. Regulations may include accountancy practices and capital adequacy requirements, structuring of SPV, licencing requirements, supervision, laws for trading of securities, data protection etc.

Mechanism and Problems of Securitization

4.3

4.3.1 Mechanism of Securitization

In its simplest form, the securitization process involves two steps. First, a financial institution with loans or other income-producing assets, known the originator, identifies the assets it wants to remove from its balance sheet and pools them into a reference portfolio. It then sells this asset pool to an issuer, known as a special purpose vehicle (SPV)—an entity set up, usually by a financial institution, specifically to buy the assets and realize their off-balance-sheet treatment for legal and accounting purposes. Next, the issuer SPV finances the acquisition of the pooled assets by issuing tradable, interest-bearing securities that are sold to the investors in the capital market. The investors receive fixed or floating rate payments (depending upon the tranches they have bought) from a trustee account funded by the cash flows generated by the reference portfolio. In most cases, the originator services the loans in the portfolio, collects payments from the original borrowers, and after deducting a servicing fee, passes them on directly to the SPV or the trustee. Alternatively, SPV may appoint a servicer for this purpose.

In a more recent arrangement, the reference portfolio is divided into several slices, called tranches, each of which has a different level of risk associated with it and is sold separately. The investment return (i.e., principal and interest repayment) as well as losses are allocated among the various tranches according to their seniority. The least risky tranche, for example, has first call on the income generated by the underlying assets, while the riskiest has last claim on that income.

The conventional securitization structure assumes a three-tier security design—junior, mezzanine, and senior tranches. This structure concentrates expected portfolio losses in the junior, or first loss position, which is usually the smallest of the tranches but which bears most of the credit exposure and accordingly is rewarded with the highest return. There is little expectation of portfolio losses in senior tranches, which, because investors often finance their purchase by borrowing, are very sensitive to changes in underlying asset quality.

How Securitization works

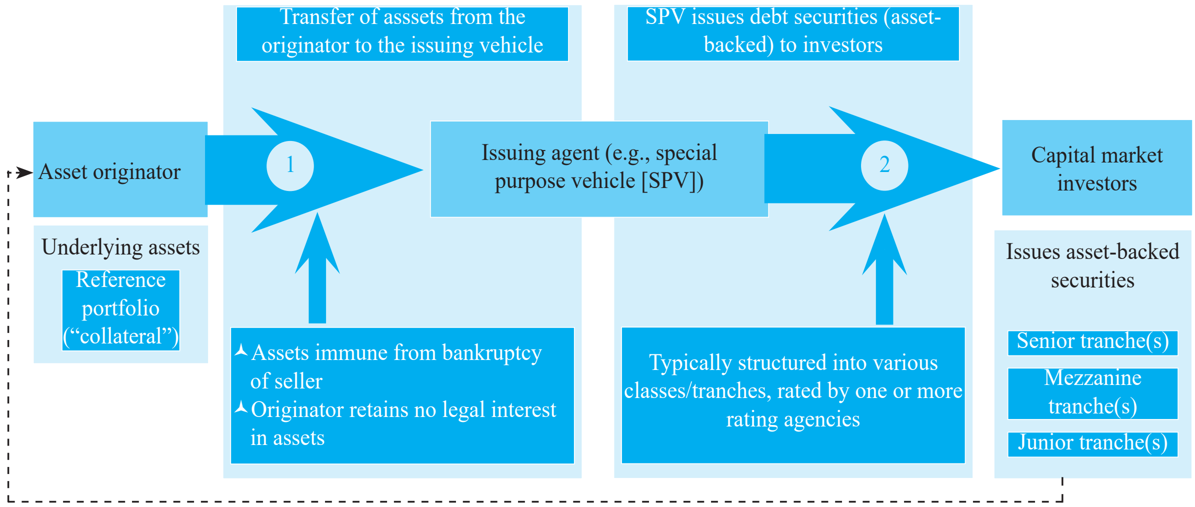

Figure 4.1: The Securitization Process

(Source: Finance & Development September 2008, IMF)

The steps can be summarized as follows:

1. The originator selects the receivables to be assigned.

2. A special purpose entity is formed.

3. The special purpose company acquires the receivables.

4. The special purpose vehicle issues securities which are publicly offered or privately placed.

5. The securities offered by the SPV are structured – usually Class A, B, C (senior, mezzanine, junior). The ratings are driven by the size of credit support, which is, in turn, driven by the expected losses from the pool, which are driven by the inherent risk of default in the pool.

6. The servicer for the transaction is appointed, and is normally the originator.

7. The debtors of the originator or **obligors** are notified depending on the legal requirements of the country concerned. Most likely, the originator will try to avoid notification.

8. The servicer collects the receivables, usually in an escrow mechanism, and pays off the collection to the SPV.

9. The SPV passes the collections to the investors or reinvests the same to pay off the investors at stated intervals. The pay-down to investors will follow the formula fixed in the transaction, which may either **sequentially** pay Class A, B and C, or pay them **proportionally**, or in any other pattern.

10. In case of default, the servicer takes action against the debtors as the SPV’s agent. If losses are realized, they are distributed in the reverse order of seniority.

11. When only a small amount of outstanding receivables are left to be collected, the originator usually cleans up the transaction by buying back the outstanding receivables.

12. At the end of the transaction, the originator's profit, if retained and subject to any losses to the extent agreed by the originator, in the transaction is paid off.

4.3.2 Problems of Securitization

In spite of its widely recognised benefits, securitization has a few limitations as well.

a. Though theoretically the cost of securitizing assets is expected to be lower than the cost of mainstream funding, actually, securitization has proved to be a costly source, primarily in emerging markets due to the higher premium demanded by the investors and additional cost of rating and legal fees.

b. Setting up of an SPV requires high initial payment. Hence, there is a certain minimum economic size below which securitization is not cost effective.

c. Securitization transfers the problem of asset liability mismatch to investors. The profile of the repayment of principal to investors in a pass-through transaction replicates the payback pattern of the assets.

d. Securitization requires high level of disclosure of information. In addition to the disclosures required by regulators, there are disclosures to services, trustees, rating agencies, and in some circumstances, even to investors.

e. Investors are interested only in asset backed securities which have a high quality. So, banks can securitize only better-quality receivables.

f. Banks often allow debt restructuring to their business clients to tide over business emergencies. Since, securitization transactions are looked after by professional trustees who do not have any discretion to allow time or skip payments, debt restructuring cannot be possible here. Restructuring provisions of bankruptcy laws also do not come to the rescue as most SPVs are structured as bankruptcy remote entities.

g. As per the current accounting standards, securitization accounting leads to upfront booking of profits. These profits represent not only the profits encashed while making the sale, but even estimated profits based on future profitability of the transaction.

Securitization Instruments

4.4

Securitization was initially used to finance simple, self-liquidating assets such as mortgages. But any type of asset with a stable cash flow can in principle be structured into a reference portfolio that supports securitized debt. Securities can be backed not only by mortgages but by corporate and sovereign loans, consumer credit, project finance, lease/trade receivables, and individualized lending agreements. The generic name for such instruments is asset-backed securities (ABS), although securitization transactions backed by mortgage loans (residential or commercial) are called mortgage- backed securities. A variant is the collateralized debt obligation, which uses the same structuring technology as an ABS but includes a wider and more diverse range of assets.

Asset-backed securities (ABSs) are financial securities backed by income-generating assets such as credit card receivables, home equity loans, student loans, and auto loans etc. These are created when a company sells its loans or other debts to an issuer, a financial institution that then packages them into a portfolio to sell to investors. These may act as an alternative of bond investments.

Mortgage-backed securities (MBS) are variations of asset-backed securities that are formed by pooling together mortgages exclusively. The bank handles the loans and then sells them at a discount to be packaged as MBSs to investors as a type of collateralized bond. For an investor, MBS is attractive as there exists mortgages as the back-up.

Collateralized debt obligations (CDOs) consolidate a group of fixed income assets such as high-yield debt or asset-backed securities into a pool, which is then divided into various tranches. They can be further divided into:

a. Collateralized bond obligations (CBOs) are CDOs backed primarily by corporate bonds.

b. Collateralized loan obligations (CLOs) are CDOs backed primarily by leveraged bank loans.

c. Commercial real estate collateralized debt obligations (CRE CDOs) are CDOs backed primarily by commercial real estate loans and bonds.

Different type of securities issued by the special purpose vehicle (SPV) in securitization transactions are as follows:

a. Pass Through Certificates: In case of a pass-through certificate, payments to investors depend upon the cash flow from the assets backing such certificates. That is to say, as and when cash (principal and interest) is received from the original borrower by the SPV, it is passed on to the holders of certificates at regular intervals and the entire principal is returned with the retirement of the assets packed in the pool. Thus, pass through have a single maturity structure and the tenure of these certificates is matched with the life of the securitized assets.

b. Pay Through Certificates: Pay through certificates has a multiple maturity structure depending upon the maturity pattern of underlying assets. Thus, the SPV can issue two or three different types of securities with different maturity patterns like short term, medium term and long term. Thus, these have a greater flexibility with varying maturity pattern needed by the investors. In case of Pay Through Certificates, the SPV instead of transferring undivided interest on the receivables issues debt securities such as bonds, repayable on fixed dates, but such debt securities in turn would be backed by the mortgages transferred by the originator to the SPV. The SPV will temporarily reinvest the cash flows to the extent required to bridge the gap between the date of payments.

c. **Preferred Stock Certificates:** These are issued by a subsidiary company against the trade debts and consumer receivables of its parent company. In other words, subsidiary companies buy the trade debts and receivables of parent companies to enjoy liquidity. Generally, these stocks are backed by guarantees given by highly rated merchant banks and hence they are also attractive from the investor's point of view. These instruments are generally short term in nature.

d. **Asset Backed Commercial Papers:** This type of structure is mostly prevalent in mortgage-backed securities. Under this the SPV purchases portfolio of mortgages from different sources (various lending institution) and they are combined into a single group on the basis of interest rate, maturity dates and underlying collaterals. They are then transferred to a Trust which in turn issued mortgage-backed certificate to the investors. These are also of short term in nature.

e. **Interest Only Certificates:** In case of these certificates, payments are made to investors only from the interest incomes earned from the assets securitized.

f. **Principal Only Certificates:** As the very name suggest payment are made to the investors only from the repayment of principal by the original borrower. These certificates enable speculative dealings since the speculators know well that the interest rate movements would affect the bond value immediately. When interest rate increases, the bond value will decline and vice-versa.

Exercise

Theoretical Questions

Multiple Choice Questions

1. In securitization who is the issue of securities?

   A. SPV

   B. Underwriter

   C. Depositer

   D. Insurer

2. Under "securitisation process", the bank or financial institution which gives loan is known as;

   A. SPV

   B. Obligor

   C. Originator

   D. Credit enhancer

3. The concept of securitisation is associated with ___________.

   A. Capital market

   B. Money market.

   C. Debt market.

   D. Foreign exchange market.

4. Under "securitisation process", _____________ are instruments which issued subsidiary company in respect of receivables of holding or parent company

   A. Pass through certificate

   B. Pay through certificate

   C. Preferred stock certificate

   D. None of these

5. Under "securitisation process", original borrower is known as;

   A. SPV

   B. Obligor

   C. Originator

   D. Credit enhancer

6. _____________ certificate under securitisation have multiple maturity structure.

   A. Pass through certificate

   B. Pay through certificate

   C. Preferred stock certificate

   D. Interest only certificate

Answer:

1	2	3	4	5	6
A	C	C	C	B	B

State True or False

1. Credit rating is integral part of securitization.
2. Debt securitization is loan which is given to financial institutions by borrowers.
3. In case of a pay-through certificate, payments to investors depend upon the cash flow from the assets backing such certificates.
4. Credit enhancement is used to improve the liquidity, marketability, appeal, and safety of the underlying cash flows (interest and principal) of a new instrument in the capital market.
5. Interest only certificates enable speculative dealings.

Answer:

1	2	3	4	5
True	False	False	True	False

Fill in the Blanks

1. ______are issued by a subsidiary company against the trade debts and consumer receivables of its parent company.
2. In ___________payments are made to investors only from the interest incomes earned from the assets securitized.
3. An __________ is an entity established by the Originator to specifically purchase the assets and realize their off-balance-sheet treatment for legal and accounting purposes.
4. _________ are CDOs backed primarily by corporate bonds
5. ____________ are CDOs backed primarily by leveraged bank loans.

Answer:

1	Preferred Stock Certificates	2	interest only certificates
3	SPV	4	CBOs
5	CLOs		

Short Essay Type Questions

1. Name the parties associated with securitization.
2. Name the different type of securities issued by an SPV under securitization.
3. Describe the basic mechanism of Securitization.

4. Write a short note on: Pass Through Certificates
5. Write a short note on: Pay Through Certificates
6. Write a short note on: Preferred Stock Certificates

Essay type Questions

1. What are the advantages of Securitization from the viewpoint of a bank?
2. What are the advantages of Securitization from the viewpoint of investors?
3. What are the steps in Securitization?
4. Describe various certificates issued by the SPV in securitization.
5. Differentiate between Assets Backed Securities and Mortgage-Backed Securities.

References:

1. Securitization: The Road Ahead – IMF Staff Discussion Note
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Section B

SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

Introduction 5

This Module includes:

5.1 Fundamental Analysis

5.2 Technical Analysis

Introduction

SLOB Mapped against the Module

To equip oneself with the knowledge of application of various techniques in security evaluation, building a portfolio, measuring its performance and making revisions to optimise the returns. (CMLO 3a)

Module Learning Objectives:

After studying this module, the students will be able to -

- Understand the meaning of technical analysis and fundamental analysis and the difference between the two approaches in security analysis.
- Appreciate various tools used under these two approaches.

Fundamental Analysis 5.1

5.1.1 Security Analysis

Security is an instrument of promissory note or a method of borrowing or lending, or a means of contributing funds needed by the corporate body or non-corporate body. Portfolio is a combination of securities with different risk return characteristics. Security analysis is the first part of investment decision process involving the valuation and analysis of individual securities. Security Analysis is primarily concerned with the analysis of a security with a view to determine the value of the security, so that appropriate decisions may be made based on such valuation as compared with the value placed on the security in the market.

Two basic approaches of Security Analysis are:

- Fundamental Analysis
- Technical Analysis

Note: This module deals with Fundamental Analysis

(i) Fundamental Analysis: This involves the determination of the intrinsic value of the Share based on the Company's profits and dividend expectations and it necessitates the following:

- **Economic Analysis:** It is concerned with the analysis of the overall economy, of which the entity is a part. Economic analysis is used to forecast National Income with its various components that have a bearing on the concerned industry and the company in particular.
- **Industry Analysis:** It involves analysis of the specific industry to which the company belongs as against analysis of the economy as a whole.
- **Company Analysis:** Economic and industry framework provides the investor with proper background against which shares of a particular company are purchased. Company Analysis requires the assessment of the particular company in which the investment is sought to be made. This requires careful examination of the company's quantitative and qualitative fundamentals.

(ii) Technical Analysis: Technical Analysis judges the fundamental strength or weakness of a company or an industry by examining the investor and price behaviour of its security. It is the study and analysis of Security Price movements on the following assumptions:

- There is a basic trend in the share price movements.
- Such trend is repetitive.
- Share prices have little relationship with Intrinsic Value and are based more on investor psychology and perception.

The purpose is to make an in-depth analysis of the company and its relative strength with reference to other companies in the industry based on share price movement and enable the investor to decide whether he should buy or sell the securities of the company.

5.1.2 Fundamental Analysis

Fundamental analysis is used to determine the intrinsic value of the share by examining the underlying forces that affect the well-being of the economy, industry groups and companies. The actual value of a security, as opposed to its market price or book value is called intrinsic value. The intrinsic value includes other variables such as brand name, trademarks, and copyrights that are often difficult to calculate and sometimes not accurately reflected in the market price. One way to look at it is that the market capitalization is the price (i.e. what investors are willing to pay for the company) and intrinsic value is the value (i.e. what the company is really worth).

The fundamental analysis of a security can be done either using top-down approach or bottom-up approach.

Top down approach

It analyses the economy first, then the Industry and finally individual companies and hence is called a top down Approach

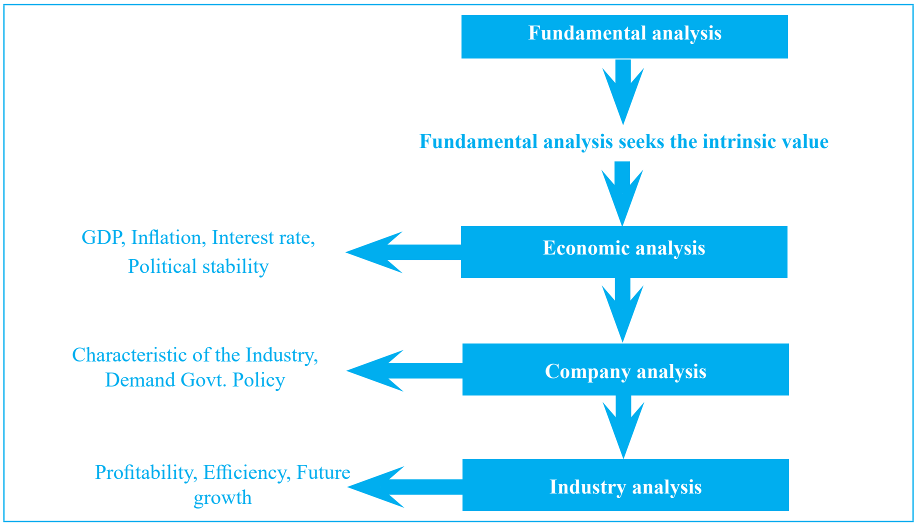

Figure 5.1 : Top-down approach of Fundamental Analysis

Bottom up approach

In this approach, investors focus directly on a company's value. Analysis of such information as the company products, its competitive position and its financial status leads to an estimate of the company's earnings potential and ultimately its value in the market. The emphasis in this approach is on finding companies with good growth prospect, and making accurate earnings estimates. Thus bottom-up fundamental research is broken in two categories: growth investing and value investing.

- **Growth Stocks:** It carries investors' expectation of above average future growth in earnings and above average valuations as a result of high price/earnings ratios. Investors expect these stocks to perform well in future and they are willing to pay high multiples for this expected growth.
- **Value Stocks:** Features are that they are cheap assets and have strong balance sheets.

In many cases, bottom-up investing does not attempt to make a clear distinction between growth and value stocks. Top-down approach is a better approach.

5.1.2.1 Economic Analysis

Economic analysis occupies the first place in the top down approach. Macro-economic is the overall economic environment in which all firms operate. When the economy is having sustainable growth, then the industry group (Sectors) and companies will get benefit and grow faster. The analysis of macroeconomic environment is essential to understand the behaviour of stock prices.

The commonly analysed macro economic factors are as follows:-

a. **The Business Cycles:** The economy recurrently experiences periods of expansion and contraction, although the length and depth of those cycles be irregular. This recurring pattern of recession and recovery is called business cycle.

b. **Gross Domestic Product:** GDP indicates the rate of growth of the economy. GDP is a measure of a country's economic activity and is defined as the total amount of goods and services produced in a country in a year. A higher growth rate is more favourable to the share market. It is calculated by adding the market values of all the final goods and services produced in a year. It measures the current production, i.e. during the year only. GDP counts the final sale value only at current value not the intermittent sale by producer to retailer, etc.

c. **Savings and Investment:** The economic growth results in substantial amount of domestic savings. Stock market is a channel through which the savings of the investors are made available to the industries. The savings and investment pattern of the public affect stock market.

d. **Inflation:** Inflation can be defined in short as 'trend of rising prices caused by demand exceeding supply'. Over time, even a small annual increase of say, 1 percent in the prices tends to influence the purchasing power of the nation. In other words, if prices rise steadily, after a few years, consumers will be able to buy only fewer goods and services, assuming that the income level does not change with inflation. The effects of inflation on capital markets are numerous. In terms of valuing financial assets, inflation reduces the value of fixed-income securities. An increase in the expected rate of inflation is expected to cause a nominal rise in interest rates. Moreover, it increases the uncertainty of future business and investment decisions. A constant mild inflationary situation in an economy will be foreseen as a positive influence on the investors and hence, market prices are likely to go up under these circumstances.

e. **Interest rates:** Interest rate is the price of credit. It is the percentage fee received or paid by individuals or organisations when they lend or borrow money. There are many types of interest rates: bank prime lending rate, treasury bill rate and so on.

   In general, increase in interest rates – whether caused by inflation, government policy, rising risk premiums or other factors reduces borrowings and leads to economic slowdown. Rising interest rates decline bond yields, depress corporate profitability and lead to an increase in the discount rate applied by equity investors, both of which have an adverse impact on stock prices.

f. **Government Budget and Expenditure:** Government expenditure consists of budgetary spending by central, state and local governments on goods and services such as infrastructure, research, road, defence, schools, hospitals, police and fire departments. This spending does not include the amount spent in the form of relief or compensation because these do not represent production of goods and services. Government revenue comes from direct taxes such as Income Tax, Corporate Tax and Indirect Taxes such as Goods and Services Tax which was introduced on April 1, 2017. Budget is the annual financial statement of the government, which deals with expected revenues and expenditures. The excess of government expenditures over revenue is known as deficit. A deficit budget may lead to high rate of inflation and adversely affect the cost of production. Surplus budget may result in deflation. Hence, balanced budget is highly favourable to the stock market.

g. **Tax Structure:** The tax structure which provides incentives for savings and investments.

h. **Balance of payment:** According to Kindle Berger, "the balance of payments of a country is a systematic record of all economic transactions between the residents of the reporting country and residents of foreign countries during a given period of time." Balance of payment can be grouped into three broad accounts: (1) current account, (2) capital account, (3) official international reserve account.

i. **Foreign exchange reserves:** Foreign exchange reserves, are the reserves which are held in foreign currencies usually in hand currencies like dollar, euro, pound, etc gold and special drawing rights (SDRs). When a country enjoys a net surplus both in current account and capital account, it increases foreign exchange reserves. Whenever current account deficit exceeds the inflow in capital account, foreign exchange from the reserve accounts is used to meet the deficit. Ultimately, foreign exchange reserve depends on balance of payments position.

j. **Monsoon and Agriculture:** India is primarily an agricultural country. The importance of agriculture in Indian economy is evident. Agriculture is directly and indirectly linked with the industries. For example, Sugar, Textile and Food processing industries depend upon agriculture for raw material. Fertilizer and Tractor industries are supplying inputs to the agriculture. A good monsoon leads better harvesting; this in turn improves the performance of Indian economy.

k. **Infrastructure facilities:** Infrastructure facilities are essential for growth of Industrial and agricultural sectors. Infrastructure facilities include transport, energy, banking and communication. In India, even though Infrastructure facilities have been developed, still they are not adequate.

l. **Demographic factors:** The demographic data provide details about the population by age, occupation, literacy and geographic location. This is needed to forecast the demand for the consumer goods.

m. **Political stability:** A stable political system would also be necessary for a good performance of the economy. Political uncertainties and adverse change in government policy affect the industrial growth.

Techniques Used in Economic Analysis:

(A) Economic Model Building Approach: In this approach, a precise and clear relationship between dependent and independent variables is determined. GNP model building or sectoral analysis is used in practice through the use of National Accounting Framework. The steps used are as follows:

- Hypothesize total economic demand by measuring total income (GNP) based on political stability, rate of inflation, changes in economic levels.
- Forecast the GNP by estimating levels of various components viz. consumption expenditure, gross private domestic investment, government purchases of goods/services, net exports.
- After forecasting individual components of GNP, add them up to obtain the forecasted GNP.
- Comparison is made of total GNP thus arrived at with that from an independent agency for the forecast of GNP and then the overall forecast is tested for consistency.

(B) Gross National Product Analysis: Gross National Product (GNP) as a measure national income reflects the growth rate in economic activities and is regarded as a forecasting tool for analyzing the overall economy along with its various components during a particular period.

Industry Analysis should take into account the following factors:

- **Characteristics of the industry:** When the demand for industrial products is seasonal, their problems may spoil the growth prospects. If it is consumer product, the scale of production and width of the market will determine the selling and advertisement cost. The nature of industry is also an important factor for determining the scale of operation and profitability.
- **Demand and market:** If the industry is to have good prospects of profitability, the demand for the product should not be controlled by the government.
- **Government policy:** The government policy is announced in the Industrial policy resolution and subsequent announcements by the government from time to time. The government policy with regard to granting of clearances, installed capacity, price, distribution of the product and reservation of the products for small industry etc. are also factors to be considered for industrial analysis.
- **Labour and other industrial problems:** The industry has to use labour of different categories and expertise. The productivity of labour as much as the capital efficiency would determine the progress of the industry. If there is a labour problem that industry should be neglected by the investor. Similarly, when the industries have the problems of marketing, investors have to be careful when investing in such companies.
- **Management:** In case of new industries, investors have to carefully assess the project reports and the assessment of financial institutions in this regard. The capabilities of management will depend upon tax planning, innovation of technology, modernization etc. A good management will also insure that their shares are well distributed and liquidity of shares is assured.
- **Future prospects:** It is essential to have an overall picture of the industry and to study their problems and prospects. After a study of the past, the future prospects of the industry are to be assessed.
- When the economy expands, the performance of the industries will be better. Similarly, when the economy contracts reverse will happen in the Industry. Each Industry is different from the other. Cement Industry is entirely different from Software Industry or Textile Industry in its products and process.

Techniques Used in Industry Analysis

- **Regression Analysis:** Investor diagnoses the factors determining the demand for output of the industry through product demand analysis. The following factors affecting demand are to be considered - GNP, disposable income, per capita consumption / income, price elasticity of demand. These factors are then used to forecast demand using statistical techniques such as regression analysis and correlation.
- **Input - Output Analysis:** It reflects the flow of goods and services through the economy, intermediate steps in production process as goods proceed from raw material stage through final consumption. This is carried out to detect changing patterns/trends indicating growth/decline of industries.

Evaluating the Industry Life Cycle

An insightful analysis when predicting industry sales and trends in profitability comes from viewing the industry over some length of time and divide its development into stages similar to those of the growth of a human being, like birth, adolescence, adulthood, middle age and old age.

A five stage model would include:

1. Pioneering development
2. Rapid accelerating growth
3. Mature growth
4. Stabilization stage and market maturity

5. Declaration of growth and decline

Figure 5.5 shows the growth path of sales during each stage. The vertical scale in logs reflects rate of growth, whereas the horizontal arithmetic scale has different width representing different, unequal time periods. To estimate industry sales, an investor must predict the length of time for each stage. This requires answers to such questions as: For how long will an industry grow at an accelerating rate (stage 2)? For how long will it be in a mature growth phase (stage 3) before its sales growth stabilizes (stage 4) and then decline (stage 5)?

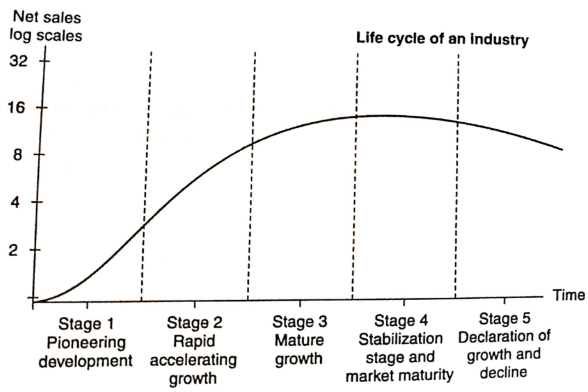

Figure 5.2 : Industry Life Cycle

Besides being useful when estimating sales, this industry life cycle analysis also provides insights into profit margins and earnings growth, although these profits may not parallel the sale growth. The profit margin series typically peaks very early in the total cycle and then levels off and declines as competition is attracted by the early success of the industry.

The following is a brief description of how these stages affect sales growth and profits:

1. **Pioneering Development:** During this start-up stage, the industry experiences modest sales growth and very small or negative profits. The market for the industry's product or service during this stage is small, and the firms incur major development costs.

2. **Rapid Accelerating Growth:** During this rapid growth stage, markets develop for the product or service and demand become substantial. The limited number of firms in the industry face little competition, and firms can experience substantial backlogs and very high profit margins. The industry builds its productive capacity as sales grow on an increasing rate and the industry attempts to meet excess demand. High sales growth and high profit margins that increase as firms become more efficient cause industry and firm profits to explode.

3. **Mature Growth:** the success in stage 2 has satisfied most of the demand for the industry goods or service. Thus, future scales growth may be above normal, but it no longer accelerates. For example, if the overall economy is growing at 8 percent, sales for this industry might grow at an above normal rate of 15 percent or 20 percent a year. Also the rapid growth of sales and high profit margins attract competitors to the industry, causing an increase in supply and lower prices, which means that the profit margins begin to decline to normal levels.

4. **Stabilization stage:** industries eventually evolve into the stabilization stage, also known as maturity stage, at which point the growth begins to moderate. This is probably the longest part of the industry life cycle. Products become more standardized and les innovative, the marketplace is full of competitors, and cost are stable rather

than decreasing though efficiency improves. For example, management's ability to control costs and produce operating efficiencies become very important in terms of individual company's profit margins, Industries at this stage, competition produces tight profit margins, rates of return on assets and equity, eventually become equal to or slightly below the competitive level.

5. **Declaration of Growth and Decline:** At this stage of maturity, the growth in sales declines because of shifts in demand or growth of substitutes. Profit margins continue to be squeezed, and some firms experience low profits or even losses. Firms that remain profitable may show very low rates of return on capital. Finally, investors begin to think about alternative uses for the capital tied up in this industry. One of the major reasons is the obsolescence of the product; for example, the steady replacement of desktop first by laptops and now by tablets.

An investor needs to analyse these competitive forces to determine the intensity of competition in an industry and assess the effect of this competition on the industry's long run profit potential. The industry's competitive structure changes. Over time investors should always update themselves with the industrial environment.

Competition and Expected Industry Returns

Porter's concept of competitive strategy is described as the search by a firm for favourable competitive position in an industry. Porter believes that the competitive environment of an industry determines the ability of the firms to sustain above average rates of return on the invested capital.

a. **Threat of New Entrants:** New entrants to an industry put pressure on prices and profits. Even if a firm has not yet entered in an industry, the potential for it to do so places pressure on prices, because high prices and profit margins encourage entry by new competitors. Therefore, barriers to entry can be key determinant of industry profitability. The various barriers to entry are:

   (i) Economies of scale.

   (ii) Brand loyalty – makes it difficult for new entrants to penetrate.

   (iii) Government regulation.

   (iv) Customer switching costs.

   (v) Absolute cost advantage.

   (vi) Ease in distribution.

   (vii) Strong capital base.

   (viii)Patent protection – it may also give advantages in serving a market.

b. **Rivalry Between Existing Competitors:** When there are several competitors in an industry, there will generally be more price competition and lower profit margins as competitors seek to expand their share of the market.

c. **Pressure from Substitute Products:** Substitute products means that the industry faces competition from firms in related industries. For example, wool producers compete with synthetic fibre producers. The availability of substitutes limits the prices that can be charged to customers.

d. **Bargaining Power of Buyers:** If a buyer purchases a large fraction of an industry's output, it will have considerable bargaining power and can demand price concessions. For example, auto products can put the pressure on suppliers of auto parts, which reduces the profitability of the auto parts industry.

5.1.2.2 Company Analysis

Company analysis is a method of assessing the competitive position of a firm, its earnings and profitability, the efficiency with which it operates its financial position and its future with respect to earnings of its shareholders. Company analysis is a study of variables that influence the future of firm both qualitatively and quantitatively.

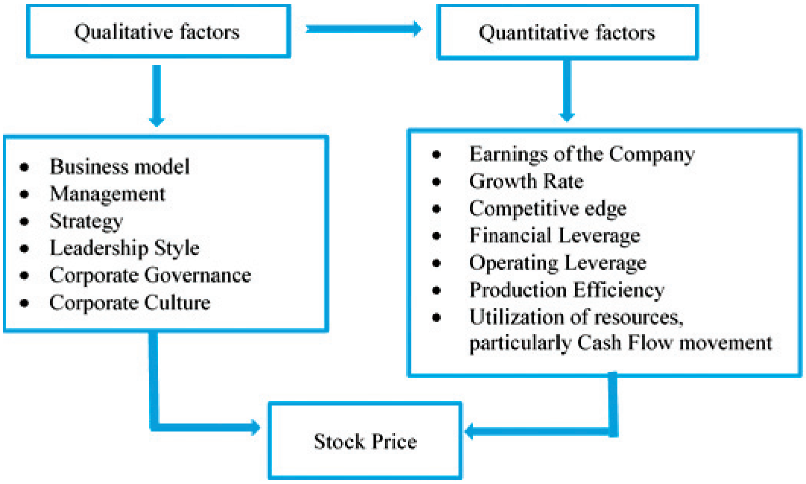

Figure 5.3 : Qualitative and Quantitative Factors

SWOT Analysis

SWOT analysis involves an examination of a firm's strengths, weaknesses, opportunities and threats.

The strengths of a company give the firm a comparative advantage in the market place. It includes strong brand image, high quality products, maintaining a good customer relationship, customer loyalty, innovative R&D, market leadership or strong financial resources. To maintain that strengths, they must continue to be developed, maintained and defended through prudent capital investment policies.

Strengths (S)	**Weaknesses (W)**	
• Technological Skill • Leading brands • Distribution Channels • Customer Loyalty Relationships • Production Quality • Scale • Management	• Absence of important skills • Weak brands • Poor access to distribution • Low customer retention • Unreliable product /service • Sub-scale • Management	Internal Factors
Opportunities (O)	**Threats (T)**	
• Change in Customer tastes • Technological advances • Changes in Government Policies • Lower Personal Taxes • Change in Population age • New distribution Channels	• Change in Customer base • Closing of geographic markets • Technological advances • Changes in Government policies • Tax increases • Change in Population age • New distribution Channels	External Factors
Positive	Negative	

Figure 5.4 : SWOT Analysis

Factors Considered in Company Analysis are:-

(A) Net Worth and Book Value:

(i) The Company's Wealth in terms of Net Worth available to Equity Shareholders and Book Value per Share is a starting point for evaluating a share's worth.

Computation:

Particulars	Amount (₹)
Equity Share Capital	XXX
Add: Free Reserves	XXX
Less: Accumulated Losses	(XXX)
Total Net Worth of Business	XXX
Book Value of Share = Total Net Worth / Number of Shares Outstanding	XX

(ii) However, Book Value may not be an indicator of the Intrinsic Worth of the Share, due to the following reasons-

- First, the market price of the share reflects the future earnings potential of the firm which may have no relationship with the value of its assets. Example: Service Sector, where intrinsic value is based more on future earning potential than on Asset Backing as per Balance Sheet.
- Second, the book value is based upon the historical costs of the assets of the firm and these may be gross underestimates of the cost of the replacement or resale values of these assets.

(B) Sources and Utilization of funds:

- The identification of sources and uses of funds is known as Fund Flow and Cash Flow Analysis.
- One of the major uses of Funds Flow Analysis is to find out whether the firm has used short term sources of funds to finance long term investments.
- Such methods of financing increases the risk of liquidity crunch for the firm, as long term investment, because of the gestation period involved may not generate enough surplus in time to meet the short term liabilities incurred by the firm. This increases the credit and default risk of the entity.

(C) Time Series Analysis, Common Size Analysis and Financial Ratio Analysis:

- Financial Statements are utilized to make Inter and Intra Firm Comparison.
- The techniques that are used to do such comparative analysis are: Common-Sized Statements, Financial Ratio Analysis, and Time Series analysis.

(D) Size and Ranking:

- A rough idea regarding the size and ranking of the company within the economy, in general, and the industry, in particular would help the investment manager in assessing the risk associated with the Company.
- It may also be useful to assess the position of the Company, in terms of Technical Know-how, Research and Development activity and Price Leadership.

(E) Growth Record:

The growth in sales, net income, net capital employed and earning per share of the company in the past few years should be examined.

(F) Quality of Management: This is an intangible factor and has a very important bearing on the value of the shares. The quality of management at the helm of the Company is reflected in the confidence of the Investor in the Company, which in turn in reflected in the price of its Shares.

(G) Location and Labour-Management Relations: The location of the Company's manufacturing facilities determines its economic viability, proximity to market, availability of inputs like power, skilled labour and raw-materials, etc. The relationship of the Company with its labourers is an essential criterion, since it has an impact on the efficiency of operations.

(H) Pattern of Existing Stock Holding: An analysis of the pattern of existing stock holdings of the Company is relevant, to know the stake of the various parties in the Company.

(I) Marketability of Shares:

(i) Mere listing of a share on the Stock Exchange does not automatically mean that a Share can be sold or purchased at will. There are many Shares which remain inactive for long periods with no transactions being affected.

(ii) In this regard, dispersal of shareholding with special reference to the extent of public holding should be seen. This is also known as the Market Depth of particular scrip.

(iii) The other relevant factors are speculative interest in the scrip, the exchange where it is traded and the volume of trading, etc.

Techniques Used in Company Analysis:

(i) **Correlation & Regression Analysis:** Simple regression is used when inter relationship covers two variables. For more than two variables, multiple regression analysis is followed. Here the inter relationship between variables belonging to economy, industry and company are found out. The same is quantified using the correlation co-efficient between the variables and standard deviation of the variables.

(ii) **Time Series and Trend Analysis:** A Trend line or characteristic line is drawn using the method of least squares to identify and extrapolate the trend obtained based on a given Time Series.

(iii) **Decision Tree Analysis:** This involves the use of probability to find out the expected value arising out a given course of action. In this method various probabilities arc assigned to states of nature and the expected value of a given course of action is determined.

Fundamental Analysis Tools:

Although the raw data of the Financial Statement has some useful information, much more can be understood about the value of a stock by applying a variety of tools to the financial data.

1. Earnings per Share

$$\text{Earning Per Share (EPS)} = \frac{\text{Total Earnings Available to Equity Shareholder}}{\text{Total No. of Equity Shares Outstanding}}$$

2. Price to Earnings Ratio (P/E Ratio)

The Price to Earnings Ratio (P/E) shows the relationship between stock price and company earnings. It is calculated by dividing the share price by the Earnings per Share.

P/E = Stock Price / EPS

3. Projected Earnings Growth Rate - PEG Ratio

A ratio used to determine a stock's value while taking into account earnings growth. The calculation is as follows:

$$\text{PEG Ratio} = \frac{\text{Price / Earning Ratio}}{\text{Annual EPS Growth}}$$

PEG is a widely used indicator of a stock's potential value. It is favoured by many over the price/earnings ratio because it also accounts for growth. Similar to the P/E ratio, a lower PEG ratio means that the stock is more undervalued.

4. **Price to Sales Ratio**

$$\text{P/S or PSR} = \frac{\text{Share Price}}{\text{Revenue Per share}}$$

5. Price to Book Ratio

$$\text{P/B} = \text{Share Price/ Book Value per Share}$$

6. Dividend Yield (Return)

Some investors are looking for stocks that can maximize dividend income. Dividend yield is useful for determining the percentage return a company pays in the form of dividends. It is calculated by dividing the annual dividend per share by the stock's price per share. Usually it is the older, well- established companies that pay a higher percentage, and these companies also usually have a more consistent dividend history than younger companies. Dividend yield is calculated as follows:

$$\text{Dividend Yield (Return)} = \frac{\text{Annual Dividend Per Share}}{\text{Market Price Per Share}}$$

7. Dividend payout ratio

Dividend payout ratio is the fraction of net income a firm pay to its stockholders in dividends:

$$\text{Dividend payout ratio} = \frac{\text{Dividends}}{\text{Net Income for the same period}}$$

$$\text{Calculated as: Dividend payout ratio} = \frac{\text{Yearly Dividend per share}}{\text{Earning per Share}}$$

$$\text{or equivalently} \quad = \frac{\text{Dividend}}{\text{Net Income}}$$

The payout ratio provides an idea of how well earnings support the dividend payments. More mature companies tend to have a higher payout ratio.

8. Book Value per Share

A measure used by owners of common shares in a firm to determine the level of safety associated with each individual share after all debts are paid accordingly.

$$\text{Book Value Per Share} = \frac{\text{Total shareholder's Equity} - \text{Preferred Equity}}{\text{Total Outstanding Shares}}$$

DuPont model

This breaks ROE down into several components so that one can see how changes in one area of the business changes return on equity.

$$\text{ROE} = (\text{Net Margin}) \times (\text{Asset Turnover}) \times (\text{Equity Multiplier})$$

$$\text{ROE} = \frac{\text{Net Income}}{\text{Revenue}} \times \frac{\text{Revenue}}{\text{Total Assets}} \times \frac{\text{Total Assets}}{\text{Equity}}$$

Return on equity grows, all else equal:

- the more net margin increases
- the more revenue is generated from a firm's assets
- The more leveraged a firm becomes

While the first two seems fairly straight forward, the third one doesn't seem to be, but it really is. If revenue generating assets are purchased through the use of debt (not equity), then the increased amount of net income generated by that greater amount of assets will increase the return on the fixed amount of equity.

Sustainable growth

Return on equity also ties into how much growth one can expect from a company. When a firm reinvests its net income, then it can be expected to grow. The fastest this can be expected to occur is the return on equity. This is calculated:

$$\text{Sustainable growth} = \text{Retention ratio} \times \text{ROE Sustainable growth} = (1 - \text{Payout ratio}) \times \text{ROE}$$

$$\text{Sustainable growth} = \frac{(1 - \text{Total Dividend Paid}) \times \text{ROE}}{\text{Net Income}}$$

Alternative Definition

Common shareholders are interested in what return the company is making on their stake to account for this, dividends paid out to preferred shareholders should be subtracted from net income before calculating ROE. So,

$$\text{ROE} = \frac{\text{Net Income - Preferred Dividends}}{\text{Average Shareholders' Equity}}$$

Other Relevant Ratios:

Ratio	Formulas
Liquidity	
(i) Current Ratio	$\frac{\text{Current Assets}}{\text{Current Liabilities}}$
(ii) Quick Ratio or Acid Test Ratio	$\frac{\text{Quick Assets}}{\text{Current Liabilities}}$
(iii) Cash Ratio	$\frac{\text{Cash+Bank+Current Investments}}{\text{Current Liabilities}}$
Leverage ratio	
(iv) Debt-Equity Ratio	$\frac{\text{Total Outside Liabilities}}{\text{Shareholders' Funds}}$
(v) Debt Asset Ratio	$\frac{\text{Total Outside Liabilities}}{\text{Total Assets}}$
(vi) Interest Coverage Ratio	$\frac{\text{PBIT}}{\text{Total Assets}}$
Turnover/Management Efficiency Ratio	
(vii) Inventory Turnover Ratio	$\frac{\text{Returns from Operations}}{\text{Average inventory}}$
(viii) Debtors' Turnover Ratio	$\frac{\text{Net Credit Sales}}{\text{Average Debtors}}$

(ix) Fixed Assets Turnover Ratio	$\frac{\text{Revenue from Operations}}{\text{Average Net Fixed Assets}}$
(x) Total Assets Turnover Ratio	$\frac{\text{Total Revenues}}{\text{Average Total Assets}}$
Profitability	
(xi) Operating Profit Margin Ratio	$\frac{\text{PBIT}}{\text{Total Revenues}}$
(xii) Net Profit Margin Ratio	$\frac{\text{Net Profit}}{\text{Total Revenues}}$
(xiii) Return on Assets	$\frac{\text{Profit after Tax}}{\text{Average Total Assets}}$
(xiv) Return on Capital Employed	$\frac{\text{PBIT (1−T)}}{\text{Average Total Assets}}$
(xv) Return on Equity or Return on Net Worth	$\frac{\text{Equity Earnings/PAT}}{\text{Average Equity}}$

Valuation of Shares

Valuation of shares is another important step of valuation of business. Hence before discussing the valuation of business, let's understand the concept of valuation of shares. There are three important methods of valuation of shares:

(a) Book value method

(b) Market value method

(c) Fair value method. Fair value = Average of Book value and Fair value.

(a) Book value/Balance sheet value/Net asset value of share: (Accountants refer this value as intrinsic value)

Book value method assumes liquidation (without liquidation expenses) i.e., we find the amount that the holder of one equity share will get if the company goes into liquidation. It is obtained by dividing current value of all assets' (including goodwill and non-trade-assets minus preference shareholder's claim) by number of equity shares.

Illustration 1

From the balance sheet of India Trading Company Limited as at 31st March, 2024, the following figures have been extracted:

Share Capital	₹
9% Preference Share capital (₹100)	3,00,000
10,000 Equity Shares of ₹10 Each fully paid	1,00,000
10,000 Equity Shares of ₹10 Each ₹5 paid	50,000
10,000 Equity Shares of ₹10 Each ₹2.50 paid	25,000
	4,75,000
Reserve and Surplus:	
General Reserve	2,00,000
Profit and Loss account	50,000
	7,25,000

On a revaluation of assets on 31st March, 2024, it was found that they had appreciated by ₹75,000 over their book value in the aggregate.

The articles of association of the company provide that in case of liquidation, preference shareholders would have a further claim to 10 per cent of the surplus assets, if any.

You are required to determine the value of the business through the values of preference shares and equity shares assuming that a liquidation of the company has to take place on 31st March, 2024, and that the expenses of winding up are nil.

Solution:

(a) Valuation of shares

	₹
Book value of assets	7,25,000
Appreciation	75,000
Total	8,00,000
Less: Paid up capital	- 4,75,000
Surplus assets	3,25,000
Share of preference shareholders in Surplus assets	32,500
Share of equity shareholders in surplus assets	2,92,500
Share per equity share in surplus assets: 2,92,500/30,000	9.75
Share per preference share in surplus assets: 32,500/3,000	10.83
Value preference share: 100 + 10.83 =	110.83
Value per equity share (₹10 paid): 10 + 9.75 =	19.75
Value per equity share (₹5 paid): 5 + 9.75 =	14.75
Value per equity share (₹2.50 paid): 2.50 + 9.75 =	12.25

(b) Market Value/Yield Value Method

This method assumes business as a going concern. Under this two approaches are there:

(i) based on dividend and

(ii) based on EPS. Based on dividend, two approaches are there, one is based on actual constant dividend this method is also called as dividend yield method) and the other is based on expected growth method which is also called dividend growth method.

MP (based on constant dividend) = $\frac{D}{K_e}$

K_e is also referred as normal rate of return on equity shares.

MP (based on dividend growing at constant rate):

$$= \frac{D_1}{K_e - g}$$

K_e is also referred as normal rate of return on equity shares.

MP (based on EPS) = $\frac{\text{E. P. S.}}{K_e}$

K_e is also referred as normal rate of return on equity shares. (This method is also called as PE method as PE is reciprocal of K_e i.e. Normal rate)

The value of the share depends upon future EPS/dividend. (The basic principle of the share valuation is that the market always discounts the future). Hence, we should take 'dividend per share/EPS' of coming year and not that of past year.

Note: In case there is no specific requirement of the question: We should apply the above mentioned methods in the following orders of preference: (i) Growth based method (ii) EPS based method (iii) Constant dividend based method.

Illustration 2

From the following Trial Balance for the year ending 31 March 2023 and other relevant information, determine the value of the business on the basis of values of equity shares of Bhakti Ltd. as on 1st April, 2023 assuming the PE ratio to be 10.

Particulars	Dr. (₹)	Cr. (₹)
Fixed Assets (Cost Price)	1,00,000	
Equity Share Capital (₹10)		3,00,000
Reserve and Surplus		1,80,000
Provision for Depreciation		30,000
Purchase/sales	8,00,000	10,00,000
Opening stock	1,00,000	
Salaries	80,000	
Rent and rates	11,000	
Fixed selling expenses	10,000	
Variable selling expenses	9,000	
Debtors /Creditors	2,60,000	80,000
Bank	2,10,000	
Bad debts	10,000	
Total	15,90,000	15,90,000

Stock is ₹1,50,000 as on 31 March, 2023.

Depreciation is provided at 10 per cent p.a. on cost price, ₹10,000 worth of fixed assets is to be added during the middle of 2023. During the year ended 31st March, 2024:

(i) Sales are likely to go up by 10 per cent at the same price

(ii) The purchase price may go up by 2 per cent

(iii) Stock holding is likely to increase by ₹65,000

(iv) Bad debts are expected to go up by 50 per cent

(v) Salaries and fixed selling expenses are likely to grow up by 10 per cent and 5 per cent respectively and

(vi) The Variable selling expenses are estimated to be higher by 10 per cent per unit, Ignore tax.

Solution:

(i)	Year ended 31st March, 2023:		₹
	Cost of goods sold (COGS)	:	7,50,000
	Sales	:	10,00,000
	COGS	:	75% of the sales

(ii)	Year ended 31st March, 2024:		₹
	Sales	:	11,00,000
	COGS (had there been no change in cost)	:	8,25,000

As the cost has increased by 2%, the COGS for the year 31.3.2024:

1,50,000 + 6,75,000 (1.02) = 8,38,500

Profit and Loss account for the year ended 31.3.2024 (₹)

Particular	Amount	Particular	Amount
COGS	8,38,500	Sales	11,00,000
Depreciation	10,750		
Salaries	88,000		
Fixed Selling expenses	10,500		
Rent and rates	11,000		
Bad debts	15,000		
Variable selling expenses	10,890		
Net Profit	1,15,360		
Total	11,00,000	Total	11,00,000

EPS= 1,15,360/30,000 = 3.8453

Market price of the share: EPS × PE ratio = 3.8453 × 10 = ₹ 38.453.

Technical Analysis

5.2

5.2.1 Introduction

Technical Analysis is the forecasting of future financial price movements based on an examination of past price movements. Like weather forecasting, technical analysis does not result in absolute predictions about the future. Instead, technical analysis can help investors anticipate what is "likely" to happen to prices over time. Technical analysis uses a wide variety of charts that show price over time.

Technical analysis is applicable to stocks, indices, commodities, futures or any tradable instrument where the price is influenced by the forces of supply and demand. Price refers to any combination of the open, high, low, or close for a given security over a specific time frame. The time frame can be based on intraday (1-minute, 5-minutes, 10-minutes, 15-minutes, 30-minutes or hourly), daily, weekly or monthly price data and last a few hours or many years. In addition, some technical analysts include volume or open interest figures with their study of price action.

5.2.2 The Basis of Technical Analysis

At the end of the century, the Dow Theory laid the foundations for what was later to become modern technical analysis. Dow Theory was not presented as one complete amalgamation, but rather pieced together from the writings of Charles Dow over several years. Of the many theorems put forth by Dow, three stand out:

- Price discounts everything.
- Price Movements Are Not Totally Random.
- 'What' is more important than 'Why'.

Price Discounts Everything

Technical analysts believe that the current price fully reflects all information. Because all information is already reflected in the price, it represents the fair value, and should form the basis for analysis. After all, the market price reflects the sum knowledge of all participants, including traders, investors, portfolio managers, buy-side analysts, sell-side analysts, market strategist, technical analysts, fundamental analysts and many others. It would be folly to disagree with the price set by such an impressive array of people with impeccable credentials. Technical analysis utilizes the information captured by the price to interpret what the market is saying with the purpose of forming a view on the future.

Price Movements are not Totally Random

Most technicians agree that prices trend. However, most technicians also acknowledge that there are periods when prices do not trend. If prices were always random, it would be extremely difficult to make money using technical analysis.

A technician believes that it is possible to identify a trend, invest or trade based on the trend and make money as the trend unfolds. Because technical analysis can be applied to many different time frames, it is possible to spot both short-term and long-term trends.

"What" is more important than "Why"

In his book, The Psychology of Technical Analysis, Tony Plummer paraphrases Oscar Wilde by stating, "A technical analyst knows the price of everything, but the value of nothing". Technicians, as technical analysts are called, are only concerned with two things:

1. What is the current price?

2. What is the history of the price movement?

The price is the end result of the battle between the forces of supply and demand for the company's stock. The objective of analysis is to forecast the direction of the future price. By focusing on price and only price, technical analysis represents a direct approach. Fundamentalists are concerned with why the price is what it is. For technicians, the why portion of the equation is too broad and many times the fundamental reasons given are highly suspect.

Technicians believe it is best to concentrate on 'what' and never mind 'why'. Why did the price go up? It is simple, more buyers (demand) than sellers (supply). After all, the value of any asset is only what someone is willing to pay for it. Who needs to know why?

5.2.3 Tools and Techniques of Techincal Analysis

There are numerous tools and techniques for doing technical analysis. Basically this analysis is done from the following four important points of view:

(i) **Prices:** Whenever there is change in prices of securities, it is reflected in the changes in investor attitude and demand and supply of securities.

(ii) **Time:** The degree of movement in price is a function of time. The longer it takes for a reversal in trend, greater will be the price change that follows.

(iii) **Volume:** The intensity of price changes is reflected in the volume of transactions that accompany the change. If an increase in price is accompanied by a small change in transactions, it implies that the change is not strong enough.

(iv) **Width:** The quality of price change measured by determining whether a change in trend spreads across most sectors and industries or is concentrated in few securities only. Study of the width of the market indicates the extent to which price changes have taken place in the market in accordance with a certain overall trends.

5.2.4 Technical Analysis Vs Fundamental Analysis

The major difference between the technical and fundamental analysis are as follows:

(i) Technical analysts try to predict short term price movements whereas fundamental analysis try to establish long term values.

(ii) The focus of technical analysis in mainly on internal market data, particularly price and volume data whereas the focus of fundamental analysis is on the factors relating to the economy, industry and the company.

(iii) Speculators who want to make quick money mostly use results of technical analysis whereas investors who invest on long term basis use the results of fundamental analysis.

(iv) Fundamental analysis involves compilation and analysis of huge amount of data and is therefore, complex, time consuming and tedious in nature. On the other hand, technical analysis is a simple and quick method on forecasting behavior of stock prices.

(v) According to the technical analysts, their method is far superior the fundamental analysis, because fundamental analysis is based on financial statements which themselves are plagued by certain deficiencies like subjectivity, inadequate disclosure etc.

(vi) Fundamental analysis is a longer term approach. Even if an analyst identifies an underpriced security, market may take time to bid its price up. Technical analysts feel that their own techniques and charts are quicker and superior to fundamental analysis.

Thus, technical and fundamental analysis provide exactly opposite approaches to valuation, but in practice, generally, a judicious combination of both these approaches is used to arrive at better results.

These two approaches are not used as substitutes but as complementary to each other.

Dow Theory

The oldest and best known theory of technical analysis is the Dow Theory, originally developed in 1900, by the editor of the Wall Street Journal, Charles H Dow, who may regard as the father of technical analysis. The basic principles of technical analysis originated from this theory. Although Dow developed the theory to describe the past price movements. William Hamilton followed up by using it to predict movements in the market. In a nutshell, this theory seeks to study the major movements in the market with a view to establish trends. Until a reversal occurs, a trend is assumed to exist. It should be noted that the Dow theory only describes the direction of market trends and does not attempt to forecast future movements or estimates either the duration or the size of such market trends [However, subsequent analysts like Robert Rhea, who provided a formalized account of the theory (‘The Dow Theory’), attempted to measure size and duration trends proposed by Dow].

Any discussion on technical analysis using price and volume data should begin with a consideration of the Dow Theory because it was among the earliest work on this topic and remains the basis for many technical indicators.

(1) Major trends or primary trends are like tides in the ocean.

(2) Intermediate trends that resemble waves and

(3) Short-run movements that are like ripples.

Followers of the Dow Theory attempt to detect the direction of the major price trend (tide), recognizing that intermediate movements (waves) may occasionally move in the opposite direction. They recognize that a major market advance does not go straight up, but rather includes small price declines as some investors decide to take profits.

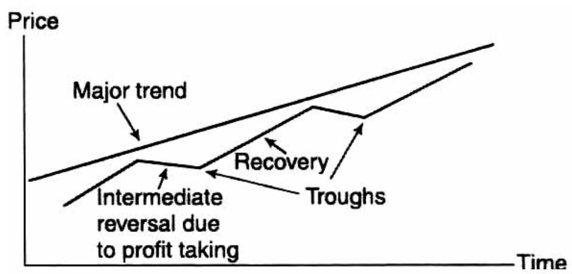

Figure 5.5 : Sample Bullish Price Pattern

Figure 5.10 shows the typical bullish pattern. The technician would look for every recovery to reach a new peak above the prior peak, and this price rise should be accompanies by heavy trading volume. Alternatively, each profit-taking reversal that follows an increase to new peak should have a trough above the prior trough with relatively light-trading volume during the profit-taking reversals. When this pattern of price and volume movements changes, the major trend may be entering a period of consolidation (a flat trend) or a major reversal.

Charts

Charts are a valuable and easiest of the tools used in technical analysis. The graphic presentation of data helps the investor to find out the trend of price without any difficulty. Charts also have the following uses:

- Help to spot current trends for buying and selling.
- Indicate the probable future action of the market by projection.
- Show historical movements.
- Indicate the key areas of support and resistance.

The charts do not lie but interpretation differs from analyst to analyst according to one's skills and experience. Leading analyst James Dines has said 'charts are like fire or electricity. They are brilliant tools if intelligently controlled and handled, but dangerous to a novice.

Analyzing the Chart-Patterns

The size of a chart pattern, and where it occurs within a trend, provides clues as to how big the next price move will be once the chart pattern completes. When the price finally breaks out of the chart pattern (completion), this indicates the direction the price is likely to continue moving. Therefore, chart patterns are useful tools for any trader, whether they trade the patterns or use them for analytical purposes.

Reversal Patterns vs. Continuation Patterns

There are two main types of charts patterns: reversal patterns and continuation patterns. Reversal patterns signal an end to the trend that was in places prior to the chart pattern forming. For example, if the price had been trending higher and then a reversal pattern forms and completes, the uptrend is likely to over. Continuation patterns signal the continuation of a trend. If the price is moving lower, then a continuation pattern forms and the price breaks out (completes) in the trending direction, then that downtrend is likely to continue.

Traders highlight chart patterns by using trend lines. Trend lines are drawn along high and low points on the chart. The trend lines are then used to signal when the price is breakout of, or completing, the pattern.

Line Chart

Line charts are single graphs drawn by plotting the closing price of the stock on a given day and connecting the points thus plotted over a period of time. The charts are easily drawn and widely used in technical analysis. The price is marked on the Y-axis and the period of time on the X-axis. Line charts help in easy identification of patterns. (See figure 5.13 for a typical chart)

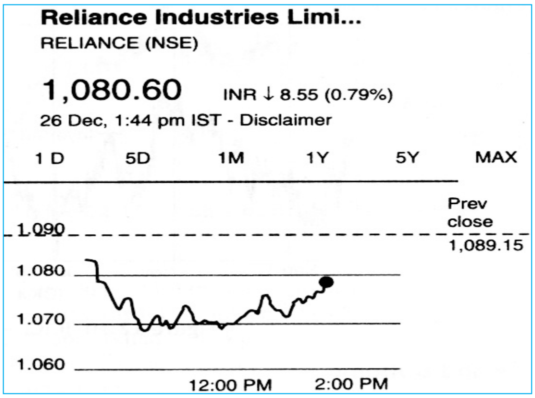

Figure 5.6: Line Chart of RIL

Bar Charts

The bar chart is the simplest and most commonly used tool of a technical analyst. To build a bar, a dot is entered to represent the highest price at which the stock is traded on that day, week or month. The another dot is entered to indicate the lowest price on that date. A line is drawn to connect these points. A horizontal number is drawn to mark the closing price. Line charts are used to show price movements. The line chart is a simplification of the bar chart. Here, a line is drawn to connect the successive closing prices.

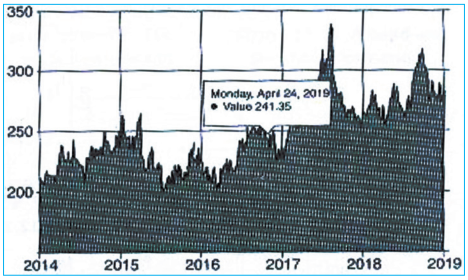

Figure 5.7: Bar Chart of ITC)

Chart Patterns

Chart reveals certain patterns that are predictive values. They are used as supplement to other information and as confirmation of signals provided by trend lines. Some of the most widely used and easily recognizable chart patterns are discussed here.

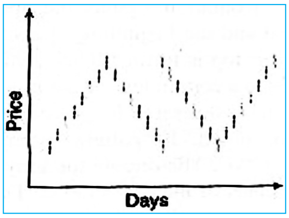

Figure 5.8: A chart with 'V' formation

'V' formation

As the name indicates, in the 'V' formation, there is a long sharp decline and a fat reversal. The 'V' pattern occurs mostly in popular stocks where the interest changes quickly from hope to feat and vice versa. In the case of an inverted 'V', first rise occurs and then decline. There can also be extended 'V's. In this, the bottom or top moves more slowly over a broader area.

Tops and Bottoms

Top and bottom formation is fascinating to watch but what is more important is the middle portion of it. The investor should buy after the upward trend has started and exit before the top is reached. Tops and bottoms are formed at the beginning or end of the new tends. The reversal from the tops and bottoms indicate sell and buy signals.

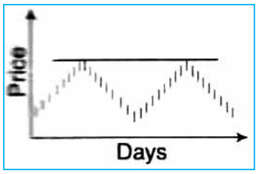

Figure 5.9: A double top formation

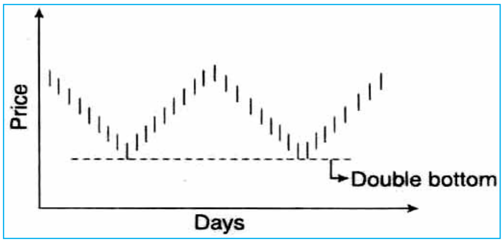

Figure 5.10: A double bottom formation

Head and Shoulders

This pattern is easy to identify and the signal generated by it is considered to be reliable. In the head-and – shoulder pattern, there are three rallies resembling the left shoulder, a head and a right shoulder. A neckline is drawn connecting the lows of the tops. When the stock price cuts the neckline from above, it signals a bear market.

The upward movement of the price for some duration creates the left shoulder. At the top of the left shoulder, people who bought during the upward trend begin to sell, resulting in a dip. Near the bottom, there will be reaction and people who have not bought in the first upward trend start buying at relatively low prices thus pushing the price upwards. The alternating forces of demand and supply create new ups and lows. This is shown in figure 5.21.

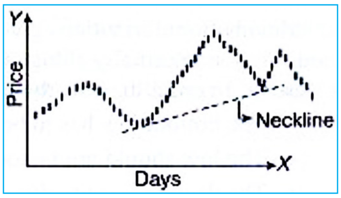

Figure 5.11 : A Head and Shoulders formation

Inverted Head and Shoulders

Here, the reverse of the previous pattern holds true. The price of stock falls and rises, which makes an inverted right shoulder. As the fall and rise in price continues, the head and left shoulders are created. Connecting the tips of the inverted head and shoulders gives the neckline. When the price pierces the neckline from below, it indicates the end of a bear market and the beginning of a bull market. These patterns have to be confirmed with the volume and trend of the market. This is illustrated in figure 5.22.

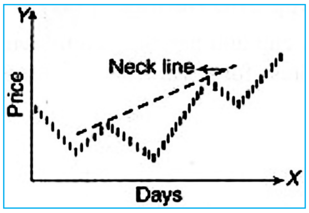

Figure 5.12 : An inverted Head and Shoulders formation

Rounding Bottom

Rounding bottom formations give a bullish signal and indicate a possible reversal of the downwards trend. They are normally elongated and U-shaped. Sometimes they are called rounding turns, bowls or saucers. In order to show the trend reversal:

- The bottom low has to be a new low.
- The low should not be too sharp and take a few weeks to form.

- The decline and the rise should take more or less equal period.
- The break out has to be higher than the beginning of the decline.
- Volumes are high at the beginning of the decline, low at the end of the decline and increase during advance.

Figure 5.23 shows the formation of a rounding bottom.

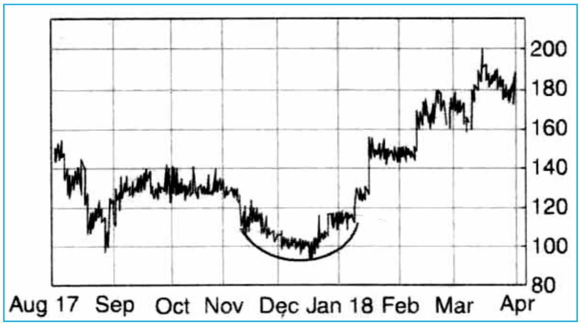

Figure 5.13 : A rounding bottom formation - IOCL

Point and Figure Charts

To predict the extent and direction of price movements of a stock or the stock market indices, technical analysts use point and figure (PF) charts. These charts are one - dimentional without any indication of time or volume. They show price changes in relation to previous prices. The change in the direction of prices can be interpreted. The charts are drawn on ruled paper. Figure 5.28 shows the PE chart.

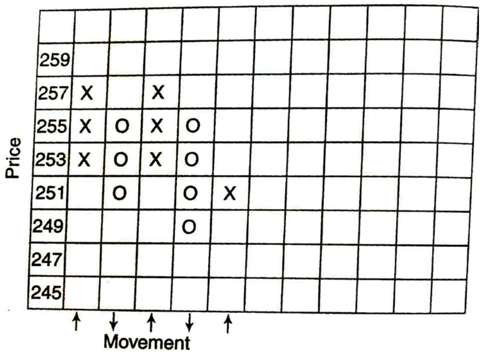

Figure 5.14 : A point and figure chart

Flags: a flag pattern is commonly seen on price charts. These patterns emerge either before a fall or a rise in the value of the scrips. These patterns show the market corrections of an over-bought or over-sold situation. These patterns form quickly. Each rally and setback may last only three to four days. If the pattern is wider, it may take three weeks to become complete.

A flag resembles a parallelogram. A bullish flag is formed by two trend lines that stoop downwards. A breakout would occur on the upper side of the trend line. In a bearish flag, both the trend lines would be stooping upwards. The breakout occurs in the downward trend line (figures 5.29 and 5.30).

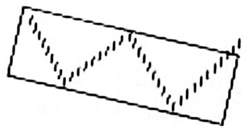

Figure 5.15 : An up flag formation

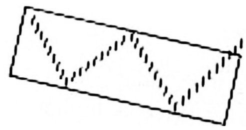

Figure 5.16 : A down flag formation

Pennant: A pennant looks like a symmetrical triangle. There can be bullish as well as bearish pennants. In a bullish pennant, the lower tops form the upper trend line. The lower trend line connects the rising bottoms. The bullish trend occurs when the value of scrip moves above the upward trend line. Likewise, in the bearish pennant, the upward trend line is a falling one and the lower trend line, a rising one (Figures 5.31 and 5.32)

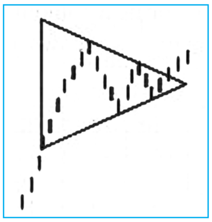

Figure 5.17 : An upward Pennant formation

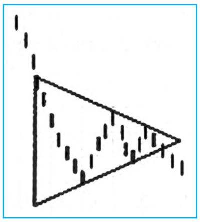

Figure 5.18 : A downward Pennant formation

Candlestick Chart

According to records, the candlestick chart is the oldest of price prediction charts. In the 1700s, people used candlesticks to forecast rice prices. During this era in Japan, use of candlestick charts helped Munehisa Homma, a rice merchant from Sakata, make a fortune and become a prominent rice trader. The application of candlesticks helped him execute more than 100 consecutive winning trades. To create a candlestick chart one needs four elements, namely, open, high, low and closing price for a given period. This is explained as follows:

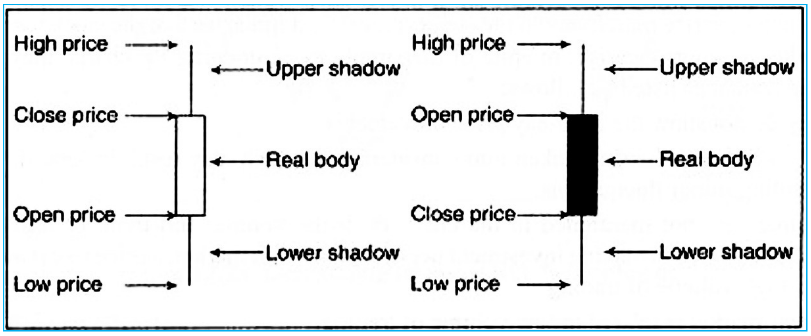

Figure 5.19 : Candlestick

When the candle body is white, it indicates the closing price is higher than the opening price, and shows a bullish trend. A black body indicates that the closing price is lower than the opening price and shows bearish trend Figure 5.34 shows the candlestick chart of NSE.

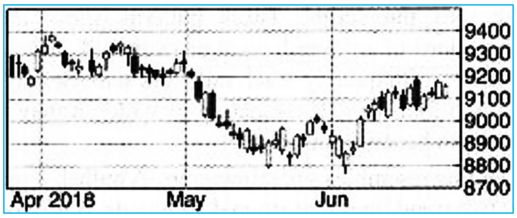

Figure 5.20 : Candlestick chart for NSE - Niffty

Elliott Wave Theory

It was Ralpha Nelson Elliott who gave the Elliott Wave theory in the late 1920s. He discovered that even though stock behaves in a somewhat chaotic manner, trade happen in repetitive cycles. His theory resembles the Dow Theory, which says that stock price move in waves.

Elliott discovered that the upward and downward swings in the market always showed up in the same repetitive patterns. These patterns are divided and termed as waves. The unique characteristics of the Elliott patterns are that they consist of five waves indicating the main trend and three corrective waves. In financial market, every action creates an equal and opposite reaction. A 5-3 waves complete a cycle. Five waves are within an impulsive wave. An impulsive wave moves along with a main trend. According to the Elliott wave theory, a 5-3 pattern remains constant, but the time span of each wave may differ. Figure 5.35 shows the wave.

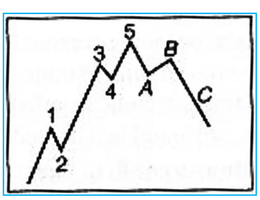

Figure 5.21 : Elliott Wave

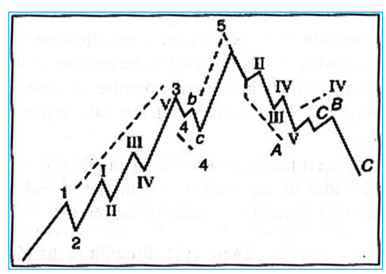

Figure 5.22 : Elliott Wave Pattern

Figure 5.36 shows five up (1-5) and three down waves (A-C). The waves 1, 3 and 5 are impulsive waves. They are in the direction of the trend. Waves 2,4 and B are corrective waves. As A and C move along the trend, they are impulsive waves.

Figure 5.36 gives a detailed breakup of the Elliott wave. Wave 2 consists of five short waves, i.e. three in the main direction and two in the correction mode. Correction wave 4 consists of three sub-waves. Thus, Figure 5.36 shows trends and counter-trends. The example given above is for a bullish market. For a bear market, a downward trend of the same pattern van be shown. The theory divides the wave into different categories such as:

- Grand super cycle
- Cycle
- Intermediate
- Super cycle
- Primary
- Minor

Relative Strength Index (RSI)

RSI was developed by Wells Wilder. It is an oscillator used to identify the inherent technical strength and weakness of a particular scrip or market. RSI can be calculated for a scrip by adopting the following formula.

$$\text{RSI} = 100 - \left(\frac{100}{1 + ₹}\right)$$

$$₹ = \frac{\text{Average Gain Per Day}}{\text{Average Loss Per Day}}$$

RSI can be calculated for any number of days depending on the wish of the technical analyst and the time frame of trading adopted in a particular stock market. RSI is calculated for 5, 7, 9 and 14 days. If the period considered is longer, the possibility of getting the wrong signal is reduced. Reactionary or sustained rise or fall in the price of the scrip is foretold by RSI.

Stochastic

It was George C Lane who developed the stochastic oscillator in the late 1950s. Stochastic oscillator is a momentum indicator, and it shows the location of the closing price relative to the high-low range in a predefined period. Usually, when the stock price increases, the closing prices tend to be near the high price of the day. When prices fall, the closing prices tend to be near the low price of the day. Lane developed this stochastic indicator on the basis of his observations.

The stochastic indicator has two lines %K and %D. The %K line is faster than the %D line. The %D line lags behind the %K line. The values of the %K and %D lines lie between 0 and 100. Thus, the lines oscillate between 0 and 100.

Slow and Fast Stochastic

The formula given above is used to calculate the fast stochastic. The stochastic is considered too fast to follow in-day trading. Hence, the slow stochastic is calculated. The % D line in the fast stochastic is the %X line in the slow stochastic. The %D line is the three-day simple moving average of the slow % K line. Thus at first, fast stochastic is calculated to arrive at slow stochastic.

Overbought and Oversold Region

In the stochastic oscillator, the overbought region is above the 70% mark and the oversold region is below the 30 mark. It is observed that the stochastic generates best buy signal below the 15 mark and the best sell signal above the 85 mark. The %D line is taken to identify the overbought and oversold zones. The presence of the %K line in the overbought and oversold regions gives early indication of the possibility of the %D line following it. The intersection of the %K and %D lines gives buy and sell signals. When the %D line is in the overbought zone, and the %K line intersects it from above, it generates a sell signal. In the oversold region, if the %K line moves above the %D line, it gives a buy signal. If the signals occur along the major trend of the scrip, they are powerful. Figure 5.42 explains this.

Exercise

Theoretical Problems

Multiple Choice Questions

1. The price-earnings ratio of a stock reflects the
   a. Growth of the company
   b. Market mood for the company stock
   c. Earnings retained and invested in the company
   d. Dividend paid out for the company's stock
2. The growth in book value per share shows the
   a. Rise in the share price
   b. Increase in the physical assets of the firm
   c. Increase in the net worth
   d. Growth in reserves
3. Which of the following is not a component of ROE analysis?
   a. Pre-tax margin
   b. Asset turnover ratio
   c. Effective tax rate
   d. Dividend payout ratios
4. Which of the following does not form a part of company analysis?
   a. A trend analysis of the company's market share
   b. Life cycle analysis of the industry
   c. Leverage and coverage ratio analysis
   d. Cost structure and break even analysis
5. An industry in the growth stage of its life cycle is indicated by
   a. High P/E ratios
   b. High dividend payout ratios
   c. High dividend yield
   d. High investment in R&D

6. Degree of financial leverage (DFL) expresses the relationship between

   a. EPS and EAIT

   b. EPS and P/E

   c. EPS and EBIT

   d. EPS and Sales

7. Liquidity of a company generally measures

   a. The ability of a company to pay its employees in a timely manner

   b. The ability to pay interest and principal on all debt

   c. The ability to pay dividends

   d. The ability to pay current liabilities

8. A common stock ratio

   a. Is directly related to the company's growth rate

   b. Can be zero for a growth firm

   c. Measures the earnings of a share as a percentage of its market price

   d. Indicates the future cash dividends to be expected

9. An industry may have short life due to

   a. Legal restrictions

   b. Evolution of replacement industry which diminishes the demand for the original industry

   c. Coming into force of a newer technology which makes the existing one unviable from operating costs point of view

   d. All of the above.

10. Competition in an industry is generally affected by the

    a. Ease with which the new entrants can enter

    b. Relationship among the existing players

    c. Bargaining power of buyers and suppliers

    d. All of the above

11. High growth rates in earnings and market share are characteristics of companies which are in

    a. Maturity stage

    b. Expansion stage

c. Pioneering stage

d. Declining stage

12. Companies in maturity stage are characterized by

a. High dividend payout ratios

b. Fluctuation in earnings

c. Presence of new investment opportunities

d. All of the above

13. Which of the following can be classified as a lag indicator of economic growth?

a. Ratio of trade inventories to sales

b. Manufacture and trade sales

c. Orders for plant and equipment

d. Business confidence index

14. In Porter's structural analysis, which of the following is not considered as an entry barrier?

a. Product differentiation

b. Switching costs

c. Capital requirements

d. Low value addition

15. According to Porter's model, the rivalry among existing competitors will be high if

a. There are diverse competitors

b. There are equally balanced competitors

c. The industry growth is high

d. None of the above

16. A business division with high growth but low relative market share is referred to as a

a. Cash cow

b. Profit center

c. Question mark

d. Star

17. An industry in the expansion stage of its life cycle in indicated by
    a. High P/E ratios
    b. High dividend pay-out ratios
    c. High dividend yield
    d. All of the above
18. In the bull market
    a. The stock prices are increasing
    b. Each peak is higher than the previous peak
    c. Each bottom is higher than the previous bottom
    d. Both (b) and (c)
19. The declining market is called 'bear market' because of the
    a. Long hibernation period of bears
    b. Traditional usage
    c. Fur coat of the bears
    d. Attacking manner of bears
20. Dow theory was developed to explain the
    a. New York stock market movements
    b. Dow Jones industrial averages
    c. Security market price movements
    d. Buy and sell strategy
21. According to stock market psychology
    a. Investors forget the past
    b. History repeats itself
    c. More faith is placed in predictions of the future
    d. Both (a) and (b)
22. Violation of a trend line means
    a. Moving away from the trend line
    b. Changing its direction
    c. Penetration of the trend line
    d. Cutting the rising trend line from above

23. The chartist believes that charts

    a. Spot the current trend for buying and selling

    b. Indicate the future action to be taken

    c. Shows historical movements

    d. All of the above

24. The stock price in the stock market

    a. Hovers around the support level or resistance level

    b. Moves between the same support and resistance levels

    c. Moves between the changing support and resistance level

    d. Both (a) and (b)

Answer:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
b	d	d	b	a	c	d	b	d	d	c	a	a	d	b	c	a	d	d	b
21	22	23	24																
b	c	d	c																

State True or False

1. Analysis of the global economy is the first step of a top-down analysis of a company's prospects.

2. Price elasticity of demand is not a key statistic used to describe the state of the macro economy?

3. The expected rate of inflation is the fundamental factors that determine the level of interest rates.

4. Cyclical industries are most volatile?

5. A company can benefit from economies of scale in relation to Investment in R&D.

6. Market indicators are employed in Evaluating the performance of the portfolios, Studying the behavior of the stock market, Calculating beats of the securities.

Answer:

1	2	3	4	5	6
True	False	True	True	True	True

Fill in the blanks

1. ____________ is a characteristic of the consolidation stage of the industry life cycle?
2. When the RBI _______ the discount rate, the money supply of the economy increases.
3. Fiscal policy refers to the government's use of _____________ to stabilize the economy.
4. Monetary policy refers to the government's _____________ to influence investment and consumption demand
5. As the business cycle enters the initial phase of economic recovery the stock prices generally ____________
6. Industries can be classified according to ____________

Answer:

1	Emergence of industry leaders	2	Lowers
3	Its spending and tax actions	4	Manipulation of the money supply
5	Decline	6	Producers

Short Essay Type Questions

1. Technical Analysts believe that one can use past price changes to predict future price changes. How do they justify this belief?
2. Technicians contend that stock prices move in trends that persist for long periods of time. What do technicians believe happens in the real world to cause these trends?
3. Briefly discuss the problems related to fundaments analysis that are considered advantages for techniques analysis.
4. Discuss some disadvantages of Technical Analysis.
5. Describe the Dow Theory and its three components. Which component is most important? What is the reason for an intermediate reversal?
6. Discuss why most technicians follow several technical rules and attempt to derive a consensus?
7. Discuss some disadvantages of technical analysis.
8. If the mutual fund cash position were to increase close to 10 percent, would a technician consider this cash position bullish or bearish? Give two reasons for this opinion.
9. Assume a significant decline in credit balances at brokerage firms. Discuss why a technician would consider this bullish or bearish.
10. If the bearish sentiment index of advisory service opinions were to increase to 61 percent, discuss why a technician would consider this bullish or bearish.
11. What is the purpose of computing a moving-average line for a stock? Describe a bullish pattern using a 50-day moving-average line and the stock volume of trading. Discuss why this pattern is considered bullish.

12. Assuming a stock price and volume chart that also contains a 50-day and a 200-day MA line, describe a bearish pattern with the two MA lines and discuss why it is bearish.
13. Explain how you would construct a relative-strength ratio for an individual stock or an industry group. What would it mean to say a stock experienced good relative strength during a bear market?
14. Discuss why most technicians follow several technical rules and attempt to derive a consensus.
15. What are the basic investment objectives?
16. What are the qualitative and quantitative factors in company analysis?

Essay Type Questions

1. 'Technical analysis is based on certain assumptions'. Explain.
2. Explain in detail the Dow Theory and how is it used to determine the direction of the stock market.
3. Do stock prices have support level and resistance level? If so, explain.
4. What is a bar chart? What is line chart?
5. What are the features of a point and figure chart?
6. Explain the significance of gaps and head and shoulder patterns in the chart.
7. How would you use a candlestick chart to predict the stock price movement? How it indicates bull and bear market?
8. Discuss the cup and handle and rounded bottom patterns.
9. Explain the concept of Elliott wave theory.
10. What are the basic premises of technical analysis?
11. What are the differences between technical analysis and fundamental analysis?
12. Discuss the basic concepts underlying chart analysis.
13. Explain the Dow Theory.
14. What is a bar chart? What is a line chart?
15. Describe briefly the important technical formations on bar and line charts and the indications provided by them.
16. Explain the techniques of moving average analysis. What buy and sell signals are provided by it?
17. What are the tools used in fundamental analysis? Explain.
18. What are the Macro-economic factors in economic analysis?
19. Explain the different stages of industry life cycle and describe how it affects the sales, growth and profit of an organisation.
20. Explain Porter's concept of competitive strategy.
21. What are the factors considered in company analysis?

Practical Problems

Multiple Choice Questions

1. A company has an ROE of 0.24 and book value of ₹25.38. the EPS for this company is

   a. 6.09

   b. 7.25

   c. 6.94

   d. 6.13

2. If ROA is 0.195 and the leverage factor of 1.38, the ROE of the company is

   a. 0.279

   b. 0.283

   c. 0.254

   d. 0.269

3. It was observed that in a certain month, 6 out of 10 leading indicators and moved up as compared to 4 indicators in the previous month. The diffusion index for the months was

   a. 20%

   b. 40%

   c. 60%

   d. 80%

Answer:

1	2	3
a	d	c

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2. Ranganathan., Security Analysis and Portfolio Management, Pearson.
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Equity and Bond Valuation and Evaluation of Performance

6

This Module includes:

6.1 Equity Valuation – Discounted Cash Flow Based Valuation, Relative Valuation using Multiples and Weights

6.2 Bond Valuation – Prices & Yields

Equity and Bond Valuation and Evaluation of Performance

SLOB Mapped against the Module

To equip oneself with the knowledge of application of various techniques in security evaluation, building a portfolio, measuring its performance and making revisions to optimise the returns. (CMLO 3a)

Module Learning Objectives:

After studying this module, the students will be able to -

- Understand various alternative approaches of valuation of equity shares.
- Learn various techniques of valuation of bonds and relation between bond prices and bond yields.

Equity Valuation – Discounted Cash Flow Based Valuation, Relative Valuation using Multiples and Weights

6.1

Two basic approaches to valuing common stocks using fundamental security analysis are as follows:

(i) Discounted cash flow techniques

(ii) Relative valuation techniques

Discounted Cash Flow Techniques

The classic method of calculating the estimated value of any security involves the use of discounted cash flow techniques, a present value analysis sometimes referred to as capitalization of income method. The value of a security can be estimated by a present value process involving the capitalization (discounting) of expected future cash flows. Therefore, the estimated value of a security is equal to the discounted (present) value of future stream of cash flows that an investor expects to receive from the security. Symbolically,

where, V_0 = Present value of an asset at time (0) or $t = 0$.

C_t = Payment at time (t)

k = Discount or capitalization rate or required rate of return.

Required Rate of Return: An investor who is considering the purchase of a common stock must assess its risk and given its risk, the minimum expected rate of return that will be required to induce the investor to make the purchase. As we have seen in capital asset pricing model (CAPM), the required rate of return is the minimum expected rate of return necessary to induce an investor to buy a particular stock, given its risk.

Expected Future Cash Flows: The other important component of the present value framework is the expected stream of future cash flows.

The only answer to all of the above questions is simply the flow of dividends, because this is the only last distribution that a corporation actually makes to its stockholders, because dividends are the only cash flow stream to be received directly by investors under normal condition, it is appropriate to base a valuation model on dividends. We now consider such a model, the dividend discount model (DDM), which is the basis for understanding the fundamental valuation of common stocks using discounted cash flow techniques. In many respects, the DDM is the foundation to understanding the valuation of common stocks.

Estimated value of a stock:

$$V_0 = \frac{D_1}{(1+k)} + \frac{D_2}{(1+k)^2} + \frac{D_3}{(1+k)^3} + \ldots + \frac{D_\infty}{(1+k)^\infty} \qquad \ldots\ldots\ldots \text{(ii)}$$

$$= \sum_{t=1}^{n} \frac{D_t}{(1+k)^t} = \text{Dividend discount model}$$

where $D_{1,}$ D_2 = Dividend expected to be received in each future period.

k = the required rate of return, discount rate or the opportunity cost of a comparable risk alternative.

This model considers that the amount of dividend is expected to grow other time, is to make some assumptions about the expected growth rate of dividends. The dividend discount model is operationalised by estimating the expected growth rate(s) in the dividend stream.

The Zero Growth Rate Model: A zero growth rate equal to a fixed money (Rupee) dividend. For example, a firm pays a dividend ₹10 per share annually and has no plans to change this amount. The zero growth rate dividend case reduces to a perpetuity.

Estimated value of a stock, $V_0 = \frac{D_0}{k}$ = zero growth rate version of the dividend discount model.

Illustration 1

India Incorporated currently pays a dividend of ₹10 per share and it will be constant during the life time of the corporation or in perpetual time. If the required rate of return of the investor is 14% a year, what will be the value of the stock using zero growth rate model?

Solution:

$$V_0 = \frac{D_0}{k} \text{ or } \frac{₹10}{0.14} = ₹\ 71.43$$

Constant growth model: Under this model, dividends are expected to grow at a constant growth rate over time. This constant or normal growth rate model is shown as:

Estimated value of stock, $V_0 = \frac{D_0(1+g)}{(1+k)} + \frac{D_0(1+g)^2}{(1+k)^2} + \frac{D_0(1+g)^3}{(1+k)^3} + \ldots \frac{D_0(1+g)^\infty}{(1+k)^\infty}$ ... ... (iii)

D_0 is the current dividend being paid and growing at the constant growth rate g, and k is the appropriate discount rate.

Equation (iii) can be simplified to the following equation:

Estimated value of stock $= \frac{D_1}{k-g}$ = Constant growth rate version ... ... (iv)

Illustration 2

MN Limited is expected to grow at the rate of 8% per annum, which currently pays ₹10 as dividend. For investments at this risk level, investor requires a return of 15% a year, what is the estimated value of the stock?

Solution:

Estimated Value of the stock $= V_0 = \frac{D_1}{k-g} = \frac{₹10(1.08)}{0.15-0.08} = \frac{₹10.80}{0.07} = ₹154.29.$

Illustration 3

Estimated present value of stock (V_1) of India Incorporated is ₹154.29 at the end of first year, if in next year or year two, all the conditions are constant, what will be the value of the stock at the end of the year 2, if all other data are same as in Illustration 2 above?

Solution:

$$V_2 = \frac{₹10.80(1.08)}{0.15-0.08} = \frac{11.66}{0.07} = ₹\ 166.63 \text{ or } ₹\ 154.29 \times (1.08)$$

The estimated value at the end of year 2 is 8% higher than the preceeding year. Change in value will be exactly by the growth rate.

$$\text{Change in value} = \frac{\text{Ending value} - \text{Beginning value}}{\text{Beginning value}}$$

$$= \frac{166.63 - 154.29}{154.29} = 0.08 \quad \text{or } 8\%$$

Equation gives us certain information:

(1) If the market lowers the required rate of return for a stock, value will rise (other things being equal).

(2) If investors decide that the expected growth rate in dividends will be higher as the result of some favourable development for the firm, value will also rise (other things being equal). Of course, the converse of these two situations also holds – a rise in the discount rate or a reduction in the expected growth rate of dividends will lower the value of the stock.

One of the limitation of the DDM is that it is very sensitive. A relatively small change in the inputs can change the value by large percentage amounts.

Illustration 4

Other things being constant, only k is considered 16% instead of 15% above in previous illustration. Find out the estimated value of the stock.

Solution:

$$\text{Estimated value at the end of year } 1 = \frac{D_0(1+g)}{k-g} = \frac{₹\,10(1.08)}{0.16 - 0.08} = ₹\ 135$$

Conclusion: One percentage change in required return causes [(154.29 – 135)/154.29] or 12.5% change in value (decrease).

Illustration 5

Other things being constant as in Illustration 4, growth rate is considered 9% instead of 8%, find out the new valuation of stock.

Solution:

$$\text{The new valuation of stock} = \frac{10(1.09)}{0.15 - 0.09} = \frac{10.90}{0.06} = ₹\ 181.67$$

An increase of previous value by 17.74%. Only one percent **change in growth rate** amounts to 17.74% change in price of the stock. Last assumption, required rate of return increased from 15% to 18% and the growth rate has dropped from 8% to 4%.

$$\text{The new price of the stock will be: } \frac{₹\,10(1.04)}{0.18 - 0.04} = \frac{₹\ 10.4}{0.14} = ₹\ 74.29$$

Therefore, the estimated value declines by 51.85% compared with the original value ₹154.29 (Illustration 2).

These differences suggest why stock prices constantly fluctuate as investors make their buy and sell decisions. Even if it is assumed that all investors will follow DDM, still there will be differences in estimation of value of the stock because:

(a) Each investor has his or her own required rate of return, resulting wide variety of ‘*k*’.

(b) Each investors have their own growth rate expectations in dividends. Small differences in growth rate (g) produces significant differences in price, everything else held.

Thus, at any point in time for a particular stock, some investors are willing to buy, whereas others wish to sell, depending on their estimate of the intrinsic value of the stock. This helps to make market active and liquid.

Equation (iv) can be modified to include the earnings per share. Assuming a constant pay-out ratio, it can be rewritten as:

$$V = \frac{(1-b)E_1}{k-g} = \frac{D_1}{k-g} \qquad \text{[where } b \text{ is the retention rate]} \qquad \text{... ... ... (v)}$$

Estimating the Capitalization Rate

The capitalization rate can be determined from the constant growth of dividend capitalization model. Under this approach, the required rate of return on the equity capitalization rate (k) will be as follows:

$$k = \frac{D_1}{P_0} + g \qquad \text{... ... ... (vi)}$$

where P_0= present value of the stock, k = capitalization rate, D_1= dividend one year hence and g = growth rate.

Multiple-Growth Rate Model

Many firms grow at a rapid rate (or rates) for a number of years and then slow down an "average" growth rate. Many companies do not pay dividends at their early growth stage. The constant growth model will be unable to tackle the situation and hence another model is required.

Under this growth model in which the expected future growth in dividends must be described using two or more growth rates (one of which could be zero). It is important to remember that at least two different growth rates are involved; this is the distinguishing characteristics of multiple growth situations.

We will segregate the portion into three-stages:

Step I. P_0 or V_0= Expected dividend stream during the super normal period of the super normal growth is to be specified and the present value of this dividend stream is to be computed for which the equation will be:

$$\sum_{t=1}^{n} \frac{D_t}{(1+k)^t}$$

Step II. the value of the share at the end of the initial growth period is to be calculated:

$P_n = \dfrac{D_{n+1}}{k-g}$ (as per the constant growth model), which is then discounted to the present value. The discounted value, therefore, is

$$\frac{D_{n+1}}{k-g_n} \times \frac{1}{(1+k)^n}$$

Step III. Now add steps, I and II to find the present value (P_0 or V_0)

$$P_0 = \sum_{t=1}^{n} \frac{D_1}{(1-k)^t} + \frac{D_{n+1}}{k-g_n} \times \frac{1}{(1-k)^n}$$

where, P_0= Price of equity at time '0'

$D_n = D_1(1+g_a)^{n-1}$

D_1 = Expected dividend one year hence

g_a = Super normal growth rate of dividends

g_n = Normal growth rate of dividends

Illustration 6

Consider the equity share of India Incorporated

D_0 = Current dividend per share ₹3.00

n = Duration of the period of super normal growth = 5 years

g_a = Growth rate during the period of super normal growth = 25%

g_n = Normal growth rate after super normal growth period is over = 7%

k = Investor's required rate of return = 14%

Find the price of the Equity Share under Multiple Growth Rate Model.

Solution:

The following are the steps involved:

Step I. Dividend stream during super normal growth period.

D_1 = ₹3.00 (1.25); D_2= ₹3.00 $(1.25)^2$, D_3 = ₹3.00 $(1.25)^3$

D_4 = ₹3.00$(1.25)^4$ and D_5 =₹3.00$(1.25)^5$

The present value of the above stream of dividends is

$$\frac{3.00(1.25)}{(1.14)}+\frac{3.00(1.25)^2}{(1.14)^2}+\frac{3.00(1.25)^3}{(1.14)^3}+\frac{3.00(1.25)^4}{(1.14)^4}+\frac{3.00(1.25)^5}{(1.14)^5}$$

= ₹ (3.29 + 3.61 + 3.96 + 4.34 + 4.76) = ₹ 19.96

Step II. The price of the shares at the end of 5 years, applying the constant growth model at that point of time will be

$$P_5=\frac{D_6}{k-g}=\frac{D_5(1+g_n)}{k-g_n}=\frac{3.00(1.25)^5(1.07)}{0.14-0.07}=₹\ 140$$

Discounted value of this price = $\frac{₹140}{(1.14)^5}$ = ₹ 72.71

Step III. The sum of Steps I and II is

₹19.96 + ₹72.71 = ₹92.67

Intrinsic Value and Market Price

After making careful estimates of the expected stream of dividends and the required rate of return for a common stock, the value of the stock today is estimated using the DDM. The value is often called the intrinsic value of the stock, which we denote as V_0. Note that intrinsic value is simply an estimated value or a formula value. This is the end objective of a discounted cash flow technique such as the dividend discount model.

The importance of intrinsic value is:

(a) If $V_0 > P_0$, the asset is undervalued and should be purchased or held if already acquired.

(b) If $V_0 < P_0$, the asset is overvalued and should be avoided, should be sold out if held or possibly sold short.

(c) If $V_0 = P_0$, this implied an equilibrium in that the asset which is correctly priced. P_0 represents the current market price, where V_0 represents the value that we have calculated by applying DDM.

Dividend Discount Model in Practice

In practice, investors use the dividend discount model in other ways to select stocks. The rearrangement can be done by using equation as:

$$k = \frac{D_1}{P_0} + g \qquad \text{... ... ... (vii)}$$

This equation states that the expected rate of return on a constant growth stock, '*k*' is the dividend yield plus the expected growth in dividends and price *'g'*. The latter term may be considered as the price change component or capital gains component. Therefore, an investor's expected rate of return from a stock is the sum of the income component and the price change component which together constitute the total return from a stock.

Illustration 7

A company's share is currently traded for ₹80 per share. It is expected that a dividend of ₹4 per share after one year will grow at 8% indefinitely. What is the expected return?

Solution:

$$k = [(\text{Div}_1)/P_0] + g = [4/80] + 0.08 = 0.13 \text{ or } 13\%$$

Three-Phase Model

Here, three phases of dividend growth pattern is assumed. Dividends are assumed to grow at a constant rate 'g' for a period of 'A' years. After the phase 'A', the growth rate of dividend declines for A + 1 years throughout phase B and the decline in the dividend rate would be linear. Afterwards, there would be perpetual growth rate 'g_n'. Sometimes the 'g_a'would be less than 'g_n' and in the second phase there would be linear growth rate. The perpetual growth rate is known as the firm's long-run normal growth rate. Figure illustrates the three-stage growth rates.

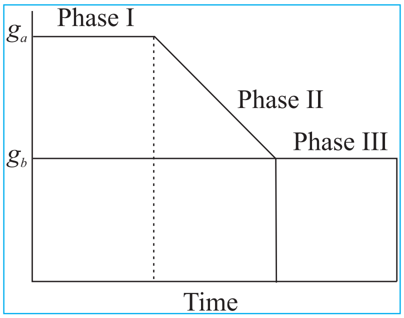

Figure 6.1: Three-phase model of stock return and valuation

$$P_0 = \sum_{t=1}^{A} \frac{D_0(1+g_a)^t}{(1+k)^t} + \sum_{t=A+1}^{B} \frac{D_{t-1}(1+g_b)}{(1+k)^t} + \frac{D_B(1+g_n)}{k-g_n(1+k)^B}$$

where D_0 = Next year dividend
g_a = Period 'A' growth rate (Phase I)
g_b = Period 'B' growth rate (Phase II)
g_n = Growth rate in the third phase
D_B = Dividend at the beginning of the third phase

Illustration 8

For the first four years, India Incorporated is assumed to grow at a rate of 10%. After four years, the growth rate of dividend is assumed to decline linearly to 6 percent. After 7 years, it is assumed to grow at a rate of 6% infinitely. The next year dividend is ₹2.00 per share and the required rate of return is 14%. Find the value of the stock.

Solution:

$$P_0 = \sum_{t=1}^{A} \frac{D_0(1+g_a)^t}{(1+k)^t} + \sum_{t=A+1}^{B} \frac{D_{t-1}(1+g_b)}{(1+k)^t} + \frac{D_B(1+g_n)}{k-g_n(1+k)^B}$$

where D_0= 2.00; g_a= 0.10; g_n= 0.06;
k = 0.14; D_B = declining rate of return from 10% to 6 %, i.e. 0.09, 0.08, 0.07, 0.06.
B = 7 years (the beginning of phase III)

Step I

$$\sum_{t=1}^{A} \frac{D_0(1+g_a)^t}{(1+k)^t} = \frac{2}{(1.14)} + \frac{2(1.1)}{(1.14)^2} + \frac{2(1.1)^2}{(1.14)^3} + \frac{2(1.1)^3}{(1.14)^4}$$

= 1.754 + 1.693 + 1.633 + 1.576 = ₹6.656

Step II

$$\sum_{t=A+1}^{B} \frac{D_{t-1}(1+g_b)}{(1+k)^t}$$

$$= \frac{2(1.1)^3(1.09)}{(1.14)^5} + \frac{2(1.1)^3(1.09)(1.08)}{(1.14)^6} + \frac{2(1.1)^3(1.09)(1.08)(1.07)}{(1.14)^7} = ₹\ 4.27$$

Step III

$$\frac{D_B(1+g_n)}{k-g_n(1+k)^B} = \frac{2(1.1)^3(1.09)(1.08)(1.07)(1.06)}{(0.14-0.06)\times 2.5023} = ₹\ 17.761$$

Step IV Add all the above components (I+II+III)

= ₹(6.66 + 4.27 + 17.76) = ₹28.69

The present value of the stock is ₹28.69

Relative Valuation Techniques

All practising security analysts recognize the foundation and intuitive nature of discounted cash flow techniques but they also recognize it in implementing these models in practice, because small differences in inputs will create large differences in value which may lead errors for determining mispricing securities.

The relative value concept is based on making comparisons in order to determine value. By using price-earnings ratio, an analyst or investor can avoid to estimate *'g'* and *'k'* parameters of dividend discount model.

P/E ratio

The P/E ratio or earnings multiplier approach is the best known and most widely used valuation technique. **Without question, the P/E ratio is one of the most widely mentioned and discussed variables both in Wall Street and Dalal Street.**

As a definition, the P/E ratio is simply the number of times investors' value earning are expressed in the stock price. For example, a stock priced at ₹200, with most recent 12-month earnings per share of ₹10, is said to be selling for a multiple of 20. In another stock, if the earnings per share is ₹5.00 and is selling at the same price of ₹200, it is said that the share is selling at a multiple of 40. It denotes that the market price of the share is 40 times the earnings per share. P/E ratio is published by the financial press on a regular basis.

It is by definition that

$$P_0 = \text{Current stock price} = E_0 \times P_0/E_0$$

where, P_0 = current stock price and E_0 = the most recent 12 month earnings per share.

It is worth nothing that stock price is the product of two variables when using this type of approach.

(1) EPS and (2) P/E multiple. (EPS states earnings per share).

Determinants of P/E ratio: The P/E ratio can be derived from the dividend discount model which is the foundation of valuation for common stocks. Please note that this process directly applies only for the case of constant growth. If a multiple growth model is applicable to the stock being considered, a different formulation from the one presented here will be needed. In fact, using the P/E ratio for multiple growth rate companies can be misleading and should be done with care.

Consider equation (iv) using the constant growth version of the model. The value of a stock or

$$P = \frac{D_1}{k-g} \qquad \text{[recall Equation (v)]}$$

Dividing both sides of the equation by expected earnings E_1

$$P/E_1 = \frac{D_1/E_1}{k-g} \qquad \text{... ... ... (viii)}$$

Equation (viii) indicates those factors that affect the estimated P/E ratio.

Variables that impact on growth of price, return and P/E ratio.

1. The expected dividend payout ratio, D_1/E_1.
2. The required rate of return which has to be estimated.
3. The expected growth rate of dividends.

The following relationship should hold, other things being equal:

1. The higher the expected payout ratio, the higher the P/E ratio.
2. The higher the expected growth rate (g), the higher the P/E ratio.
3. The higher the required rate of return (k), the lower the P/E ratio.

Conclusion:

1. Other things being equal, as the expected growth in dividends increases the expected return, i.e. total return (= dividend yield + capital gain) depends more on the capital gain less on the dividend yield.
2. Other things being equal, the price-earnings ratio increases as the expected growth rate in dividend increases.
3. High dividend yield and low price-earnings ratio imply limited growth prospects.
4. Low dividend yield and high price-earnings ratio imply considerable growth prospects.

Understanding the P/E Ratio

Most investors intuitively realize that the P/E ratio should be higher for companies whose earnings are expected to grow rapidly. However, how much higher is not an easy question to answer. The market will assess the degree of risk involved in the expected future growth of earnings – if the higher growth rate carries a high level of risk, the P/E ratio will be affected accordingly. Future more, high growth rate may be attributable to several different factors, some of which are more desirable than others.

P/E ratio reflects investors expectations about the growth potential of a stock and the risk involved. These two factors can offset each other. Other things being equal, the greater the risk of a stock, the lower the P/E ratio; however, growth prospect may offset the risk and lead to a higher P/E ratio. The internet companies that were so popular in the late 1990s were clearly very risky but investors valued their potential very highly and were willing to pay very high prices for these companies.

The required rate of return, in turn, is also closely related to interest rates, which are the required returns on bonds. As interest rates increase, required rate of return on all securities, including stock, also generally increase. As interest rates increase, bonds become more attractive compared to stocks on a current return basis. **There is an inverse relationship between P/E ratios and interest rates. As interest rates rise (decline), other things being equal, P/E ratios should decline (rise).**

Price-earnings is derived: $g = b \times ROE$, $P_0 = D_1 /(k - g)$ or $P_0/E_1 = (1 - b)/[k - (ROE \times b)]$.

The growth rate of a growing firm that is sustainable equals to P_0/E_1.

Bond Valuation – Prices & Yields

6.2

Bond

Bonds are fixed income securities because the interest payments (for coupon bonds) and the principal repayment for a typical bond are specified at the time the bond is issued and fixed for the life of the bond. At the time of purchase, the bond buyer knows the future stream of cash flows to be received from buying and holding the bond to maturity. Barring default by the issuer, these payments will be received at specified intervals until maturity, at which time the principal will be repaid. However, if the buyer decides to sell the bond before maturity, the price received will depend on the level of interest rates at the time.

Bond Characteristics

Face Value: This value is stated on the face of the bond and is also known as par value. A bond is issued normally at a par value of 1000

Coupon Rate: A bond carries a specific rate of interest which is called the coupon rate and it is the periodic rate of interest which is paid by the issuer to the holder of the bonds. Interest on bonds is typically paid semi-annual.

Maturity: A bond is issued for a specific period of time and is repaid on maturity. Typically corporate bonds have a maturity period of 7-10 years whereas government bonds have a maturity period upto 30 years. The last coupon payment is also paid on the maturity date.

Redemption Value: The value which a bondholder gets on maturity is called redemption value. A bond may be redeemed at par, at premium (more than par) and at discount (less than par value).

Market Value: A bond may be traded in a stock exchange. Market value is the price at which the bond is usually bought or sold. Market value may be different from the redemption value.

Call Date: For bonds which are callable, i.e. bonds which can be redeemed by the issuer prior to maturity. The call date represents the date at which the bond can be called.

Call Price: The amount of money the issuer has to pay to call a callable bond is known as call price.

Required Return: It is the rate of return demanded currently by an investor on a bond is known as required rate of return.

Yield to Call (YTC): The rate of return that an investor would earn if he bought a callable bond at its current market price and held until the bond was called on the call date.

Yield to Maturity (YTM): The rate of return that an investor would earn if It is bought at the current market price and held until maturity is called as its YTM. **In other words, it represents the discount rate which equates the discounted value of a bond's future cash flows to its current market price.**

Bond Yields: Bond yields and the interest rate is the same concept. Threfore, we begin our discussion of bond yields with a brief consideration of interest rates. The basic foundation of market interest rate is the opportunity cost of foregoing consumption, representing the rate that must be offered to individuals to persuade them to save rather than consume.

Interest rates measure the price paid by borrower to a lender for the use of resources over some time period, that is, interest rates are the price for loanable funds. The price differs case to case, based on the demand and supply for these funds, resulting in a wide variety of interest rates.

Types of Bond:

- **Zero Coupon Bond:**
  - Zero Coupon Bond is issued at a discount and repaid at face value. No periodic interest is paid.
  - The difference between the issue price and redemption price represents the return to the holder.
- **Convertible Bond:** Bond which carries an option to convert the bond into Equity at a fixed conversion price.
- **Bearer Bonds:** It is an official certificate issued without recording the name of the holder. These are very risky because they can be either lost or stolen.
- **Registered Bonds:** It is a bond whose ownership is recorded by the issuer or by a transfer agent.
- **Term Bonds:** Most corporate bonds are term bonds, that is, they run for a specific term of years and then become due and payable.
- **Serial Bonds:** While issuing bonds some corporate arrange them in such a way that specific principal amounts become due on specified dates prior to maturity. They are termed as serial bonds.
- **Puttable Bonds:** A puttable bond grants the bondholder the right to sell the issue back to the issuer at par value on designated dates.
- **Callable Bonds:** These bonds refer to the ability of the issuer to pay off a debt obligation prior to its maturity at the option of the issuer of debt.
- **Exchangeable Bonds:** It grants the bondholder the right to exchange the bonds for the common stock of a firm other than that of the issuer of the bond.
- **Fixed Rate Bonds:** These are bonds with a coupon or a stated rate of interest which remains constant throughout the life of the bond.
- **High Yield Bonds:** They are bonds that are rated below investment grade by the credit rating agencies. They are also called junk bonds.
- **Mortgage Bonds:** A bond that is secured through a lien against the property of the firm is known as mortgage bond.
- **Subordinated Bonds:** These bonds have a lower priority than secured debts, debentures and other bonds and the general creditors of the issuer in case of liquidation.
- **Guaranteed Bonds:** It is an obligation guaranteed by another entity.
- **Perpetual Bonds:** These bonds are also called perpetuities. It has no maturity date.

- **Global bonds:** Bonds that are designed so as to qualify for immediate trading in any domestic capital market and in the Euro market are called global bonds.

- **Easy Exit Bonds:** These are bonds which provide easy liquidity and exit route to investors by way of redemption or buy back facility where investors can get the benefit of ready encashment in case of need to withdraw before maturity.

- **Option Bonds:** These are cumulative and non-cumulative bonds where interest is payable on maturity or periodically. Redemption premium is also offered to attract investors. These were issued by institutions like IDBI, ICICI, etc.

- **Double Option Bonds:** The face value of each bond is ₹5,000. The bond carries interest at 15% p.a. compounded half-yearly from the date of allotment. The bond has a maturity period of 10 years. Each bond has two parts in the form of two separate certificates, one for principal of ₹5,000 and other for interest (including redemption premium) of ₹16,500. Both these certificates are listed on all major stock exchanges. The Investor has the facility of selling either one or both parts at anytime he wishes so.

- **Floating Rate Bonds:** Here, Interest rate is not fixed and is allowed to float depending upon the market conditions. This is an instrument used by the issuing Companies to hedge themselves against the volatility in the interest rates. Financial institutions like IDBI, ICICI, etc. have raised funds from these bonds.

- **Inflation Bonds:** Inflation Bonds are bonds in which interest rate is adjusted for inflation. Thus, the investor gets an interest free from the effects of inflation. For example, if the interest rate is 10% and the inflation is 2%, the investor will earn 12.20% [i.e. (1 + Interest Rate) × (1 + Inflation Rate) -1]. This is similar to Floating Rate Bonds, i.e. rate of return varies over a period of time.

Bond Price

The Valuation Principle: What determines the price of a security? The answer is obviously estimated value. A security's estimated value determines the price that investor place in the open market.

Security's intrinsic value or estimated value is the present value of the estimated cash flows from that asset. Any security purchased is expected to provide one or more cash flows some time in the future. These cash flows could be periodic, such as interest or dividends, or simply a terminal price or redemption value, or a combination of these. Since these cash flows occur in the future, they must be discounted at an appropriate rate to determine the present value. The sum of these discounted cash flows is the estimated intrinsic value of the asset. Calculating intrinsic value, therefore, requires the use of present value techniques. It can be shown as:

$$\text{Present Value } (P_0) = \sum_{t=1}^{n} \frac{\text{Cash Flows}}{(1+R)^t} \quad \text{or} \quad \sum_{t=1}^{n} \frac{C_t}{(1+R)^t}$$

Where P_0 = Estimated value of the asset now (time period 0).

Cash flows (C_t) = Future cash flows resulting from ownership of the asset.

R = Appropriate discount rate or rate of return required by an investor by an investor for an investment of this type.

n = Number of periods over which the cash flows are expected.

Illustration 9

Calculate the value of an asset if the annual cash flow is ₹3,000 per year for the next 7 years and the discount rate is 18%.

Solution:

The value of an asset can be calculated as

$$P_0 = \sum_{t=1}^{n} \frac{C_t}{(1+R)^t} = \sum_{t=1}^{n=t} \frac{3000}{(1+0.18)^7} = 3000\ (PVIFA_{18\%,\ 7\ years})$$

$$= 3000 \times 3.812 = ₹11,436$$

Valuation of Bonds

The price of a bond should equal the present value of its expected cash flows. The coupons and the principal repayment of ₹1,000 face value are known, and the present value, or price, can be determined by discounting these future payments from the issuer at an appropriate required yield r, for the issue. The equation will be an follows:

$$P_0 = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t} + \frac{FV}{(1+r)^n}$$

Where, P_0 = Present value or price of the bond today (time period 0).

C = Semi-annual coupon or interest payments.

FV = Face value (or par value) of the bond.

n = Number of semi-annual periods until the bond matures.

r = Appropriate semi-annual discount rate or market yield.

If the coupon payment is an ordinary annuity, the formula for present value of annuity will be:

$P = C \times (PVIFA_{r,n}) + FV \times (PVIF_{r,n})$

Illustration 10

Consider a 10 year, 12% coupon bond with a par value of ₹10,000. Assume that the required yield on this bond is 13%. Find out the value of the bond.

Solution:

Coupon payment = Coupon Rate × Par Value

Coupon payment = 12% × ₹ 10,000

Coupon payment = ₹ 1,200 per year

The value of the bodn is:

$P = 1200 \times (PVIFA_{13\%,\ 10\ years}) + 10,000 \times (PVIF_{13\%,\ 10\ years})$

$P = 1200 \times 5.426 + 10000 \times 0.295$

$P = 6511.2 + 2950$

$P = 9461.2$

Illustration 11

Consider the case where an investor purchases a bond whose face value is ₹1,000, maturity period is 5 years and the coupon rate of interest is 7%. The required return is 8%. What should he be willing to pay now to purchase the bond if it matures at par?

Solution:

Annual interest = ₹70; Principal repayment after 5 years = ₹1000

∴ The intrinsic value or the present value of the bond

$$= ₹70\ (PVIFA_{8\%,\ 5\ years}) + ₹1{,}000\ (PVIF_{8\%,\ 5\ years})$$

$$= ₹70 \times 3.993 + ₹1{,}000 \times 0.681 = 279.51 + 681 = ₹960.51$$

Bond values with Semi-annual Interest: Most of the bonds pay interest semi-annually. For valuation of those bonds the equation is given below:

$$P = \sum_{t=1}^{2n} \frac{C/2}{(1+r/2)^t} + \frac{FV}{(1+r/2)^{2n}}$$

Where P is the value of the bond, C/2 is the semi-annual coupon payment, r/2 is the periodic applicable to a half year period, M is the maturity value and 2n is the maturity period expressed in terms of half yearly periods.

Illustration 12

Consider an 8 year, 12% coupon bond with a par value of ₹ 1,000 on which interest is payable semiannually. The required rate of return on this bond is 14. Find out the value of the bond.

Solution:

The value of the bond is

$P = 60 \times (PVIFA_{7\%,16}) + 1000\times (PVIF_{7\%,16})$

$P = 60 \times (9.447) + 1000 \times (0.339)$

$P = 566.82 + 339$

$P = 905.82$

P = ₹ 906

Illustration 13

Semi-annual payment of interest on bond 'A' of ₹1,000 value carries a coupon rate of 10% and a maturity period of 6 years. Interest is payable semi-annually. If the required rate of return is 12%, calculate the value of the bond.

Solution:

P $= ₹\ 50\ (PVIFA_{6\%,\ 12\ years}) + 1000\ (PVIF_{6\%,\ 12\ years})$

$= ₹\ 50 \times 8.384 + 1000 \times 0.497$

$= 419.20 + 497$

$= ₹916.20$

Now, consider bond 'B', issued five years ago with face value ₹1,000, when the interest rate demanded for such a bond was 7%. Assume that the current discount rate or required yields on bonds of this type is 10% on an annual basis or 5% semi-annual basis and the bond has three years left to maturity, the current price of the bond would be

P $= ₹\ 35\ (PVIFA_{5\%\ for\ 6\ years}) + ₹1000\ (PVIF_{5\%\ for\ 6\ years})$

$= (₹\ 35 \times 5.076) + (₹\ 1000 \times 0.746) = 177.66 + 746 = ₹923.66$

Thus, bond B is valued like any other asset on the basis of its future stream of cash flows, using an appropriate market yield. Since the numerator is always specified for coupon-bearing bonds at the time of issuance, the only issue in valuing a typical bond is to determine the denominator or the discount rate. The appropriate rate is the bond's required yield.

The required yield, r, in equation is specific for each particular bond. It is the current market rate being earned by the investor on comparable bonds with the same maturity and the same credit quality. In other words, we can say, it is an opportunity cost. Thus market interest rate are incorporated directly into the discount rate used to solve for the fundamental value of a bond.

The appropriate rate is the bond's required yield

Since market interest rates fluctuate constantly, required yields do also. When solving for a bond price, it is customary to use the yield to maturity. If the YTM is used, we can, for convenience, restate Equation (i)* in terms of price and YTM as in Equation (ii)

$$P_0 = \sum_{t=1}^{n} \frac{C_t}{(1+YTM)^t} + \frac{FV}{(1+YTM)^n} \quad \text{.........................} \ (*)$$

Measuring Bond Yields

Current yield measures the rate of return earned on a bond if it is purchased at its current market price and the coupon interest is received.

$$\therefore \text{ Current yield} = \frac{\text{Coupon Interest}}{\text{Current Market Price}}$$

If the current market price of a 10%, ₹1,000 bond is ₹920, the current yield will be ₹100/920 or 10.87%. Current yield is a not a true measure of the return to a bond purchaser because it does not account for the difference between the bond's purchase price and its eventual redemption at par value.

Yield to Maturity

The rate of return on bonds often quoted for investors is the yield to maturity (YTM), a promised rate of return that will occur only under certain assumptions. It is the compound rate of return an investor will receive from a bond at the current market price if:

(a) The bond is held till maturity, and

(b) The coupons received while the bond is held are reinvested at the calculated yield to maturity.

An investor will earn actually this promised rate if, and only if, these two conditions are satisfied. The likelihood of second condition is extremely difficult to achieve in reality. YTM is the periodic interest rate that equates the present value of the expected future cash flows (both coupons and maturity value) to be received on the bond to the initial investment in the bond, which is its current price. Yield to maturity is the internal rate of return (IRR) on the bond investment, similar to the IRR used in capital budgeting analysis (and subject to the same limitations).

> YTM is the discount factor that makes the present value of future cash flows from a bond equal to current price of the bond.

Illustration 14

Consider a ₹1,000 par value bond whose current market price is ₹850. The bond carries a coupon rate of 8% and has a maturity period of 9 years. What should be the rate of return that an investor earns if he purchases the bond and holds till maturity?

Solution:

$$P = \sum_{t=1}^{n} \frac{C_t}{(1+YTM)^t} + \frac{FV}{(1+YTM)^n}$$

We know C_t = ₹80 annual, FV = ₹1,000, n = 9 years, YTM = ?

Through financial calculator or computer excel spreadsheet, we can easily find out YTM = 10.67% for annual and 10.63% semi-annual.

A	B	C
Settlement date	01-01-2013	01-01-2013
Maturity date	01-01-2022	01-01-2022
Annual coupon rate	0.08	0.08
Bond price (Flat)	85	85
Redemption value	100	100
Coupon payment per year	2	1
Yield to maturity	**0.1063**	**0.1067**
	Semi-annual coupons	Annual coupons
Formula used		
B9	=YIELD (B2,B3,B4,B5,B6,B7)	
C9	=YIELD (C2,C3,C4,C5,C6,C7)	

* The price of a bond should equal the present value of its expected cash flows. The coupons and the principal repayment of ₹1,000 face value are known, and the present value, or price, can be determined by discounting these future payments from the issuer at an appropriate required yield r, for the issue. The equation will be as follows:

$$P_0 = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t} + \frac{FV}{(1+r)^n} \text{ .... (i)}$$

Where P_0 = Present value or price of the bond today (time period 0)

C = Semi-annual coupon or interest payments.

FV = Face value (or par value) of the bond.

n = Number of semi-annual periods until the matures.

r = Appropriate semi-annual discount rate or market yield.

The yield to maturity calculation for zero coupon bond is here on the same process expressed in the above equation, equating the current price to the future cash flow to find YTM, and then doubling the result to obtain the annual YTM, because there are no coupons, the only cash flow is the face value of the bond to be received at maturity. **The YTM calculation for a zero coupon bond will be as follows:**

$$\text{YTM} = [\text{FV/P}]^{1/n} - 1$$

An approximation: Instead of trial and error, we have an another method to find the approximate YTM on a bond:

$$\text{YTM} = \frac{\text{C} + (\text{M} - \text{P})/\text{n}}{0.4\ \text{M} + 0.6\ \text{P}}$$

where YTM is the yield to maturity, C is the annual coupon payment, M is the maturity value of the bond, P is the present value of the bond, n is the years to maturity. Consider Illustration 22:

$$\text{YTM} = \frac{80 + (1000 - 850)/9}{0.4 \times 1000 + 0.6 \times 850}$$

$$= \frac{80 + 16.66}{400 + 510} \qquad = 10.62\%$$

Yield to Call: Most corporate bonds, as well as government bonds, are callable by the issuers, typically after some deferred call periods. For bonds likely to be called, the yield to maturity calculation is unrealistic and a better calculation is the yield to call.

Illustration 15

Suppose the 8% coupon, 20-year maturity bond sells for ₹1,120 and is callable in 10 years at a call price of ₹1,090. Calculate its yield to maturity and yield to call using the following inputs:

	Yield to call (₹)	Yield to Maturity (₹)
Coupon Payment	40	40
Number of Semi-annual periods	20	40
Final payment	1,090	1,000
Present Price	1,120	1,120

Solution:

With the help of spreadsheet, we can easily calculate: Yield to call = 6.95% or yield (issue date as 01- 01- 2003, 01-01-2013, interest .08% present price 112, redemption price 109, no. of installments in a year 2). Yield to maturity = 7.00%

A	B
	Semi-annual coupons
Settlement date	1-1-2012
Maturity date	1-1-2022
Annual coupon rate	0.08

Bond Price (flat)	112
Redemption value	109
No. of installments in a year	2
Yield to call	**0.0695**
Formula uses	
B9 yield to call	= Yield (B2, B3, B4, B5, B6, B7)

Realized Compound Yield

After the investment period for a bond is over, an investor can calculate the Realized Compound Yield (RCY). This rate measures the compound yield on the bond investment actually earned over the investment period, taking into account all immediate cash flows and reinvestment rates. The semi-annual realized compound yield can be calculated using the following formula:

$$RCY = \left[\frac{\text{Total ending wealth}}{\text{Purchase Price of bond}}\right]^{1/n} -10$$

Assume an investor had ₹1,000 to invest 2 years ago. This investor purchased a 10% coupon bond with a two-year maturity at face value. The promised YTM for this bond was 10%. Assume that investor invested exactly at 10% at the end of each year and after 2 years the amount would come exactly at ₹ 1,210.

At time (0) - the amount of investment	= ₹1,000
Add: Interest at the end of 1st year re-invested @10%	= ₹ 100
Opening balance at the beginning of year 2	= ₹1,100
Add: Interest at the end of 2nd year re-invested @10%	= ₹ 110
Ending value	₹1,210

$P_2 = P_0 [(1 + r)^2]$

Or, ₹1,000 $(1 + r)^2$ = ₹1,000 $[(1 + 0.10)^2]$ = ₹1,210 or r = 0.10 = 10%

With a reinvestment rate equal to the 10% yield to maturity, the realized compound return equals to yield to maturity.

Price Yield Relationship

The earlier section discussed price of bond. However, it is required to understand different types of bond yield. The commonly employed bond yield measures are:

(i) **Current yield:** The current yield relates the annual coupon interest to the market price. It is calculated by using the formula:

Current Yield = Annual Interest/Price

(ii) **Yield to Maturity:** The yield to maturity (YTM) is defined as the interest rate that makes the present value of a bond's payments equal to its price. This interest rate is often interpreted as a measure of the average rate of return that will be earned on a bond if it is bought now and held until maturity.

(iii) **Yield to Call:** Some bonds carry a call feature that entitles the issuer to call (buy back) the bond prior to the stated maturity date in accordance with a call schedule.

The basic property of a bond is that its price varies inversely with yield. If the required yield decreases, the present value of the cash flow increases; hence the price of the bond increases. Conversely, when the required yield increases, the present value of cash flow decreases. The higher the coupon rate, the smaller the percentage price change due to any given change in interest rate are positively related. The graph of the price-yield relationship for the bond has a convex shape.

The relationship between the coupon rate, the required yield and the price of bond is as follows:

Coupon Rate > Required Yield ⟷	Price > Par (Premium Bond)
Coupon Rate = Required Yield ⟷	Price = Par
Coupon Rate < Required Yield ⟷	Price < Par (Discount Bond)

Consider, a bond carrying a coupon rate of 14% issued 3 years ago for ₹1,000 (its par value) by XYZ Co. The original maturity of bond was 10 years, so its residual maturity now is 7 years. The interest rate is fallen in the last 3 years and investors now expect a return of 10% from this bond. So the price of the bond now would be ₹1,194.70 (based on the formula mentioned above).

Additional Illustrations

1. A company has an EPS of ₹5 for the current year and a DPS of ₹2. The earnings growth rate during the past four years was 4% and expected to grow at 2% a year in the long run. Currently, it is trading at 7 times its earnings. If the required rate of return is 14%, compute the following:

   (a) An estimate of the P/E ratio.

   (b) The long-term growth rate implied by the current P/E ratio.

   Solution:

   (a) EPS current year = ₹5.00; expected growth rate = 2%; required rate of return = 14%, DPS = 2.

   We know that : $P_0 = \frac{D_0(1+g)}{k-g} = \frac{2(1.02)}{(0.14-0.02)} = ₹17.00$

   $$\text{P/E ratio} = \frac{17}{\text{EPS}} = \frac{17}{5} = 3.4$$

   (b) Again $P_0 = \frac{D_0(1+g)}{k-g}$

   Dividing throughout by EPS, we have

   $$\frac{P_0}{E} = \left(\frac{D_0}{E}\right)\frac{(1+g)}{k-g}$$

   Given that $\frac{P_0}{E} = 7$ or $7 = \left(\frac{2}{5}\right)\frac{(1+g)}{(0.14-g)}$

   Solving, $g = 0.078378$ or 7.84%

2. Chandra Chemicals earned ₹7.00 per share during the last year and paid a dividend of ₹2.50 per share. The earnings were expected to grow @10% for the next 3 years and thereafter stabilize at 3%. The payout ratio is expected to remain at the same level during the three years and then increase to 60%. If the required rate of return is 16%, compute:

   (a) The expected price of the share at the end of third year.

   (b) The current price of the stock

   Employ the two-stage dividend growth model.

Solution:

(a) We compute the expected EPS, expected DPS at the end of the third year.

Expected EPS at the end of fourth year = $7(1.10)^3$ (1.03) = ₹9.60

Expected DPS at the end of fourth year = (9.60) (0.60) = ₹5.76

Given that the required rate of return is 16%. Therefore, the expected share price at the end of third year will be given by:

$$P_3 = \frac{\text{DPS in the fourth year}}{k-g}$$

$$= \frac{₹\,5.76}{0.16-0.03} = ₹\,44.31$$

(b) The current price of the stock is given by

$$P_0 = \sum_{t=1}^{3} \frac{D_t}{(1-k)^t} + \frac{P_3}{(1+k)^3}$$

The dividends are obtained as follows on the assumption that DPS also grows at the same rate at which the EPS grows.

Year	DPS (₹)
1	2.50 (1.10) = 2.75
2	2.75 (1.10) = 3.03
3	3.03 (1.10) = 3.33

$$P_0 = \frac{2.75}{(1.16)} + \frac{3.03}{(1.16)^2} + \frac{3.33}{(1.16)^3} + \frac{44.31}{(1.16)^3}$$

= 2.37 + 2.25 + 2.13 + 28.39 = ₹ 35.14

3. You have been reading about Software Ltd. which currently retains 90 per cent of its earnings (₹5 a share this year). It earns a ROE of almost 30 percent.

   (a) Assuming a required rate of return of 14 percent, how much would you pay for the share on the basis of earnings multiplier model?

   (b) What would you pay for the stock if its retention rate was 60 percent and its ROE was 19 percent?

Solution:

(a) Required rate of return (k) = 14%

Return on Equity (ROE) = 30%

Retention Rate (RR) = 90%

Earnings per share = ₹5.00

Then growth rate = RR × ROE = 0.90 × 0.30 = 0.27

$$P/E = \frac{D/E}{k-g} = \frac{0.10}{0.14-0.27}$$

Since, the required rate of return (k) is less than the growth rate (g), the earnings multiplier cannot be used (the answer is meaningless).

(b) However, if ROE = 0.19 and RR = 0.60

then, Growth rate = 0.60 × 0.19 = 0.114

$$P/E = \frac{0.40}{0.14-0.114} = \frac{0.40}{0.026} = 15.38$$

If next years earnings are expected to be:

₹5.57 = ₹5.00 × (1 + 0.114)

Applying the P/E ratio: Price = 15.38 × 5.57

= ₹85.69

Thus, you would be willing to pay up to ₹85.69

4. Zed Ltd. is currently selling for ₹60 per share and is expected to pay a dividend of ₹3.00. The expected growth rate in dividends is 8 percent for the foreseeable future. Calculate the required rate of return for this stock.

Solution:

To solve this problem for k, we can simply rearrange the equation of basic DDM.

$$k = \frac{D_1}{P_0} + g\ ; \quad \text{or} \quad k = \frac{3.00}{60} + 0.08 = 0.13 \text{ or } 13\%$$

5. X Ltd. pays a dividend of ₹1.22, which is expected to grow indefinitely at 5%. If the current value of X Ltd's share based on the constant DDM is ₹40.00, what is the required rate of return?

Solution:

$$k = \frac{D_0(1+g)}{P_0} + g = \frac{1.22(1.05)}{40} + 0.05 = 8.20\%$$

6.

(a) Software stocks currently provide an expected rate of return of 16%. Zed Ltd. a large computer company, will pay a year end dividend of ₹2.00 per share. If the stock is currently selling at ₹50 per share, what must be the market's expectations of the growth rate of Zed Ltd. dividends?

(b) If dividend growth forecasts for Zed Ltd. are revised downward to 5% per year, what will happen to the price of Zed Ltd. stock? What (qualitatively) will happen to the company's price-earnings ratio?

Solution:

(a) $k = \dfrac{D_1}{P_0} + g$ or $0.16 = \dfrac{₹\,2.00}{₹\,50} + g$ or $g = 12\%$

(b) $P_0 = \dfrac{D_1}{k-g} = \dfrac{₹\,2}{0.16-0.05} = ₹\,18.18$

The price falls in response to the more pessimistic dividend forecast. The forecast for current year earnings, however, is unchanged. Therefore, the P/E ratio falls. The lower P/E ratio is evidence of the diminished optimism concerning the firm's growth prospects.

7.

(a) Exe Ltd. has an ROE of 16% and a plough back ratio of 50%. If the coming year's earnings are expected to be ₹2.00 per share, at what price should the stock sell? The market capitalization rate is 12%.

(b) What price do you expect Exe's share to sell for in 3 years?

Solution:

(a) $g = ROE \times b = 16\% \times 0.50 = 8\%$

$D_1 = ₹\,2 \times (1 - b) = ₹\,2 \times (1 - 0.50) = ₹\,1.00$

$P_0 = \dfrac{D_1}{k-g} = \dfrac{₹\,1.00}{0.12-0.08} = ₹\,25.00$

(b) $P_3 = P_0\,(1 + g)^3 = ₹\,25(1.08)^3 = ₹\,31.49$

8. AB Ltd. is expected to pay a dividend of ₹4.00 at the end of first year, a dividend of ₹7.00 at the end of second year, a dividend of ₹11.00 at the end of 3rd year. From 4th year onwards, the dividends are expected to grow at a constant growth rate of 4%. If the required rate of return is 14%, compute the present value of the stock.

Solution:

$$P_0 = \frac{D_1}{(1+k)} + \frac{D_2}{(1+k)^2} + \frac{D_3}{(1+k)^3} + \frac{D_3(1+g)}{(1+k)^3(k-g)}$$

Subtituting these values:

$$P_0 = \frac{4}{(1.14)} + \frac{7}{(1.14)^2} + \frac{11}{(1.14)^3} + \frac{11.44}{(1.14)^3(0.14-0.04)}$$

$= 3.509 + 5.39 + 7.415 + 77.22$

$= ₹\,93.54$

Therefore, the price of the share is ₹ 93.54 through DDM (dividend discount model)

9.

(a) A Ltd's earnings per share is ₹10 and growth rate of earning is 4%. The earnings growth rate is expected to stay at this level in the near future. If its payout ratio is 55% and the cost of capital is 15%, what is the current market price of the share?

(b) What will be the price of the above-mentioned stock after three years?

Solution:

(a) Given, current EPS = ₹10; earnings growth rate = 4%; pay-out ratio = 55%, required rate of return = 15%. If we substitute the values in the equation, we have

$$P_0 = \frac{E_1(1-b)}{k-g} = \frac{10(1.04)(0.55)}{(0.15-0.04)} = ₹\,52$$

(b) The price after 3 year is computed as follows:

$$P_3 = \frac{E_4(\text{b})}{k-g} = \frac{E_0(1+\text{g})^4(b)}{k-g} \text{ or } P_3 = \frac{10(1+0.04)^4(0.55)}{(0.15-0.04)} = ₹\,58.49$$

The price after 3 years will be ₹ 58.49

10. Akai Ltd's latest annual dividend of ₹1.25 a share was paid yesterday and maintained its historic 7% annual rate of growth. You plan to purchase the stock today because you believe that the dividend growth rate will increase to 8% for the next three years and the selling price of the stock will be ₹40.00 per share at the end of that time.

(a) How much should you be willing to pay for the share if you require a 12% return?

(b) What is the maximum price you should be willing to pay for the stock if you believe that the 8% growth rate can be maintained indefinitely and you require a 12% return?

(c) If the 8% rate of growth is achieved, what will be the price at the end of year 3, assuming the conditions in part (b)?

Solution:

(a) Projected dividends for next 3 years:

Year 1 (₹1.25 × 1.08) = ₹1.35

Year 2 (₹1.35 × 1.08) = ₹1.46

Year 3 (₹1.46 × 1.08) = ₹1.58

Required rate of return = 12%

Growth rate of dividends = 8%

The present value of stock is:

$$V = \frac{1.35}{1.12} + \frac{1.46}{(1.12)^2} + \frac{1.58}{(1.12)^3} + \frac{40}{(1.12)^3}$$

$$= 1.21 + 1.16 + 1.12 + 28.47 = ₹\,31.96$$

(b) Growth rate = 8%

Required rate of return = 12%

$$V = \frac{1.35}{0.12-0.08} = \frac{1.35}{0.04} = ₹33.75$$

(c) Assuming all the above assumption remain the same, the price at the end of year 3 will be:

$$P_3 = \frac{D_4}{k-g} = \frac{1.25 \times (1.08)^4}{0.12-0.08} = \frac{1.25 \times 1.3605}{0.04} = ₹42.52$$

11. A bond with a face value of ₹1,000 provides 12% annual return and pays ₹1,050 at the time of maturity, which is 10 years from now. If the investor required rate of return 13%, at which price should the company issue the bond?

Solution:

₹ 120 × $PVIFA_{(13\%, 10 years)}$ + ₹ 1050 × $PVIF_{(13\%, 10 years)}$ = ₹ 120 × 5.426 + ₹1,050 × 0.295

= 651.12 + 309.75 = ₹ 960.87. The company should issue the bond at ₹960.87.

12. Mr. Khanna purchased ₹ 1,000 par value bond for ₹ 950. The coupon payment on this bond is ₹ 90. One year later he sells the bond for ₹900. Find out his rate of return.

Solution:

Holding period return = 90 + (900-950) / 950 = 4.21%

13. ABC Ltd. has provided the following information: (a) annual interest payment ₹ 60; (b) par value of the bond ₹ 995; (c) current market price ₹ 700; (d) years to maturity 5 years. Find out the yield to maturity.

Solution

Through excel presentation yield to maturity = 14.68% or

YTM = [1+(F-P)/n]/[0.4F+ 0.6 P] = 60 +[(995-700)/5]/[0.4 (995)+0.6(700)] = (60 +59)/(398+420) = 119/818 = 14.54%

14. A financial institution issues two types of bonds with one year and another three years' maturity respectively. The first, which pays ₹10,000 a year hence, is now selling for ₹8,929. The second which pays ₹100 next years, ₹100 after two years and ₹1,100 at the end of third year is now offered at ₹997.18. Find out the implied rates of these two bonds.

Solution:

Assume k_1 and k_2 are the implied interest rates on bonds I and II, respectively.

Bond I:

₹ 10,000 PVIF(k_1, I) = ₹ 8929

or ₹10,000 / (1+k_1) = ₹ 8929 or ₹ 8929 (1+k_1) = ₹ 10,000

or Solving, we get k_1, = 12%

Bond II:

977.18 = 100 PVIF (k_2, I_1) + 100 PVIF (k_2, I_2) + ₹ 1100 PVIF (k_2, I_3)

or 977.18 = $100/(1+k_2) + 100/(1+k_2)^2 + 1100/(1+k_2)^3$

Solving, we get k_2 = 10.1%

∴ Implied interest rate on bond, I and II are, respectively, 12% and 10.1%.

15. An AAA rated bond of face value ₹1,000 is currently quoting in the market at ₹1,062. The coupon rate of the bond is 14% payable semi-annually. The remaining maturity of the bond is five years and the principal is repayable at two equal instalments at the end of the 4th and 5th year from now. Find out the YTM of the bond.

Solution:

The required YTM is given by r in the following equation:

$1062 = 70\ PVIFA_{r,8} + 500 \times PVIF_{r,8} + 35\ PVIF_{r,9} + 535 \times PVIF_{r,10}$

for r = 6%,

RHS = 70 × (6.210) + 500 × (0.627) + 35 × (0.592) + 535 × 0.558 = ₹1067.45

for r = 7%,

RHS = 70 × (5.971) + 500 × (0.582) + 35 × (0.544) + 535 × (0.508) = ₹ 999.79

r = 6%+(7-6) % × (1067.45-1062)/(1067.45-999.79) = [(6+1)×5.45]/67.66 = 6.08%

Required rate = 6.08 × 2 = 12.16%

16. A company is offering a bond with the issue price of ₹ 100, annual coupon rate is 12% with maturity period 5 years. If the bond is to be redeemed at par and the investor faces a 30% tax on income and a 10% capital gains tax, find out the effective yield to maturity for the investor.

Solution:

Let the yield to maturity be 'i', then,

$100 = 12 \times 0.7 \times PVIFA_{(i,5)} + 100\ PVIF_{(i,\ 5)}$

Solving, we get i = 8.41%

17. A Ltd. issued bonds face value ₹ 1,000 having a maturity premium of 10% and a coupon rate of 9%. The bonds are presently trading at par. The yield to maturity of the bond to an investor as of now, by approximation method, is 12%. What will be the approximate maturity period for the bonds?

Solution:

Let the approximate maturity period be n years and the face value of the bond be ₹ 1,000.

∴ YTM through approximation method would be

YTM = 1+ [(F-P)/n] /[(F+P)/2]

We have I = ₹ 90; P = ₹ 1000; F = ₹ 1100 and YTM = 12%

∴ 0.12 = 90+[(1100-1000)/n]/[(1100 +1000)/2]

or 0.12 = [(90+100)/n]/1050

or n=2.78 years

18. Two bonds have identical times to maturity and coupon rates. One is callable at ₹105, the other at ₹110. Which should have the higher yield to maturity? Why?

Solution:

The bond callable at ₹105 should sell at a lower price because the call provision is more valuable to the firm. Therefore, its yield to maturity should be higher.

19. Which security has a higher effective annual interest rate?

(a) A 3-month T-bill selling at ₹ 97,645 with par value ₹ 1,00,000.

(b) A coupon bond selling at par and paying a 10% coupon semi-annually

Solution:

(a) Effective annual rate for 3-month T-bill;

$(1,00,000/97,645)^4 - 1 = 10\%$

(b) Effective annual interest rate for coupon bond paying 5% semi-annually:

$(1.05^2\text{-}1) = 0.1025$ or 10.25%.

Therefore, the coupon bond has the higher effective annual interest rate.

20. Consider a bond with 10% coupon and with YTM = 8%. If the bond's YTM remains constant, then in 1 year, will the bond price be higher, lower or unchanged? Why?

Solution:

The bond price will be lower. As time passes, the bond price, which is now above par value, will approach par.

21. Consider an 8% coupon bond selling ₹ 953.10 with 3 years until maturity making annual coupon payments. The interest rates in coming 3 years would be, with certainty, r_1 = 8%, r_2 = 10% and r_3 = 12%. Calculate the YTM and realized compound yield of the bond.

Solution

Using a spreadsheet, YTM = 9.88%.

Realized compound yield: First find the future value, which is (re-invested coupons and principal):

FV = (₹80 × 1.10 × 1.12) + (₹80 × 1.12) + ₹1,080 = ₹1,268.16

Find the rate, that makes the FV of purchase price equal to ₹1,268.16.

₹953.10 × (1 + Realized yield)^3 = ₹1,268.16

or Realized rate = 9.99% or 10% (approx.)

22. Face value of a bond ₹1,000, coupon rate 6%, Current market price ₹900. Current Yield?

Solution:

Current Yield (60/900) ×100 = 6.67%

23. A company issues Zero coupon bond of 10 years' maturity. Issue price ₹260. Maturity value ₹1,000. Ignore tax. What is the YTM?

Solution:

Present value of ₹1,000 to be received after 10 years = ₹260

PV of ₹1 to be received after 10 years = 0.26. Consulting the PVF table, we find that the rate of interest in this case is in the range of 14% to 15%.

NPV at 14 % = -260+ (1000 × 0.270) = + 10

As NPV (at 14%) is positive, this shows that the return is greater than 14%.

Let calculate NPV at 15%.

NPV at 15% = - 260 + (1000 × 0.247) = -13

As NFV (at 15%) is negative, this shows that the return is less than 15%. We can find the exact return (called YTM. also called current interest rate) through interpolation.

YTM or current interest rate:

$$= \text{Lower rate} + \frac{\text{Lower rate NPV}}{(\text{Lower rate NPV - Higher rate NPV})} \times (\text{difference in rates})$$

$$= 14 + \frac{10}{10 - (-13)} \times 1 = 14.43\%$$

24. What is the YTM of ₹1,000 10 years zero coupon bond if the issue price ₹190?

Solution:

- Present value of ₹1,000 to be received after 10 years ₹190.
- PV of ₹1 to be received after 10 years = 0.19.
- Consulting the PVF table, we find that the rate of interest in this case is in the range of 18% to 19%.
- NPV at 18% = -190 + (1000 × 0.191) = + 1
- As NPV (at 18%) is positive, this shows that the return is greater than 18%.

Let's calculate NPV at 19%.

- NPV at 19% = -190+ (1000 × 0.176) = - 14
- As NPV (at 19%) is negative, this shows that the return is less than 19%.

We can find the exact return (called YTM, also called current interest rate) through interpolation.

YTM or current interest rate:

$$= \text{Lower rate} + \frac{\text{Lower rate NPV}}{(\text{Lower rate NPV - Higher rate NPV})} \times (\text{difference in rates})$$

$$= 18 + \frac{1}{1 - (-14)} \times 1 = 18.066\%.$$

Solved Case Study

Naveen has joined Excel Corporation as a finance trainee. He has given the following details and have been asked to find out the following which are as follows:

The current yield curve for default free zero coupon bonds is as follows:

Maturity (years)	YTM %
1	10
2	11
3	12

(a) What are the implied 1-year forward rates?

(b) Assume that the pure expectations hypothesis of the term structure is correct. If the market expectations are accurate, what will be the pure yield curve (that is, the yields to maturity on 1-year and 2-year zero coupon bonds) next year?

(c) If an investor purchase a 2-year zero coupon bond now, what is the expected total rate of return over the next year? What if you purchase a 3-year zero coupon bond? Ignore taxes.

(d) What should be the current price of a 3-year maturity bond with a 12% coupon rate paid annually? If you purchased it at the price, what would be your total expected rate of return over the next year (coupon plus price change)? (Ignore taxes).

Solution:

(a) We obtain forward ate from the following table:

Maturity	YTM	Forward Rate	Price [for parts (c) and (d)]
1 year	10%	---	₹1000/1.10 = ₹909.09
2 years	11%	$(1.11^2 / 1.10) – 1 = 12.01\%$	$₹1000/1.11^2$ = ₹811.62
3 years	12%	$(1.12^3 / 1.11^2) – 1 = 14.03\%$	$₹1000/1.12^3$ = ₹711.78

(b) We obtain next year's prices and yields by discounting each zero's face value at the forward rates for next year that we derived in part (a).

Maturity	Price	YTM
1 year	₹1000/1.1201 = ₹892.78	12.01%
2 years	₹1000 / (1.1201 × 1.1403) = ₹782.93	13.02%

Please note that this year's upward sloping yield curve implies, according to the expectation hypothesis, a shift upward in the next year's curve.

(c) Next year, the 2-year zero will be a 1-year zero, and will therefore sell at a price of: ₹1000/1.1201 = ₹892.78. Similarly, the current 3-year zero will be a 2-year zero and will sell for ₹782.93.

Expected total rate of return:

2-year bond = (₹892.78 ÷ ₹811.62) - 1 = 1.1000 – 1 = 10%

3-year bond = (₹782.93 ÷ ₹711.78) - 1 = 1.1000 – 1 = 10%

(d) The current price of the bond should equal to the value of each payment times the present value of ₹1 to be received at the "maturity" of that payment. The present value schedule can be taken directly from the prices of zero-coupon bonds calculated above.

Current price = (₹120 × 0.9090) + (₹120 × 0.8116) + (₹1,120 × 0.71178) = ₹1,003.68

Similarly, the expected prices of zeros one year from now can be used to calculate the expected bond value at that time.

Expected price 1 year from now = (₹120 × 0.89278) + (₹1,120 × 0.78293) = ₹984.02

∴ Total expected rate of return = [₹120 + ₹(984.02 - 1003.68) ÷ 1003.68] = 10%

Exercise

Theoretical Questions

Multiple Choice Question

1. Default risk is nil in:
   a. Treasury bills
   b. IDBI bonds
   c. ICICI bonds
   d. Reliance bonds
2. Value of the bond depends on
   a. Coupon rate
   b. Expected yield to maturity
   c. Years to maturity
   d. All of the above
3. Coupon yield of the bond is
   a. The discounted value of the bond
   b. Coupon payment stated as a percentage of a bond's features
   c. Coupon payment stated as a percentage of a bond's present price
   d. Both (a) and (b)
4. Yield to maturity is same as
   a. NPV
   b. IRR
   c. Geometric mean
   d. Both (b) and (c)
5. By investing in bonds, a trader is subjecting himself to the following risks:
   a. Interest rate risk
   b. Default risk
   c. Reinvestment risk
   d. All of the above
6. If a bondholder is to receive the stated yield to maturity, he has to invest the interim cash flow at
   a. Existing interest rates
   b. Coupon rate
   c. Stated YTM
   d. Current yield
7. The definition "the promised compounded rate of return an investor will receive from a bond purchased at the current market price and held to maturity" pertains to
   a. Yield to maturity
   b. Realized yield
   c. Current yield
   d. Yield to call

8. Bond volatility is inversely related to
   a. Term to maturity
   b. Yield to maturity
   c. Coupon rate
   d. Both (b) and (c)
9. The constant growth dividend discount model will not produce a finite value for a stock if the dividend growth rate is
   a. Above its historical average
   b. Below its historical average
   c. Equal to the historical average
   d. Above the required rate of return of the stock
10. Which among the following is/are the determination of price - earnings ratio?
   a. Dividend payout ratio
   b. Growth rate in dividends
   c. Required rate of return
   d. All of (a), (b) and (c) above

Answer:

1	2	3	4	5	6	7	8	9	10
a	d	c	d	d	c	a	d	c	d

State True or False

1. There is no default in payment of interest and principal while calculating YTM
2. The YTM of a bond will be equal to the realized yield if, The coupon payments are reinvested at YTM
3. Realized yield of a debt instrument is Always less than the current yield
4. The yield maturity is equal to the realized compound return if all coupon interest payments, Are reinvested at the bonds yield to maturity
5. A bond that gives the bondholder the option to exchange it for common stock prior to maturity is a Callable bond
6. As the interest rate rises in the economy, the P/E Ratio decreases considering that other parameters will remain constant
7. A grwoth stock is usually indicated by high market discounting
8. A bond that gives the bondholder the option to exchange it for common stock prior to maturity period is a convertible bond
9. Realised yield of a debt instrument is closer to teh re-investment rate, as the maturity lengthens
10. The capitalization rate used in valuing a particular security return is determined by risk of security, growht rate of dividends and dividend payout ratio

Answer:

1	2	3	4	5	6	7	8	9	10
False	True	False	True	False	True	True	True	True	True

Fill in the Blanks

1. The government made a cut in the interest rate by 30 basis points. This means there is a change of __________
2. The term structure of the bond is the relationship between the ___________ and _________
3. Yield to maturity is same as _____ and _______
4. By investing in bonds, a trader is subjecting himself to the __________risks
5. If a bondholder is to receive the stated yield to maturity, he has to invest the interim cash flow at _________
6. The definition "the promised compounded rate of return an investor will receive from a bond purchased at the current market price and held to maturity" pertains to ___________
7. Bond volatility is inversely related to ________ and ___________

Answer:

1	0.30%	2	Yield and time taken to mature
3	IRR and Geometric mean	4	Interest rate risk, Default risk and Reinvestment risk
5	Stated YTM	6	Yield to maturity
7	Yield to maturity and Coupon rate		

Short Essay Type Question

1. Under what conditions will it be ideal to use one or several of the relative valuation ratios to evaluate a stock?
2. Discuss a scenario where it would be appropriate to use one of the present value of cash flow techniques for the valuation.
3. Why is the required rate of return for a stock, the discount rate to be used in valuation analysis?
4. In what circumstances would you choose to use a dividend discount model rather than a free cash flow model to value a firm?
5. In what circumstances is it important to use multistage DDMs rather than constant growth models?
6. If a security underpriced (i.e., intrinsic value > market price), then what is the relationship between its market capitalization rate and its expected rate of return.
7. What problems are encountered in using the dividend discount model?

Essay Type Question

1. In what circumstances would you choose to use a dividend discount model rather than a free cash flow model to value a firm?
2. In what circumstances is it important to use multistage DDMs rather than constant growth models?
3. If a security is underpriced (i.e. intrinsic value > market price), then what is the relationship between its market capitalization rate and its expected rate of return?
4. Discuss why the two valuation approaches (present value of cash flows and the relative valuation ratios) are competitive or complementary.
5. Discuss the impact of growth on price, returns and P/E ratio.

6. What are the types of bond?
7. Under what conditions will it be ideal to use one or several of the relative valuation ratios to evaluate a stock.
8. Discuss a scenario where it would be appropriate to use one of the present value of cash flow techniques for the valuation.
9. Discuss why the two valuation approaches (present value of cash flows and the relative valuation ratios) are competitive or complementary.
10. Why do bond prices go down when interest rates go up?
11. Does lenders like high interest rates?
12. What is the dividend discount model? Write this model in equation form.
13. Discuss the constant growth model.
14. Explain the two-stage growth model.
15. What are the key determinants of price-earnings multiple?

Practical Problems

Multiple Choice Question

1. All other things being equal, which one of the following bonds will have the maximum volatility?
   a. 15 year, 15% coupon bond
   b. 5 year, 10% coupon bond
   c. 15 year, 10% coupon bond
   d. 5 year, 15% coupon bond
2. A Ltd. has 1 million AAA rated 12% bonds outstanding, maturity in 7 years from now. If the market interest rate is 14%, the price of the bond is (assume FV ₹100) and coupons are payable annually
   a. 90.00
   b. 91.46
   c. 93.00
   d. 94.00
3. If the YTM on a one-year GOI bond and a two-year GOI bonds are 7.97% and 8.86%, respectively then the implicit one-year forward rate at the end of year 1 is
   a. 8.09%
   b. 9.23%
   c. 9.66%
   d. 9.76%
4. You just purchased a 10-year maturity, semi-annual coupon bond for ₹1,148.77 (face value ₹1,000), a coupon rate of 8% and a yield to maturity 6%. The bond is callable in four years at ₹1,080. what is the yield to call?
   a. 5.6%
   b. 6.0%
   c. 7.2%
   d. 8.0%

   [Hints: n = 8; call price = ₹1080; semi-annual interest payment will be ₹40. spreadsheet or calculator entries will be N = 8; PV = -1148.77; PMT = 40, FV = 1080, CPT 1/Y 2.80. the annual yield to call = 2.80 × 2 = 5.60%]

5. A 20-year maturity bond with a par value ₹1,000 makes semi-annual payments at a coupon rate of 8%. The YTM is 9%. How much should you pay for the bond?
   a. ₹1080
   b. ₹1000
   c. ₹908
   d. ₹966
6. A bond with a par value of ₹1,000 has a 6% annual coupon rate. Interest is paid semi-annually and the price of the bond is ₹1,025. what is the current yield?
   a. 3.0%
   b. 2.9%
   c. 6.2%
   d. 5.9%
7. A semi-annual coupon bond is currently selling for ₹1,142.12. The bond has a maturity of 10 years, a par value of ₹1,000 and a 9% coupon rate. What is the yield to maturity?
   a. 3.5%
   b. 7.0%
   c. 7.5%
   d. 9.0%
8. One year ago, you purchased an annual coupon bond for ₹817.84. At that time the bond had a maturity of 15 years, a face value of ₹1,000, a coupon rate of 5% and a yield to maturity of 7%. One year later, the yield to maturity increased to 7.5%. what is the total rate of return for the year?
   a. 9.79%
   b. 2.44%
   c. 7.50%
   d. 3.75%
9. Mr. X expects 20% return from his investment. The dividend from the stock is ₹2.0 and the present price is ₹50. What should be the future price of the stock?
   (a) ₹ 56.39
   (b) ₹ 58.00
   (c) ₹ 60.00
   (d) ₹ 62.30
10. A stock of ₹10 face value has declared 35% dividend for the current year. The stock is currently selling for ₹40. What I the dividedly yield?
    (a) 35%
    (b) 8.75%
    (c) 7.0%
    (d) 8.25%
11. According to the constant growth model, the next year's dividend is ₹2.00, required rate of return is 15% and the growth rate is 10%, the market price would be
    (a) ₹ 50

(b) ₹ 45

(c) ₹ 40

(d) ₹ 48

12. The current price is ₹100, the required rate of return is 20% and the dividend paid ₹3.00 on a share of ₹10 face value. What is the expected growth rate?

(a) 15%

(b) 16%

(c) 18%

(d) 17%

13. A stock with a dividend pay-out ratio of 45%, required rate of return is 15% and a constant growth rate of 10% will have a P/E ratio of

(a) 3 times

(b) 9 times

(c) 8 times

(d) 7.5 times

14. A company with PAT of ₹ 40 Lakh, tax rate of 50%, RONW of 100%, reserves of ₹ 30 lakh and a par value ₹5 will have pre-tax EPS of

(a) ₹ 4.00

(b) ₹ 40.00

(c) ₹ 36.00

(d) ₹ 42.00

15. The current dividend, market price and the annual dividend growth rate of a company are ₹2.50 per share, ₹50 per share and 5%, respectively. The capitalization rate of the equity will be

(a) 0.0526

(b) 0.10

(c) 0.1050

(d) 0.1025

Answer:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
d	b	d	a	c	d	b	b	b	b	c	d	b	b	d

References:

1. Chandra. P., Investment Analysis and Portfolio Management, McGarw Hill.
2. Ranganathan., Security Analysis and Portfolio Management, Pearson.
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Mutual Funds 7

This Module includes:

7.1 Meaning, Advantages and Disadvantages, Structure and Types

7.2 Regulations

7.3 Computation of NAV

7.4 Evaluation of Performance and Movements in Security Values and NAVs of Mutual Funds for Investment Decisions: Perspective of AUM Managers and Individual Investors

7.5 ETF, REIT, InvIT

Mutual Funds

SLOB Mapped against the Module

To equip oneself with the knowledge of application of various techniques in security evaluation, building a portfolio, measuring its performance and making revisions to optimise the returns. (CMLO 3a)

Module Learning Objectives:

After studying this module, the students will be able to -

- Understand the basic concepts associated with mutual funds.
- Appreciate relevant regulations relating to mutual funds in India.
- Learn the process of calculation of NAV of mutual funds units.
- Understand various ways of measuring eth performance of mutual funds
- Learn basic concepts associated with ETFs, REITs and InvITs.

Meaning, Advantages and Disvantages, Structure and Types

7.1

7.1.1 Meaning of Mutual Fund

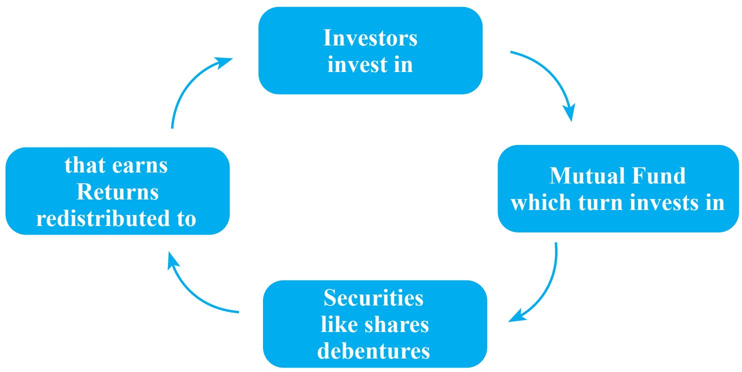

Figure 7.1: Mutual Fund a common pool for investment

A Mutual Fund is a trust that pools he savings of a number of investors who share a common financial goal. The money thus collected is then invested in capital market instruments such as shares, debentures and other securities. The incomeearned through these investments and the capital appreciations realized are shared by its unit holders in proportion to the number of units owned by them. Thus a Mutual Fund is the most suitable investment for the common man as well as HNIs since it offers an opportunity to invest in a diversified, professionally managed basket of securities at a relatively low cost.

7.1.2 Entities Involved

There are various entities involved in the overall structure.

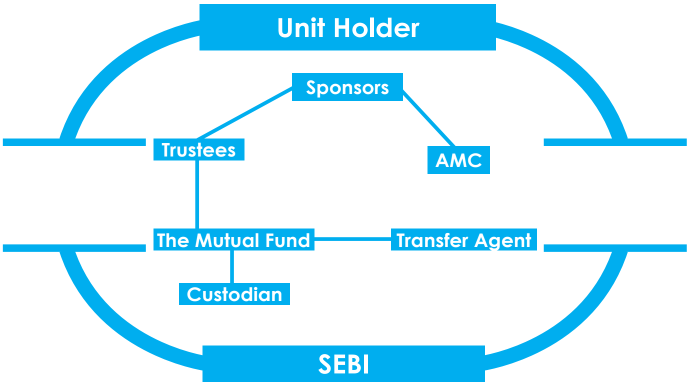

Figure 7.2: Various Entities involved in Mutual Fund

A MF enterprises five separate entities, namely sponsor, mutual fund trust, AMC, registars and transfer agents and custodian. The sponsor establishes the MF and gets it registered with SEBI.

1. Sponsor

The sponsor is a body corporate who establishes a mutual fund after completing the formalities as prescribed by SEBI. A mutual fund has to be established through the medium of a sponsor.

Conditions:

(a) Sponsor should have a sound track record and general reputation of fairness and integrity in all its business transactions.

(b) Sponsor should be carrying on business in financial services for a period of not less than five years.

(c) Sponsor should contributed at least 40% to the worth of the AMC.

(d) A deed shall be executed by the sponsor in favour of the trustees in the instrument of trust.

2. Trustees

'Trustees" means Board of Trustees or the Trustee Company who holds the property of the mutual fund in trust for the benefit of the unit holders.

Conditions:

(a) A mutual fund shall appoint trustees in accordance with the mutual fund regulations.

(b) An asset management company or any of its officers or employees shall not be eligible to act as a trustee of any mutual fund.

(c) Two-thirds of the trustees shall be independent persons and shall not be associated with the sponsors.

(d) No person appointed as a trustee of a mutual fund can be appointed as a trustee of any other mutual fund unless that a person is an independent trustee.

(e) The person so appointed as a trustee should have a thorough knowledge about financial markets and have not been found guilty by any laws.

3. Asset Management Company (AMC)

The AMC manages the fund of the various schemes and employs a large number of professionals for investment, research and agent servicing. The AMC also comes out with new schemes periodically. **It plays a key role in the running of the mutual fund and operates under the supervision and guidance of the trustees.** An AMC's income comes from the management fees, it charges for the schemes it manages and the **management fees**, is calculated as a percentage of net assets managed.

SEBI has issued the following guidelines for the formation and functioning of the AMCs:

(a) An AMC should be headed by an independent non-interested and non-executive chairman

(b) The managing director and other executive staff should be full time employees of AMC

(c) Fifty percent of the board of trustees of AMC should be outside directors who are not in any way connected with the AMC

(d) The AMC's will not be permitted to conduct other activities such as merchant banking or issue management.

4. Distributors

Distributors earn a commission for bringing the investors into the schemes of a mutual fund. This commission is an expense for the scheme. Depending upon the financial and physical resources at their disposal, the distributors could be:

(a) Tier 1 distributors who have their own or franchised network reaching out to investors all across the country; or

(b) Tier 2 distributors who are generally regional players with some reach within other region; or

(c) Tier 3 distributors who are small and marginal players with limited reach.

5. Custodian/Depository in a MF

The MF shall appoint a custodian to carry out the custodial services for the schemes of the fund and sent intimation of the same to the Board within fifteen days of the appointment of custodian. In case of dematerialized securities, holdings will be held by depository through depository participant. The custodian handles the investment back office operations of a mutual fund. This ensures an ongoing independent record of the investments of the scheme. It looks after the receipt an delivery of securities, collection of income, distribution of dividends and segregation of assets between schemes. The sponsor of a mutual fund can't act as a custodian. This condition is meant to ensure that the assets of the mutual fund are not in the hands of its sponsor.

6. Registrars and Transfer Agents

An investor's holding in mutual fund scheme is typically tracked by the Registrar and Transfer Agent (R&T). Their functions include: (a) issuing units, (b) redeeming units, (c) sending fact sheets, (d) annual reports, etc. Some funds handle such functions in-house, while others outsource it to SEBI-approved registrars and transfer agents like CAMs etc.

7.1.3 History of Mutual Find in India

The mutual fund industry in India started in the year 1963 with the formation of Unit Trust of India, at the initiative of Government of India and Reserve Bank of India with the primary objective was to mobilize the small savings.

The history of mutual fund industry can be divided into five phases.

Phase I Establishment and Growth of Unit Trust of India 1964-1987

Unit Trust of India was established in the year 1963 by an Act of Parliament. It was set up by RBI and it continued to operate under the regulating control of the RBI until the two were delinked in the year 1978 and the entire control was transferred in the hands of Industrial Development Bank of India.

UTI's first innovative and most successful launch was Unit Scheme 1964 or popularly known as US-64.

Phase II Entry of Public Sector Funds (1987-1993)

In 1986, the Government of India amended banking regulation act and allowed public sector commercial banks to set up mutual funds. This led to SBI, PNB, Canara Bank, Bank of India, Bank of Baroda, etc. commercial banks to set up their own mutual funds.

In 1987, GoI further granted permission to insurance corporations in the public sector to float mutual funds and accordingly LIC and GIC set up their own mutual funds. The period of 1987-1993 can be termed as the period of public sector mutual funds, from a single player in 1985 to 8 players in 1993. However, UTI remained the leader with about 60% market share and asset under management of the industry has increased seven times to ₹47,100 crores.

Phase III Emergence of Private Sector Banks (1993-1996)

The permission was given to the private sector funds including foreign funds management companies (most of them entering through joint venture with Indian promoter) to enter the mutual fund industry in 1993. In 1993, the first mutual fund regulation came into being under which all mutual funds, except UTI was to be registered. The Kothari Pioneer (now merged with Franklin Templeton) was the first private sector mutual fund registered in July 1993).

Phase IV Growth and SEBI Regulation (1996-2004)

The mutual fund industry witnessed robust growth and strict regulations from SEBI after 1996. The mobilization of funds and the number of players operating in the industry reached new heights as investors started showing more interest in mutual funds.

Investor's interests were safeguarded when SEBI (Mutual Funds) Regulation 1996 was introduced and the Government of India offered tax benefits to investors through their budget proposal in the year 1999 which exempted all divided incomes in the hands of the investors. Various investor awareness programmes were also initiated by SEBI and Association of Mutual Funds in India (AMFI).

Phase V Growth and Consolidation (2004 Onwards)

During this phase, the industry witnessed several mergers and acquisitions, e.g. Alliance Mutual Fund have been taken over by Birla Sun Life. Simultaneously, more international mutual fund players entered India like Fidelity, Franklin Templeton Mutual Fund, etc.

7.1.4 Types of Schemes

The schemes floated by mutual funds can be grouped into three broad categories based on their operations, investment objectives and others.

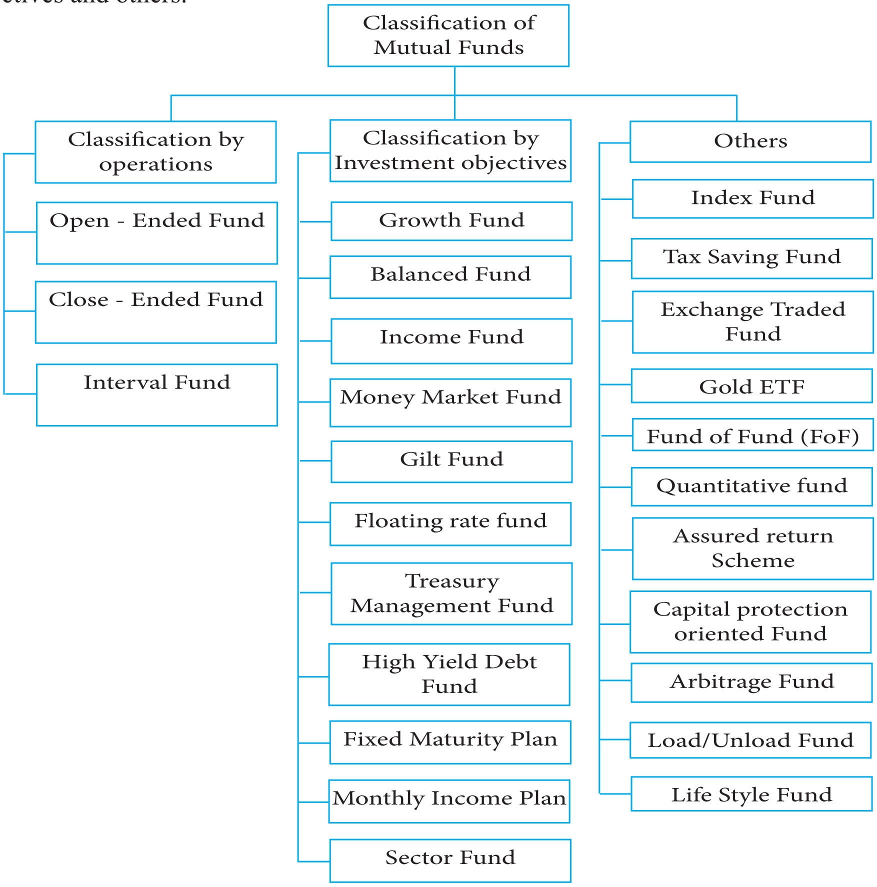

Figure 7.3: Classification of Mutual Funds

7.1.4.1 Classification by Operations

Open-Ended Fund

When the units are sold and redeemed, everyday or continuously on an all-going basis at the price determined by the fund's NAV, they are call OEFs. These funds have to announce their sale and repurchase prices from time to time and these prices and NAVs normally remain close to each other. There is not ceiling of the amount of investment by the investors and similarly as and when the investors chose to sell, the MF is legally bound to repurchase those units. As a result, the corpus changes daily heavily. The units of such funds are perpetuities, that is without any redemption date, no lock in period and they need not to be listed on the stock markets since in their case, the investor carryout transactions directly with MFs. OEFs have to invest a good part of their capital/ fund in liquid assets in order to be ever ready to repurchase their units. Usually, the investors of OEFs are assured of dividends, capital appreciation, safety and liquidity, etc, make the OEFs quite popular amongst wide range of investors.

Closed-End Funds

A closed-end fund has a stipulated maturity period which generally range from 3 to 15 years. The fund is open for subscription only during a specified period. Investors can invest in the scheme at the time of new fund offer (NFO) and thereafter they can buy or sell the units of the scheme on the stock exchanges where they are listed. Their corpus remains fixed till their redemption, the date of which is fixed and declared at the time of issue itself. They have a lock in period of 3-5 years and they may offer guaranteed dividend. Once there units are listed, they may trade at a discount (market price < NAV) or at a premium or at NAV, but it has been found that they mostly trade at a discount. This may provide investors the chance to arbitrage the spreads especially when the redemption date is close by. In practice, many CEFs in India offer a return profile which is similar to that of debentures or bonds or deposits. In order to provide an exit route to the investors, some closed-ended funds give an option of selling back the units to the mutual fund through periodic repurchase at NAV related prices. SEBI regulations stipulate that at least one of the two exit routes must be provided to the investors.

Difference between Open End and Closed End Funds:

Aspect	Open End Funds	Closed End Funds
Initial Subscription	Open-End Fund is one which is available for subscription all through the year.	Fund is open for subscription only during a specified period.
Maturity	Do not have a fixed maturity.	Stipulated maturity period (3 to 15 Years)
Subsequent Transactions	Investors can buy and sell units at Net Asset Value related prices.	Investors can invest at the time of the initial public issue and thereafter they can buy or sell the units of the scheme on the stock exchanges where they are listed.
Repurchase	Any time.	Based on terms of the fund. Periodic repurchase at NAV related price.

7.1.4.2 Classification by Investment Objectives

Growth Fund: It is primarily aimed at achieving capital appreciation over medium to long-term. In these schemes, a higher amount of fund is invested inequity and equity-linked instruments and the remaining are in debt and money market securities. Investors willing to consume a medium to higher level of risk in anticipation of a sound capital appreciation in the future usually prefer to invest in these funds. They are also known as 'nest egg' or 'long haul' investments.

Income Fund: It provides regular and constant income to the investors. Such schemes generally invest in fixed income securities such as bonds, corporate debentures and of government securities. Such funds are less risky as compared to equity schemes as they are not affected by the fluctuations in equity markets.

Balanced Fund: It provides both capital appreciation and periodic returns over a long period of time. The portfolio of these kinds of funds constitutes of both equity and debt as indicated in their offer documents. Usually, a balanced fund invests 60 per cent of net assets in equity and 40 per cent in debt instruments, money market instruments and cash.

Money Market Mutual Funds: The aim of money market funds is to provide easy liquidity, preservation of capital and moderate income. These schemes generally invest in safer short-term instruments such as treasury bills, certificates of deposit, commercial paper and inter-bank call money. Returns on these schemes may fluctuate depending upon the interest rate prevailing in the market.

Gilt Funds: These funds exclusively put their funds in Government securities, both Central and State Governments and Treasury Bills. Highest safety is achievable with a comparative low return and these funds can be both short-term and long-term and depending on their investment horizon.

Floating Rate Funds: These funds focus on the securities that pay a floating rate interest such as bank loans, bonds and other debt securities. Floating rate funds are of two types such as long-term and short-term. Short-term fund plan contains securities of shorter maturity period, with higher liquidity, whereas the portfolio of long-term plan is skewed towards longer term maturation.

High Yield Debt Funds: These funds generate a higher interest income as they park their funds in instruments having lower credit ratings. These funds are also known junk bond funds and are popular abroad but not prevalent in India. Credit Suisse High Yield, Fidelity Capital and Income Fund are examples of high yield debt funds.

Monthly Income Plan (MIP): MIP is a marginal equity product, which works for conservative investors who are comfortable in investing a small component of their money in equity. The risk profile of these funds is low to medium. DSP Black Rock Monthly Income Plan, HDFC Monthly Income Plan, Reliance Monthly Income Plan are few examples of MIP.

Sector Funds

These funds allocate capital in a specified sector of the economy or may be in a specified particular industry. As these funds do not allow diversification, the risk is more in comparison to other well-diversified portfolios. Baroda Pioneer Banking and Financial Services Fund, Reliance Media and Entertainment Fund, SBI Magnum Sector Funds (Umbrella-Pharma), UTI Auto Sector Fund are some of the examples of sector funds in India.

7.1.4.3 Other Funds

Index Fund: These funds are designed to replicate the performance of a well-established stock market index or a particular segment of the stock market. In India, an Index fund mirrors the major market index, like nifty or sensex as closely as possible by investing in all the stocks that comprise in proportions equal to the weightage of those stocks in the index.

Tax-Saving Funds (Equity Linked Savings Schemes): In India, these funds offer rebates under Section 80C of Income Tax Act. They are also known as equity linked savings schemes. These funds usually have a lock-in period of 3 years.

Exchange Traded Funds (ETFs): A new investing trend of increasing importance is the exchange-traded funds (ETFs). These few financial assets have some characteristics of index mutual funds, closed-end funds and even individual stocks.

An ETF is a basket of stocks that tracks a particular sector, investment style, geographical area, or the market as a whole.

Gold ETFs (GETFs): These are exchange traded finds that are meant to close track the price of physical gold. Each unit of the ETF allows the investor to own 1 g. of gold without physically owning it. Thus investing in a gold ETF provided the benefit of liquidity and marketability which area a limitation of possessing physical gold. As there is no physical gold transaction, owners of these funds do not bear any carrying cost.

Fund of Funds (FOFs): Fund of Funds is a mutual fund which invests in other mutual funds. Just a mutual fund invests in a number of different securities, a fund of funds holds shares of many different mutual funds. These funds were designed to achieve even greater diversification than traditional mutual funds.

Assured Return Schemes: These schemes assure a specific return to the investors irrespective of performance of the scheme. The return and other benefits are clearly stated in the offer document.

Arbitrage Funds: These funds focus to derive benefits from the price differences between cash and future derivative markets. For example, a fund may purchase equity shares in the cash market and simultaneously sell the same in the futures market. Return is the difference between the price of the two markets. The higher return of the fund depends on the volatility of the equity market. Arbitrage funds have a low risk return trade-off and generate moderate returns.

Load Fund: As the term implies, this fund charges a percentage of NAV for entry into or exit from these funds. That is, investors pay a charge each time they buy or sell units in the fund. This charge is used by the mutual funds for marketing and distribution expenses.

Life Style Fund: This is a special type of fund where the asset mix is determined by the level of risk and return that is appropriate for an individual investor. Several factors such as investor's age, risk appetite, investment purpose and the time duration of investment, determine the asset mix. Aditya Birla Sun Life India, Gennext Fund, Kotal Lifestyle Fund and UTI Life Style Fund are some examples of life style funds in India.

7.1.5 Options of Mutual Funds

Indian mutual funds offer three broad options to Indian investors. They are:

(a) **Growth option:** The growth option reinvests the profits back into scheme and it is the ideal option for investors who are looking to create a corpus for long-term goal.

(b) **Dividend option:** Under the dividend pay-out option, the scheme distributes realized profits to investors as dividends. This option is useful to investors looking for periodic income from their mutual fund investments.

(c) **Dividend reinvestment option:** Dividend reinvestment option does not distribute the dividends to investors, the dividend is declared but not physically paid out. Instead, it is reinvested back into the scheme and the additional units are issued. These additional units are treated like a fresh purchase.

7.1.6 Systematic Withdrawal Plan and Systematic Investment Plan

A Systematic Withdrawal Plan (SWP) allows investors to receive a regular income while still managing their investments growth potential. Investors can use a SWP to supplement the income they are receiving from any other source. A SWP includes convenient pay-out options and has several tax advantages. An investor can choose to withdraw from the capital appreciation in the NAV without affecting the principal amount or can withdraw a fixed amount every month or quarter and any amount thereafter.

Systematic Investment Plan (SIP): SIP is a feature specially designed for those who are interested in building wealth over a long-term and plan out a better future for themselves and their family. The SIP allows investors to save a fixed amount of money every month or quarter for the purchase of additional units. Anyone can enroll for this facility by starting an account with minimum investment amount and giving post-dated cheques or ECS of periodic investment every month for a specified period based on one's convenience. This disciplined approach to investing gives advantage like benefit of compounding, rupee cost averaging, convenience and help to build wealth over the long-term and avoiding the risk of timing the market.

7.1.7 Advantages of Mutual Funds

(i) **Professional Management:** Mutual funds are managed by a body of professional managers who are highly experienced and posit requisite skills to manage funds efficiently along with a good research team. The performance of mutual fund schemes depends on the quality of fund manager employed.

(ii) **Diversification:** Mutual funds allocate their funds across industries and sectors. In this way, investors hold a diversified portfolio even with a small amount of investment that would otherwise required a big amount of capital.

(iii) **Convenient Administration:** It reduces administrative jargons, saves time and makes investing easy. It also helps to avoid many problems such as bad deliveries, delayed payments and unnecessary follow up with brokers and companies.

(iv) **Return Potential:** It has been observed that over a medium term to long-term, mutual funds have the potential to provide high return as they invest in a diversified basket of selected securities.

(v) **Low Costs:** Investors bear a low cost by investing in m utual funds as brokerage, custodial and other fees are relatively less as compared to directly investing in the capital markets.

(vi) **Liquidity:** In open-ended schemes, investors can get their money back promptly at net asset value related prices from the mutual fund. With close-end schemes, investors can sell their units on a stock exchange at the prevailing market price or avail of the facility of direct repurchase at NAV related prices which some closed-ended and interval schemes offer periodically.

(vii) **Transparency:** The mutual fund companies regularly disclose to investors their related value of investment/s, in which companies the investments have been made by the scheme, the proportion invested in each class of assets and the fund manager's investment strategy and outlook.

(viii) **Flexibility:** Through features such as systematic investment plans (SIPs), systematic withdrawal plans (SWPs) and dividend reinvestment plans, one can systematically invest or withdraw funds according to his requirements and expediency.

(ix) **Choice of Schemes:** Many mutual funds cater the need of investors and allow them to switch from one fund to another according to investor's choice. For example, if investor's objective changes from capital appreciation (gain) to income, they can switch from growth to income funds and vice-versa.

(x) **Investment Strategy:** Investors individually may lack sufficient funds to invest in blue chip stocks. Whereas, a mutual fund because of its large corpus allows even a small investor to take the benefit of its affordability for investment strategy.

(xi) **Well Regulated:** All mutual funds are registered with SEBI and they function within the provisions of strict regulations designed to protect the interests of investors. The operations of mutual funds are regularly monitored by SEBI.

7.1.8 Limitations of Mutual Funds

(i) Through diversification a mutual fund reduces risk, but it does not ensure against any losses of funds that may occur during turmoil.

(ii) Performance of many funds are below the benchmark due to poor performance of fund managers and policies of the fund houses.

(iii) Investors have no option while choosing the securities they want to invest in.

(iv) Many mutual funds provide positive returns but well below the benchmark level.

(v) Investors rely on the past performance of mutual funds to select a good fund and it may not be a guarantee for a good return in future.

(vi) Despite the liquidity of mutual funds, most mutual funds (particularly open-ended funds) cannot be bought or sold in the middle of the trading day. One can only buy and sell them at the end of the day once current value of holding is calculated.

(vii) Diversification reduces the risk no doubt, however, on the other hand, the diversification has a disadvantage of dilution. This implies that investment in a single security may double or triple its value over a certain period whereas in an MF investment the security counts only a small part.

(viii) If fund manager's pay is linked to performance of the fund, he may be tempted to perform only on short-term neglecting the long run performance of the fund.

(ix) Sometimes excessive management fees is charged by the fund, which reduces the return available to an investor. The annual fund operative fees in India is 1 to 3%. This fees is charged to investors regardless the performance of the fund. If the investment is not sufficiently diversified, it will be a huge loss to the investors.

(x) Mutual funds usually maintain large cash reserves against a large number of simultaneous withdrawals. Although this provides investor with liquidity, it means that some of the fund money is invested in cash instead of assets which tend to lower the investor's potential return.

Solved Questions

1. What are the comparative advantages of investing in the following:

   (a) Open-end mutual funds

   (b) Individual stocks and bonds that you choose for yourself

   Answer:

   (a) **Open-end mutual funds:** Diversification from large-scale investing, lower transactions costs associated with large-scale trading, professional management that may be able to take advantage of buy or sell opportunities as they arise, record keeping.

   (b) **Individual stocks and bonds:** No management fee, ability to coordinate realization of capital gains or losses with investors' personal tax situations, capability of designing portfolio to investor's specific risk and return profile.

2. Open-end equity mutual funds find it necessary to keep a significant percentage of total investments, typically around 5% of the portfolio, in very liquid money market assets. Closed-end funds do not have to maintain such a position in 'cash equivalent' securities. What difference between open-end and closed-end funds might account for their differing policies?

Answer:

Open-end funds are obligated to redeem investor's shares at net asset value and thus must keep cash or cash-equivalent securities on hand in order to meet potential redemptions. Close-end funds do not need the cash reserves because there are no redemptions for closed-end funds. Investors in closed-end funds sell their shares when they wish to cash out.

3. Balanced funds, life-cycle funds and asset allocation funds all invest in both the stock and bond markets. What are the differences among these types of funds?

Answer:

Balanced funds keep relatively stable proportions of funds invested in each asset class. They are meant as convenient instruments to provide participation in a range of asset classes. Life cycle funds are balanced funds whose asset mix generally depends on the age of the investor. Aggressive life cycle funds, with larger investment in equities are marketed to younger investors, while conservative life-cycle funds, with larger investment in fixed income securities, are designed for older investors. Asset allocation funds, in contrast, may vary the proportions invested in each asset class by large amounts as predictions of relative performance across classes vary. Asset allocation funds therefore, engage in more aggressive market timing.

4. Why can closed-end funds sell at prices that differ from net asset value while open-end funds do not?

Answer:

Unlike an open-end fund, in which underlying shares are redeemed when the fund is redeemed, a closed-end fund trades as a security in the market. Thus, their prices may differ from the NAV.

Regulations

7.2

7.2.1 Establishment of a Mutual Fund

1) **SEBI Regulations:** Mutual Funds should be registered with SEBI, for collecting funds from the public. Mutual Funds are governed by SEBI Regulations, are subject to monitoring and inspection by SEBI.

2) **Sponsor:**

   (a) **Meaning:** Sponsor is a Body Corporate who establishes a Mutual Fund after completing the formalities prescribed in the SEBI's Mutual Fund Regulations. A Mutual Fund has to be established through the medium of a sponsor.

   (b) **Conditions:**

   - Sponsor should have a sound track record and general reputation of fairness and integrity in all its business transactions.
   - Sponsor should contribute at least 40% to the Net Worth of the Asset Management Company.
   - A Deed shall be executed by the Sponsor, in favour of the trustees named in the instrument of trust.

3) **Trust:**

   (a) **Constitution:** Mutual Fund should be established as either a Trustee Company or a Trust, under the Indian Trust Act and the instrument of trust shall be in the form of a deed.

   (b) **Registration:** The Trust Deed shall be duly registered under the provisions of the Indian Registration Act, 1908.

   (c) **Contents:** Deed should contain the clauses specified in the Third Schedule of SEBI Regulations.

Eligibility criteria for grant of a certificate of registration as per Regulation 7 of SEBI (Mutual Funds) Regulations, 1996. For the purpose of grant of a certificate of registration, the applicant has to fulfil the following, namely:-

a) The sponsor should have a sound track record and general reputation of fairness and integrity in all his business transactions.

   Explanation: For the purposes of this clause "sound track record" shall mean the sponsor should -

   1. Be carrying on business in financial services for a period of not less than five years; and
   2. The net worth is positive in all the immediately preceding five years; and
   3. The net worth in the immediately preceding year is more than the capital contribution of the sponsor in the asset management company; and

4. The sponsor has profits after providing for depreciation, interest and tax in three out of the immediately preceding five years, including the fifth year.

b) The applicant is a fit and proper person.

c) In the case of an existing mutual fund, such fund is in the form of a trust and the trust deed has been approved by the Board;

d) The sponsor has contributed or contributes atleast 40% to the net worth of the asset management company;

Provided that any person who holds 40% or more of the net worth of an asset management company shall be deemed to be a sponsor and will be required to fulfil the eligibility criteria specified in these regulations.

e) The sponsor or any of its directors or the principle officer to be employed by the mutual fund should not have been guilty of fraud or has not been convicted of an offence involving moral turpitude or has not been found guilty of any economic offence.

f) Appointment of trustees to act as trustees for the mutual fund in accordance with the provisions of the regulations;

g) Appointment of asset Management Company to manage the mutual fund and operate the scheme of such funds in accordance with the provisions of these regulations;

h) Appointment of custodian in order to keep custody of the securities or gold and gold related instrument or other assets of the mutual fund held in terms of these regulations, and provide such other custodial services as may be authorised by the trustees.

Investors looking to invest in mutual funds must be aware of rules and regulations that govern the Indian mutual fund sector – SEBI guidelines for mutual funds.

In India, the SEBI MF Regulations of 1996 govern the working of mutual funds. These guidelines treat mutual funds like Public Trusts that fall under the Indian Trust Act of 1982. For handling mutual funds and ensuring accountability on the trustees, the guidelines specify a three-tier set up comprising of the fund managers, the investors, and the representatives.

SEBI may conduct an on-site due-diligence of the existing businesses of the sponsor to study the following:

1. Existing infrastructure for client servicing, complaints handling;
2. Track record of complaint / grievance handling; and
3. Compliance philosophy and practice.

7.2.2 Restrictions and Conditions for investments by Mutual Funds

(I) Inter-Scheme Transfer: Transfers of Investments from one scheme to another scheme in the same Mutual Fund will be allowed only if —

(a) Market Price: Transfers are done at prevailing market price for quoted instruments on spot basis.

(b) Investment Objective: Securities transferred should be in conformity with the investment objective of the scheme to which such transfer has been made.

(II) Fees for Investment: A Scheme can invest in another scheme — (a) under the same AMC, (b) other Mutual Fund, without charging any fees.

(III) Issue Expenses: Initial Issue Expenses of any scheme should not exceed 6% of funds raised there under.

(IV) Delivery Based Transactions:

(a) Delivery: Mutual Fund should buy and sell securities only on the basis of deliveries. It should take, delivery of the securities for purchases, and deliver the securities in case of sale.

(b) Prohibition: Purchase and sale should not result in a position where the Mutual Fund has to make short sale or carry forward transaction.

(c) Derivative Transaction: Mutual Funds can enter into Derivatives Transactions in a Recognized Stock Exchange for the purpose of hedging and portfolio balancing, in accordance with the guidelines issued by SEBI.

(V) Title: Every MF should get the securities purchased or transferred in the name of Mutual Fund on account of the concerned scheme, wherever investments are intended to be of long-term nature.

(VI) Bank Deposits: Pending deployment of funds of a scheme as per the investment objective, Mutual Funds can invest the same in Short-term Deposits of Scheduled Commercial Banks.

(VII) Restriction on Investments: Investments made by Mutual Funds should confirm to the following limits:

Instrument / Investment in	Quantum of Investment and
(a) Debt instruments of a single issuer and Mortgaged backed Securitised Debt	⅄ 15% of NAV of the Scheme ⅄ 20% with approval of Board of Trustees and AMC ⅄ Govt. Securities and Money Market ⅄ Instruments.
(b) Unrated Debt Instruments (Approval of Board of Trustees and AMC required)	⅄ Individually (for each issuer) - 10% of NAV of Scheme ⅄ Aggregate Investment - 25% of the NAV of Scheme
(c) Share Capital of a Company	⅄ 10% of the Company's Paid Up Capital.
(d) Scheme under the same AMC or other Mutual Fund under the same management or schemes of other AMC	⅄ 5% of the NAV of the Mutual Fund.
(e) Equity Shares or Equity Related instruments of a Company	⅄ 10% of the NAV of the Scheme ⅄ Not applicable to investments in index fund or sector or industry specific scheme
(f) Unlisted Equity Shares/Equity Related instrument — Open Ended Scheme — Close Ended Scheme	⅄ 5% of the NAV of the scheme ⅄ 10% of the NAV of the scheme

(VIII) Prohibited Investments: A Mutual Fund should not invest in -

(a) any unlisted security of an Associate or Group Company of the Sponsor,

(b) any security issued by way of private placement by an Associate or Group Company of the Sponsor,

(c) listed securities of Group Companies of the Sponsor which is in excess of 25% of the Net Assets,

(d) any Fund of a Fund Scheme.

7.2.3 Investors' Rights & Obligations under the Mutual Fund Regulations

(A) Rights:

(i) Unit holder has proportionate right in the beneficial ownership of the scheme assets, as well as any dividend or income declared under the scheme.

(ii) Unit holder is entitled to receive dividend warrant within 42 days.

(iii) AMC can be terminated by 75% of the unit holders.

(iv) Unit Holder has the right to inspect major documents i.e., material contracts, Memorandum of Association and Articles of Association of the AMC, Offer Document, etc.

(v) 75% of the unit holders have the right to approve any changes in the close-ended scheme.

(vi) Every unit holder have right to receive copy of the annual statement.

(B) Limitations to Investors' Rights:

(i) No right against Trust: Unit holders cannot sue the Trust, but they can initiate proceedings against the Trustees, if they feel that they are being cheated.

(ii) No right to sue for lower returns: Except in certain circumstances, AMC cannot assure a specified level of return to the investors. AMC cannot be sued to make good any shortfall in such schemes.

(C) Investors' Obligations:

(i) Study of risk factors: An investor should carefully study the risk factors and other information provided in the Offer Document. Failure to study will not entitle him for any rights thereafter.

(ii) Monitoring schemes: It is the responsibility of the investor to monitor his schemes, by studying the Reports and other Financial Statements of the Funds.

7.2.4 Trustees with regard to setting up of a Mutual Fund and their eligibility for appointment

(A) Meaning: Trustees means Board of Trustees or the Trustee Company who hold the property of the Mutual Fund in trust, for the benefit of the unit holders.

(B) Regulations: Mutual Fund shall appoint trustees in accordance with Mutual Fund regulations.

(C) Eligibility Conditions: A person can be appointed as a Trustee, only if he—

(a) is a person of ability, integrity and standing,

(b) Has not been found guilty of moral turpitude, and

(c) Has not been convicted of any economic offence or violation of any securities laws, and

(d) Has furnished the required particulars and information.

(D) Not Eligible for appointment as Trustee:

(a) Asset Management Company

(b) Officers or Employees of AMC

(E) Restriction on Further Appointment: A person who is appointed as a Trustee of a Mutual fund, cannot be appointed as a Trustee of any other Mutual Fund unless —

(a) He is an independent trustee.

(b) Prior approval of the Mutual Fund of which he is a trustee has been obtained for such an appointment.

(F) Independent Trustees: At least 2/3rd of the trustees should be independent persons and shall not be associated with the sponsors or be associated with them in any manner whatsoever.

(G) Company as Trustee: In case a Company is appointed as a Trustee, then its Directors can act as trustees of any other trust, provided that the object of the trust is not in conflict with the object of the Mutual Fund.

7.2.5 Criteria for appointment of AMC and other conditions to be satisfied by an AMC

(A) Eligibility Criterion:

(i) Financial Performance:

- Sound Track Record (Net Worth and Profitability), good reputation and fairness in transaction.
- Minimum Net Worth = ₹10 Crores.

(ii) Directors / Key Personnel

- **Qualification and Experience:** Directors of AMC to have adequate professional experience in finance and financial services related field.
- **Clean Records:** Should not have been found guilty of moral turpitude or convicted of any economic offence or violation of any securities laws / economic laws.
- **Previous Employment:** They should not have worked for any AMC / Mutual Fund / Intermediary during the period when such AMC / MF / Intermediary were suspended by SEBI.

(iii) Independent Directors: Board of Directors of AMC to have atleast 50% Independent Directors, i.e. not associated with, the sponsor or any of its subsidiaries or the Trustees.

(iv) Chairman: Chairman of the AMC should not be Trustee of any Mutual Fund.

(B) Other Terms and Conditions: Approval granted shall be subject to the following conditions —

(i) Restriction on Directorship: Director of the AMC shall not be Director in another AMC. Independent Directors are excluded from this restriction.

(ii) Furnishing of Particulars: In case of any material change in the information/ particulars previously furnished, AMC should immediately inform the SEBI.

(iii) Appointment of Directors: Appointment of Director of an AMC will require the prior approval of the Trustees.

(iv) Compliance with Regulations: AMC should comply with SEBI Regulations.

(v) Change in Controlling Interest: Change in controlling interest of the AMC will require the prior approval of Trustees, SEBI and the Unit Holders.

(vi) Furnishing of Documents / Information to Trustees: AMC should furnish information and documents to the Trustees as and when required by the Trustees.

(C) Restriction on Activities of AMC:

(i) Not to be Trustee: AMC should not act as a Trustee of any Mutual Fund.

(ii) Business Activities: Without the approval of SEBI, an AMC cannot undertake any other business activities except :-

- Portfolio Management Services,
- Management and advisory services to Offshore Funds, Pension Funds, Provident Funds, Venture Capital Funds, etc.

(iii) Not to Invest in Schemes: AMC should not invest in any of its schemes, unless full disclosure of such intention has been made in the offer document.

Duties and obligations of an AMC with reference to management of Mutual Fund Scheme:

1) **Regulations:** AMC should ensure that the Scheme Funds are invested only in accordance with SEBI Regulations and the Trust Deed.

2) **Investment Decisions:** It should take all its investment decisions with care and diligence, in the same manner as any other person in the same business would have taken.

   (a) Liability for Acts of Persons: AMC is responsible for the acts of commission or omissions by its Employees, or

   (b) Persons whose services have been procured by the AMC.

3) **Non-Exclusion from Liability:** AMC or its Directors or other Officers shall not be absolved of liability to the Mutual Fund for their acts of commission or omission, while holding such position or office.

4) **Activity Report to Trustees:** AMC should submit a report on its activities and the compliance with the SEBI regulations. Such a report should be furnished every quarter.

5) **Related Party Transaction:**

   (a) AMC should not utilize the services of the — (i) Sponsor, or (ii) any of its Associates, or (iii) Employees or their relatives, for any securities transaction and distribution and sale of securities without proper disclosure.

   (b) Report to SEBI/Trustees: Transactions entered into with any of the associates should be reported to SEBI and the Board of Trustees.

   (c) Transactions by Key-Management Personnel: AMC should furnish the details of transactions in securities by the key personnel of the AMC in their own name or on behalf of the AMC and shall also report to SEBI, as and when required by SEBI.

6) **Large Investor Particulars:**

   (a) Situation: Company has invested more than 5% of the NAV of a Scheme.

   (b) Reportable Information: Investment made by the Mutual Fund in that Company/ Subsidiaries.

(c) **Reporting and Disclosure:** The above information should be brought to the notice of the Trustees by the AMC, and disclosed in the half yearly and annual accounts of the respective schemes.

7) **Personnel Related Information:** Detailed bio-data of all its Directors along with their interest in other Companies, within 15 days of their appointment, should be submitted to the Trustees.

8) **Restriction on Appointment of Personnel:** AMC should not appoint any person as key personnel who has been found guilty of any economic offence or involved in violation of securities laws.

9) **Appointment of Registrar/Agents:** AMC shall appoint Registrars and Share Transfer Agents who are registered with SEBI.

7.2.6 Regulatory requirements with regard to Money Market Funds and the issues that act as hurdles for the success of Money Market Mutual Funds

1) **Regulatory Framework:** Instructions based on recommendations of the Task force constituted under the chairmanship of Shri D. Basu on MMMFs were as follows -

   (a) No minimum amount of investments prescribed.

   (b) Minimum lock-in-period is 46 days.

   (c) Minimum of 25 percent of funds (20 percent earlier) shall be invested in treasury bills and dated Government securities having an unexpired maturity upto one year.

   (d) Maximum of 30 percent of funds (20 percent earlier) shall be diverted to call money market.

   (e) Investment in Commercial Papers restricted to 15 percent.

   (f) Maximum of 20 percent of funds may be invested in commercial transactions and accepted/ coaccepted by banks.

   (g) Investments in Capital Market Instruments have been barred so as to avoid undue risks.

   (h) Borrowing and Lending between schemes of the Money Market Mutual Funds and between sponsoring bank and the Money Market Mutual Funds are also prohibited. Switching of assets between Schemes will have to be at market rates and based on conscious investment decisions.

2) **Regulatory impediments for the success of Money Market Funds:**

   (a) The Lock-in period hampers the liquidity of the fund. Money Market Fund should ideally operate like a savings account.

   (b) Investors expect to get more than what they would get on bank fixed deposits. Considering the administrative expenses involved, the yield on Money Market Funds should be relatively higher.

   (c) Retail investors have to be educated about Money Market Funds. A huge network is needed to target such investors.

   (d) A large corpus is needed to deal in the money market on a consistent basis.

   (e) No regulatory body has been determined.

Computation of NAV

7.3

7.3.1 Computation of NAV

Mutual Funds are a vehicle that collects money from investors to buy securities. These investors have a common objective, and this pool of money is advised by the fund manager who decides how to invest the money. A Mutual Fund is an organisation (in India this organisation must be in the form of a trust) that pools the savings of a number of investors called as unit holders who share a common goal. The money thus collected is invested by the professional fund managers in different types of securities depending upon the objectives of the scheme. The return/ loss on investment is shared by the unit holders in proportion to the number of units owned by them.

Net Asset Value

The performance of a particular scheme of a mutual fund is denoted by Net Asset Value (NAV). In simple words, NAV is the market value of the securities held by the scheme. Mutual funds invest the money collected from investors in securities markets. Since market value of securities changes every day, NAV of a scheme also varies on day to day basis. The NAV per unit is the market value of securities of a scheme divided by the total number of units of the scheme on any particular date. The net assets value of any MF scheme is the current value of its all assets net of its liabilities. Division of this amount by number of outstanding units of the scheme, we get NAV per unit. NAV per unit represents the amount which the holder of one unit will get if the scheme is dissolved or liquidated (for this calculation, forced or distress sale is not assumed, moreover the liquidation or dissolution costs are not considered). NAV per unit is generally called as NAV (ignoring the phrase "per unit").

Net Asset Value in Relation to a Mutual Fund

Net asset value (NAV) of a mutual fund (MF) scheme is the market value per unit of all the assets of the scheme. It is the value of each of the scheme. It includes dividends, interest accruals and reduction of liabilities and expenses.

(A) **Ascertainment:**

- (i) The investor's subscription is treated as the capital in the balance sheet of the fund and the investments on their behalf are treated as assets.
- (ii) NAV per unit = Net asset value of the fund ÷ Number of units outstanding.
- (iii) It reflects the realizable value that the investor will get for unit that he is holding if the scheme is liquidated on that date.
- (iv) Net assets = (Market value of investments + Receivables + Accrued income + Other assets) – (Accrued expenses + Payables + Other liabilities).

(B) **Utility**

- (i) The performance of a particular scheme of a mutual fund is denoted by NAV.
- (ii) NAV plays an important part in investor's decisions to enter or to exit the schemes.
- (iii) Analysts use the NAV to determine the yield on the schemes.

Illustration 1

Calculate the NAV of Excellent Fund from the following data:

Size of the fund, ₹300 crore; face value, ₹10 per unit, market value of investment, ₹360 crore; receivables, ₹6 crore; accrued income, ₹4 crore, Liabilities, ₹2 crore; and accrued expenses, ₹1 crore

Solution:

$$\text{NAV} = \frac{\text{Market value of investment} + \text{Receivables} + \text{Accrued income} - \text{Liabilities} - \text{Accrued expenses}}{\text{Number of units outstanding}}$$

$$= \frac{360+6+4-2-1}{\frac{300}{10}} = \frac{367}{30} = ₹12.23 \text{ per unit}$$

Rate of Returns: It is the difference between the net asset value at the end and net asset value at the beginning plus the amount of dividend, if any, declared by the fund. It can be monthly, quarterly, annually or long-term basis.

Illustration 2

A mutual fund has a net asset value of ₹50 at the beginning of the year. During the year, a sum of ₹4 was distributed as income (dividend) besides ₹3 as capital gains distribution. At the end of the year, NAV was ₹55. Calculate total return for the year. Suppose the aforesaid mutual fund in the next year declared a dividend of ₹5 as income distribution and no capital gains distribution and NAV at the end of second year was ₹50, what is the return for the second year?

Solution:

$$\text{Total return in year I} = \frac{\text{Change in NAV} + \text{Distribution (Dividend + Capital)}}{\text{NAV at the begining of the period}}$$

$$= \frac{(55-50)+4+3}{50} = \frac{12}{50} \text{ or } 24\%$$

$$\text{Total return in year II} = \frac{(50-55)+0+5}{50} = 0\%$$

For example, if the market value of securities of a mutual fund scheme is INR 200 lakh and the mutual fund has issued 10 lakh units of INR 10 each to the investors, then the NAV per unit of the fund is INR 20 (i.e. 200 lakh/10 lakh). NAV is required to be disclosed by the mutual funds on a daily basis. Unlike stocks (where the price is driven by the market and changes from minute-to-minute), mutual funds don't declare NAVs through the day. Instead, NAVs of all mutual fund schemes are declared at the end of the trading day after markets are closed, in accordance with SEBI Mutual Fund Regulations. Further, as per SEBI Mutual Fund Regulations, for all mutual fund schemes, other than liquid fund schemes, the mutual fund Units are allotted only at prospective NAV, i.e., the NAV that would be declared at the end of the day, based on the closing market value of the securities held in the respective schemes.

NAV of a fund scheme = (1) Market value of traded listed securities + (2) Estimated value of (i) Non-traded listed securities (ii) Unlisted securities + (3) Liquid assets/ cash + (4) Accrued dividend/interest - (5) Accrued expenses - (6) Other liabilities

Net Asset Value = Net Asset of the Scheme ÷ Number of units outstanding

Illustration 3

Mr. Ajay on 1.7.2020, during the initial offer of some Mutual Fund invested in 10,000 units having face value of ₹10 for each unit. On 31.3.2021 the dividend operated by the M.F. was 10% and Mr. Ajay found that his annualized yield was 153.33%. On 31.12.2022, 20% dividend was given. On 31.3.2023 Mr. X redeemed all his balance of 11,296.11 units when his annualized yield was 73.52%. What are the NAVs as on 31.3.2021, 31.12.2022 and 31.3.2023?

Solution:

Annualized Return = % Return from date of investment to the date on which annualized return is given or calculated ÷ Period of the above return in terms of years.

31.3.2021:

Annualized Return = Return from 1.7.2020 to 31.3.2021 / 0.75 year

or, 153.33 = Return from 1.7.2020 to 31.3.2021 / 0.75 year

Return from 1.7.2020 to 31.3.2021 = 115%

It means the investment made on 1.7.2020 has grown to ₹ 2,15,000 on 31.3.2021

Let the NAV = X

X = [10,000 units + (Amount of dividend/X)] X = 2,15,000

[10,000 units + (₹10,000/X)] X = 2,15,000

NAV = 20.50

Total no. of units = 10487.80

31.12.2022

No of units issued (reinvestment of dividend as on 31.12.2022):

11296.11- 10487.80 = 808.20

NAV = [10487.80 × Dividend per share] /808.20

= [10487.80 × 2] /808.20 = 25.95

31.3.2023

Annualized Return = Return from 1.7.2020 to 31.3.2023 / 2.75 year

73.52 = Return from 1.7.2020 to 31.3.2023 / 2.75 year

Return from 1.7.2020 to 31.3.2023 = 202.18%

It means the investment of ₹1,00,000 made on 1.7.2020 has grown to ₹3,02,180 on 31.3.2023.

NAV = 302180 / 11296.11 = 26.75

Illustration 4

Name of the Scheme	ABC
Size of the Scheme	₹100 lakhs
Face Value of the Share	₹10
Number of the outstanding shares	10 lakhs
Market value of the fund's investments Receivables	₹180 lakhs
Accrued Income	₹1 lakh
Receivables	₹1 lakh
Liabilities	₹50,000
Accrued expenses	₹50,000

Find NAV per unit?

Solution:

NAV per unit = (Investment + Receivables + Accrued Income – Liabilities – Accrued expenses)/No of units (mutual fund) = (180 lakhs + 1 lakh + 1 lakh – 0.50 lakh – 0.50 lakh)/10 lakhs = 18.1 lakhs.

Evaluation of Performance and Movements in Security Values and NAVs of Mutual Funds for Investment Decisions: Perspective of AUM Managers and Individual Investors

7.4

7.4.1 Methods for evaluating the performance of Mutual Fund

1) Sharpe Ratio:

(a) Nature: Sharpe Ratio is a composite measure to evaluate the performance of Mutual Funds by comparing the reward to risk ratio of different funds. This formula uses the volatility of portfolio return.

(b) Basis: The reward, i.e. portfolio return in excess of the average risk free rate of return, is divided by standard deviation. Since it considers standard deviation as a measure of risk, it takes into account both Systematic and Unsystematic Risk.

(c) Risk Premium: This measure indicates the risk premium return per unit of total risk. Excess return earned over the risk free return on portfolio to the portfolio's total risk measured by the standard deviation.

(d) Computation:

Sharpe Ratio = $(R_P - R_F) \div \sigma_P$

Where,

R_P = Return on Portfolio

R_F = Risk Free Return

σ_P = Standard Deviation of Portfolio

(e) Use: Sharpe Ratio is an appropriate measure of performance for an overall portfolio when it is compared with another portfolio. The result on its own cannot lead to any comparison. It has to be compared with returns from other portfolio for making any meaningful conclusion.

2) Treynor's Ratio:

(a) Nature: Treynor Ratio is a measure to evaluate the performance of mutual funds by comparing the reward to volatility ratio of different funds. Risk considered here is only Systematic Risk, and not Total Risk.

(b) Assumption: It assumes a completely diversified portfolio, i.e. that the investor would have eliminated all the unsystematic risk by holding a diversified portfolio.

(c) Basis: Excess return earned over the risk free return on portfolio to the portfolio's total risk measured by the Beta of Portfolio. The ratio expresses the portfolio's risk premium per unit of beta.

(d) Computation:

Treynor's Ratio = $(R_P - R_F) \div \beta_P$

Where, R_P = Return on Portfolio

R_F = Risk Free Return

β_P = Beta of Portfolio

(e) Use: It is appropriate only in case of comparison with completely diversified portfolio. As in the case of Sharpe Ratio, Treynor's measure cannot be used in an isolated manner. It should be compared with such results of other portfolio to draw conclusions.

3) Jensen's Alpha:

(a) Nature: It is an absolute measure of evaluating a fund's performance. It compares desired performance (based on benchmark portfolio) with actual performance.

(b) Benchmark Performance: Benchmark Performance is computed using Capital Asset Pricing Model (CAPM), i.e. by factoring the sensitivity of the portfolio return to that the Market Portfolio.

(c) Computation:

Jensen's Alpha [a] = Actual Return Less Return under CAPM

(d) Evaluation and Appropriateness:

- If Jensen's Alpha is positive, it reflects that the Mutual Fund has exceeded the expectations and outperformed the Market Portfolio and vice-versa.
- Alpha would give meaningful results only if its used to compare two portfolios of similar beta factors.
- It is used for measuring performance of a portfolio and to identify the part of the performance that can be attributed solely to the portfolio.
- This model considers only systematic risk and not the total risk.

Different kinds of expenditure incurred by a Mutual Fund and the way to treat them in computing the net asset value:

(A) Initial Issue Expenses: AMC incur some expenses when a scheme is launched. The benefits of these expenses accrue over many years. Therefore, they cannot be charged to any single year. SEBI permits amortization of initial expenses as follows —

i. Close End Scheme: Such schemes floated on a load basis, the initial issue expense shall be amortized on a weekly basis over the period of the scheme.

ii. Open Ended Scheme: Initial issue expenses may be amortized over a period not exceeding 5 years.

Issue expenses incurred during the life of an open end scheme cannot be amortized.

(B) Recurring Expenses: It includes the followings :-

(i) Marketing and selling expenses including Agent's Commission.	(i) Cost of fund transfers from location to location.
(ii) Brokerage and Transaction Costs.	(ii) Cost of providing accounts statements and dividend/redemption cheques and warrants.
(iii) Registrar Services for transfer of units sold or redeemed.	(iii) Insurance Premium paid by the Fund.
(iv) Audit Fees.	(iv) Winding up costs for terminating a fund or a scheme.
(v) Custodian Charges.	(v) Costs of Statutory Advertisements.
(vi) Costs related to investor communication.	(vi) Other costs as approved by SEBI.

(C) Total Expenses: Total Expenses of the scheme as charged by the AMC excluding issue or redemption expenses but including investment management and advisory fees, are subject to the following limits-

(i) On the first ₹100 Crores of the average weekly Net Assets - 1.5%

(ii) On the next ₹300 Crores of the average weekly Net Assets - 2.25%

(iii) On the next ₹300 Crores of the average weekly Net Assets - 2.0%

(iv) On the balance of the assets 1.75%

7.4.2 Value of Traded Securities and Non-Traded Securities of Mutual Fund

1) Traded Securities:

(a) Last Quoted Closing Price: Traded Securities should be valued at the last quoted closing price on the Stock Exchange.

(b) More than One Stock Exchange: If the securities are traded on more than one Stock Exchange then the valuation should be as per the last quoted closing price on the Stock Exchange where the security is principally traded.

(c) No Trading on Principal Stock Exchange: When on a particular valuation day, a security has not been traded on the selected Stock Exchange, the value at which it is traded on another Stock Exchange may be used.

2) Non-Traded Securities:

(a) Meaning: If a security is not traded on any Stock Exchange for a period of 60 days prior to the valuation date, the scrip must be valued as a non-trade scrip.

(b) Valuation: Non-Traded Scrips should be valued in good faith by the AMC on the basis of valuation methods approved by the AMC.

(c) General Principles in Valuation:

- **Equity Instruments:** Valued on the basis of capitalization of earnings solely or in combination with the Net Asset Value. Price Earning Ratios of comparable traded securities, with an appropriate discount for lower liquidity, should be used for the purpose of capitalization.

- **Debt Instruments:** Valued on YTM (Yield to Maturity) basis. Capitalization factor being determined for comparable traded securities with an appropriate discount for lower liquidity.
- **Government Securities:** Valued at YTM based on the prevailing market rate.
- **Money Market Instruments:** Valued at Cost Plus Accruals.
- **Convertible Debentures/Bonds:** Non-convertible component should be valued as a debt Instrument, and Convertibles as any Equity Instrument.

7.4.3 Computation of the Time Weighted and Rupee Weighted Rate of Return

1) **Total Return (Investors' Perspective):**

Total Return = Distributions + Capital Appreciation NAV at the beginning of the period

Where, Distributions = Dividend Distribution or Capital Distribution Capital Appreciation

= Closing NAV Less Opening NAV

2) **Time Weighted Rate of Return (TWROR):**

(a) It is the rate of return earned per rupee invested over a period of time. It eliminates the effect of additional cash flows and the return on such cash flows.

(b) It seeks to measure the rate of return earned per rupee invested in the fund over a period of time, had there been no withdrawals from or further investments to that rupee.

3) **Rupee Weighted Rate of Return (RWROR):**

(a) This method seeks to measure the internal rate of return based on absolute movements in cash with reference to the Mutual Fund. The Fund Value at the beginning of the year is equated to investment and the dividend distribution and the year end fund value are equated to cash flows received.

(b) **Factors:** Factors affecting the RWROR are —

- Beginning and ending market values.
- Timing of the net contributions to the fund.

Please see Module 10.1 for further discussion

Illustration 5

Chintamani Fund, a fund which invests exclusively in Public Sector Undertakings, yielded ₹3.75 per Unit for the year. The opening NAV was ₹21.20. Chintamani Fund has a risk factor of 3.50%.

Ascertain the Sharpe Ratio and evaluate the funds performance in juxtaposition with performance of the Sensex if —

(a) Risk Free Return is 5%, Return on Sensex is 15% with a standard deviation of 2.75%.

(b) Risk Free Return is 4%, Return on Sensex is 17% with a standard deviation of 3%.

(c) Risk Free Return is 7%, Return on Sensex is 18% with a standard deviation of 4%.

Solution:

1. Formula for Computing Sharpe Ratio.

   Sharpe Ratio = $(R_P - R_F) \div \sigma_p$

   Where, R_P = Return on portfolio

   R_F = Risk Free Return

   σ_P = Standard Deviation of Portfolio

Particulars	Case A	Case B	Case C
Risk Free Return $[R_F]$	5%	4%	7%
Market Return $[R_M]$	15%	17%	18%
Standard Deviation of Market Return $[\sigma_M]$	2.75%	3.00%	4.00%
Sharpe Ratio for Chintamani Fund $[(R_P\text{-}R_F) \div \sigma_p]$ [A]	3.63 [(17.69% - 5%)÷ 3.50%]	3.91 [(17.69% -4%) ÷ 3.50%]	3.05 [(17.69% -7%) ÷ 3.50%]
Sharpe Ratio for Market Return $[(R_M\text{-} R_F)\text{-} \sigma_M]$ [B]	3.64 [(15% - 5%) ÷ 2.75%]	4.33 [(17%-4%) ÷ 3%]	2.75 [(18% -7%) ÷ 4%]
Sharpe Ratio is Higher for	Market Return	Market Return	Chintamani Fund
Inference / Evaluation	Market has outperformed Chintamani Fund's performance.	Market has outperformed Chintamani Fund's performance.	Chintamani Fund has outperformed Market's performance.

Note: Return on Chintamani Fund = Yield ₹ 3.75 ÷ Opening NAV ₹ 21.20 = 17.69%.

Illustration 6

Four friends S, T, U, and V have invested equivalent amount of money in four different funds in tune with their attitude to risk, S prefers to play aggressive and is keen on equity-funds, T is moderately aggressive with a desire to invest upto 50% of his funds in Equity, whereas U does not invest anything beyond 20% in Equity. V, however, relies more on movement of market, and prefers any fund which replicates the market portfolio.

Their investment particulars, returns therefrom and Beta of the fund are given below —

Fund Invested	Return for the year	Beta Factor
Money Multiplier Fund (100% Equity)	23.50%	1.80
Balanced Growth Fund (50% Equity - 50% Debt)	16.50%	1.25
Safe Money Fund (20% Equity and 80% Debt Funds)	12.50%	0.60

If the Market Return was 16% and the Risk Free Return is measured at 7%, which of the four friends were rewarded better per unit of risk taken?

Solution:

Particulars	**S**	**T**	**U**	**V**
Risk Free Return [R_F]	7%	7%	7%	7%
Fund Invested	Money Multiplier Fund	Balanced Growth Fund	Safe Money Fund	Market Portfolio
Beta of the Portfolio [β_P]	1.80	1.25	0.60	1.00
Return on Portfolio [R_P]	23.50%	16.50%	12.50%	16.00%
Treynor Measure [$(R_P-R_F) \div \beta_P$]	9.17 [23.50–7] ÷1.80	7.60 [16.50–7] ÷ 1.25	9.17 [12.50–7] ÷ 0.60	9.00 [16–7] ÷ 1
Ranking	1	3	1	2

Evaluation: Both S and U have earned the same Reward per unit of risk taken, which is more than the Market Reward to Risk of 9.00.

Illustration 7

Following information is available regarding four mutual funds:

Mutual Fund	**Return**	**Risk (σ)**	**β (Beta)**	**Risk free rate**
P	13	16	0.90	10
Q	17	23	0.86	10
R	23	39	1.20	10
S	15	25	1.38	10

Evaluate performance of these mutual funds using Sharp Ratio and Treynor's Ratio. Comment on the evaluation after ranking the funds.

Solution:

Mutual Fund	**Under Sharpe's Method [$(R_P-R_F) \div \sigma_P$]**	**Ranking**	**Under Treynor Method [$(R_P-R_F) \div \beta_P$]**	**Ranking**
P	[(13-10) ÷ 16] = 0.19	4	[(13-10) ÷ 0.90] = 3.33	4
Q	[(17-10) ÷ 23] = 0.31	2	[(17-10) ÷ 0.86] = 8.14	2
R	[(23-10) ÷ 39] = 0.33	1	[(23-10) ÷ 1.20] = 10.83	1
S	[(15-10) ÷ 25] = 0.2	3	[(15-10) ÷ 1.38] = 3.63	3

Inference: Ranks obtained as per sharp Ratio as well as Treynor's Ratio is same. This indicates that all the mutual fund seem to be reasonably well diversified.

Illustration 8

The following particulars are furnished about three Mutual Fund Schemes, P, Q and R

Particulars	Scheme P	Scheme Q	Scheme R
Dividend Distributed	₹1.75	—	₹1.30
Capital Appreciation	₹2.97	₹3.53	₹1.99
Opening NAV	₹32.00	₹27.15	₹23.50
Beta	1.46	1.10	1.40

Ascertain the Alpha of the three schemes and evaluate their performance, if Government of India Bonds carry an interest rate of 6.84% and the NIFTY has increased by 12.13%.

Solution:

Particulars	Scheme P	Scheme Q	Scheme R
Dividend Distributed	₹1.75	-	₹1.30
Add: Capital Appreciation	₹2.97	₹3.53	₹1.99
Total Return [A]	₹4.72	₹3.53	₹3.29
Opening NAV [B]	₹32.00	₹27.15	₹23.50
Actual Return [A] ÷ [B] = [C]	14.75% [4.72 ÷32.00]	13.00% [3.53 ÷ 27.15]	14.00% [3.29 ÷ 23.50]
Beta [D]	1.46	1.10	1.40
Expected Return under CAPM [E(R_P)] [E] $R_F + \beta_P \times (R_M - R_F)$ = 6.84 + [D] × (12.13 - 6.84)	14.56% [6.84 + 1.46 × (12.13 – 6.84]	12.66% [6.84 + 1.10 × 12.13 – 6.84]	14.25% [6.84 + 1.40 × (12.13 – 6.84]
Jensen's Alpha (σ_p) [C] – [E] 0.19%	0.19% (14.75-14.56)	0.34% (13.00-12.66)	(0.25%) (14.00-14.25)
Ranking	2	1	3

ETF, REIT, InvIT

7.5

Exchange Traded Funds (ETF)

ETFs are mutual fund units that investors can buy or sell at the stock exchange. This is in contrast to a normal mutual fund unit that an investor buys or sells from the AMC (directly or through a distributor). In the ETF structure, the AMC does not deal directly with investors or distributors. Units are issued to a few designated large participants called Authorised Participants (APs). The APs provide buy and sell quotes for the ETFs on the stock exchange, which enable investors to buy and sell the ETFs at any given point of time when the stock markets are open for trading. ETFs therefore trade like stocks and experience price changes throughout the day as they are bought and sold. Buying and selling ETFs requires the investor to have dematted and trading accounts. Many investors implicitly assume that the price of exchange-traded funds (ETFs), vehicles that provide passive exposure to a basket of securities and real-time liquidity, stays extremely close to their net asset value (NAV).

Real Estate Investment Trusts (REIT)

Real Estate Investment Trusts (REITs) are investment vehicles that invest in the mortgage market. Although extensive research has been performed on traditional REITs, with a focus on the commercial real estate market, little research has been performed on the valuation of mortgage REITs, particularly agency mortgage REITs. Investment in REITS easier than investment in Real Estate properties. REITs stocks are listed in stock market; hence details will be available on public domain. REITs allow anyone to invest in portfolios of real estate assets the same way they invest in other industries – through the purchase of individual company stock or through a mutual fund or exchange traded fund (ETF). Direct investment in real estate property is very capital intensive. Capital appreciation can be phenomenal.REITs generate income in form of dividend. REITs dividend payment is relatively assured as most of their income is in the form of rental (lease) income. Dividend earned by the investors of REIT will be tax free.

Infrastructure Investment Trusts (InvIT)

An InvIT is established as a trust and is registered with the SEBI. They are required to be registered with SEBI as debenture trustees. Also, they are required to invest at least 80% into infra assets that generate steady revenue. An infrastructure investment trust, simply put, is a pooled investment vehicle like a mutual fund. While mutual funds invest the sum received in financial securities, an InvIT invests the same in real infrastructure assets like roads, power plants, transmission lines, pipelines etc. InvIT is a business trust (like REIT), registered with the market regulator, that owns, operates, and manages operational infrastructure assets. These long-term revenue-generating infrastructure assets, in turn generate cash flows, which are then distributed to the unit holders periodically. InvITs are a hybrid between equity and debt investment, i.e., it has features of both equity and debt. While the operating business model helps provide stable, predictable, and relatively low-risk cash flows like debt, there is growth potential like equity as the returns are not fixed with a scope of change in the unit price. As a body corporate of LLP, an investment manager supervises all the operational activities surrounding InvITs.

7.5.1 Exchange Traded Funds (ETF)

Features of ETFs: ETFs offer a number of unique characteristics including the following.

a) Dynamic Pricing: Though in terms of generic nature, ETFs resemble mutual funds, they are traded intra-day in stock exchanges just like shares and hence are continuously priced.

b) Similar to Derivatives: Similar to derivatives, ETFs track a given underlying (share, bond, metal or any index). As a result their value fluctuates with the fluctuations in the price of the underlying. For example, Gold ETFs have physical gold as their underlying. Hence the price and NAV of Gold ETFs fluctuate with the price of physical gold.

c) High Transparency: Since ETFs are designed to replicate the performance of their underlying, investors are least assured about the composition of their portfolios. Additionally, due to efficient disclosure practices adopted by them, it is possible to access information such as expense ratio, portfolio holding etc. frequently.

d) Tax Efficiency: ETFs are mostly passively managed and hence are characterized by lower turnover and less realized capital gains. Since these capital gains are actually shared by the investors, ETFs offer greater tax efficiency.

e) Low Cost: Due to its passive management style, ETFs pay lower management and administrative fees as compared to traditional actively managed mutual funds. Lower cost positively affects the returns of ETFs.

f) High Liquidity: ETFs are highly liquid as the shares are traded on a real time basis. Hence investors can easily sell their holding and realize their investment at an efficient price. In case of traditional mutual funds redemption requests are processed only at the closing NAV.

g) Diversification and Precision: Through index ETFs investors can invest in multiple securities and can enjoy better diversification. In case of other ETFs which invest in a particular asset class the precision is really appreciable.

Advantages and Disadvantages of Exchange Traded Funds versus Mutual Funds

Advantages of an ETF over a Mutual Fund:

(a) ETF are continuously traded and can be sold or purchased on margin.

(b) There are no capital gains tax triggers when an ETF is sold (shares are just sold from one investor to another).

(c) Investors buy from brokers; thus eliminating the cost of direct marketing to individual small investors. This implies lower management fees.

Disadvantages of an ETF over a Mutual Fund:

(a) Prices can depart from NAV (unlike an open-end fund).

(b) There is a broker fee when buying and selling (unlike a no-load fund).

7.5.2 Real Estate Investment Trust (REIT)

A Real Estate Investment Trust is a corporation or a business trust that combines the capital of many investors to acquire (or provide financing for) various real estate assets. Investors are able to invest in a professionally managed portfolio of real estate assets. The structure also qualifies as a pass-through entity and distributes maximum portion of its earnings as dividends to shareholders. One of the major advantages of this investment is its liquidity as compared to traditional direct investment and through private equity route, which offer low liquidity on investment. The primary reason for the liquid nature of REITs is that they are traded in major exchanges as any ordinary share of a company. It provides the advantage of portfolio diversification and long-term capital appreciation.

REIT's were first introduced by SEBI in 2007 and are monitored and regulated by the SEBI to ensure adherence to industry practices and safeguard the interest of the investors.

(a) It must be structured either as a corporation, a business trust or similar association.

(b) A board of Directors or trustees must manage it.

(c) Shares are fully transferable.

(d) Minimum number of shareholders should be 100 and five or less members should not hold more than 50 per cent of the shares.

(e) 90% of the income must be distributed as a dividend.

(f) 80% of the investment must be in properties that generate revenue.

(g) Only 10% of the total investment must be in real-estate under construction.

(h) Derive at least 75 per cent of gross income from rents or mortgage interest.

(i) Have no more than 20% of its assets in stock in taxable REIT subsidiaries.

(j) The company must have an asset base of ₹500 crore.

(k) NAVs need to be update twice in each financial year.

Working of REIT

(a) REIT industry boasts of a diverse profile that offers investors a chance to make investments in real-estate related funds. REIT could be classified as **Equity REIT** and **Mortgage REIT**.

(b) Equity REIT hold in their vicinity properties such as offers, hotels, shopping centers, condominiums and draw most of their revenues from the rent of these properties.

(c) Mortgage REIT looks over the financing of the properties that may be residential or commercial in nature, thereby drawing income from interest earned on the investment in mortgages or mortgage-backed securities.

Types of REITs

(a) **Equity REITs:** They are the owners of the real estate properties and lease it to companies or individuals to make money. The income is then distributed among the REIT investors as a dividend.

(b) **Mortgage REITs:** They are not the owners but get EMIs against the property from the owners and builders. The earnings are via net interest margin (difference of interest earned on mortgage and cost of funding the loan) which they distribute among the REIT investors as a dividend.

(c) **Hybrid REITs:** Invest in both equity and mortgage REITs.

Difference Between REIT and Real Estate Mutual Fund

REITs and real estate mutual funds are different but they are similar as they both offer liquidity and a cheap way to get exposure to diversified and large capital real estate assets. Long-term investors have the potential to reap the rewards of dividend income and capital appreciation over a long period of time.

For retail or short-term investors with a low investible surplus, these real estate funds create an opportunity to invest in properties that otherwise may not be feasible to invest in. A real estate fund can invest in a real estate investment trust to offer benefits to investors, making REIT a part of the investment.

(a) Real estate mutual funds offer wider diversification than the REITs based on the investment strategy and have the benefits of experts and professionals managing their portfolio, unlike the REITs.

(b) REITs distribute a higher amount of dividend each year to its shareholders or investors than REMFs.

(c) In case of continuous inflationary trend, the return to the REIT, investor will be better than REMF investors.

(d) REIT or REMF investment should be spread across several real estate categories or funds so as to minimize the risk and it should not be more than 10% of the portfolio.

The RBI's proposal to allow banks to invest in REITs will propel a lot of companies to bring in their REITs and get it listed on the exchange. REITs are governed by SEBI and thus are looked as a sure measure by the GoI to pool in greater investments in India's realty sector. Once the REITs are up and ready for the investment we can hope to see an increase in the retail sector participation.

7.5.3 Infrastructure Investment Trusts (InvIT)

InvITs (Infrastructure Investment Trust)

Infrastructure investment trusts are investment instruments that work like mutual funds and are regulated by the Securities and Exchange Board of India. Abbreviated as InvITs, their units are listed on different trading platforms like stock exchanges and are a wholesome combination of both equity and debt instruments.

The primary objective of InvITs is to promote the infrastructure sector of India by encouraging more individuals to invest in it and can be modified according to a given situation. Typically, such a tool is designed to pool money from several investors to be invested in income-generating assets. The cash flow thus generated is distributed among investors as dividend income. When compared to Real Estate Investment Trust or REITs, the structure and operation of both are quite similar.

Structure of InvITs in India

An InvIT is established as a trust and is registered with the SEBI. Typically, infrastructure investment trust SEBI comprises 4 elements, namely –

- **Trustee:** They are required to be registered with SEBI as debenture trustees. Also, they are required to invest at least 80% into infra assets that generate steady revenue.
- **Sponsor:** Typically, a body corporate, LLP, promoter or a company with a net worth of at least ₹ 100 crore classifies as a sponsor. Further, they must hold at least 15% of the total InvITs with a minimum lock-in period of 3 years or as notified by any regulatory requirement. When it comes to a public-private partnership or PPP projects, sponsors serve as a Special Purpose Vehicle (SPV).
- **Investment manager:** As a body corporate of LLP, an investment manager supervises all the operational activities surrounding InvITs.

- **Project manager:** The authority is mostly responsible for executing projects. However, in the case of PPP projects, it serves as an entity that also supervises ancillary responsibilities.

The table below highlights the structure of infrastructure investment trust.

Elements	Role
Trustee	Invest a minimum of 80% in infra assets.
Sponsor/s	Holds 15% of the total InvITs.
Investment manager	Manages investment and supervises operational activities concerning InvIT.
Project manager	Executes projects.

Purpose of InvITs

The purpose of InvITs is to enable Infrastructure Companies to repay their debt obligation quickly and effectively. Since infrastructure-oriented projects tend to take time to generate substantial cash flow, InvITs come in handy for paying off loan interests and other expenses conveniently.

Advantages of InvITs

Though InvITs were regarded as one of the most expensive investment avenues previously, they tend to offer several benefits to investors.

The following highlights the most prominent benefits of infrastructure trusts in general.

- **Diversification**

  InvITs with multiple assets offer individuals an opportunity to diversify their investment portfolio. Such a feature directly helps lower associated risks and further allows investors to generate steady returns in the long run.

- **Accrues fixed income**

  The option to redistribute risks and accrue a fixed income serves as a potent alternative for generating fixed income, especially for retirees. Also, including such an investment tool would help those who intend to plan retirement effectively.

- **Liquidity**

  Generally, it is easy to enter or exit from infrastructure investment trust, which directly enhances their liquidity aspect. However, small investors may find it challenging to sell a high-valued property quickly.

- **Quality asset management**

  InvITs offers investors the opportunity to get their assets managed professionally. It not only ensures effective management and allocation of resources but also helps to prevent fragmentation of holdings.

  Nevertheless, the pointers below help to understand how different elements tend to benefit by investing in an infrastructure investment trust.

- **Investors**

  Parking funds into this investment option allows investors to generate fixed returns on the same. For instance, an infrastructure investment trust has to distribute 90% of its total net cash flow to its investors. It means that investors can generate steady earnings throughout the course of investment.

  Additionally, investors also receive dividend income on their investment in case the InvITs have surplus cash flow.

- **Promoters**

  By investing in InvITs, promoters would be able to lower their debt burden significantly via an asset sale. Further, promoters can use the proceeds to reinvest in other portfolio projects.

Disadvantages of InvITs

Although investors can benefit in several ways by parking their funds in InvITs, they are exposed to certain drawbacks as well. Consequently, to make the most of such an investing option, individuals should weigh the pros and cons beforehand to streamline the process effectively.

For instance, the following highlights the significant drawbacks of this investment tool.

- **Regulatory risk**

  Even the slightest change in the regulatory framework like taxation or policies concerning the infrastructure sector would have a ripple effect on InvITs.

- **Inflation risk**

  A high rate of inflation has a significant impact on the performance of infrastructure investment trusts. For instance, inflation may increase the sector's operating cost. Further, an increase in the toll rates would lower the prospect of generating substantial returns.

- **Asset risk**

  Typically, investment in infrastructure has a long gestation period, and hence the process of generating returns is often delayed. Such a delay not only takes a toll on the cash flow but further hampers profit projections.

Additional Illustrations

1. Mr. Shyam invested in a mutual fund when the NAV was ₹12.65 per unit. 60 days later the asset value per unit of the fund was ₹12.25. In the meantime, Shyam had received a cash dividend of ₹0.50 and a capital gain distribution of ₹0.30. Compute the monthly return.

   Solution:

   [Divided + Capital gain distribution + Capital appreciation] / Opening NAV

   = (0.50 + 0.30 – 0.40)/12.65 = 3.16%

   Annualized return = (Return × 365)/60 days = 19.22% p.a.

   Monthly return = 19.22/12 or 1.60% p.m.

2. Mr. Sharma can earn a return of 16% by investing in equity shares of his own. Now he is considering a recently announced equity-based mutual fund scheme in which initial expenses are 5.7 percent and annual recurring expenses are 1.7 percent. How much should the mutual fund earn to provide Mr. Sharma a return of 16 percent?

   Solution:

   Let the return on mutual fund be ₹X.

   Investor's expectation denotes the return from the amount invested.

   $$\text{Returns from mutual funds} = \frac{\text{Investor's expectations}}{100 - \text{Issue expectations}} + \text{Annual recuring expenses}$$

   $$X = \frac{16}{1-0.057} + 1.7 \qquad = 16.96 + 1.7 \qquad = 18.67\%$$

   The Mutual Fund should earn so as to provide a return of 16% = 18.67%.

3. You have purchased 2000 shares of India Hope Fund which had a net asset value of ₹10.00 per unit at the beginning of the year. The fund deducted a front-end load of 5%. The securities in the fund increased in value by 10% during the year. The fund's expense ratio is 1.1%. What is your rate of return on the fund if you sell your shares at the end of the year?

Solution:

Initial investment = (₹10×2000)/0.95 = ₹21052.63.

The ending value of the shares includes the increase of 10% minus the expense ratio of 1.1%

Ending value = ₹20,000 × (1.10-0.011) = ₹21,780.

The returns are equals to:

(Ending value – Beginning value) – 1 = (₹21780.00/21052.63) –1 = 3.46%

4. You are considering an investment of ₹5,000 in a mutual fund with a 6% load and an annual expense ratio of 0.8%. You plan to invest for five years. Assume the portfolio rate of return net of operating expenses is 10% annually. What is the value of portfolio after five years?

Solution:

Investment of ₹5,000 with a 6% front-end load comes to ₹5,000×(1–0.06) = ₹4,700

The net annual return is (10.00%-0.80%) = 9.20%

The future value equals to ₹4,700×$(1.092)^5$ = ₹7,298.12 (4700×1.5528)

5. (a) An open-end fund has a net asset value of ₹10.80 per unit. It is sold with a front load of 6%. What is the offering price?

   (b) If the offering price of an open-end fund is ₹12.50 per unit and the fund is sold with a front load of 5%, what is the net asset value?

Solution:

(a) Offering price = $\dfrac{\text{NAV}}{1-\text{Load / Expenses}} = \dfrac{₹\,10.80}{1-0.06} = ₹\,11.49$

(b) NAV = Offering × (1–Load) = ₹12.50 × (1–0.05) = ₹11.88

6. (a) The composition of Good hope fund portfolio is as follows:

Stock	Shares	Price/Unit (₹)
P	2,00,000	35
Q	3,00,000	40
R	4,00,000	20
S	6,00,000	25

The fund has not borrowed any funds, but its accrued management fee with the portfolio manager currently totals ₹30,000. There are 4 million units outstanding. What is the net asset value of the fund?

(b) If during the year the portfolio manager sells all of the holdings of stock S and replaces it with 2,00,000 shares of stock T at ₹50 per share and 2,00,000 shares of stock U at ₹25 per share, what is the portfolio turnover rate?

Solution:

(a)

Stock	Value of Stock held by Fund (₹)
P	70,00,000
Q	1,20,00,000
R	80,00,000
S	1,50,00,000
Total	4,20,00,000

$$\text{Net asset value} = \frac{4,20,00,000 - 30,000}{40,00,000} = ₹\,10.49$$

(b) Value of stock replaced

(i) S – 2,00,000 shares @ ₹50 per share = ₹1,00,00,000

(ii) U - 2,00,000 shares @ ₹25 per share = ₹ 50,00,000

1,50,00,000

$$\text{Turnover rate} = \frac{1,50,00,000}{4,20,00,000} = 0.3571 \text{ or } 35.71\%$$

7. Closed-end fund of 'X' has a portfolio currently worth ₹200 million. It has liabilities of ₹3 million and 5 million shares outstanding.

(a) What is the NAV of the fund?

(b) If the fund sales for ₹36 per unit, what is the premium or discount as a percent of net asset value?

Solution:

(a) $$\text{NAV} = \frac{₹2,00,000,000 - 30,00,000}{50,00,000} = ₹39.40$$

(b) $$\text{Premium (or discount)} = \frac{\text{Price} - \text{NAV}}{\text{NAV}} = \frac{36 - 39.40}{39.40} = -\,8.63\%$$

The fund sells at a 8.63% discount from NAV

8. (a) A mutual fund started the year with a net asset value of ₹12.50 per unit. By year end, its NAV equals ₹12.10 per unit. The fund paid year-end distributions of income and capital gains of ₹1.50 per unit. What was the pre-tax rate of return to an investor in the fund?

(b) A closed-end fund starts the year with a net asset value of ₹12.50. By year-end, NAV equals ₹12.10. At the beginning of the year, the fund was selling at a 2% premium to NAV. By the end of the year, the fund is selling at a 7% discount to NAV. The fund paid year-end distributions of income and a capital gain of ₹1.50.

(i) What is the rate of return to an investor in the fund during the year?

(ii) What would have been the rate of return to an investor who held the same securities as the fund manager during the year?

Solution:

(a) $$\frac{(NAV_1 - NAV_0) + \text{Distributions}}{NAV_0} = \frac{(₹\,12.10 - ₹\,12.50) + ₹\,1.50}{₹\,12.50} = 0.088 \text{ or } 8.8\%$$

(b) Start of the year price: P_0 = ₹12.00 × 1.02 = ₹12.24

(i) End of year price P_1 = ₹12.10 × 0.93 = ₹11.25

Although NAV increased by ₹0.10, the price of the fund decreased by ₹0.99

$$\text{Rate of return} = \frac{(P_1 - P_0) + \text{Distributions}}{P_0} = \frac{₹\,11.25 - ₹\,12.24 + ₹\,1.50}{₹12.24} = 0.042 \text{ or } 4.20\%$$

(ii) An investor holding the same security as the fund manager would have earned a rate of return based on the increase in the NAV of the portfolio:

$$\frac{(NAV_1 - NAV_0) + \text{Distributions}}{NAV_0} = \frac{₹\,12.10 - ₹\,12.00 + ₹\,1.50}{₹\,12.00} = 13.33\%$$

9. Mr. Rakash Yadav has invested in three mutual fund schemes as given below:

Particulars	Scheme A	Scheme B	Scheme C
Date of investment	1-4-2023	1-5-2023	1-7-2023
Amount of investment	12,00,000	4,00,000	2,50,000
Net asset value (NAV) at entry date	10.25	10.15	10.00
Dividend declared up to 31-7-2023	23,000	6,000	NIL
NAV as at 31-7-2023 (₹)	10.20	10.25	9.90

You are required to calculate the effective yield on per annum basis in respect of each of the three schemes to Mr. Rakash Yadav up to 31-7-2023.

Solution:

Schemes	Investment (₹)	Unit Numbers (Investment/NAV at Entry Date)	Unit NAV 31/7/2023 (₹)	Total NAV 31/7/2023 (Unit Numbers × Unit NAV as on 31/7/2023 (₹)
MF A	12,00,000	1,17,073.17	10.20	11,94,146.33
MF B	4,00,000	39,408.87	10.25	4,03,940.92
MF C	2,50,000	25,000.00	9.90	2,47,500.00

Schemes	NAV (+)/(-) (NAV as on 31/7/2023 – Investment	Dividend Received	Total Yield Change in NAV + Dividend	Number of Days	Effective Yield (% p.a.) (Total Yield/Investment) × (365/No. of Days) × 100
MF A	(-) 5,853.67	23,000	17,146.33	122	4.275%
MF B	(+) 3,940.92	6,000	9,940.92	92	9.86%
MF C	(-) 2,500.00	NIL	(-) 2500.00	31	-11.77%

10. On 01-07-2020, Mr. X invested ₹50,000 at an initial offer in mutual funds at a face value of ₹10 each per unit. On 31-3-2021, a dividend was paid @ 10% and the annualized yield was 120%. On 31-3-2022, 20% dividend and capital gain of ₹0.60 per unit was given. Mr. X redeemed all his 6271.98 units when his annualized yield was 71.50% over the period of holding. Calculate NAV as on 31-3-2021, 31-3-2022 and 31-3-2023.

Solution:

Yield for 9 months (120% × 9/12) = 90%

Market value of investments as on 31-3-2021 = ₹50,000 + (50000×90%) = ₹95,000

Therefore, NAV as on 31/3/2021 = (₹95,000 –₹5,000)/5,000 =₹18.00

Since dividend was reinvested by Mr. X, additional units acquired = $\frac{₹\,5,000}{₹\,18}$ = 277.78 units.

Therefore, number of units as on 31-3-2021 = 5000 + 277.78 = 5277.78

Alternatively, (₹95,000/₹18) = 5277.78 units

Dividend as on 31-3-2022 = 5277.78 × ₹10 × 0.2 = ₹10,555.56

Let X be the NAV as on 31-3-2022, then number of new units reinvested will be ₹10,555.56/X.

Accordingly, 6271.98 units shall consist of reinvested units of 5277.78 (as on 31-3-2021).

Thus, by way of equation it can be shown as follows:

$$6271.98 = \frac{₹\,10,555.56}{X} + 5277.78$$

or X = ₹10,555.56/(6271.98-5277.78) = ₹10.62

NAV as on 31-3-2023 = ₹50,000 (0.715×33/12)/6271.98 = ₹15.68

11. There are two mutual funds viz. X mutual fund and Y mutual fund. Each having closed-ended equity schemes. NAV as on 31-12-2023 of equity schemes of X mutual fund is ₹70.71 (consisting 99% equity and remaining cash balance) and that of Y mutual fund is ₹62.50 (consisting 96% equity and balance in cash).

Following is the other information:

Particulars	Equity Schemes	
	X Mutual Fund	Y Mutual Fund
Sharpe ratio	2	3.3
Treynor ratio	15	15
Standard deviation	11.25	5

There is no change in portfolios during the next months and annual average cost is ₹3 per unit for the schemes of both the mutual funds. For calculation, consider 12 months in a year and ignore number of days for particular month. Calculate NAV after one month if the market goes down by 5%.

Solution:

Working Notes:

(i) Decomposition of funds in equity and cash components

	Mutual Fund X	Mutual Fund Y
NAV on 21/12/23 (₹)	70.71	62.50
(%) of Equity	99%	96%
Equity element in NAV	₹70.00	₹60.00
Cash element in NAV	₹0.71	₹2.50

(ii) Calculation of Beta

(a) 'X' mutual fund

$$\text{Sharpe ratio} = 2 = \frac{E(R) - R_f}{\sigma_x} = \frac{ER - R_f}{11.25}$$

or $E(R) - R_f = 22.50$

$$\text{Treynor ratio } = 15 = \frac{E(R) - R_f}{\beta_x} \quad \text{or } 15\beta_x = 22.50 \Rightarrow \beta_x = 22.50/15 \text{ or } 1.50$$

(b) 'Y' mutual fund

$$\text{Sharpe ratio } = 3.3 = \frac{E(R) - R_f}{\sigma_y} = \frac{E(R) - R_f}{5} \quad \text{or } E(R) - R_f = 16.50$$

$$\text{Treynor ratio} = 15 = \frac{E(R) - R_f}{\beta_y} = \frac{16.50}{\beta_y} \quad \text{or } \beta_y = \frac{16.50}{15} = 1.1$$

(iii) Decrease in the value of equity

	Mutual Fund X	Mutual Fund Y
Market goes down by	5.00%	5.00%
Beta	1.50	1.10
Equity component goes down	7.50%	5.50%

(iv) Balance of cash after 1 month

	Mutual Fund X	Mutual Fund Y
Cash in hand on 31-12-23	₹0.71	₹2.50
Less: expenses per month	₹0.25	₹0.25
Balance after 1 month	0.46	₹2.25

NAV after 1 month

	Mutual Fund X	Mutual Fund Y
Value of equity after 1 month		
70×(1-0.075)	₹64.75	--
60×(1-0.055)	--	₹56.70
Cash balance	0.46	2.25
Balance after 1 month	65.21	58.95

12. Mr. Z has invested in the three mutual funds as per the following details:

	MF 'X'	MF 'Y'	MF 'Z'
Amount of investment (₹)	2,00,000	4,00,000	2,00,000
Net assets value (NAV) at the time of purchase (₹)	10.30	10.10	10.00
Dividend received upto 31/03/2023 (₹)	6,000	NIL	5,000
NAV as on 31/03/2023 (₹)	10.25	10.00	10.20
Effective yield p.a. as on 31/03/2023	9.66	-11.66	24.15

Assume 1 year = 365 days

Mr. Z has misplaced the documents of his investment. Help him in finding the date of his original investment after ascertaining the following:

(i) Number of units in each scheme

(ii) Total net present value

(iii) Total yield

(iv) Number of days of investment held

Solution:

(i) Number of units in each scheme

MF 'X' ________ $\frac{₹\ 2,00,000}{₹\ 10.30} = 19,417.48$

MF 'Y' ________ $\frac{₹\ 4,00,000}{₹\ 10.10} = 39,603.96$

MF 'Z' ________ $\frac{₹\ 2,00,000}{₹\ 10.00} = 20,000.00$

(ii) Total NAV as on 31/3/2023

MF 'X' ________	19,417.48 × ₹10.25	=	₹1,99,029.17
MF 'Y' ________	39,603.96 × ₹10.00	=	₹3,96,039.60
MF 'Z' ________	20,000 × ₹10.20	=	₹2,04,000.00
			₹7,99,068.77

(iii) Total yield

Name of Mutual Funds	Capital Yield	Dividend Yield	Total
MF 'X'	₹1,99,029.17 - ₹2,00,000 = - ₹970.83	₹6,000	₹5,029.17
MF 'Y'	₹3,96,039.60 - ₹4,00,000 = - ₹3,960.40	NIL	-3,960.40
MF 'Z'	₹2,04,000 - ₹2,00,000 = ₹4,000	₹5,000	₹9,000.00
		Total	10,068.77

$$\text{Total yield} = \frac{₹\,10068.77}{₹\,8,00,000} \times 100 = 1.2586\%$$

(iv) No. of days investment was held

	MF 'X'	MF 'Y'	MF 'Z'
Let number of days be	X	Y	Z
Initial Investment	2,00,000	4,00,000	2,00,000
Yield (₹)	5029.17	-3960.40	9,000
Yield (%)	2.5146	-0.9901	4.5
Period of holding (Days)	(2.5146 ÷ 9.66) × 365 = 95 days	[(-0.9901) ÷ (-11.66)] × 365 = 31 days	(4.5 ÷ 24.15) × 365 = 68 days
Date of Original Investment	26.12.22	28.02.23	22.01.23

13. Consider the recent performance of the closed fund, a closed-end fund devoted to finding underdeveloped, thinly traded stocks:

Period	NAV (₹)	Premium/Discount (%)
0	10.00	0.0
1	11.25	-5.0
2	9.85	+2.3
3	10.50	-3.2
4	12.30	-7.0

a. Calculate the average return per period for an investor who bought 100 shares of the closed fund at the invitation and then sold her position at the end of period 4.

b. What was the average periodic growth rate in NAV over that same period?

c. Calculate the periodic return for another investor who bought 100 shares of closed fund at the end of period 1 and sold his position at the end of period 2.

d. What was the periodic growth rate in NAV between periods 1 and 2?

Solution:

Period	NAV (₹)	Premium/Discount (%)	Price	Annual Rating
0	10.00	0.0	10.00	---
1	11.25	-5.0	10.69	6.97
2	9.85	+2.3	10.08	-5.7
3	10.50	-3.2	10.16	0.8
4	12.30	-7.0	11.44	12.6

a. Using the above data, the arithmetic average return per year is 3.65%. On an annual compound (geometric average) basis, the average annual return is 3.42%. This later answer is the same as if the annual return is computed using only the end points, shares were worth ₹11.44 at the end of year 4 and were purchased for ₹10.00, giving a compounded return of $(₹11.44/₹10.00)^{0.25} – 1 = 3.42\%$

b. $(₹12.30/10)^{0.25} – 1 = 5.31\%$

c. Ignoring commission, shares were purchased ₹10.69 and sold at ₹10.08, a return of –5.7%

d. Change in NAV is ₹1.40 (₹9.85–11.25); the percentage change is ₹1.40/₹11.25 = –12.44%

14. A mutual fund having 300 units has shown its NAV of ₹8.75 and ₹9.45 at the beginning and the end of the year respectively. The Mutual fund has given two options to the investors:

(i) Get dividend of ₹0.75 per unit and capital gain of ₹0.60 per unit, or

(ii) These distributions are to be reinvested at an average NAV of ₹8.65 per unit.

What difference would it make in terms of returns available and which option is preferable by the investors?

Solution:

Option 1: When Dividend and Capital Gain are paid:

Calculation of monthly return on the mutual funds:

$$r = \frac{(NAV_1 - NAV_0) + \text{Distribution}}{NAV_0}$$

$$= \frac{(₹9.45 - ₹8.75) + (₹0.75 + ₹0.60)}{8.75}$$

$$= \frac{0.70 + 1.35}{8.75}$$

$$= 23.43\%$$

Option 2: When Dividend and Capital gain are reinvested:

If all dividends and capital gain reinvested into additional units are ₹8.65 per unit the position would be.

Total amount reinvested	= ₹1.35 × 300	= ₹405
Additional units added	$= \frac{₹405}{8.65}$	= 46.82 units or 47 units
Value of units at the end	= 346.82 units × ₹9.45	= ₹3,277.45
Or	= 347 units × ₹9.45	= ₹3,279.15

Price paid for 300 units as the beginning = (300 × 8.75) = ₹2,625

Return = (₹3,277.45 – ₹2,625) / ₹2,625 = 24.86%

Or Return = (₹3,279.15 - ₹2,625)/(₹2,625) = (₹654.15)/(₹2,625) = 24.92%

From the above, it can be said the reinvestment option is better.

15. Orange purchased 200 units of Oxygen Mutual fund at ₹45 per unit of 31st December 2022. In 2023, he received ₹1.00 as dividend per unit and a capital gains distribution of ₹2 per unit. Required:

(i) Calculate the return for the period of one year assuming that the NAV as on 31st December 2023 was ₹48 per unit

(ii) Calculate the return for the period of one year assuming that the NAV as on 31st December 2023 was ₹48 per unit and all dividends and capital gains distributions have been reinvested at an average price of ₹46.00 per unit.

Ignore Taxation.

Solution:

(i) Returns for the year (All changes on a Per-Unit Basis)

Change in price:	₹48 – ₹45 =	₹3.00
Dividends received:		₹1.00
Capital gains distribution		₹2.00
Total return		₹6.00
Holding period return:	(₹6.00 / ₹45)×100 = 13.33%	

(ii) When all dividends and capital gains distributions are re-invested into additional units of the fund @(₹46/unit)

Dividend + Capital gains per unit	= ₹1.00 + ₹2.00 = ₹3.00
Total received from 200 units	= ₹3.00 × 200 = ₹600/-
Additional units acquired	₹600/₹46 = 13.04 Units
Total No. of Units	200 units + 13.04 units = 213.04 units
Value of 213.04 units held at the end of the year	= 213.04 units × ₹48 = ₹10225.92
Price paid for 200 units at the beginning of the year	= 200 units × ₹45 = ₹9,000.00
Holding Period Return ₹(10,225.92 – 9,000.00)	= ₹1,225.92
Holding Period Return	₹1,225 / ₹9,000 × 100 = 13.62%

16. During the year 2023 an investor invested in a mutual fund. The capital gain and dividend for the year was ₹3.00 per unit, which were re-invested at the year end NAV of ₹23.75. The investor had total units of 26,750 as at the end of the year. The NAV had appreciated by 18.75% during the year and there was an entry load of ₹0.05 at the time when the investment was made. The investor lost his records and wants to find out the amount of investment made and the entry load in the mutual fund.

Solution:

NAV in the Beginning of year = $\frac{₹23.75}{118.75} \times 100 = ₹20$

No. of Units after Bonus issue = 26,750

Let x be the No. of Units acquired then

$$26{,}750 = x + \frac{x \times 3}{23.75}$$

or, x = 23,750 units

Investment Amount = 23,750 units (₹20 + ₹0.05) = ₹4,76,187.50

Entry load = ₹1,187.50 i.e. (23750 × 0.05)

17. Mr. A has invested in three Mutual Fund (MF) schemes as per the details given below:

Particulars	MF 'A'	MF 'B'	MF 'C'
Date of Investment	01/11/2022	01/02/2023	01/03/2023
Amount of investment (₹)	1,00,000	2,00,000	2,00,000
Net Asset Value (NAV) at entry date (₹)	10.30	10.00	10.10
Dividend Received upto 31-3-2023 (₹)	2,850	4,500	NIL
NAV as on 31-3-2023 (₹)	10.25	10.15	10.00

Assume 1 year = 365 days

Show the amount of rupees upto two decimal points

You are required to find out the effective yield (upto three decimal points) on per annum basis in respect of each of the above three Mutual Fund (MF) schemes upto 31-3-2023.

Solution:

Particulars	MF 'A'	MF 'B'	MF 'C'
(a) Investments	₹1,00,000	₹2,00,000	₹2,00,000
(b) Opening NAV	₹10.30	₹10.00	₹10.10
(c) No. of units (a/b)	9,708.74	20,000	19,801.98
(d) Unit NAV ON 31-3-2023	₹10.25	₹10.15	₹10.00
(e) Total NAV on 31-3-2023 (c×d)	₹99,514.59	₹2,03,000	₹1,98,019.86
(f) Increase / Decrease of NAV (a-e)	(₹485.41)	₹3,000	(₹1,980.20)
(g) Dividend Received	₹2,850	₹4,500	Nil
(h) Total Yield (f+g)	₹2,364.59	₹7,500	(₹1980.20)
(i) Number of Days	152	60	31
(j) Effective yield p.a. (h/a × 365 /i × 100)	5.678%	22.813%	(-) 11.657%

Solved Case Studies

1. Summer Mutual Fund sponsored open-ended equity-oriented fund.

   There were three plans size 'S', dividend reinvestment plan; 'T', bonus plan and 'U', growth plan.

   At the time of initial public offer on 1-4-2013, Mr. Sachin, Mr. Sourav and Mr. Rahul, three investors invested ₹1,00,000 each and chosen 'T', 'U' and 'S' plans, respectively.

   The history of the fund is as follows:

	Dividend (%)	Bonus Ratio	Net Asset Value Per Unit (FV = ₹10)		
			Plan S	Plan T	Plan U
28-07-2017	20	--	30.70	31.40	33.42
31-03-2018	70	5:4	58.42	31.05	70.05
31-10-2021	40	--	42.18	25.02	56.15
15-03-2022	25	--	46.45	29.10	64.28
31-03-2022	--	1:3	42.18	20.05	60.12
24-03-2023	40	1:4	48.10	19.95	72.40
31-07-2023	--	--	53.75	22.98	82.07

[Ignore Education Cess]

On 31st July, 2023, all three investors redeemed all the balance units. Calculate the annual rate of return to each of the investors consider:

(i) Long-term capital gain is exempt from income tax.

(ii) Short-term capital gain is subject to income tax @ 10%.

(ii) Security transaction tax is 0.2 percent only on sale/redemption of units.

Solution:

Return from plan 'S' – dividend reinvestment for Rahul.

Under dividend reinvestment plan, the amount of dividend is reinvested in the business at the prevailing rate.

(a) Statement of units, value and return on investment

Date	Dividend (%)	Investment (₹)	Rate (₹)	Units	Commutative Units	Value (₹)
(1)	(2)	(3) = Div × Cum. Units	(4)	(5) = (3)/(4)	(6)	(7) = 6×₹10
01-04-2013	Initial offer	1,00,000	10.00	10,000.00	10,000.00	1,00,000
28-07-2017	0.20	20,000 (2×10,000)	30.70	651.47	10,651.47	1,06,515
31-03-2018	0.70	74,560 (7×10,651.47)	58.42	1,276.28	11,927.75	1,19,278
31-03-2021	0.40	47,711 (4×11,927.75)	42.18	1,131.13	13,058.88	1,30,589
15-03-2022	0.25	32,647 (2.5×13,058.88)	46.45	702.85	13,761.73	1,37,617
24-03-2023	0.40	55047 (4×13,761.33)	48.10	1,144.43	14,906.16	1,49,062
31-07-2023	—	—	53.75	—	14,906.16	1,49,062

(b) Return on Investment

Particulars	₹
Redemption value = 14,906.16 × 53.75	8,01,206.10
Less: Short-term capital gain tax @ 10% = 1,144.43 units (53.75 - 48.10) × 10%	646
	8,00,560.10
Less: Securities transaction tax @ 0.2% on ₹8,01,206.10	1,602.41
Redemption value net of taxes	7,98,957.69
Less: Investment	1,00,000.00
Net return from investment	6,98,957.69
Period of investment (1/4/2013 to 31/07/2023) in months	124
Annual average return = $\frac{[\text{Net Return} \times 12 \text{ months} \times 100]}{\text{Purchase price} \times \text{Period of investment (in months)}}$ $= \frac{6,98,957.69 \times 12 \times 100}{1,00,000 \times 124}$	67.64%

- Short-term capital gains is only in respect of investment made on 24-3-2023 where the period of holding is less than 1 year.
- Securities transaction tax is not to be considered for short-term capital gains and hence deducted from the net amount to ascertain cash flows.

Returns from Plan 'T' – Bonus plan for Mr. Sachin

Under the bonus plan, bonus units are issued in the specified ratio.

(a) Statement of units, bonus and value per unit

Date	Bonus Ratio	Units	Cum. Units	NAV/Unit (₹)
(1)	**(2)**	**(3)**	**(4)**	**(5)**
01-04-2013	Initial issue	10,000	10,000	10.00
31-03-2018	5:4	12,500 (10,000×5/4)	22,500	31.05
31-03-2022	1:3	7,500 (22,500×1)/3	30,000	20.05
24-03-2023	1:4	7,500 (30,000×1)/4	37,500	19.95

(b) Return on Investment

Particulars	₹
Redemption value = 37,500 × 22.98	8,61,750.00
Less: Short-term capital gain tax @ 10% = 7500 ×(22.98 - 0)× 10% (See Note below)	17,235.00
	8,44,515.00
Less: Securities transaction tax @ 0.2%	1,723.50
Net of tax	8,42,791.50
Less: Investment	1,00,000.00
Net gain	7,42,791.50

Annual average return = $\dfrac{[\text{Net Return} \times 12 \text{ months} \times 100]}{\text{Purchase price} \times \text{Period of investment (in months)}}$ $= \dfrac{7{,}42{,}719.50 \times 12 \times 100}{1{,}00{,}000 \times 124}$	71.88%

Note:

(i) For income tax purposes, cost of acquisition of bonus shares is considered as NIL.

(ii) Short-term capital gains is only in respect of bonus issued on 24-3-2023 as the period of holding is less than 1 year.

Return from plan U - Growth plan to Mr. Sourav

Particulars	₹
Redemption value (10,000 × 82.07)	8,20,700.00
Less: Security transaction tax (S.T.T) is 0.2%	1,641.40
Net amount received	8,19,058.60
Less: Investment	1,00,000.00
Net Gain	7,19,058.60
∴ Average annual return = [(7,19,058.60 × 12 × 100)] ÷ [(1,00,000 × 124)]	= 69.59%

Note: There is no short-term capital gains as the period of holding is more than 1 year.

2. The following particulars relates to Gift Fund Schemes:

	Particulars	Value (₹ in Crore)
1.	Investment in Shares (at cost)	
	(a) IT and ITES companies	28
	(b) Infrastructure companies	15
	(c) Aviation, Transport and Logistics	7
	(d) Automotive	32
	(e) Banking/Financial services	8
2.	Cash and Other Assets in Hand (even throughout the fund period)	2
3.	Investment in Fixed Income Bearing Bonds	
	(a) Listed bonds (10,000; 10.50% Bonds of ₹10,000 each)	10
	(b) Unlisted bonds	8
4.	Expenses payable as on closure date	3
5.	Market expectation on Listed Bonds	8.40%
6.	Number of units Outstanding	5.50

The particulars relating to sectoral Index are as follows -

Sector	Index on the Date of Purchase	Index on the Valuation Date
IT and ITES	1750	2950
Infrastructure	1375	2475
Aviation, Transport and Logistics	1540	2570
Automotive	1760	2860
Banking/Financial	1600	2300

Required:

(i) Net asset value of the fund

(ii) Net asset value per unit.

(iii) If the period under consideration is 2 years and the fund has distributed ₹2.00 per unit per year as cash dividend. Ascertain the Net Return (Annualized)

(iv) Ascertain the Expense Ratio, if the fund has incurred the following expenses:

Management and Advisory Fees	₹275 lakhs
Administration expenses (including Fund Managers Remuneration)	₹350 lakhs
Publicity and Documentation	₹80 lakhs
	₹705 lakhs

Solution:

(1) Net asset value of the fund

	Particulars	₹ in Crore
1.	Market value of shares in	
	(a) IT and ITES [Cost ₹28×Closing Sector Index 2950÷Opening Sector Index 1750]	47.20
	(b) Infrastructure [Cost ₹15×Closing Sector Index 2475÷Opening Sector Index 1375]	27.00
	(c) Aviation [Cost ₹7×Closing Sector Index 2570÷Opening Sector Index 1540]	11.68
	(d) Automotive [Cost ₹32×Closing Sector Index 2860 ÷ Opening Sector Index 1760]	52.00
	(e) Banking [Cost ₹8×Closing Sector Index 2300÷Opening Sector Index 1600]	11.50
2.	Market Value of Investment in Listed Bonds [(Face value ₹10 crores × Interest on Face Value @10.50%) ÷ Market Expectation 8.40%]	12.50
3.	Cost of investment in Unlisted Bonds	8.00
4.	Cash and Other Assets	2.00
	Total Assets of the fund Less: Outstanding Expenses	171.88 (3.00)
	Net Asset Value of the Fund	**168.88**

Note: It is assumed that Cash and Other Assets existed from the beginning of the period at the same values.

(2) **Net asset value per unit**

NAV Per Unit = Net Asset Value of the Fund ÷ No. of units outstanding

= ₹168.88 crore ÷ 5.50 crore units = ₹30.71

(3) Annualized return on Fund

(a) Computation of Opening NAV

	Particulars	₹ in crore
1.	Investment in Shares (at Cost)	
(a)	IT and ITES Companies	28.00
(b)	Infrastructure Companies	15.00
(c)	Aviation, Transport and Logistics	7.00
(d)	Automotive	32.00
(e)	Banking/Financial Services	8.00
2.	Investment in Fixed Income Bearing Bonds	
(a)	Listed Bonds [10,000; 10.50% bonds of ₹10,000 each]	10.00
(b)	Unlisted Bonds	8.00
	Net Asset Value	108.00

Note: Cash and Other Assets are not included because they arise out of investments made in the beginning.

(b) Computation of Opening NAV per unit

Net asset value of the fund ÷ No. of units outstanding = ₹108.00 crore ÷ 5.50 crore units

= ₹19.64/unit

(c) Computation of Returns per units

(i) Capital appreciation = Closing NAV per unit – Opening NAV per unit

= ₹30.71-₹19.64

= ₹11.07

(ii) Cash dividend = ₹2.00×2 years

= ₹4.00

(iii) Returns = (Cash dividend+Capital appreciation)/Opening NAV

= (₹4.00+₹11.07)/₹19.64

= 77%

(iv) Returns per year = Total return/Period = 77%/2

= 38.50%

4. **Expense ratio**

(i) Total expenses = Management advisory fees ₹2.75 cr + Administration expenses ₹3.50 crore + Publicity and documentation ₹0.80 crore = ₹7.05 crores

(ii) Average value of portfolio = (Opening Net Asset Value + Closing Net Asset Value) ÷ 2

$$= \frac{₹\,(108 + 168.88)}{2}$$

= ₹276.88 ÷ 2 = ₹138.44 crores

(iii) Expense Ratio = Total Expenses ÷ Average Value of Portfolio

= (₹7.05 Crores ÷ ₹138.44 Crores) × 100

= 5.09%

(iv) Expense per unit = Total expenses ÷ No. of units

$$= \frac{₹\ 7.05\ \text{crore}}{5.50\ \text{crore}}$$

= ₹1.282.

Exercise

Theoretical Problems

Multiple Choice Questions

1. The important role while establishing the mutual fund scheme is played by the

   (a) AMC

   (b) Trustees

   (c) Sponsors

   (d) Custodians

2. Settlement are done at the instance of the

   (a) Custodian

   (b) AMC

   (c) Trustees

   (d) Sponsors

3. The functions of the trustees is/are

   (a) Marketing the mutual fund schemes

   (b) To seek the RBI approval in case the scheme is open for NRIs

   (c) Submitting compliance reports to SEBI

   (d) All of the above

4. Balanced funds have the following characteristics

   (a) They consist of equity and bonds in equal proportion

   (b) They have moderate risk component

   (c) They have above average growth potential

   (d) None of the above

5. The function(s) of AMC is/are
   (a) Taking investment decisions and committing the funds in the primary/secondary market
   (b) Maintaining the records and necessary information systems
   (c) Inform the trustees of the latest happenings and decisions
   (d) All of the above
6. Which among the following increases the NAV of a mutual fund scheme?
   (a) Value of investments
   (b) Receivables
   (c) Accrued income
   (d) All of (a), (b) and (c)
7. Following is/are the advantages of investing in mutual funds
   (a) Diversified investment
   (b) Professional management
   (c) Tax benefits
   (d) All of (a), (b) and (c)
8. Which of the following benefits is not usually conferred by mutual funds?
   (a) Diversified investment portfolio
   (b) Professional stock selection and asset management
   (c) Tax benefits
   (d) Assured returns
9. Which of the following is not an advantage of mutual funds?
   (a) Expertise in selection and timing of investment
   (b) Economies of scale and lower transaction costs
   (c) Reinvestment of dividend income possible
   (d) Limited investment opportunities and hence no need for the investor to have knowledge on investment management

10. The mutual funds are likely to perform better in the market than a small investor because they

    (a) Depend on the technical analysis tools and have the expertise to use them

    (b) Depend on the fundamental analysis which ensures the long-term performance of the fund

    (c) Have access to better information, ability and infrastructure to utilize it

    (d) None of the above

11. Identify the statement that applies to open-end mutual funds

    (a) They do not redeem or issue shares

    (b) Shares of such funds are traded on organized exchanges

    (c) Their price can't fall below the NAV

    (d) Exit from such funds involves selling shares to other investors.

12. Which of the following is an advantage to investors of exchange traded funds (ETFs) that is not available to investors in open-end mutual funds?

    (a) ETFs allow investors to invest in broad market indexes as well as international indexes

    (b) Investors can avoid incurring an expense in the form of a bid ask spread by purchasing an ETF rather than investing in an open-end mutual fund

    (c) ETFs offer a potential tax advantage to investors who incur capital gains taxes only when they sell ETF shares

    (d) ETF prices cannot deviate from net asset value

13. An investor has invested in a mutual fund when the NAG was ₹ 15.50 per unit. After 90 days the NAV was ₹ 14.45 per unit. During the period the investor got a cash dividend of ₹ 1.35 per unit and capital gain distribution of ₹ 0.20. The annualized return based on 360 days year count will be

    (a) 3.23%

    (b) 12.92%

    (c) 0.8075%

    (d) 16.45%

14. A certain mutual fund has a return of 17% with standard deviation of 3.5% and the sharpe ratio is 4. The risk free rate is

    (a) 12.5%

    (b) 4%

    (c) 3%

    (d) 7.5%

15. B can earn a return of 18% by investing in equity shares on his own. Now he is considering a recently announced equity based Mutual Fund Scheme in which initial expenses are 1% and annual recurring expenses are 2%. How much should be Mutual Fund earn to provide B, a return of 18%?

    (a) 18.18%

    (b) 20.18%

    (c) 22.18%

    (d) 21%

16. The following information is extracted from MF, a mutual fund scheme. NAV on 01- 11-2019 is ₹ 65.78, annualized return is 15%. Distributions of income and capital gains were ₹ 0.50 and ₹ 0.30 per unit in the month. What is the NAV on 30-11-2019?

    (a) ₹ 67.50

    (b) ₹ 66.14

    (c) ₹ 65.80

    (d) ₹ 66.96

17. The market price (ex-dividend) of a unit of an open-ended mutual fund scheme was ₹30 at the beginning of the year. A dividend of ₹3 has been paid during the year. Theprice of the unit is ₹35 at the year end. The rate of return of the past year of the unit is

    (a) 24.32%

    (b) 26.67%

    (c) 25.52%

    (d) 28.56%

Answer:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
c	b	d	b	d	d	d	d	d	c	d	b	b	c	b	c	b

State True or False

1. The funds that combine features of both open-ended and close-ended schemes are called Middle Funds
2. Day to day operations of a mutual fund is handled by AMC
3. Diversified equity fund is a category of funds that invest in a diverse mix of securities that cut across sectors and market capitalization.
4. The asset allocation that is worked out for an investor based on risk profiling is called Strategic Asset Allocation
5. The funds that combine features of both open-ended and close-ended schemes are called Dual Funds
6. When the trustees / AMC make any change in the fundamental attributes of a scheme, Unit-holders are given the option to exit at the prevailing Net Asset Value. This exit window must be kept open for 15 days.
7. Diversified equity fund is a category of funds that invest in a diverse mix of securities that cut across sectors and market capitalization
8. AMCs are required to invest seed capital of 1% percent of the amount raised subject to a maximum of Rs. 50 Lakhs in all the growth option of the mutual fund schemes (excluding close-ended schemes) through the lifetime of the scheme.
9. While the AMC manages the investments of the scheme, the assets of the scheme are held by the Custodian.
10. Mutual Fund Units involve investment risks including the possible loss of principal.

Answer:

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
False	True	True	True	False	False	True	True	True	True

Fill in the blanks

1. The First player of the Mutual fund industry was ___________
2. In India, AMC must be registered with ___________
3. ___________ schemes not exposed to sudden and large movements of funds.

4. Investors can enter and exit under ____________ at any time.

5. ____________ approve the contents of the Offer document.

6. ____________ is a supplementary document that contains additional information of the fund.

7. ____________ is a myth about Mutual Fund Investment in India.

8. The performance of a scheme is reflected in its ____________

9. CAGR stands for ____________

10. ____________ of a mutual fund is the price at which units are bought or sold by investor.

Answer:

1.	UTI MF	2.	Securities Exchange Board of India
3.	Close-Ended Funds	4.	Open-Ended Funds
5.	Trustee	6.	SAI
7.	Demat account	8.	Net asset value
9.	Compounded Annual Growth Rate	10.	NAV

Short Essay Type Questions

1. What are the key differences between close-ended and open-ended schemes?

2. What is a fund-of-fund scheme?

3. Describe in brief about systematic withdrawal plan and systematic investment plan.

4. What do you mean by net asset value of a mutual fund?

5. Discuss the tax aspects of a mutual fund investment.

6. What are the factors to be considered for selecting a mutual fund for investment?

7. Explain the following terms: alpha, beta, asset mix, rate of return, ex-mark (R^2), gross yield, portfolio turnover ratio, expense ratio.

8. What is ETF?

9. What do you mean by Real Estate Investment Trust (REIT)?

Essay Type Questions

1. Define A mutual fund and state its advantages and disadvantages in brief.

2. Discuss the role of various entities in a mutual fund operation

3. Discuss in brief the different types of schemes in a mutual fund

4. What is an exchange traded fund? How is it structured?

5. What are the restrictions and conditions for investments by mutual funds?

6. What are the methods commonly applied for valuation of traded and non-traded securities of a mutual fund?

7. What are the rights and obligations of mutual fund investors?

8. How does ETF, REIT & InVIT work?

9. Enumerate the differences between REIT & Real Estate Mutual Fund.

Practical Problem

Multiple Choice Question

1. How much money would you need to purchase 400 shares of a mutual fund with a NAV of ₹ 55 per share and a 3% load?

   (a) ₹22,000

   (b) ₹21,450

   (c) ₹23,200

   (d) ₹22,660

2. If a mutual fund NAV is 50 and its expense ratio is 2% what are the total expenses per share?

   (a) 2

   (b) 10

   (c) 1

   (d) 5

3. You invested 1,000 in a mutual fund with a 4% load when NAV was 20 per share. If you sell your shares at a NAV of 20 per share, what is the return of your investment?

   (a) 14.8%

   (b) 15.2%

   (c) 12.5%

   (d) 10.8%

4. A mutual fund has a beginning balance of 100 million earns interest of 10 million, receives dividends of 15 million, and has expenses of 5 million. If 10 million shares are outstanding, what is the NAV?

   (a) 10.50

   (b) 11.00

   (c) 12.00

   (d) 12.50

5. A scheme has average weekly net assets of ₹ 324 Cr and has annual expenses of ₹ 3.24Cr, it's expenses ratio is

   (a) 1%

   (b) 10%

   (c) Can't say

   (d) Insufficient information

6. If a scheme has 45 Cr units issued and has an FV of ₹10 and NAV is at 11.33, unit capital (₹ in Cr) would be equal to

   (a) 500.85

   (b) 50.85

   (c) 950.85

   (d) 450

7. For a scheme to be defined as an equal fund, it must have a minimum

   (a) 65% in Indian equities

   (b) 65% in equities

   (c) 51% Indian equities

   (d) 35% in Indian equities

8. On average, actively managed mutual funds have an expenses ratio of about

   (a) 1.5%

   (b) 2.5%

   (c) 3%

   (d) 5%.

9. If opening units 10,000 Units subscribe 3000, Units redeem 1000 then Closing units?

   a) 10,000 units

   b) 13,000 units

   c) 12,000 units

   d) 14,000 units

10. If opening units 1,25,000 Units subscribe 2,00,000, Units redeem 50,000 then Closing units?

    a) 3,25,000 units

    b) 2,75,000 units

    c) 3,75,000 units

    d) 2,50,000 units

11. A mutual fund had average daily assets of ₹500 million in the past year. During the year, the fund sold ₹60 million of stock X and purchased ₹90 million of stock Y. What was the fund's turnover ratio?

    (a) 12%

    (b) 15%

    (c) 18%

    (d) 30%.

12. A closed-end fund has a portfolio currently worth ₹350 million. The fund has liabilities of ₹5 million and 17 million units outstanding. What is the net asset value of the fund?

    (a) ₹20.28

    (b) ₹20.29

    (c) ₹20.59

    (d) ₹29.17

Answer:

1	2	3	4	5	6	7	8	9	10	11	12
d	c	b	b	a	b	b	a	c	b	a	b

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Portfolio Theory and Practice 8

This Module includes:

8.1 Portfolio Return and Risk, Systematic and Unsystematic Risk, Diversification strategies (Naïve vs the Markowitz Model)

8.2 Optimal Portfolio, Efficient Frontier, Capital Market Line

8.3 Principles of Asset Allocation, Active and Passive Asset Allocation

Portfolio Theory and Practice

SLOB Mapped against the Module

To equip oneself with the knowledge of application of various techniques in security evaluation, building a portfolio, measuring its performance and making revisions to optimise the returns. (CMLO 3a)

Module Learning Objectives:

After studying this module, the students will be able to -

- Understand the basic concepts relating to risk and returns of portfolios.
- Appreciate the process of diversification of portfolio risks.
- Learn about optimal portfolio, efficient frontier and capital market line.
- Understand alternative principles of asset allocation in a portfolio.

Portfolio Return and Risk, Systematic and Unsystematic Risk, Diversification strategies (Naïve vs the Markowitz Model)

8.1

8.1.1 Portfolio Management

8.1.1.1 Portfolio Return

Harry Markowitz, the father of modern portfolio theory, published an article in the Journal of Finance in March

1952. It was the first scientific approach to determine the risk return, covariance of the securities and developed a methodology for determining the optimum portfolio. Before Markowitz, it was the knowledge of smart investors, i.e., the traditional theory that 'don't put all the eggs into a single basket.' That represents the risk diversification without adequate scientific knowledge about risk. Individual securities have risk return characteristics of their own. But portfolios which are combination of securities do not take the aggregate characteristics of risk and return in the same direction as compared to their individual parts. In recognition for his contribution in the field of finance, Harry Markowitz was awarded Nobel Prize in Economics in the year 1990.

Concept of Return: We can calculate the portfolio's expected return using historical data or using the probability of future returns of the securities. Portfolio theory is primarily concerned with the ex-ante (future) events which indicate expected future results. All portfolio decisions are for future, and hence we should consider ex-ante values. On the other hand, if we want to evaluate the portfolio performance, we should calculate the actual return and risk for past periods, i.e., ex-post values. It is very important to understand that ex-ante values which will always be the projected values and ex-post values will always be actual values of past results.

Measurement of historical returns: Any historical return may be calculated as Holding Period yield.

$$\frac{[(\text{Share price at the end of year - Share price at the beginning of the year}) + \text{Dividend received}]}{(\text{Share price at the beginning of the year})}$$

Illustration 1

Mr. Amit bought 10 shares of TCS on 1.4.2018 for ₹ 30,050. The company paid a dividend of ₹30 per share and the value of the stock as on 31.3.2019 was ₹34,280. Calculate the holding period yield of the investor.

Solution:

Holding period return: = [(₹ 34,280 - ₹30,050) + ₹300]/(₹30,050) = 15.07%.

It is better to split it into two parts (a) Current yield; and (b) Capital appreciation.

Current yield = (Dividend received)/(Initial investment)

= (₹300)/(₹30,050)

= 0.00998

Capital appreciation = (Closing value-Opening value)/(Initial investment)

= (₹34,280 - ₹30,050)/(₹30,050)

= 0.14076

Total yield = 0.00998 + 0.14076 = 15.07%.

We can find out the historical return of a portfolio by considering the respective weights attached to it and the combined portfolio weights will be equal to one or hundred percent.

$$\therefore \quad E(R_p) = \sum_{i=1}^{n} W_i (R_i)$$

Illustration 2

A portfolio manager invests in five portfolios namely P, Q, R, S and T in the ration of 30%, 20%, 25%, 15% and 10% and the respective returns of the portfolios are 12%, 14% - 20%, 10% and 9%.

The combined portfolio return will be:

Solution:

RP = 0.30 × 0.12 + 0.20 × 0.14 + 0.25 × -0.20 + 0.15 × 0.10 + 0.10 × 0.09

= 0.036 + 0.028 – 0.05 + 0.015 + 0.009

= 3.8%.

Ex-ante Return of a Portfolio

Ex-ante return will always be the projected or future returns. We are putting probability factor to determine the future expected value. The future expected returns of the portfolio may be calculated as the probability multiplied by the returns of individual securities.

∴ Ex-ante return of a portfolio = $\Sigma P_i R_i$

Illustration 3

Calculate the return of a portfolio which has 60% invested in TCS and the rest in RIL. The probable return in different conditions of the economy are as follows:

Condition of the economy	Probability of occurrence (%)	Return on TCS(%)	Return of RIL(%)
Growth	50	16	12
Stable	40	12	14
Recession	10	-6	-2

Find out only the return of the portfolio.

Solution:

Returns on TCS shares = 16 × 0.5 + 12 × 0.4 – 6 × 0.10

= 8 + 4.8 – 0.60

= 12.2%

Returns on RIL shares = 0.50 × 12 + 0.40 × 14 + 0.10 × -2

= 6 + 5.60 – 0.20

= 11.40%.

W_A = TCS = 60%; and W_B = RIL = 40%

$\therefore$ $ER_P = W_A \times R_{TCS} + W_B \times R_{RIL}$

$= 0.60 \times 12.2 + 0.40 \times 11.40$

$= 7.32 + 4.56$

$= 11.88\%$

Regardless of the number of securities in a portfolio, the expected return on the portfolio is always a weighted average or proportion of the individual securities attached to the portfolio.

8.1.1.2 Portfolio Risk

Portfolio risk or variance measures the amount of uncertainty in portfolio returns. Portfolio variance can be calculated by taking the variance of both sides of the return equation as follows, where Cov (R_1, R_2) is the covariance of returns R_1 and R_2, W_1 is the weight in asset 1, W_2 (= 1 - W_1) is the weight in asset 2, and σ_1^2, σ_2^2 are the variances of the two assets:

$$\sigma^2_P = \text{Var}(R_P) = \text{Var}(W_1R_1 + W_2R_2)$$

$$= W^2_1 \text{Var}(R_1) + W^2_2 \text{Var}(R_2) + 2W_1W_2 \text{Cov}(R_1,R_2)$$

$$= W^2_1 \sigma^2_1 + W^2_2 \sigma^2_2 + 2W_1W_2 \text{Cov}(R_1, R_2)$$

The standard deviation, or risk, of a portfolio of two assets is given by the square root of the portfolio's variance:

$$\sigma_P = \sqrt{W^2_1\sigma^2_1 + W^2_2\sigma^2_2 + 2W_1W_2\text{Cov}(R_1,R_2)}$$

Type of Risks

A. Systematic Risk: It arises out of external and uncontrollable factors, which are not specific to a security or industry to which such security belongs. It is that part of risk caused by factors that affect the price of all the securities. Systematic Risk cannot be eliminated by diversification.

(i) Market Risk

- These are risks that are triggered due to social, political and economic events. Example: When CBDT issued a draft circular on how to treat income from trading in shares, whether as Capital Receipts or Business Receipts, the stock prices fell down sharply, across all sectors.
- These risks arise due to changes in demand and supply, expectations of the investors, information flow, investor's risk perception, etc. consequent to the social, political or economic events.

(ii) Interest Rate Risk

- Uncertainty of future market values and extent of income in the future, due to fluctuations in the general level of interest, is known as Interest Rate Risk.
- These are risks arising due to fluctuating rates of interest and cost of corporate debt. The cost of corporate debt depends on the interest rates prevailing, maturity periods, credit worthiness of the borrowers, monetary and credit policy of RBI, etc.

(iii) Purchasing Power Risk: Purchasing Power Risk is the erosion in the value of money due to the effects of inflation.

B. Unsystematic Risk: These are risks that emanate from known and controllable factors, which are unique and/or related to a particular security or industry. These risks can be eliminated by diversification of portfolio.

(i) Business Risk

- It is the volatility in revenues and profits of particular Company due to its market conditions, product mix, competition, etc.
- It may arise due to external reasons or (Government policies specific to that kind of industry) internal reasons (labour efficiency, management, etc.)

(ii) Financial Risk

- These are risks that are associated with the Capital Structure of a Company. A Company with no Debt Financing, has no financial risk. Higher the Financial Leverage, higher the Financial Risk.
- These may also arise due to short term liquidity problems, shortage in working capital due to funds tied in working capital and receivables, etc.

(iii) Default Risk: These arise due to default in meeting the financial obligations on time. Non- payment of financial dues on time increases the insolvency and bankruptcy costs.

C. Risk Involved In Investment in Government Securities [G. Sec.]

Interest Rate Risk

(i) Interest Rate Risk are on account of inverse relation of price and interest. These are typical of any fixed coupon security with a fixed period to maturity.

(ii) However, this risk can be completely eliminated in case an investor's investment horizon (intended period of holding) identically matches the term of security.

Re-investment Risk

(i) Re-investment risk is the risk that the rate at which the interim cash flows are re-invested may fall thereby affecting the returns.

(ii) The most prevalent tool deployed to measure returns over a period of time is the yield-to- maturity (YTM) method which assumes that the cash flows generated during the life of a security is reinvested at the rate of YTM.

Default Risk

(i) Default risk in the context of a Government Security is always zero.

(ii) However, these securities suffer from a small variant of default risk, i.e. maturity risk.

(iii) Maturity Risk is the risk associated with the likelihood of Government issuing a new security in place of redeeming the existing security. In case of Corporate Securities, it is referred to as Credit Risk.

Extent of Risk in Government Securities:

- Government Securities are usually referred to as risk free securities. However, these securities are subject to only one type of risk, i.e. interest rate risk.
- Subject to changes in the overall interest rate scenario, the price of these securities may appreciate or depreciate.

Components of Risk

Total Risk = Systematic Risk + Unsystematic Risk

- **Systematic Risk:** It represents that portion of Total Risk which is attributable to factors that affect the market as a whole. Beta is a measure of Systematic Risk.
- **Unsystematic Risk:** It is the residual risk or balancing figure, i.e. Total Risk Less Systematic Risk.

Measure of Risk

Circumstances: An investor will look at the Standard deviation of an individual security as a proper measure of risk in the following circumstances —

(i) His portfolio consists of only one security.

(ii) Investor who is evaluating the diversifiable risk, i.e. a rational risk-averse investor who wants to bring down the risk associated with his portfolio.

No Return for Diversifiable Risk: While risk is analysed into diversifiable and non-diversifiable segments, the market generally does not reward for diversifiable risk, since the investor himself is expected to diversify the risk himself.

Statistical Tools, Standard Deviation & Variance

A. Statistical Tools: Statistical tools such as measures of dispersion can be used to evaluate the risk associated with returns from an investment. Measures of dispersion include Variance and Standard Deviation.

B. Standard Deviation as a Measure of Risk:

- The Standard Deviation is a measure of how each possible outcome deviates from the Expected Value. The higher the value of dispersion (i.e. Standard Deviation), the higher is the risk associated with the Portfolio and vice-versa.
- Generally, Standard Deviation of a specified security or portfolio is considered to be the Total Risk associated with that security or portfolio.
- Standard Deviation is the average or mean of deviations. Deviations are the movement in returns from the mean return. it measures the risk in absolute terms.

Mathematical Notation:

a. When Standard Deviation is taken as Total Risk

$\sigma_s = \sigma_s \times \rho_{SM} + \sigma_s \times (1 - \rho_{SM})$

(or) $\beta_{SM} \times \sigma_M + \sigma_s \times (1 - \rho_{SM})$

Systematic Risk + Unsystematic Risk Where

Where σ_s = Standard Deviation of the Returns from Security S

ρ_{SM} = Correlation Co-efficient between Returns from Security S and Market Portfolio

β_{SM} = Beta of Security S with reference to Market Returns

C. Variance as a Measure of Risk: Variance measures is the sum of square of deviations from the mean.

Mathematical Notation:

When Variance is taken as Total Risk

$\sigma_s^2 = \beta_s^2 \times \sigma_M^2 + \sigma_s^2 \times (1 - \rho^2_{SM})$

Systematic Risk + Unsystematic Risk

Where σ_s^2 = Variance of the Returns from Security S

ρ^2_{SM} = Square of Correlation Co-efficient between Returns from Security S and Market (Co-efficient of Determination)

Note: Unsystematic Risk is computed only as the balancing figure, and not as a separate item.

Beta Measures Non-Diversifiable Risk

Type of Investor: For an investor who invests his money in a portfolio of securities, Beta is the proper measure of risk.

Non-Diversifiable Risk: Only a portfolio investor would look into eliminating the diversifiable risk and evaluate the exact extent of systematic or non-diversifiable risk.

Concept of Beta

(i) Measure of Sensitivity: Beta of a security measures the sensitivity of the security with reference to a broad based market index like BSE Sensex, NIFTY.

(ii) Measure of Systematic Risk: Beta measures systematic risk i.e., that which affects the market as a whole and hence cannot be eliminated through diversification.

(iii) Factors: Beta is a factor of the following —

- Standard Deviation (Risk) of the Security or Portfolio,
- Standard deviation (Risk) of the Market, and
- Correlation between the Security and Market

The relationship is explained as follows —

$$\text{Beta of Security } S(\beta) = \frac{\sigma_s}{\sigma_m} \times \rho_{SM}$$

$$\downarrow \qquad \downarrow$$

Movement in Security S per unit of movement in market portfolio × Extent of Correlation between Security S and Market Portfolio

(iv) Beta = Expected Movement: It gives the expected movement in the return of a security (or market price of the security) per unit of movement in the market portfolio return.

(v) Inferences:

Beta Value is	Security is
less than 1	less risky than the market portfolio
Equal to 1	As risky as the market portfolio. Normal Beta security. When security beta = 1 then if mkt. move up by 10% security will move up by 10%. If mkt. fell by 10% security also tend to fall by 10%.
more than 1	More risk than the market portfolio. Termed as Aggressive Security/High beta Security. A Security beta will tend to move twice as much as the market. If market went up by 10% security tends to rise by 20%. If market fall by 10% Security tends to fall by 20%.

less than 0	Negative Beta. It indicates negative (inverse) relationship between security return and market return. If market goes up security will fall & viceversa. Normally gold is supposed to have negative beta.
Equal to 0	Means there is no systematic risk and share price has no relationship with market. Risk free security is assumed to be zero.

(vi) Mathematical Formulae:

- **Using Standard Deviation and Correlation:**

  Beta of a Security $(\beta_s) = \dfrac{\sigma_s}{\sigma_m} \times \rho_{SM}$

- **Using Covariance and Market Variance:**

  Beta of a Security $(\beta_s) = \dfrac{COV_{SM}}{\sigma_m}$

- From Basic Data:

  Beta of a Security $(\beta_s) = \dfrac{\sum R_M R_S - n\overline{R}_M \overline{R}_S}{\sum R^2_M - nR^2_m}$

  n = No. of pairs considered (generally the number of years / months / days)

  $\sum R_M R_S$ = Aggregate of Product

  $\sum R_M{}^2$ = Aggregate of Return Square

  $\overline{R}_M$ = Mean of Market Return = Aggregate of Market Returns ÷ No. of Years

  $\overline{R}_S$ = Mean of Security Return = Aggregate of Security Returns ÷ No. of Years

Standard Deviation of A Portfolio Standard Deviation as a Measure of Risk

Risk of a portfolio is not equal to the sum of its parts. This is because all securities are neither correlated with each other to the same extent or in the same manner, nor are relationship expressible in linear or arithmetic terms. choice of securities in a portfolio can either go about to increase the risk factor which is greater than the sum of the individual risk of securities. It can also be lower than the risk factor of the least risky security in the portfolio.

Therefore, Standard Deviation of a Portfolio is not the weighted average of the standard deviation of its individual securities, since it does not consider the correlation between different such securities and a common base, i.e. market return.

Formulae:

(a) Formulae (Two Securities): Risk of Portfolio, i.e. Standard Deviation of Portfolio of A and B

$$\sigma AB = \sqrt{(\sigma_A{}^2 \times W_A{}^2) + (\sigma_B{}^2 \times W_B{}^2) + 2(\sigma_A \times W_A \times \sigma_B \times W_B \times \rho_{AB})}$$

(b) Formulae (Three Securities): (i) Standard Deviation of 3 securities σ STP is given by —

$$= \sqrt{(\sigma_P{}^2 \times W_P{}^2)+(\sigma_Q{}^2 \times W_Q{}^2)+(\sigma_R{}^2 \times W_R{}^2)+2(\sigma_P \times W_P \times \sigma_Q \times W_Q \times \rho_{PQ})+2(\sigma_P \times W_P \times \sigma_R \times W_R \times \rho_{PR})+2(\sigma_Q \times W_Q \times \sigma_R \times W_R \times \rho_{QR})}$$

(ii) Matrix Approach:

Securities		P	Q	R
	Weights	W_P	W_Q	W_R
P	W_P	(σ_P^2)	(Cov_{PQ})	(Cov_{PR})
Q	W_Q	(Cov_{PQ})	(σ_Q^2)	(Cov_{QR})
R	W_R	(Cov_{PR})	(Cov_{QR})	(σ_R^2)

After plotting the values in the above matrix (which can be extended to n securities), variance can be measured as follows —

	Description
1	$W_P \times W_P \times \sigma P^2$
2	$W_P \times W_Q \times Cov_{PQ}$
3	$W_P \times W_R \times Cov_{PR}$
4	$W_Q \times W_P \times Cov_{PQ}$
5	$W_Q \times W_Q \times \sigma_Q^2$
6	$W_Q \times W_R \times Cov_{QR}$
7	$W_R \times W_P \times Cov_{PR}$
8	$W_R \times W_Q \times Cov_{QR}$
9	$W_R \times W_R \times \sigma_R^2$
Total	**Variance of Portfolio**

Note: The Covariance between the Securities P and Q is given by the Formula -

$$Cov_{PQ} = \beta_P \times \beta_Q \times \sigma^2_M$$

Where, σ^2_M = Variance of Market

(c) The Total Risk of the Portfolio can be split as follows (Variance Approach)-

Systematic Risk of the Portfolio = $\beta_{portfolio} \times \sigma^2_M$

Unsystematic Risk of the Portfolio = $\sigma^2_{portfolio}$ − Systematic Risk of the Portfolio

Co-efficient of Variation As A Tool to Measure Risk

Co-efficient of Variation translates the standard deviation of different probability distributions so as to compare on the basis of one particular base. It is the deviation per unit of the mean return.

The coefficient of variation for a probability distribution is the ratio of its standard deviation to its expected value.

Illustration 4

Two securities A and B have a standard deviation of 10% and 20% each. On first glance, Security B is more riskier than Security A. If mean (average) returns of Securities A and B is 10% and 30% respectively, then we can observe that A has more risk per unit of return, while B has a lower risk per unit of return.

Solution:

Particulars	Security A	Security B
Standard Deviation	10%	20%
Mean Return (Average Expected Return)	10%	30%
Co-Efficient of Variation [Standard Deviation ÷ Average Return]	10% ÷ 10% = 1	20% ÷ 30% = 0.67

Purpose:

Standard Deviation measures the dispersion in absolute terms. It does not provide a base for comparison. Coefficient of variance provides a common base. i.e. extent of variance, which can be used to compare different investments.

Formula:

Co-efficient of Variation = Standard Deviation ÷ Expected NPV

Meaning of covariance it is the relationship or responsiveness of returns between two securities – how they move or change each other**. It is the product of deviations of returns from their arithmetic mean.** It is calculated as follows:

(a) When historical data is given: $\frac{1}{N}\Sigma(R_A - \overline{R}_A)(R_B - \overline{R}_B)$

where R_A denotes return from security A, R_B denotes return from security B, $\overline{R}_A$, is the arithmetic mean of returns from security A, $\overline{R}_B$, is the arithmetic mean of returns from security B, N = No. of terms.

(b) When probability or ex-ante data is used the formula will be

$$\sum_{i=1}^{n} P_i (R_{iA} - \overline{R}_A)(R_{iB} - \overline{R}_B).$$

Illustration 5

The return in two securities and their associated probabilities are given below. Find out the value of (r), i.e., correlation coefficient.

State of economy	Probability	Return of security X (%)	Return of security Y (%)
1	0.20	12	15
2	0.30	15	12
3	0.10	-7	15
4	0.25	11	-4
5	0.15	7	6

Solution:

Calculation of covariance						
State of economy	**Probability**	**Return on Security X (%)**	**Return of Security Y (%)**	**Deviation of return of security X from it mean**	**Deviation of return of security Y from its mean**	**Product of the deviation X probability**
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	0.20	12	15	12-10 = 2	15–8 = 7	2.80
2	0.30	15	12	15-10 = 5	12–8 = 4	6.00
3	0.10	–7	15	–7–10 = –17	15–8 = 7	–11.9
4	0.25	11	–4	11–10 = 1	–4 –8 = –12	–3.0
5	0.15	7	6	7–10 = –3	6–8 = –2	0.9 Sum = –5.2

The expected return on security X:

$= E(R_x) = (0.20 \times 12) + (0.30 \times 15) + (0.10 \times -7) + (0.25 \times 11) + (0.15 \times 7)$

$= 2.4 + 4.5 - 0.70 + 2.75 + 1.05 = 10\%$

The expected return on security Y:

$= E(R_y) = (0.20 \times 15) + (0.30 \times 12) + (0.10 \times 15) + (0.25 \times -4) + (0.15 \times 6)$

$= 3.00 + 3.6 + 1.5 - 1.00 + 0. = 8\%$

Covariance between the returns of securities is – 5.2.

We have to calculate the S.D. of X and S.D. of Y respectively to find out the value of (r)

$\sigma^2_x = 0.20\ (12\text{-}10)^2 + 0.30\ (15\text{-}10)^2 + 0.10\ (\text{-}7\text{-}10)^2 + 0.25\ (11\text{-}10)^2 + 0.15\ (7\text{-}10)^2$

$= 0.20\ (4) + 0.30\ (25) + 0.10\ (289) + .25\ (1) + 0.15\ (9)$

$= 0.8 + 7.5 + 28.9 + 0.25 + 1.35 = 38.8.$

Or $\sigma_x = 6.23\%$

$\sigma^2_Y = .20\ (15 - 8)^2 + 0.30\ (12 - 8)^2 + 0.10\ (15 - 8)^2 + 0.25\ (-4 - 8)^2 + 0.15\ (6 - 8)^2$

$= 0.20\ (49) + 0.30\ (16) + 0.10\ (49) + 0.25\ (144) + 0.15\ (4)$

$= 9.8 + 4.8 + 4.9 + 36 + 0.60 = 56.10$

or $\sigma_Y = 7.49\%.$

Covariance may be calculated in this process also:

$\text{Cov}\ (X, Y) = [0.20\ (12 - 10)\ (15 - 8) + 0.30\ (15 - 10)\ (12 - 8) + 0.10\ (-7 - 10)\ (15 - 8)$

$+ 0.25\ (11 - 10)\ (-4 - 8) + 0.15\ (7 - 19)\ (6 - 8)]$

$= 0.20\ (14) + 0.30\ (20) + 0.15\ (-119) + 0.25\ (-12) + 0.15\ (6)$

$= 2.80 + 6 - 11.90 - 3 + 0.90$

$= -5.2.$

Correlation coefficient $r = [\text{Cov}(X, Y)] \div [\sigma_x \times \sigma_Y] = -5.2 \div [6.23 \times 7.49]$

or $r = (-5.2) \div 46.6627 = -0.11.$

Correlation and Diversification

A. Correlation Co-efficient

Correlation Co-efficient is a measure of closeness of the relationship between two random variables and is bounded by the values +1 and -1.

Different Meaning of Co-relation Coefficient (r)

The value of r varies from -1 to +1. When the value of r is -1, it represents a complete perfect negative correlation by which we can reduce our portfolio risk to zero, provided the other conditions are satisfied. When the value of r is zero, it means there is no correlation or co-movement. The returns are independent and still we can reduce our risk. When the value of r represents +1, it denotes a perfect positive correlation and hence no risk reduction is possible.

Formulae:

The formulae for determining the correlation coefficient are—

(i) Based on Covariance and Standard Deviation:

$$\rho_{XY} = Cov_{XY} \div (\sigma_X \times \sigma_Y)$$

(ii) Based on Probability Distribution of Future Returns:

$$\rho_{XY} = \frac{\sum[X_i - E(X_i)] \times [_i - E(Y_i)]}{\sum R^2_M - nR^2_m}$$

(iii) Based on historical realized returns

$$\rho_{XY} = \frac{n\sum X_i Y_i - \sum X_i \sum Y_i}{\sqrt{[n\sum X_i^2 - (\sum X_i)^2] - [n\sum Y_i^2 - (\sum Y_i)^2]}}$$

Valuation and Inference

Portfolio Risk will be —

(a) Maximum when two components of a portfolio stand perfectly positively correlated.

(b) Minimum when two components of a portfolio stand perfectly negatively correlated.

B. Diversification:

Diversification refers to investing in more than one security, i.e. dividing the Portfolio into different stocks and not investing the money in one particular stock. Some of the risks associated with individual assets can be eliminated by forming Portfolio by way of spreading an investment across assets. This is called diversification.

Features:

(i) Diversification reduces risks because prices of different stocks do not move exactly together. It helps to reduce Portfolio risk by eliminating unsystematic risk for which investors are not rewarded.

(ii) Investors are rewarded for taking market risk.

(iii) Diversification averages the returns of the assets within the Portfolio, thereby it attenuates the potential highs (and lows).

(iv) Diversification among companies, industries and asset classes, protects against business risk, and financial risk.

C. Relationship Between Correlation and Diversification:

Relationship Between Securities: The level of diversification of a Portfolio depends on how the investments (in the Portfolio) react with one another. If they offset each other properly, then the value of Portfolio is well protected.

Examination of Correlation: The interaction among the investments can be determined by examining the correlation coefficient between pairs of investments.

Inference from Correlation: The relationship between Correlation and Diversification can be described as follows —

Correlation coefficient	Nature	Diversification
$\rho = +1$	Perfectly positively correlated	(a) Investments do not offset each other and they move in tandem. (b) No diversification.
$\rho = -1$	Perfectly negatively correlated	(a) Investments offset each other totally and they move in opposite direction. (b) Full diversification achieved.
$\rho = Q$	No correlation	(a) No predictability of movement of investments. (b) Not a good diversification.

A Portfolio With The Minimum Level of Risk

The following formula is used to determine the appropriate proportions that will create the minimum Variance Portfolio (containing two securities A and B —

Proportion of Investment in Security A, $W_A = \dfrac{\sigma_B{}^3 - Cov_{AB}}{\sigma_A{}^3 + \sigma_B{}^2 - 2Cov_{AB}}$

Proportion of Investment in Security B, $W_B = 1 - W_A$

Where — W_A is the Proportion of Investment in Portfolio A.

W_B is the Proportion of Investment in Portfolio B.

σ_A is the Standard Deviation of Portfolio A,

σ_B is the Standard Deviation of Portfolio B.

Cov_{AB} is the Co-variance between Portfolio A and B.

Illustration 6

Portfolio Risk and Return

An Investor has decided to invest ₹1,00,000 in the Shares of two Companies, namely ABC and XYZ. The projections of Returns from the Shares of the two Companies along with their probabilities are as follows:

Probability	0.20	0.25	0.25	0.30
ABC (%)	12	14	-7	28
XYZ (%)	16	10	28	-2

You are required to-

1. Comment on Return and Risk of Investment in Individual Shares.
2. Compare the Risk and Return of these two Shares with a Portfolio of these Shares in equal proportions.
3. Find out the proportion of each of the above Shares to formulate a minimum Risk Portfolio.

Solution:

1. Computation of Expected Returns and Risk of the Individual Shares

P	R_A	R_B	$P \times R_A$	$P \times R_B$	$D_A=\overline{R}_A-R_A$	$D_B=\overline{R}_B-R_B$	$P \times (D_A)^2$	$P \times (D_B)^2$	$P(D_A \times D_B)$
0.20	12	16	2.40	3.20	0.55	3.90	0.06	3.04	0.43
0.25	14	10	3.50	2.50	1.45	-2.10	0.53	1.10	-0.76
0.25	-7	28	-1.75	7.00	-19.55	15.90	95.55	63.20	-77.71
0.30	28	-2	8.40	-0.60	15.45	-14.10	71.61	59.64	65.35
			$\overline{R}_A$=12.55%	$\overline{R}_B$=12.10%			σ^2_A=167.75	σ^2_B = 126.98	-143.39

Standard Deviation = $\sigma_A = \sqrt{167.75} = 12.95\%$, Standard Deviation = $\sigma_B = \sqrt{126.98} = 11.27\%$

Computation of Co-efficient of Variation (Risk per unit of Return):

For ABC: 12.95 ÷ 12.55 = 1.03	For XYZ: 11.27 ÷ 12.10 = 0.93

Conclusion: Hence, based on Risk, XYZ is more preferable.

2. Risk and Return of the Portfolio (50% : 50% mix)

(a) Return of the Portfolio: Returns in %: (12.55 × 0.50) + (12.10 × 0.50) = 12.325%

Returns in Amount: 1,00,000 × 12.325% = ₹12,325

(b) Risk of the Portfolio-Standard Deviation of the Portfolio (Matrix Approach):

	$W_{ABC}(0.05)$	$W_{XYZ}(0.05)$	
W_{ABC} (0.05)	$= 0.5 \times 0.5 \times \sigma_{ABC}^2$ $= 0.25 \times (12.95)^2 = 41.9256$	$0.5 \times 0.5 \times \text{Cov}(_{XYZ, ABC})$ $= 0.25 \times (-144.255) = -36.0638$	$\sigma_{ABC\ XYZ}^2 = 41.9256+31.7532+2 \times (-36.0638)$ $= 1.5512\%$
W_{XYZ} (0.05)	$= 0.5 \times 0.5 \times \text{Cov.} (_{XYZ, ABC})$ $= 0.25 \times (-144.255) = 36.0638$	$0.5 \times 0.5 \times \sigma_{XYZ}^2$ $= 0.25 \times (11.27)^2 = 31.7532$	$\sigma_{ABC\ XYZ}^2 = 1.245\%$

So, Minimum Risk Portfolio $W_{ABC} = [\sigma_{XYZ}^2 - \text{COV}(_{ABC\ XYZ})]/[(\sigma_{ABC}^2 + \sigma_{XYZ}^2 - 2\text{COV}(_{ABC\ XYZ})]$

$= [(11.27)^2 - (-143.39)]/[(12.95)^2 + (11.27)^2 - 2(-143.39)]$

W_{ABC} = 46.50% (Proportion of Investment in ABC share)

W_{XYZ} = 100% - W_{ABC} = 53.50% (Proportion of investment in XYZ share)

Expected Return of A Security Under Sharpe Single Index Market Model

Market Model: Market Model does not pre-suppose the existence of risk free return for the purpose of estimating return from a security. Under this model (assumption), the market risk affects the whole of return from a security, and not just the return in excess of the risk-free rate.

Formulae:

1. Expected Return [$E(R_P)$]: Without considering Risk Free Return

$$\rightarrow E(R_P) = \alpha_P + (\beta_P \times R_M) + e$$

Components:

Notation	Description
α_P (Alpha Intercept)	It is the return from a Security / Portfolio when Market Return is Zero. = Average Return **Less** Expected Return (Beta Adjusted Return) = $\overline{R}_p - \beta_P \times R_M$ Over a longer period, α should be Zero.
$\beta_P \times R_M$	Beta Adjusted Market Return.
e	Error Factor (with Zero Mean and constant standard deviation)

2. Expected Return: Considering Risk Free Return (Risk Adjusted Excess Return Approach)

$$\rightarrow E(R_P) = \alpha_P - [R \times (1-\beta_P)] + R_F + [\beta_P (R_M - R_F)] + e$$

Components:

Notation	Description
$\alpha_P - [R \times (1 - \beta_P)]$	Risk Adjusted Excess Return (Alpha Value adjusted for Risk Rate of Return)
R_F	Risk Free Rate of Return
$[\beta_P \times (R_M - R_F)]$	Market Risk Premium adjusted for Beta Factor
e	Error Factor (with Zero Mean and constant standard deviation)

Computation of Beta:

- Under Market Model, computation of Beta is done using annualized returns from security and the market on a daily basis.
- Return for this purpose = (Dividend + Price Increase) ÷ Price at the beginning of the day.

Alpha

The difference between the investment's actual expected return and its fair return (as per CAPM) is known as the investment's alpha (i.e. α). It is an absolute measure, which is the return on the Portfolio in excess of the CAPM predicted return. Alpha measures the relative value addition provided by an Asset Manager compared to a market index, given a Portfolio's market risk. Alpha can also be interpreted as the deviation from the SML in the CAPM.

Features:

(i) Alpha is appropriate, when the investment represents one of the many investments held by a client.

(ii) Alpha enables to evaluate how well a Manager has performed, when accounting for the level of risk undertaken to achieve their returns.

Value:

(i) Positive Alpha: A positive alpha indicates that the expected return from this stock is higher than the return under CAPM, to the extent of the alpha value. Hence stocks with positive alpha should be considered as under-valued stocks and hence should be bought.

(ii) Negative Alpha: A negative Alpha value indicates that expected return from the stock is less than the return under CAPM, to the extent of the alpha value. Hence stocks with negative alpha should be considered as over-valued stocks and should be sold.

Markowitz Model of Risk-Return Optimization

A. Propounded By: Harry Markowitz is regarded as the father of modern portfolio theory. He propounded the Markowitz Model of Risk Return optimization.

B. Basis:

(i) Investors are mainly concerned with two properties of an asset — Risk and Return.

(ii) Investor can trade off between return and risk, by diversification of portfolio. To the investor, risk of an individual asset does not matter. What really matters is the contribution it makes to the investor's total risk. The tradeoff between risks and returns must be reflected in the required rates of returns on investment opportunities.

(iii) The theory focuses on balancing safety, liquidity and return depending on the preference of different investors.

C. Application: The model is used to address the following portfolio selection problems / questions —

(i) Finding the mean variance efficient portfolios and

(ii) Selecting one such portfolio.

D. Assumptions of the Model: The model has taken into account risks associated with investments using variance or standard deviation of the return. The model is based on the following assumptions —

(i) Return on an investment adequately summarises the outcome of the investment.

(ii) Investors can visualise a probability distribution of rates of return.

(iii) Investors' risk estimates are proportional to the variance of return they perceive for a security or portfolio.

(iv) Investors base their investment decisions on two criteria i.e. expected return and variance of return (Risk).

(v) Investors are risk averse. For a given expected return he prefers to take minimum risk, for a given level of risk the investor prefers to get maximum expected return.

(vi) Investors are assumed to be rational in so far as they would prefer greater returns to lesser ones given equal or smaller risk and are risk averse. Risk aversion in this context means merely that as between two investments with equal expected returns, the investment with the smaller risk would be preferred.

(vii) 'Return' could be any suitable measure of monetary inflows, but yield has been the most commonly used measure of return, in this context, so that where the standard deviation of returns is referred to we shall mean the standard deviation of yield about its expected value.

E. Diversification and Efficient Portfolio:

(i) Efficient Frontier: Markowitz developed the concept of efficient frontier. For selection of a portfolio, comparison between combinations of portfolios is essential. A portfolio is not efficient if there is another portfolio with —

- Higher expected value of return and a lower standard deviation (risk).
- Higher expected value of return and the same standard deviation (risk)
- Same expected value but a lower standard deviation (risk)

(ii) Optimum Portfolio: Investor has to select a portfolio from amongst all those represented by the efficient frontier. This will depend upon his risk-return preference. As different investors have different preferences with respect to expected return and risk, the optimal portfolio of securities will vary considerably among investors.

(iii) Diversification: Diversification is the process which combines assets that are less than perfectly positively correlated in order to reduce portfolio risk without sacrificing any portfolio returns. If an investors' portfolio is not efficient he may —

- Increase the expected value of return without increasing the risk.
- Decrease the risk without decreasing the expected value of return, or
- Obtain some combination of increase of expected return and decrease risk.

Illustration on Systematic and Unsystematic Risk

Illustration 7

Calculate the Systematic and Unsystematic Risk for the Companies Stock. If equal amount of money is allocated for the stocks, what would be the risk of Portfolio?

	Company A	Company B	Sensex
Average Return	0.15	0.25	0.66
Variance of Return	6.30	5.86	2.25
Beta	0.71	0.685	
Co efficient of determination	0.18		

Solution:

SR = Systematic Risk, USR = Unsystematic Risk, Total Risk

Co	Beta	Beta^2	SR = Beta^2 × σ_M^2	TR = σ^2	USR = TR - SR	Weight × β	USR × W^2
A	0.71	0.5041	0.5041 × 2.25 = 1.134	6.30	6.30 – 1.134 = 5.166	0.3550	1.292
B	0.685	0.4962	0.4692 × 2.25 = 1.056	5.86	5.86 – 1.056 = 4.804	0.3425	1.201
						0.6975	2.493

Risk of Portfolio = SR (0.6957^2 × 2.25) + USR 2.493 = 3.5876.

Illustration 8

From the following, you are required to find the Risk of the Portfolio, if the Standard Deviation of the Market Index (σ_m) is 18%.

Security	B	Random Error σ_{ei}	Weight
A	1.60	7	0.25
B	1.15	11	0.30
C	1.40	3	0.25
D	1.00	9	0.20

Solution:

1. Computation of Risk of Portfolio

Security	β	Weight	Product	Unsystematic Risk (SD) = σ_{ei}	Unsystematic Risk (Variance Approach)	Product = Unsys. Risk x $(\text{Weight})^2$
(1)	(2)	(3)	(4)=(2) x (3)	(5)	(6) = $(5)^2$	(7) = (6) x $(3)^2$
A	1.60	0.25	0.40	7	49	49 x 0.25 x 0.25 = 3.06
B	1.15	0.30	0.345	11	121	121 x 0.30 x 0.30 = 10.89
C	1.40	0.25	0.35	3	9	9 x 0.25 x 0.25 = 0.56
D	1.00	0.20	0.20	9	81	81 x 0.20 x 0.20 = 3.24
Total		**1.00**	**1.295**			**ΣUnsystematic Risk = 17.75**

1. Beta of the portfolio β = 1.295
2. Systmetic risk (Variance Approach) of the portfolio $= \beta^2 \times \Sigma_M^{\ 2} = (1.295)^2 \times (18)^2 = 543.35$
3. Total risk (Variance Approach) = Systematic Risk 543.35 + Unsystematic Risk 17.75 = 561.11.

Optimal Portfolio, Efficient Frontier, Capital Market Line

8.2

8.2.1 Optimal Portfolio

Modern Portfolio Theory (MPT) seeks to construct an optimal portfolio by considering the relationship between risk and return. The theory recommends that the risk of a particular security should not looked on a standalone basis, rather it should be looked in relation to portfolio. A security may be very risky but when combined with some other security, the combination may not be that much risky (because some of its negative fluctuations may be set off by positive fluctuations of the other security). The theory explores how an investor can use diversification to optimize his portfolio.8 Markowitz showed that, using portfolio, the risk can be minimized without reducing the expected return, by diversifying out the unsystematic risk. Consider two securities, A and B. A's expected return is 10% and SD is 15%, B's expected return is 20%, SD is 30%. Coefficient of correlation between the returns of the two assets is 0. An investor is planning to invest all his money in A because he finds that he cannot bear the risk of B (because B's risk is quite high). A portfolio manager suggests him that he may invest 80% of his funds in A and 20% of funds in B. This will enhance his return to 12% and risk will be reduced to 13.40%.

The theory suggests three steps for portfolio decisions:

(I) To select the securities of one's choice and to construct all possible portfolios.

(II) To classify these portfolios into two parts:

- (a) Efficient
- (b) Inefficient

A portfolio is classified as efficient one if it is not inefficient.

A portfolio is inefficient if:

(a) it is rejected by application of Set A, or

(b) there exists some other portfolio which is better than this portfolio in both the respects. i.e. it has higher return and lower risk.

When the efficient portfolios are plotted in risk-return space, we get efficient frontier. A set of all efficient portfolios is known as efficient frontier. As per MPT, an investor should seek a portfolio that lies on the efficient set.

Efficient Frontier

If we examined different two-asset combinations and derived the curves assuming all the possible weights, we would have a graph like that in Figure 8.1. The envelope curve that contains the best of all these possible combinations is referred to as the efficient frontier. Specifically, the efficient frontier represents that set of portfolios that has the maximum rate of return for every given level of risk, or the minimum risk for every level of return.

An example of such a frontier is shown in Figure 8.2. Every portfolio that lies on the efficient frontier has either a higher rate of return for equal risk or lower risk for an equal rate of return than some portfolio beneath the frontier. Thus, we would say that Portfolio A in Figure 8.2 dominates Portfolio C because it has an equal rate of return but substantially less risk. Similarly, Portfolio B dominates Portfolio C because it has equal risk but a higher expected rate of return, because of the benefits of diversification among imperfectly correlated assets, we would expect the efficient frontier to be made up of portfolios of investments rather than individual securities. Two possible exceptions arise at the end points, which represent the asset with the highest return and that asset with the lowest risk.

Numerous Portfolio Combinations of Available Assets

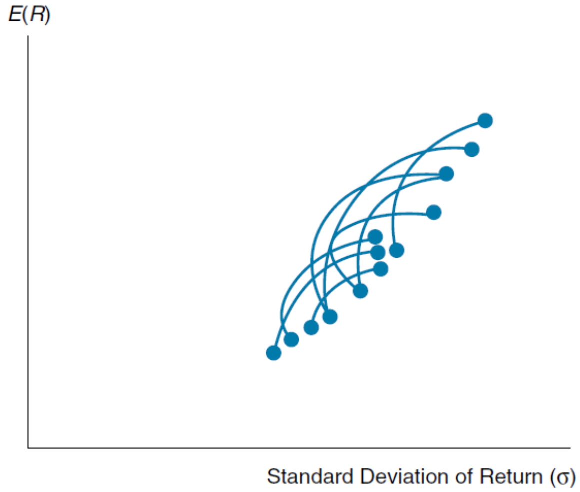

Figure 8.1

Efficient Frontier for Alternative Portfolios

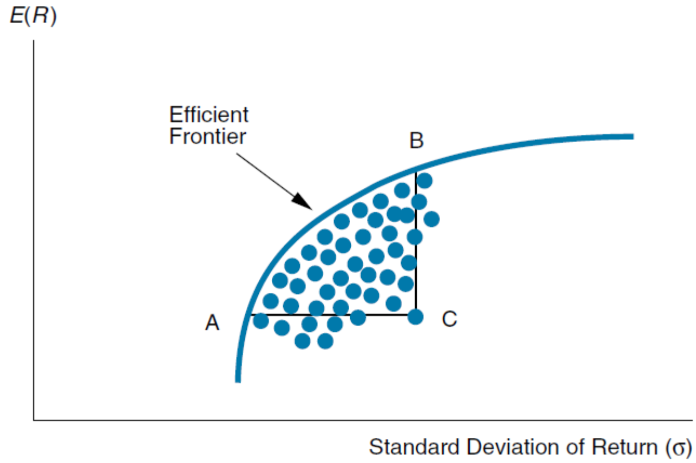

Figure 8.2

As an investor, one will target a point along the efficient frontier based on one's utility function and attitude toward risk. No portfolio on the efficient frontier can dominate any other portfolio on the efficient frontier. All of these portfolios have different return and risk measures, with expected rates of return that increase with higher risk.

Utility Analysis: Utility is the satisfaction that an investor enjoys from his portfolios return. An ordinary investor is assumed to receive greater utility from higher return and vice versa. It is a common theory that the investor gets more satisfaction or more utility in X + 1 rupees than from a single rupee. If he is allowed to choose between two certain events obviously he will choose the one which gives him larger outcome. Thus, utility increases with increase in return.

For the purpose of risk preferences, we can categorize the investors as : (a) Risk averse (b) Risk neutral and (c) Aggressive. The character of each type of investors can be explained with the help of a 'fair gamble '. If a coin is tossed the outcome is either head or tail, i.e., chance is always 0.5 each. Head represents a winning toss and will yield ₹10 whereas the tail denotes nil outcome or a dead loss i.e., 0. The cost of the game is ₹ 5 in each case. The expected value of the game each time will be ($^1/_2$ × ₹10) + ($^1/_2$ × 0) = ₹5, which is exactly the entry cost.

Risk averse type investors will always reject a fair gamble because the disutility of the loss is greater for him than the utility of an equivalent gain.

Risk neutral investor will be indifferent whether fair gamble is undertaken or not, The aggressive or risk taking investors will accept it because the expected utility of investing is higher than the expected utility of not investing. [for details, refer chapter 5. These three different types of investors utility are shown individuality:

The upward sloping curved X indicates increasing utility. The increasing utility suggests that the utility increases more than proportional increase in return and shows the risk lover's attitude towards risk.

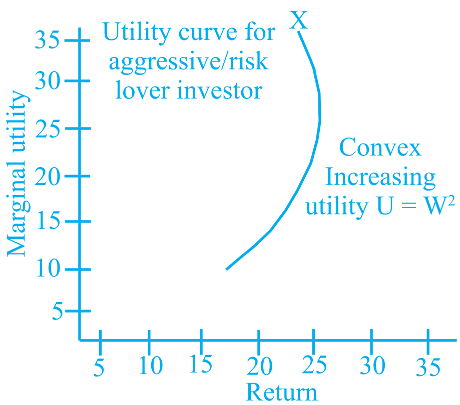

Figure 8.3

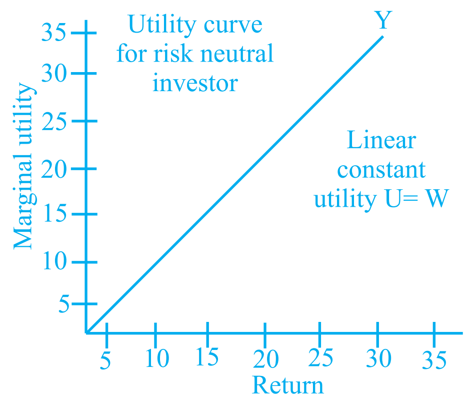

Figure 8.4

The straight line Y shows the constant utility, a linear function where doubling of returns would doubt the utility and it indicates risk neutral situation.

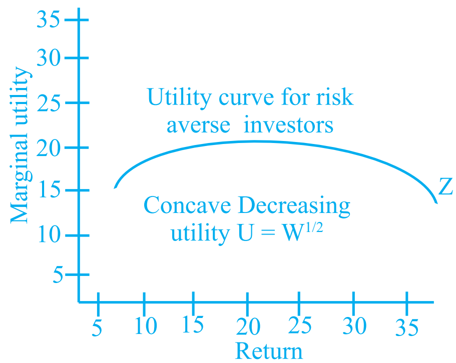

Figure 8.5

Curve Z shows diminishing utility for risk averse type of investor.

Utility function or indifference curves are normally used to represent investors.

Utility functions or indifference curves are normally used to represent investor's preferences. Let us prepare an indifference curves that are parallel to one each other and linear. The higher a curve, the more desirable are the situations lying along it. Each curve carries equal satisfaction along its length Figure 8.5 and labelled it from 1 to 5 in order of increasing desirability.

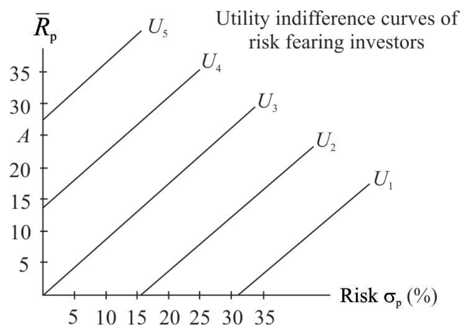

Figure 8.6

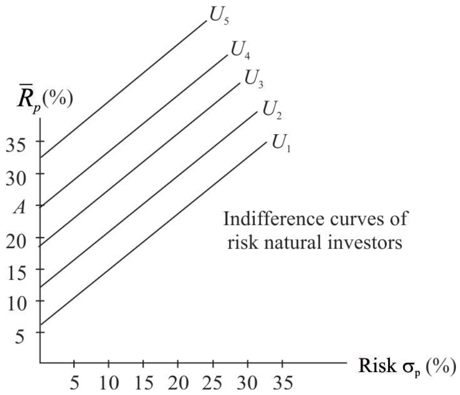

Figure 8.7

Investors generally like to get more return for additional risk assumed and the lines will be positively sloped. See figure 8.6 for a set of indifference curves (lines) for a risk lover. His indifference curves are negatively sloped and convex towards the origin.

The risk lover is happy with the high level of portfolio risk (σ_p). If an efficient frontier is drawn on the figure, the only point of tangency with the risk lover's indifference curves would be at the upper right point of the frontier. This point contains one security and follows the aggressive investors maxim of putting all the eggs into a single basket. For the risk fearing, lower the risk of portfolio, happier he would be. The degree of the slope of indifference curve indicates the degree of risk aversion. The conservative investor needs larger return to undertake small increase in risk and just reverse in case of aggressive investors.

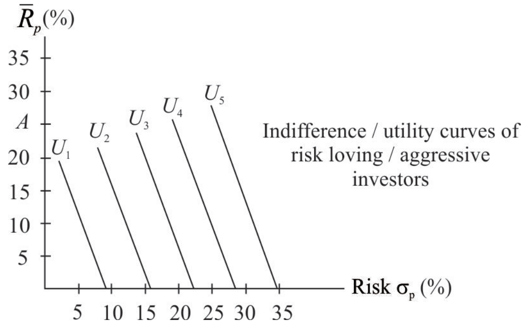

Figure 8.8

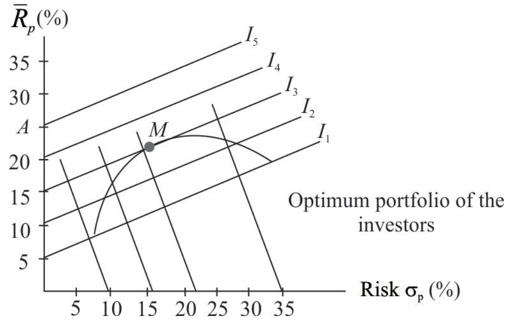

Figure 8.9

After pointing out the various indifferent/utility curves of the investors the final question comes: what would be the optimum portfolio, or in other words, how will the investor find the feasible portfolio tangent to the best attainable (highest) indifference line/curve. The Figure 8.8 can solve the query of the investor.

Point 'M' is his best portfolio because (i) it is efficient and (ii) at this point, the frontier will be tangent to the indifference curve (line).

Risk Penalty: Utility is the expected return minus risk penalty. This risk penalty depends on portfolio risk and the investor's risk tolerance. More risk means more undesirable unit of additional risk. It can be assumed that twice the risk is four times of the undesirable risk. The risk penalty is as follows:

$$\text{Risk penalty} = (\text{Risk})^2 \div \text{Risk tolerance}$$

Risk squared is the variance of return of the portfolio. Risk tolerance is a number from 0 to 100. High risk tolerance means investor's appetite to bear more risk for more return. Low tolerance is just reversed. Risk penalty decreases as tolerance increases.

Example expected return from a portfolio is 16%, variance of return (risk squared) is 289% and the investor's tolerance is 60, the risk penalty will be = 289% ÷ 60 = 4.82%

$$\text{Utility is} = ER_p \text{ - Risk penalty } = 16\% - 4.82\% = 11.18\%$$

If the investor's utility is minimum 10%, and since it exceeds 105, so the return from the portfolio will be accepted by him.

Determination of Optimum Portfolio with inclusion of Risk Free Assets

So far, we have discussed the risk-return trade off only on risky asst i.e., determination of optimum portfolio of risky assets. But when a risk free asset (r_f) is included with risky assets, what will be the optimum portfolio? And, how funds will be allocated amongst different asset classes.

It's a critical question as to how an investor will allocate his funds on two risky securities (say security A and security B or stocks and bonds) and one risk free security with the help of capital allocation line. When optimizing capital allocation, we want to work with the capital allocation line (CAL) offering the highest slope or Sharpe ratio. The steeper the CAL, the greater is the expected return corresponding to any level of volatility. Now, we proceed to asset allocation: constructing the risky portfolio of major asset classes, here a bond and a stock fund, with the possible Sharpe ratio.

The asset allocation decision requires that we consider T-bills or another safe asset along with the risky asset classes. The reason is that the Sharpe ratio we seek t maximize is defined as the risk premium in excess of the risk free rate, divided by the standard deviation of the portfolio. We use T-bills as the risk free rate in evaluating the Sharpe ratios of all possible portfolios. The portfolio that maximises the Sharpe ratio is the solution to the asset allocation problem. Using only stocks, bonds, and bills is actually not so restrictive, as it includes all three major asset classes.

To find out the optimum allocation of funds we require to find the Sharpe ratio and respective weights of risky assets. The objective is to maximize the slope of the capital allocation line for any portfolio . thus, our objective function is the slope or the Sharpe ratio or S_p.

$$S_P = [E(r_p) - r_f] \div \sigma_P$$

When we maximize the objective function, S_p, we have to satisfy the constraint that the weight of the portfolio's sum will be equal to 1 or (100%), i.e., W(Stock A + Stock B) = 1 or $W_A + W_B = 1$

$\therefore$ To optimize Max $S_p = [E(r_p) - r_f] \div \sigma_p$, subject to $\sum W_i = 1$. This is non-linear problem that can be solved using standard tools of calculus.

In the case of the two risky assets, the solution for the weights of the optimal risky portfolio, P, is given by the following equation:

$$W_A = \frac{[E(R_x) - R_f] \times \sigma_y^2 - [E(R_x) - R_f] \times Cov_{xy}}{[E(R_x) - R_f] \times \sigma_y^2 + [E(R_y) - R_f] \times \sigma_x^2 - [E(R_x) - R_f + E(R_y) - R_f] \times Cov_{(xy)}}$$

In earlier chapters, we found the optimal complete portfolio given as optimal risky portfolio and the CAL generated by a combination of this portfolio and T-bills. Now that we have constructed the optimal risky portfolio P, we can use the individual investor's degree of risk aversion, A, to calculate the optimal proportion of the complete portfolio to invest in the risky component.

Illustration 9

Following is the data regarding six securities:

Securities	A	B	C	D	E	F
Return (%)	8	8	12	4	9	8
Risk (%) (Standard Deviation)	4	5	12	4	5	6

1. Which of the securities will be selected?
2. Assuming perfect correlation, is it preferable to Invest 75% in Security A and 25% in Security C?

Solution:

1. Selection of Securities

(a) Securities A, B and F have identical return at 8%. However, Security A has a risk of 4% only (least among A, B and F). Therefore, A should be selected (as it is the security with the least risk and highest return in its risk category).

(b) Securities B and E have identical risk factor at 5%. However, return on Security E is more than B. Therefore, E should be preferred over B.

Selection: A and E may be selected.

Note: Security C and B may also be selected on grounds of higher return.

2. Portfolio = 75% in A and 25% in C

Since there is a perfect correlation between A & C, Risk and Return can be averaged with proportion, computed as under

(a) Portfolio Return = Weighted Return = $(W_A \times R_A) + (W_C \times R_C)$ = (8 × 75%) + (12 × 25%) = 6 + 3 = 9%

(b) Portfolio Risk = Weighted Risk = $(W_A \times \sigma_A) + (W_C \times \sigma_C)$ = (4 × 75%) + (12 × 25%) = 3 + 3 = 6%

Recommendation: Compared to investment in Securities A and C, investment in E is better. This is because, for the same Return (i.e. 9%), Security E has a lower risk factor (at 5% against 6% for the Portfolio of A and C.)

Illustration 10

Europium Ltd has been specially formed to undertake two Investment Opportunities. The Risk and Return characteristics of the two projects are shown below:

Particulars	A	B
Expected Return	12%	20%
Risk	3%	7%

Europium plans to Invest 80% of its available funds in Project A and 20% in Project B. The directors believe that the correlation co-efficient between the returns of the Projects is +1.0.

Required -

1. Calculate the Returns from the proposed Portfolio of Projects A and B.
2. Calculate the Risk of the Portfolio,
3. Suppose the correlation co-efficient between A and B was -1, how should the Company Invest its Funds in order to obtain zero Risk Portfolio.

Solution:

1. **Basic Values of Factors for Portfolio Return & Risk**

Standard Deviation = σ	Correlation Co-efficient = ρ	Weights (W)	Return = R
$\sigma_A = 3\%$	$\rho AB = +1$	$W_A + 0.80$	$R_A = 12\%$
$\sigma_B = 7\%$		$W_B + 0.20$	$R_B = 20\%$

Portfolio Return = Weighted Return = $(W_A \times R_A) + (W_B \times R_B) = (12 \times 80\%) + (20 \times 20\%) = 9.6 + 4 = 13.6\%$

2. **Risk of Portfolio [80% : 20% Ratio]**

$$\text{Risk } (\sigma_{AB}) = \sqrt{(\sigma_A^2 \times W_A^2) + (\sigma_B^2 \times W_B^2) + 2(\sigma_A \times W_A \times \sigma_B \times W_B \times \rho_{AB})}$$
$$= \sqrt{(3^2 \times 0.80^2) + (7^2 \times 0.20^2) + (2 \times 3 \times 0.80 \times 7 \times 0.20 \times 1)}$$
$$= \sqrt{(5.76+1.96+6.72)}$$
$$= \sqrt{14.44}$$
$$= 3.8\%$$

3. **Computation of Proportion of Investment in Security A and B if ρAB = -1**

$\rho_{AB} = COV_{AB}/(\sigma_A \times \sigma_B)$

$-1 = COV_{AB}/(3 \times 7)$ Hence, $COV_{AB} = -21$

Proportion of Investment in Security A is computed as under –

⇨ $W_A = (\sigma_B^2 - COV_{AB})/(\sigma_A^2 + \sigma_B^2 - 2COV_{AB})$

⇨ $W_A = [7^2 - (-21)]/[3^2+7^2 - 2(-21)] = [(49+21)]/[9+49+42] = 70/100 = 0.70$

So, Proportion of Investment in Security B, $W_B = 1 - W_A = 1 - 0.70 = 0.30$

Illustration 11

L Ltd and M Ltd has the following Risk and Return estimates:

R_L	R_M	σ_L	σ_M	Correlation co-efficient = r_{LM}
20%	22%	18%	15%	-1

Calculate the proportion of Investment in L Ltd and M Ltd to minimize the Risk of Portfolio.

Solution:

1. Basic Values of Factors for Determination of Portfolio Risk

Standard Deviation of L Ltd	σ_L	18%
Standard Deviation of M Ltd	σ_M	15%
Correlation co-efficient	ρ_{LM}	-1
Weight of Security A	W_L	X
Weight of Security B	W_M	1 - X

2. Computation of Investment in Security A (W_A)

(a) Computation of Covariance

$\rho_{LM} = COV_{LM}/(\sigma_L \times \sigma_M)$

$\Rightarrow -1 = COV_{LM}/(18 \times 15)$

$\Rightarrow COV_{LM} = -270$

(b) Proportion of investment in L Ltd and M Ltd

$W_L = (\sigma_M^2 - COV_{LM})/(\sigma_L^2 + \sigma_M^2 - 2COV_{LM})$

$= (15^2 - (-270))/(18^2 + 15^2 - 2 \times (-270))$

$= (225 + 270)/(324 + 225 + 540)$

$= 495/1089$

$= 0.45$

(c) Proportion of investment in M Ltd

$W_M = 1 – 0.45 = 0.55$

8.2.2 Capital Market Line (CML)

The Markowitz mean-variance model is modified by introducing into the analysis the concept of risk-free asset. If it is assumed that the investor has access to risk-free securities (for example, Treasury bills) in addition to the universe of risky securities, then he can construct a new set of portfolios as depicted by the line R_t. At point R_t the investor is investing all his investible fund in risk-free securities, whilst at point M he is holding an all –equity portfolio. The combination of risk-free investment and risky investments in portfolio which may be achieved by points between these two limits are termed as lending portfolios. Let us now assume that the investor can lend and borrow funds at the same risk-free interest rate. In such circumstances the efficiency boundary simply becomes the straight line drawn from R_t which is a tangent to the original risky portfolio efficiency boundary. The efficiency boundary that arises out of this assumption of the identical risk free lending and borrowing rates leads to some very important conclusions and is termed as 'Capital Market Line' (CML).

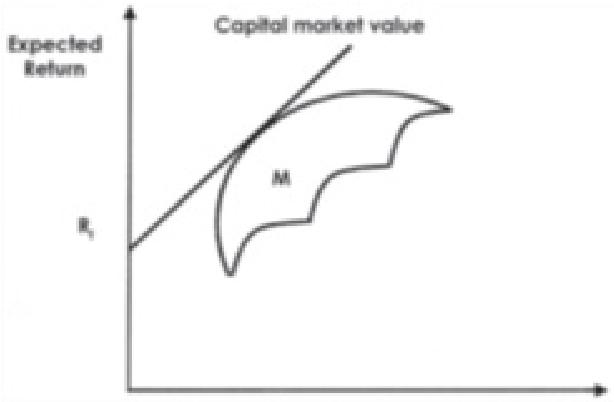

Figure 8.10: Capital Market Line

Purpose:

The Capital Market Line (CML) provides the best risk and return tradeoff for an investor. CML enables an investor to estimate the Expected Return from a Portfolio.

Feature:

(i) Portfolio is assumed to be efficient i.e., exact replication of the market portfolio in terms of risks and rewards.

(ii) CML assumes no unsystematic risk i.e., all the unsystematic risk is completely taken care off by proper diversification similar to that of market portfolio.

(iii) Capital Market Line estimates the return for a portfolio based on the Total Risk Route i.e., it assumes existence of perfect correlation between the portfolio return and market return.

(iv) Individual securities does not lie on Capital Market Line. This is because they have some extent of unsystematic risk associated with their returns.

Market Price of Risk: Market Price of Risk of a Portfolio X = $(R_M - R_F) \div \sigma_M$

Where — R_M = Market Return

R_F = Risk Free Rate of Return

σ_M = Standard Deviation of the Market Portfolio.

Expected Return on Portfolio under CML Approach:

$E(R_P)$ $R_F + \lambda \times \sigma_P$

Where $E(R_P)$ = Expected Return on Portfolio

R_F = Risk Free Rate of Interest/ Return

λ = Market Price of Risk, i.e. Risk Premium per Unit of Market Risk

σ_P = Risk of the Portfolio (Standard Deviation)

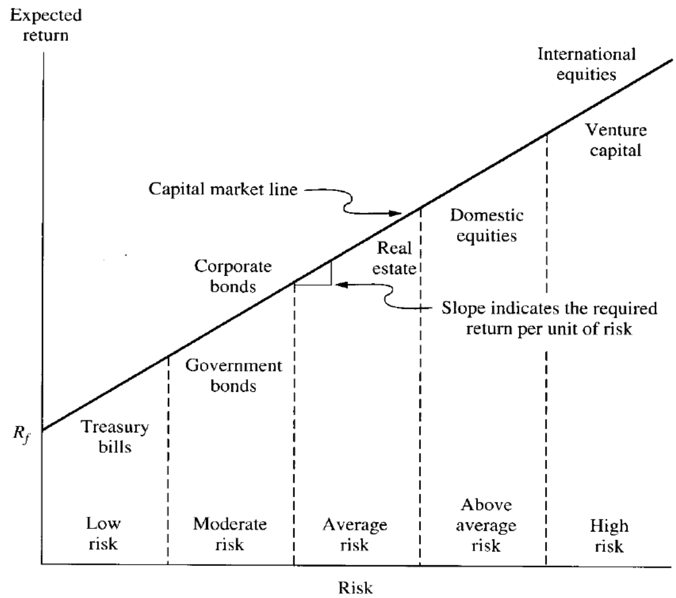

Figure 8.11: Expected Return under CML approach

Figure 8.11 is a capital market line showing an expected relationship between risk and return for representative asset classes arrayed over a range of risk. Note that the line is upward-sloping, indicating that higher risk should be accompanied by higher return. Conversely, the capital market relationship can be considered as showing that higher return can be generated only at the "expense" of higher risk. When measured over longer periods of time, the realized return and risk of the asset classes conform to this sort of relationship.

Treasury bills are positioned at the low end of the risk range, consistent with these securities' generally being considered as representative of risk-free investing, at least for short holding periods. Correspondingly, the return offered by T-bills is usually considered as a basic risk-free return. On the other hand, equities as a class show the highest risk and return, with venture capital at the very highest position on the line, as would be expected. International equities, in turn, are shown as higher risk than domestic equities.

Bonds and real estate are at an intermediate position on the capital market line, with real estate showing higher risk relative to both corporate and government bonds.

Security Market Line (SML)

Security Market Line (SML) reflects the linear relationship between Systematic Risk and Expected Return in financial markets that result when Expected Returns and Beta Coefficients are plotted across a graph. SML is the relationship between Expected Return and Beta, on which both portfolios and individual securities lie.

Purpose:

SML helps to determine if the investment is offering a return that is appropriate for its level of risk. Given its risk class, a security's return should be on the SML.

Evaluation based on SML:

Value of a security can be judged based on where the return from such security is plotted with reference to the SML as follows —

Actual Return is	Inference	Security is
Above SML	Stock is yielding a higher return than what can be expected.	Underpriced
On SML	Stock is yielding a return equivalent to can be expected.	Correctly Priced
Below SML	Stock is yielding a lower return than what can be expected.	Overpriced

Graphical Representation (Security Market Line): Security Market Line expresses the basic theme of the CAPM, i.e. expected return increases linearly with risk, measured by Beta.

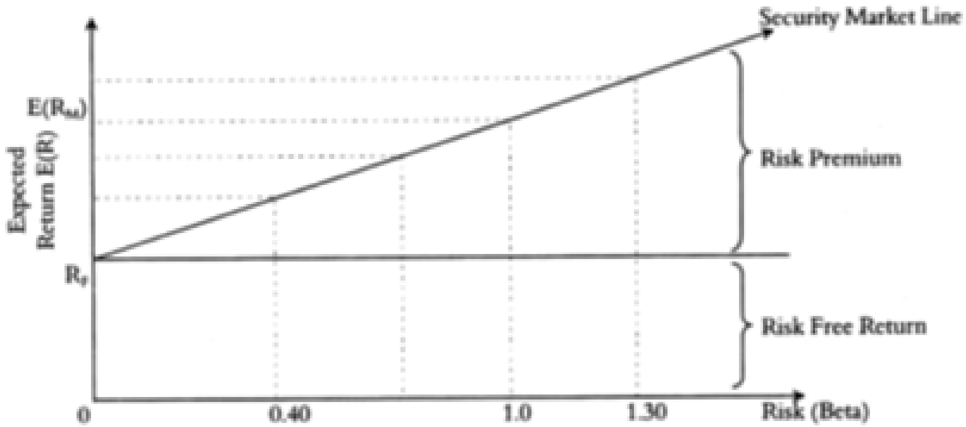

Figure 8.12: Security market line

Individual Security vs. Portfolio of Securities:

(a) A major implication of CAPM is that both, an Individual Security and all the Portfolios as well be placed on the Security Market Line.

(b) This is because of an efficient market hypothesis, i.e. all securities are expected to yield returns commensurate with their riskiness, measured by Beta.

Differences Between Security Market Line And Capital Market Line:

Aspect	Capital Market Line	Security Market Line
1. Risk Considered	Capital Market Line uses Standard Deviation, i.e. Total Risks across the x-axis.	Security Market Line uses Beta or Systematic Risk across the x-axis. (i.e. that part of Total Risk which is commonto the whole of the market).
2. Nature of Portfolios	It uses only efficient portfolios, i.e. one which is a perfect replication of the Market Portfolio in terms of risks and rewards.	Security Market Line uses both efficient and non-efficient portfolios.
3. Combination	Every point on the Capital Market Line is a proportional combination between Risk free Rate of Return and Market Return.	It graphs all portfolios and securities which lie on and off the Capital Market Line.

Characteristic Line

Characteristic Line is a graph depicting the relationship between Security's Returns and Market Index Returns. Security Characteristic Line is a time series graph. Return considered for this is the excess return, i.e. expected return over and above the Risk Free Rate of Return.

Purpose:

Security Characteristic Line is used to estimate beta and also to determine how a security return correlates to a market index return.

Beta:

Beta estimate comes from the slope estimate of the security characteristic line.

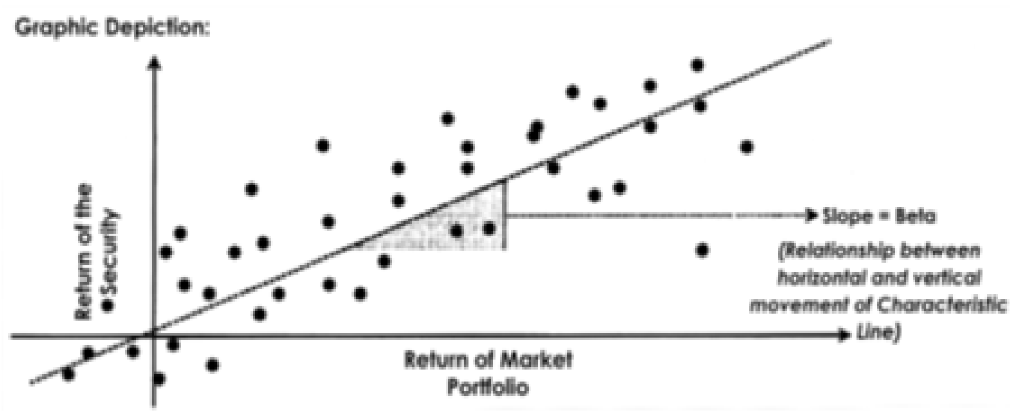

Figure 8.13: Characteristic Line

● represents set of return of the Security and Return of the Market at a particular point.

.... represents Characteristic Line (a line which covers most of the dots on the graph)

Distinguish between a "Security Market Line (SML)" and "Characteristic Line (CL)"

Aspect	Security Market Line	Characteristic Line
Scheme	It represents the relationship between return and risk (measured in terms of systematic risk) of a security or portfolio.	It represents the relationship between the returns of two securities or a security and the market return, over a period of time.
Nature of Graph	Security Market Line is a cross-sectional graph.	Security Characteristic Line is a Time Series Graph.
Comparison	Security Market Line graphs beta versus expected return.	Characteristic Line graphs time series of Security Returns versus the Index Returns.
Utility	It is used for estimating the expected return for a security relative to its beta risk.	To estimate beta and also to determine how a security return correlates to a market index return.

Principles of Asset Allocation, Active and Passive Asset Allocation

8.3

8.3.1 Asset Allocation

Asset allocation involves dividing an investment portfolio among different asset categories, such as stocks, bonds, and cash.

Asset allocation is an investment strategy that aims to balance risk and reward by apportioning a portfolio's assets according to an individual's goals, risk tolerance, and investment horizon. The three main asset classes - equities, fixed-income, and cash and equivalents - have different levels of risk and return, so each will behave differently over time.

Ideal asset allocation is the mix of investments, from most aggressive to safest, that will earn the total return over time that you need. The percentage of one's portfolio depends on the time frame and the tolerance for risk.

Determining a strategic asset allocation is arguably the most important aspect of the investment process. The process of creating a diversified, multi-asset class portfolio typically involves two separate steps. The first step is the asset allocation decision, which can refer to both the process and the result of determining long- term (strategic) exposures to the available asset classes (or risk factors) that make up the investor's opportunity set.

Asset allocation is the first and primary step in translating the client's circumstances, objectives, and constraints into an appropriate portfolio (or, for some approaches, multiple portfolios) for achieving the client's goals within the client's tolerance for risk.

The second step in creating a diversified; multi-asset-class portfolio involves implementation decisions that determine the specific investments (individual securities, pooled investment vehicles, and separate accounts) that will be used to implement the targeted allocations.

8.3.2 Asset Allocation Strategies in Portfolio Management

The four Asset Allocation Strategies in Portfolio Management are -

1. **Integrated Asset Allocation:** Here, Capital Market conditions and Investor Objectives and Constraints are analysed, and the allocation that best serves the Investor's needs while incorporating the Capital Market forecast is determined.

2. **Strategic Asset Allocation:** Here, Optimal Portfolio mixes based on Returns, Risk, and Co-variances is generated using historical information and adjusted periodically to restore target allocation within the context of the Investor's objectives and constraints.

3. **Tactical Asset Allocation:** Here, the Investor's risk tolerance is assumed constant and the Asset Allocation is changed based on expectations about capital market conditions.

4. **Insured Asset Allocation:** Here, the risk exposure for changing portfolio values (wealth) is adjusted. More value means more ability to take risk.

8.3.3 Active and Passive Asset Allocation

Active Portfolio Strategy (APS) and the principles thereof.

Note: Portfolio Strategy is classified into Active Portfolio Strategy (APS) and Passive Portfolio Strategy.

The Active Portfolio Strategy (APS) is described as follows

1. Concept of APS:

(a) APS is followed by Investment Professionals and aggressive Investors, who strive to earn superior return after adjustment for risk.

(b) "Active" Fund Management involves researching individual Companies, gathering extensive data about their financial performance, business strategies and management characteristics, etc. to identify and invest in stocks of those Companies that the Fund Managers think will produce better returns, and beat the overall market (or Index).

(c) Active Strategy is based on the assumption that the Capital Market is characterized by efficiency, which can be exploited by resorting to specific techniques.

2. Techniques / Principles of APS:

Technique	Description
(a) Market Timing	Market Timing is based on an explicit or implicit forecast of general market movement, based on tools like business cycle analysis, moving average analysis, advance-decline analysis, econometric models, etc. The forecast for the general market movement as derived with the help of these tools is tempted by the subjective judgment of the Investors.

(b) Sector Rotation	Sector or Group Rotation (or shifting) applies to both Equity and Debt components of the portfolio. It is used more compulsorily with respect to strategy. In case of Equity, the weightage for various industry sectors is based on their asset outlook, and the industry's future prospects. In case of Bonds, Sector Rotation implies a shift in the composition of the Bond Portfolio in terms of quality as reflected in credit rating, coupon rate, term of maturity, etc.
(c) Security Selection.	Security Selection involves a search for under-priced security. In case of Equity, the APS Manager employs fundamental / technical analysis to identify Stocks which seems to promise superior return, and concentrate the stock components of portfolio more on them, rather than on Stocks which are perceived to be unattractive. In case of Bonds, Security Selection calls for choosing Bonds which offer the highest YTM (Yields to-Maturity) at a given level of risk.
(d) Specialised Investment Concept	Specialised Investment Concept / Philosophy is used particularly for investment in Stocks. Using this concept, investments are made in Growth Stocks, Neglected or Out-of-Favour Stocks, Asset Stocks, Technology Stocks and Cyclical Stocks. Specialized Investment Concept helps to - i. Focus one's effort on a certain kind of investment that reflects one's ability and talent. ii. Avoid the distraction of perusing other alternatives. iii. Master an approach or style through sustained practice and continual self-criticism. However, focussing exclusively on a Specialized Concept may it obsolete. Changes in market risk may affect the validity of the basic premise underlying the investor philosophy.

Passive Portfolio Strategy.

1. **Meaning:** Passive Strategy is based on the assumption that the Capital Market is fairly efficient, with respect to the available information. Hence, the Fund Managers search for superior return.
2. **Guidelines:** Passive Strategy involves adhering to the following two guidelines -
   (a) Create a well-diversified portfolio at a pre-determined level of risk.

(b) **Hold** the portfolio relatively unchanged over time, unless it became adequately diversified or inconsistent with the investor risk-return preference.

3. **Example of Passive Strategy = Index Fund:**

(a) An Index Fund is a Mutual Fund Scheme that invests in the securities of the Target Index in the same proportion or weightage. Thus, they are passively managed Funds.

(b) An Index Fund's daily returns are the same as the daily returns obtained from an Index.

(c) An Index Fund carries all the risks normally associated with the type of asset the fund holds. So, when the overall stock market rises / falls, the price of Shares in the Index Fund also rises / falls.

(d) An Index Fund does not mitigate market risks. Indexing merely ensures that the Investors' returns will not stray far from the returns on the Index that the fund seeks to imitate.

Additional Illustrations

1. Securities X and Y have standard deviations of 3% and 9%. Nitin is having a surplus of ₹20 Lakhs for investment in these two securities. How much should he invest in each of these securities to minimize risk, if the correlation coefficient for X and Y is: (a) -1; (b) -0.30; (c) 0; (d) 0.60

Solution:

1. **Basic Values of Factors for Determination of Portfolio Risk**

Standard Deviation of Security X	σ_X	3%
Standard Deviation of Security Y	σ_Y	9%
Correlation co-efficient of Securities X and Y	ρ_{XY}	-1,- 0.30, 0,0.60
Weight of Security X	W_X	a
Weight of Security Y	W_Y	1-a

2. **Computation of Investment in Securities**

Proportion of Investment in Security X, $W_X = \dfrac{\sigma_Y^2 - Cov_{XY}}{\sigma_X^2 + \sigma_Y^2 - 2Cov_{XY}}$

Proportion of Investment in Security Y, $W_Y = 1 - W_X$

$$Cov_{XY} = \rho_{XY} \times \sigma_X \times \sigma_Y$$

If r_{XY} is	Cov_{XY} is	Computation	Investment
-1	-27 (-1×3×9)	→ $W_X = [\sigma_Y^2 - Cov_{XY}] \div [\sigma_X^2 + \sigma_Y^2 - 2Cov_{XY}]$	0.750 in X
		→ $W_X = [9^2 - (-27)] \div [3^2 + 9^2 - 2 \times (-27)]$	0.250 in Y
		→ $W_X = [81 + 27] \div [9 + 81 + 54]$	₹15,00,000 in X
		→ $W_X = 108/144 = 0.75$	₹5,00,000 in Y

-0.3	-8.1 (-0.3×3×9)	$\rightarrow W_X = [\sigma_Y^2 - Cov_{XY}] \div [\sigma_X^2 + \sigma_Y^2 - 2Cov_{XY}]$ $\rightarrow W_X = [9^2 - (-8.1)] \div [3^2 + 9^2 - 2 \times (-8.1)]$ $\rightarrow W_X = [81 + 8.1] \div [9 + 81 + 16.2]$ $\rightarrow W_X = 89.1 / 106.2 = 0.839$	0.839 in X 0.161 in Y ₹16,78,000 in X ₹3,22,000 in Y
0	0 (0×3×9)	$\rightarrow W_X = [\sigma_Y^2 - Cov_{XY}] \div [\sigma_X^2 + \sigma_Y^2 - 2Cov_{XY}]$ $\rightarrow W_X = [9^2 - 0] \div [3^2 + 9^2 - 2 \times 0]$ $\rightarrow W_X = [81 - 0] \div [9 + 81 - 0]$ $\rightarrow W_X = 81/90 = 0.90$	0.900 in X 0.100 in Y ₹ 18,00,000 in X ₹ 2,00,000 in Y
0.60	16.2 (0.6×3×9)	$\rightarrow W_X = [\sigma_Y^2 - Cov_{XY}] \div [\sigma_X^2 + \sigma_Y^2 - 2Cov_{XY}]$ $\rightarrow W_X = [9^2 - 16.2] \div [3^2 + 9^2 - 2 \times 16.2]$ $\rightarrow W_X = [81 - 16.2] \div [9 + 81 - 32.4]$ $\rightarrow W_X = 64.8 / 57.60 = 1.125 > 1$ At this correlation level, risk reduction is not possible.	Reducing Risk below 3% is not possible.

2. An investor is considering two investment opportunities with the following risk and return characteristics.

Project	P	Q
Expected return	15%	22%
Risk	3%	7%

The investor plans to invest 80% of its available funds in share P and 20% in Q. the directors believe that the correlation co-efficient between the returns of the shares is +1.0.

Required—

(a) Calculate the returns from the proposed portfolio of shares P and Q.

(b) Calculate the risk of the portfolio;

(c) Suppose the correlation coefficient between P and Q was -1. How should the company invest its funds in order to obtain zero risk portfolio.

Solution:

1. Return of the Portfolio

Securities	Expected return	Proportion	Return from portfolio
(1)	(2)	(3)	(4) = (2)×(3)
P	15	0.8	12
Q	22	0.2	4.4
Return of the Portfolio			16.4

2. Basic Values of Factors for Determination of Portfolio Risk

Particulars	Notation	Value
Standard deviation of Security P	σ_P	3%
Standard deviation of Security Q	σ_Q	7%
Correlation co-efficient of Securities P and Q	ρ_{PQ}	+ 1
Weight of Security P	W_P	0.80
Weight of Security Q	W_Q	0.20

Risk of Portfolio i.e. Standard deviation of Portfolio of P and Q [80% : 20% Ratio]

$$\sigma PQ = \sqrt{(\sigma_P^2 \times W_P^2) + (\sigma_Q^2 \times W_Q^2) + 2(\sigma_P^2 \times W_P \times \sigma_Q \times W_Q \times \rho_{PQ})}$$

$$= \sqrt{(3^2 \times 0.80^2) + (7^2 \times 0.20^2) + (2 \times 3 \times 0.80 \times 7 \times 0.20 \times 1)}$$

$$= \sqrt{(9 \times 0.64) + (49 \times 0.04) + (6.72)}$$

$$\text{Risk} = \sqrt{5.76 + 1.96 + 6.72}$$

$$= \sqrt{14.44}$$

$$= 3.8\%$$

3. Computation of Investment in Security P and Q

Proportion of Investment in Security P, $W_P = \dfrac{\sigma_Q^2 - Cov_{PQ}}{\sigma_P^2 + \sigma_Q^2 - 2Cov_{PQ}}$

Proportion of Investment in Security Q, $W_Q = 1 - W_P$

$Cov_{PQ} = \rho_{PQ} \times \sigma_P \times \sigma_Q$

$= -1 \times 3 \times 7 = -21$

$\rightarrow W_P = [\sigma_Q^2 - Cov_{PQ}] \div [\sigma_P^2 + \sigma_Q^2 - 2Cov_{PQ}]$

$\rightarrow W_P = [7^2 - (-21)] \div [3^2 + 7^2 - 2 \times (-21)]$

$\rightarrow W_P = [49 + 21] \div [9 + 49 + 42]$

$\rightarrow W_P = 70 / 100$

$= 0.70$

Proportion of Investment in Security Q, $W_Q = 1 - W_P = 1 - 0.70 = 0.30$

3. An investor has two portfolios known to be on minimum variance set for a population of three securities R, S and T having the weights mentioned below:

	W_R	W_S	W_T
Portfolio X	0.30	0.40	0.30
Portfolio Y	0.20	0.50	0.30

It is supposed that there are no restrictions on short sales.

(a) What would be the weight for each stock for a portfolio constructed by investing ₹6,000 in Portfolio X and ₹4,000 in Portfolio Y?

(b) Suppose the investor invests ₹5,000 out of ₹10,000 in Security R. How he will allocate the balance between security S and T to ensure that his portfolio is on minimum variance set?

Solution:

1. Investment in Individual Securities

Security	Portfolio X	Portfolio Y	Total	Weight
R	6,000 × 0.30 = 1,800	4,000 × 0.20 = 800	2,600	2,600 ÷ 10,000 = 0.26
S	6,000 × 0.40 = 2,400	4,000 × 0.50 = 2,000	4,400	4,400 ÷ 10,000 = 0.44
T	6,000 × 0.30 = 1,800	4,000 × 0.30 = 1,200	3,000	3,000 ÷ 10,000 = 0.30
	6,000	4,000	10,000	1.0000

2. Investment Strategy to Ensure Minimum Variance

Given the following equations $\rightarrow W_R = 0.50$ (₹5,000 ÷ ₹10,000)

$\rightarrow W_R + W_S + W_T = 1$

Therefore, it naturally follows that

$$\rightarrow W_T + W_S = 0.50 \quad ...(1)$$

A simple linear equation establishing an equation between two variables W_R and W_S or the Variables W_S and W_T in the given manner—

$$W_T = a + bW_S$$

Substituting the values of W_R & W_S from the data given (Portfolio X and Y), we get -

$0.30 = a + b \times 0.40,$

$0.30 = a + b \times 0.50,$

$b = 0,$

$a = 0.30,$

$W_T = 0.30 - 0W_S.$

or

$W_T + 0W_S = 0.30 \quad ...(2)$

Therefore solving (1) and (2) we get $W_T = 0.30$ and $W_S = 0.20$

Conclusion: Allocation of Funds -

R = ₹ 5,000 (Given)

S = 0.20 × ₹ 10,000 = ₹ 2,000.

T= 0.30 × ₹ 10,000 = ₹ 3,000.

Alternatively,

Since the Proportion of Investment in T is 0.30 and is constant across both the Portfolio, any linear equation drawn from the Data given would result in the Weight of T being a constant 0.30.

Therefore, W_R= 0.50 (Given), W_T = 0.30 (Constant),

Therefore, W_S = 0.20 (W_S= 1- 0.50 - 0.30 = 0.20).

4. From the following information, ascertain the risk of the portfolio —

Securities	Standard Deviation	Proportion in Portfolio
A	8%	0.30
B	12%	0.50
C	6%	0.20

Correlation Co-efficient

AB = 0.50

AC = - 0.40

BC = + 0.75

Solution:

1. **Formula Approach (Alternative 1)**

(a) Basic Values of Factors for Determination of Portfolio Risk

Standard Deviation of Security A	σ_A	8%
Standard Deviation of Security B	σ_B	12%
Standard Deviation of Security C	σ_C	6%
Correlation co-efficient of Securities A and B		0.50
Correlation co-efficient of Securities A and C		-0.40
Correlation co-efficient of Securities B and C		0.75
Weight of Security A	W_A	0.30
Weight of Security B	W_B	0.50
Weight of Security C	W_C	0.20

(b) Computation of Portfolio Risk (σ_{ABC})

$$= \sqrt{(\sigma_A{}^2\times W_A{}^2)+(\sigma_B{}^2\times W_B{}^2)+(\sigma_C{}^2\times W_C{}^2)+2(\sigma_A\times W_A\times\sigma_B\times W_B\times\rho_{AB})+2(\sigma_A\times W_A\times\sigma_C\times W_C\times\rho_{AC})+2(\sigma_B\times W_B\times\sigma_C\times W_C\times\rho_{BC})}$$

$$= \sqrt{(8^2\times0.3^2)+(12^2\times0.5^2)+(6^2\times0.2^2)+(2\times8\times0.3\times12\times0.5\times0.5)+(2\times8\times0.3\times6\times0.2\times(-0.4))+(2\times12\times0.5\times6\times0.2\times0.75)}$$

$$= \sqrt{(64\times0.09)+(144\times0.25)+(36\times0.04)+(14.4)+(-2.304)+(10.8)}$$

$$= \sqrt{5.76 + 36 + 1.44 + 14.4 - 2.304 + 10.8}$$

$$= \sqrt{66.096}$$

= 8.13%

2. Matrix Approach (Alternative 2)

(a) Basic Values of Factors for Determination of Portfolio Risk

Variance of Security A		$\sigma_A{}^2$	$8^2 = 64$
Variance of Security B		$\sigma_B{}^2$	$12^2 = 144$
Variance of Security C		$\sigma_C{}^2$	$6^2 = 36$
Covariance of Securities A and B	[$P_{AB}\times \sigma_A\times \sigma_B$]	COV_{AB}	$0.50 \times 8 \times 12 = 48$
Covariance of Securities A and C	[$P_{AC}\times \sigma_A\times \sigma_C$]	COV_{AC}	$- 0.40 \times 8 \times 6 = - 19.2$
Covariance of Securities B and C	[$P_{BC}\times \sigma_B\times \sigma_C$]	COV_{BC}	$0.75 \times 12 \times 6 = 54$
Weight of Security A		W_A	0.30
Weight of Security B		W_B	0.50
Weight of Security C		W_C	0.20

(b) Matrix

Securities		A	B	C
	Weights	0.30 W_A	0.50 W_B	0.20 W_C
A	0.30 W_A	64 ($\sigma_A{}^2$)	48 (Cov_{AB})	-19.2 (Cov_{AC})
B	0.50 W_B	48 (COV_{AB})	144 ($\sigma_B{}^2$)	54 (Cov_{BC})
C	0.20 W_C	-19.2 (Cov_{AC})	54 (Cov_{BC})	36 ($\sigma_C{}^2$)

(c) Computation of Portfolio Variance (σ_{ABC}^2)

	Description	Computation ($W \times W \times Cov$) or ($W \times W \times \sigma^2$)	Product
1	$W_A \times W_A \times (\sigma_A^2)$	0.30 × 0.30 × 64	5.76
2	$W_A \times W_B \times COV_{AB}$	0.30 × 0.50 × 48	7.20
3	$W_A \times W_C \times COV_{AC}$	0.30 × 0.20 × (-19.2)	(1.15)
4	$W_B \times W_A \times COV_{AB}$	0.50 × 0.30 × 48	7.20
5	$W_B \times W_B \times \sigma_B^2$	0.50 × 0.50 × 144	36
6	$W_B \times W_C \times COV_{BC}$	0.50 × 0.20 × 54	5.40
7	$W_C \times W_A \times COV_{AC}$	0.20 × 0.30 × (-19.2)	(1.15)
8	$W_C \times W_B \times COV_{BC}$	0.20 × 0.50 × 54	5.40
9	$W_C \times W_C \times \sigma_C^2$	0.20 × 0.20 × 36	1.44
	Variance of the Portfolio (σ_{ABC})		**66.10**
	Standard Deviation (Risk) of the Portfolio (σ_{ABC})		**8.13%**

5. Aditi is interested to construct a portfolio of Securities M and N. She has collected the following information about the proposed investment.

	M	N
Expected return	20%	25%
σ	12%	16%

Co-efficient of Correlation, (r), between M and N is 16.

Aditi wants to constitute only five portfolios of M and N as follows.

I. All funds invested in M.

II. 50% of funds in each M and N.

III. 75% of funds in M and 25% in N.

IV. 25% of funds in M and 75% in N.

V. All funds invested in N.

You are required to calculate —

(1) Expected return under different portfolios,

(2) Risk factor associated with these portfolios,

(3) Which portfolio is best from the point of view of Risk.

(4) Which portfolio is best from the point of view of Return.

Solution:

1. Expected Return under different Portfolios

Portfolio	M		N		Expected Return of Portfolio
	Probability	Return	Probability	Return	
I	1	0.20	0	0.25	1 × 0.20 + 0 × 0.25 = 20%
II	0.5	0.20	0.5	0.25	0.5 × 0.20 + 0.5 × 0.25 = 22.50%
III	0.75	0.20	0.25	0.25	0.75 × 0.20 + 0.25 × 0.25 = 21.25%
IV	0.25	0.20	0.75	0.25	0.25 × 0.20 + 0.75 × 0.25 = 23.75%
V	0	0.20	1	0.25	0 × 0.20 +1 × 0.25 = 25%

2. Risk factor associated with different Portfolios:

Portfolio	Computation	σMN
I	$=\sqrt{(\sigma_M{}^2\times W_M{}^2)+(\sigma_N{}^2\times W_N{}^2)+2(\sigma_M\times W_M)\times(\sigma_N\times W_N\times\rho_{MN})}$ $=\sqrt{(12^2\times1^2)+(16^2\times0^2)+(2\times12\times1\times16\times0\times0.16)}$ $=\sqrt{144}$ = 12%	12%
II	$=\sqrt{(\sigma_M{}^2\times W_M{}^2)+(\sigma_N{}^2\times W_N{}^2)+2(\sigma_M\times W_M\times\sigma_N\times W_N\times\rho_{MN})}$ $=\sqrt{(12^2\times0.50^2)+(16^2\times0.50^2)+(2\times12\times0.50\times16\times0.50\times0.16)}$ $=\sqrt{36+64+15.36}$ $=\sqrt{115.36}$ = 10.74%	10.74%
III	$=\sqrt{(\sigma_M{}^2\times W_M{}^2)+(\sigma_N{}^2\times W_N{}^2)+2(\sigma_M\times W_M\times\sigma_N\times W_N\times\rho_{MN})}$ $=\sqrt{(12^2\times0.75^2)+(16^2\times0.25^2)+(2\times12\times0.75\times16\times0.25\times0.16)}$ $=\sqrt{81+16+11.52}$ $=\sqrt{108.52}$ = 10.42%	10.42%
IV	$=\sqrt{(\sigma_M{}^2\times W_M{}^2)+(\sigma_N{}^2\times W_N{}^2)+2(\sigma_M\times W_M\times\sigma_N\times W_N\times\rho_{MN})}$ $=\sqrt{(12^2\times0.25^2)+(16^2\times0.75^2)+(2\times12\times0.25\times16\times0.75\times0.16)}$ $=\sqrt{9+144+11.52}$ $=\sqrt{164.52}$ = 12.38%	12.83%

V	$= \sqrt{(\sigma_M^2 \times W_M^2)+(\sigma_N^2 \times W_N^2)+2(\sigma_M \times W_M \times \sigma_N \times W_N \times \rho_{MN})}$ $= \sqrt{(12^2 \times 0^2)+(16^2 \times 1^2)+(2 \times 12 \times 0 \times 16 \times 1 \times 0.16)}$ $= \sqrt{256}$ $= 16\%$	16%

3. Best Portfolio from the point of view of risk:

The Best Portfolio from the point of view of risk is the one which has the least risk factor i.e., 10.42%. Portfolio III [i.e., 75% of funds invested in M and 25% in N].

4. Best Portfolio from the point of return:

Portfolio V [i.e., 100% funds invested in the security, N] is the best from the point of return. This Portfolio will earn a return of 25%.

6. From the following information, ascertain the Market Price (X) of Risk of the portfolio -

Market Return (R_m)	Standard Deviation on Market Return (σ_m)	Return on Government Bonds (R_f)	Standard Deviation of the Portfolio (σ_p)
18%	6%	6%	8%
20%	8%	7%	4%
22%	9%	8%	12%

Also, determine the expected return for each of the above cases.

Solution:

1. Formulae for Expected Return and Market Price of Risk

Expected Return on Portfolio $R_p = R_f + \lambda \times \sigma_P$

Market Price of Risk of Portfolio $\lambda = (R_m - R_f)/\ \sigma_M$

2. Expected Return and Market Price of Risk

Market Return (R_m)	Standard Deviation on Market Return (σ_m)	Return on Government Bonds (R_f)	Standard Deviation of Portfolio (σ_p)	Market Price of Risk (λ) $[(R_m - R_f) \div \sigma_M]$	Expected Return $(R_P) = [R_f + \lambda \times \sigma_P]$
(1)	(2)	(3)	(4)	(5)=[(1)-(3)]/(2)	(6)=(3)+(5)×(4)
18%	6%	6%	8%	2 [(18-6)/6]	22% [6% + 2 × 8%]

20%	8%	7%	4%	1.625 [(20-7)/8]	13.50% [7% + 1.625 × 4%]
22%	9%	8%	12%	1.556 [(22-8)/9]	26.67% [8% + 1.556 × 12%]

7. X Co. Ltd., invested on 1.4.2021 in certain equity shares as below:

Name of Co.	No. of shares	Cost (₹)
D Ltd.	1,000 (₹ 10 each)	20,000
G Ltd.	500 (₹1 each)	15,000

In September, 2021,10% dividend was paid out by D Ltd. and in October, 2021, 30% dividend paid out by G Ltd. On 31.3.2022 market quotations showed a value of ₹22 and ₹29 per share for D Ltd. and G Ltd. respectively.

On 1.4.2022, investment advisors indicate (a) that the dividends from D Ltd. and G Ltd. for the year ending 31.3.2023 are likely to be 20% and 35%, respectively and (b) that the probabilities of market quotations on 31.3.2023 are as given below:

Probability factor	Price/ share of D Ltd.	Price/ share of G Ltd.
0.2	22	29
0.5	25	31
0.3	28	33

You are required to—

(a) Calculate the average return from the portfolio for the year ended 31.3.2022

(b) Calculate the expected average return from the portfolio for the year 2022-23; and

(c) Advise X Co. Ltd., of the comparative risk in the two investments by calculating the standard deviation in each case.

Solution:

1. Calculation of return on Portfolio for 2021-2022 (Calculation in ₹/ share)

Particulars	D	G
1. Market value by 31.03.22	22	29
2. Cost of investment	20	30
3. Gain / loss	2	(1)
4. Dividend received during the year Capital gain / loss by 31.03.22	1	0.3
5. Yield [(3) + (4)]	3	(0.7)

6. % return [(5) ÷ (2)] × 100	15	(2.33)
7. Weight in the Portfolio [20 : 15]	57	43
Weighted average return = (57 × 15%) - (43 ×- 2.33%) = 7.55%		

2. Calculation of Expected Return for 2022-23

Particulars	D	G
1. Expected dividend	2	0.35
2. Capital gain by 31.03.23		
• (22 × 0.2) + (25 × 0.5) + (28 × 0.3)-22 = (25.3-22)	3.3	
• (29 × 0.2) + (31 × 0.5) + (33 × 0.3)-29 = (31.2-29)		2.2
3. Yield[(1) + (2)]	5.3	2.55
4. Market value 01. 04.22	22	29
5. % return [(3) ÷ (4)]	24.09%	8.79%
6. Weight in Portfolio (1,000 × 22) : (500 × 29)	60.3	39.7
Weighted Average (Expected) Return = 18.02%		

3. Standard deviation of D Ltd.

Expected Market Value	Expected Gain	Expected Dividend	Expected Yield	D [(4) -5.3]	D^2	Probability	PD^2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
22	0	2	2	-3.3	10.89	0.2	2.17
25	3	2	5	-0.3	0.09	0.5	0.05
28	6	2	8	2.7	7.29	0.3	2.19
							4.41

Standard deviation $= \sqrt{PD^2} \quad = \sqrt{4.41} \quad = 2.1$

4. Standard deviation of G Ltd.

Expected Market Value	Expected Gain	Expected Dividend	Expected Yield	D [(4) -2.55]	D^2	Probability	PD^2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
29	0	0.35	0.35	-2.2	4.84	0.2	0.97
31	2	0.35	2.35	-0.2	0.04	0.5	0.02
33	4	0.35	4.35	1.8	3.24	0.3	0.97
							1.96

Standard deviation = $\sqrt{PD^2}$ = $\sqrt{1.96}$ = 1.4

Share of company D Ltd. is more risky as the S.D. is more that of company G Ltd.

8. The historical rates of return of two securities over the past ten years are given.

Calculate the Covariance and the Correlation coefficient of the two securities;

Years	1	2	3	4	5	6	7	8	9	10
Security A : (Return %)	12	8	7	14	16	15	18	20	16	22
Security B : (Return %)	20	22	24	18	15	20	24	25	24	18

Solution:

1. Computation of Factors

Year	Return of		Deviation from Mean		Variance of		Covariance of
	Security A (R_1)	Security B (R_2)	SA (R_1 - $\overline{R}_1$) (D_1)	SB (R_2 - $\overline{R}_2$) (D_2)	(D_1^2)	(D_2^2)	R_1 & R_2 [$D_1 \times D_2$]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	12	20	-2.8	-1	7.84	1	2.8
2	8	22	-6.8	1	46.24	1	-6.8
3	7	24	-7.8	3	60.84	9	-23.4
4	14	18	-0.8	-3	0.64	9	2.4
5	16	15	1.2	-6	1.44	36	-7.2
6	15	20	0.2	-1	0.04	1	-0.2
7	18	24	3.2	3	10.24	9	9.6
8	20	25	5.2	4	27.04	16	20.8
9	16	24	1.2	3	1.44	9	3.6
10	22	18	7.2	-3	51.84	9	-21.6
	$\sum R_1 = 148$	$\sum R_2 = 210$			207.6	100	-20

	Security A	Security B
Mean	$\overline{R}_1 = \sum R_1 \div n$ $= 148 \div 10 = 14.8$	$\overline{R}_2 = \sum R_2 \div n$ $= 210 \div 10 = 21$
Variance	$\sigma_A^2 = \sum D_1^2 \div n = 207.6 / 10 = 20.76$	$\sigma_B^2 = \sum D_2^2 \div n = 100 / 10 = 10$
Standard Deviation	$\sigma_A = \sqrt{20.76} = 4.55$	$\sigma_B = \sqrt{10} = 3.162$

2. Covariance and Correlation:

Combination	Security A and B
Covariance	$Cov_{AB} = \Sigma[D_1 \times D_2] \div n = -20 \div 10 = -2$
Correlation	$\rho_{AB} = Cov_{AB} / \sigma_A \times \sigma_B$ $= -2 / (4.55 \times 3.162) = -0.1390$

9. The distribution of return of security "P" and the market portfolio "Q" is given below:

Probability	Return %	
	P	Q
0.30	30	-10
0.40	20	20
0.30	0	35

You are required to calculate the expected return of security "P" and the market portfolio "Q", the covariance between the market portfolio and security and beta for the security,

Solution:

1. Expected Return and Risks of Security P

Scenario	Probability (P)	Return (R)%	Expected Return %	Deviation (D)%	D^2	Variance ($P \times D^2$)
(1)	(2)	(3)	(4) = (2) × (3)	(5) = (3)-(2×4)	(6)	(7) = (2)×(6)
1	0.30	30	9	13	169	50.7
2	0.40	20	8	3	9	3.6
3	0.30	0	0	(17)	289	86.7
			17.00%			141

Expected Return on Security P = 17.00%

Risk on Security (P) = $\sigma_P = \sqrt{\text{Variance}} = \sqrt{141} = 11.87\%$

2. Expected Return and Risks of Market Portfolio Q

Scenario	Probability (P)	Return (R)%	Expected Return %	Deviation (D) %	D^2	Variance ($P \times D^2$)
(1)	(2)	(3)	(4) = (2) × (3)	(5) = (3)-∑(4)	(6)	(7) = (2)×(6)
1	0.30	(10)	(3)	(25.5)	650.25	195.075
2	0.40	20	8	4.5	20.25	8.1
3	0.30	35	10.5	19.5	380.25	114.07
			15.50%			317.245

Expected Return on Market Portfolio Q = 15.50%

Risk on Security (Q) = $\sigma_Q = \sqrt{\text{Variance}} = \sqrt{317.24} = 17.81\%$

3. Computation of Covariance of Securities P and Market Portfolio Q

Scenario	Probability (P)	Deviation (D_P) from Mean for P%	Deviation (D_Q) from Mean for Q%	Deviation Product (D_{PQ}) = $D_P \times D_Q$	Covariance ($P \times D_{PQ}$)
(1)	(2)	(3)	(4)	(5) = (3)×(4)	(6) = (2)×(5)
1	0.30	13	(25.5)	(331.5)	(99.45)
2	0.40	3	4.5	13.5	5.4
3	0.30	(17)	19.5	(331.5)	(99.45)
					(193.5)

Covariance of Securities P and Market Portfolio Q [Cov_{PQ}] = (193.5)

Beta = $Cov_{PQ} \div \sigma_P^2$ = -193.5 ÷ 317.245 = - 0.6099

10. The rates of return on the Security of Company A and Market portfolio for 10 periods are given below:

Period	Return of Security A (%)	Return on Market portfolio (%)
1	18	22
2	20	20
3	24	18
4	26	16
5	18	20
6	-5	8
7	17	-6
8	19	5
9	-7	6
10	20	11

(a) What is the beta of Security A?

(b) What is the characteristic line for security A?

Solution:

1. Computation of Beta of Security

	Return of	Deviation from Mean	Variance of	Covariance of

Period	Mkt. (R_M)	A (R_A)	Mkt. ($R_M - \bar{R}_M$) (D_M)	A ($R_A - \bar{R}_A$) (D_A)	Mkt. (D_M^2)	A (D_A^2)	R_M & R_A [$D_M \times D_A$]
(1)	(2)	(3)	(4) [(2)-12]	(5) [(3)-15]	(6) $(4)^2$	(7) $(5)^2$	(8) (4)×(5)
1	22	18	10	3	100	9	30
2	20	20	8	5	64	25	40
3	18	24	6	9	36	81	54
4	16	26	4	11	16	121	44
5	20	18	8	3	64	9	24
6	8	-5	-4	-20	16	400	80
7	-6	17	-18	2	324	4	-36
8	5	19	-7	4	49	16	-28
9	6	-7	-6	-22	36	484	132
10	11	20	-1	5	1	25	-5
	120	**150**			**706**	**1174**	**335**

	Market Portfolio	Shares of Company A
Mean	$\bar{R}_M = \sum R_M \div n$ $= 120 \div 10$ $=12$	$\bar{R}_A = \sum R_A \div n$ $= 150 \div 10$ $=15$
Variance	$\sigma_M^2 = \sum D_M^2 \div n$ $= 706 \div 10$ $= 70.6$	$\sigma_A^2 = \sum D_A^2 \div n$ $= 1174 \div 10$ $= 117.4$
Standard Deviation	$\sigma_M = \sqrt{70.6} = 8.40$	$\sigma_A = \sqrt{117.4} = 10.84$

Covariance and Correlation:

Combination	Market and A
Covariance	$Cov_{MA} = [\sum D_M \times D_A] \div n$ $= 335 \div 10$ $= 33.5$
Beta β	$\beta = Cov_{MA} \div \sigma_M^2$ $= 33.5 \div 70.6$ $= 0.4745$

2. Computation of Characteristic Line for Security A

Particulars	**Value**
$y = \bar{R}_A$	15

β	0.4745
$x = \overline{R}_M$ (Expected Return on Market Index)	12

Characteristic Line for Security A = y = $\alpha + \beta x$,

$15 = \alpha + 0.4745 \times 12$

$\alpha = 15 - (0.4745 \times 12) = 9.306\%$

Characteristic line for Security A = $9.306 + 0.4745\ R_M$

Note: It is assumed that rates of return for market portfolio and the security given in the question are returns in excess of risk free rate of return.

11. Security A has an expected return of 20 percent and a standard deviation of 30 percent. Security B has an expected return of 26 percent and a standard deviation of 60 percent. If the correlation between A and B is 0.5, what is the expected return and standard deviation of a portfolio comprising of 40 percent of Security A and 60 percent of Security B?

Solution:

The expected portfolio return is given by

$r_P = W_A\, r_P + (1 - W_A)\, r_B$

$= 0.4(0.2)+0.6(0.26) \qquad = 0.235 \qquad = 23.6\%$

The portfolio standard deviation is given by

$\sigma_P = \sqrt{W_A^2\sigma_A^2 + (1 - W_A)^2\, \sigma_B^2 + 2W_A(1 - W_A)\rho_{AB}\sigma_A\sigma_B}$

$= \sqrt{0.4^2\,(0.3^2) + 0.6^2\,(0.6^2) + 2(0.4)\,(0.6)\,(0.5)\,(0.3)\,(0.6)} \qquad = 0.4326$

12. The standard deviations of the returns of two securities are 5% and 10%, with expected returns of 8% and 12% respectively. A portfolio is invested with 40% in the first security and 60% in the second security. Calculate the expected return and standard deviation of the portfolio assuming that the correlation coefficients between the returns of the securities are (1) 1.0, (2) 0 and (3) −1.0.

Solution:

(1) When correlation coefficient between the returns of the securities is 1.0

The expected portfolio return is given by

$r_P \quad = W_1 r_1 + W_2 r_2$

$= 0.4(0.8\%) + 0.6(0.12\%) \quad = 10.4\%$

The portfolio standard deviation is given by

$\sigma_p \quad = \sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\ \rho_{12}\sigma_1\sigma_2}$

$= \sqrt{0.4^2 (5\%^2) + 0.6^2 (10\%^2) + 2(0.4)(0.6)(1)(5\%)(10\%)}$

$= 8\%$

When the correlation is 1, the expected return is 10.4% and the standard deviation of returns is 8.0%.

(2) When correlation coefficient between the returns of the securities is 0

The expected portfolio return is given by

$r_P \quad = W_1 r_1 + W_2 r_2$

$= 0.4(0.8\%) + 0.6(0.12\%)$

$= 10.4\%$

The portfolio standard deviation is given by

$\sigma_p \quad = \sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\ \rho_{12}\sigma_1\sigma_2}$

$= \sqrt{0.4^2 (5\%^2) + 0.6^2 (10\%^2) + 2(0.4)(0.6)(0)(5\%)(10\%)}$

$= 6.3\%$

When the correlation is zero, the expected return is 10.4% and the standard deviation of returns is 6.3%.

(3) When correlation coefficient between the returns of the securities is - 1.0

The expected portfolio return is given by

$r_P \quad = W_1 r_1 + W_2 r_2 \quad = 0.4(0.8\%) + 0.6(0.12\%) \quad = 10.4\%$

The portfolio standard deviation is given by

$\sigma_p \quad = \sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\ \rho_{12}\sigma_1\sigma_2}$

$= \sqrt{0.4^2 (5\%^2) + 0.6^2 (10\%^2) + 2(0.4)(0.6)(-1)(5\%)(10\%)} \quad = 4\%$

When the correlation is -1, the expected return is 10.4% and the standard deviation of returns is 4.0%.

13. Calculate mean returns and standard deviation of returns for the following individual stocks.

Year	Stock - X(%)	Stock -Y(%)
2019	12.40	-19.00
2020	7.20	-23.40
2021	8.00	27.60
2022	4.80	-10.60
2023	0.40	19.00

Solution:

Table showing the necessary calculations

Year	Return (X_i)	Return (Y_i)	$(X_i - \overline{X})^2$	$(Y_i - \overline{Y})^2$
2019	12.40	-19.00	34.11	314
2020	7.20	-23.40	0.41	489.29
2021	8.00	27.60	2.07	834.05
2022	4.80	-10.60	3.10	86.86
2023	0.40	19.00	37.95	411.28
	32.80	-6.40	77.64	2135.48

Mean return from stock X $= \Sigma X_i/n = 32.80/5 = 6.56\%$

Mean return from stock Y $= \Sigma Y_i/n = -6.40/5 = -1.28\%$

$\sigma x^2 = \Sigma(X_i - \overline{X})^2/n\text{-}1 = 77.64/4 = 19.41$

$\sigma y^2 = \Sigma(Y_i - \overline{Y})^2/n\text{-}1 = 2135.48/4 = 533.87$

Standard deviation of returns from stock X (σ_x) $= \sqrt{19.41} = 4.41\%$

Standard deviation of returns from stock Y (σ_y) $= \sqrt{533.87} = 23.11\%$

14. On the basis of the results from illustration 14, find out the portfolio return and portfolio risk assuming that

(i) weights are equal in both the stocks

(ii) weights are not given

Solution:

(i) Table showing the necessary calculations for covariance

Year	$(X_i - \overline{X})$	$(Y_i - \overline{Y})$	$(X_i - \overline{X})(Y_i - \overline{Y})$
2019	5.84	-17.72	-103.48

2020	0.64	-22.12	-14.16
2021	1.44	28.88	41.59
2022	-1.76	-9.32	16.40
2023	-6.16	20.28	-124.92
			-184.57

$W_x = 0.5$ $\quad W_y = 0.5$

Covariance (x,y) $= \Sigma(X_i - \overline{X})(Y_i - \overline{Y}) / (n-1)$

$= -184.57/4$

$= -46.14$

Portfolio return (R_p) $= W_x\ \overline{X} + W_y - \overline{Y}$

$= 1/2\times6.56 + 1/2\times(-1.28)$

$= 3.28-0.64$

$= 2.64\%$

Variance of return (σ_p^2) $= W_X^2\ \sigma_X^2 + W_y^2\ \sigma_y^2 + 2W_XW_y\ \sigma_{Xy}$

$= (0.5)^2(19.41) + (0.5)^2(533.87) + [2\times0.5\times0.5\times(-46.14)]$

$= 4.85 + 133.47 - 23.07$

$= 115.25$

Portfolio risk (σ_p) is given by the Standard Deviation of return $= \sqrt{115.25} = 10.74\%$

(ii) Correlation coefficient (ρ_{xy}) $= \sigma_{xy} / \sigma_x\sigma_y$

$= -46.14 / (4.41\times23.11)$

$= -0.45$

W_x $= \sigma_y^2 - \sigma_x\sigma_y\rho_{xy} / (\sigma_x^2 + \sigma_y^2 - 2\sigma_x\sigma_y\rho_{xy})$

$= (533.87-[4.41\times23.11\times(-0.45)])/(19.41+533.87-[2\times4.41\times23.11\times(-0.45)])$

$= 0.90$

W_y $= 1 - W_x$

$= 1 - 0.90$

$= 0.10$

R_p $= W_x\ \overline{X} + W_y\ \overline{Y}$

$= 0.90 \times 6.56 + 0.10 \times (-1.28)$

$= 5.904 - 0.128$

$= 5.78\%$

$\sigma_p^2 \quad = W_X^2\,\sigma_X^2 + W_y^2\,\sigma_y^2 + 2W_X W_y \sigma_{Xy}$

$= (0.90)^2 \times 19.41 + (0.10)^2 \times 533.87 + 2 \times 0.90 \times 0.10 \times (-46.14)$

$= 15.72 + 5.3387 - 8.3052$

$= 12.7535$

$\sigma_p \quad = \sqrt{12.7535}$

$= 3.57\%.$

15. **Illustration on Beta, Portfolio Variance, etc.**

Following are the details of a portfolio consisting of three Shares:

Share	Portfolio Weight	Beta	Expected Return %	Total Variance
A	0.20	0.40	14	0.015
B	0.50	0.50	15	0.025
C	0.30	1.10	21	0.100

Standard Deviation of Market Portfolio Returns= 10%

You are given the following additional data: Covariance (A, B) = 0.030, Covariance (A, C) = 0.020, Covariance (B, C) = 0.040

Calculate the following: (i) The Portfolio Beta, (ii) Residual Variance of each of the three Share, (iii) Portfolio Variance using Sharpe Index Model, (iv) Portfolio Variance (on the basis of Modern Portfolio Theory given by Markowitz).

Solution:

1. Determination of Portfolio Beta

Share Name	Portfolio Weight	Beta	Weighted Beta
A	0.20	0.40	0.08
B	0.50	0.50	0.25
C	0.30	1.10	0.33
Portfolio Beta			0.66

2. Residual Variance (Using Variance Approach)

Particulars	Share A	Share B	Share C
Total Variance (Given)	0.015	0.025	0.100
Less: Systematic = Market Variance × β^2 = $(SD)^2 \times \beta^2$	$(0.1)^2 \times (0.4)^2$ = 0.0016	$(0.1)^2 \times (0.5)^2$ = 0.0025	$(0.1)^2 \times (1.10)^2$ = 0.0121
Unsystematic = Residual Variance	0.0134	0.0225	0.0879

3. Computation of Portfolio Variance using Sharpe Index Model

(a) Systematic Variance of Portfolio = Market Variance × (Beta of Portfolio)^2 = $(0.10)^2 \times (0.66)^2$ = 0.0044

(b) Unsystematic Variance of Portfolio=Weighted Average Unsystematic Risk of Individual Securities Portfolio

Security	Unsystematic Risk (UR)	Weight (W)	W^2	Product (UR × W^2)
A	0.0134	0.2	0.04	0.0005
B	0.0225	0.5	0.25	0.0056
C	0.0879	0.3	0.09	0.0079
Total				0.0140

(C) Portfolio Variance = Systematic Variance of Portfolio + Unsystematic Variance of Portfolio

= 0.0044 + 0.0140 = 0.0184

(4) Markowitz Approach (Matrix Computation)

Securities		A	B	C
	Weights	$W_A = 0.20$	$W_B = 0.50$	$W_C = 0.30$
A	$W_A = 0.20$	$\sigma_A^2 = 0.015$	Cov(A,B) = 0.030	Cov(A,C) = 0.020
B	$W_B = 0.50$	Cov(A,B) = 0.030	$\sigma_B^2 = 0.025$	Cov(B,C) = 0.040
C	$W_C = 0.30$	Cov(A,C) = 0.020	Cov(B,C) = 0.040	$\sigma_C^2 = 0.100$

	A	B	C
A	$W_A \times W_A \times \sigma_A^2$ $0.20 \times 0.20 \times 0.015 = 0.0006$	$W_A \times W_B \times Cov_{AB}$ $0.20 \times 0.50 \times 0.030 = 0.0030$	$W_A \times W_C \times Cov_{AC}$ $0.30 \times 0.20 \times 0.020 = 0.0012$
B	$W_A \times W_B \times Cov_{AB}$ $0.20 \times 0.50 \times 0.030 = 0.0030$	$W_B \times W_B \times \sigma_B^2$ $0.50 \times 0.50 \times 0.025 = 0.0063$	$W_B \times W_C \times Cov_{BC}$ $0.50 \times 0.30 \times 0.040 = 0.0060$
C	$W_A \times W_C \times Cov_{AC}$ $0.30 \times 0.20 \times 0.020 = 0.0012$	$W_B \times W_C \times Cov_{BC}$ $0.50 \times 0.30 \times 0.040 = 0.0060$	$W_C \times W_C \times \sigma_C^2$ $0.30 \times 0.30 \times 0.100 = 0.0090$
Variance of the Portfolio (σ_{ABC}^2)			0.0363

16. **Illustration on Covariance among Securities and Systematic and Unsystematic Risk Portfolio**

A study by a Mutual Fund has revealed the following data in respect of the three Securities:

Security	σ (%)	Correlation with Index, (p_{sm})
A	20	0.66
B	18	0.95
C	12	0.75

The Standard Deviation of the Market Portfolio (BSE Sensex) is observed to be 15%

1. What is the Sensitivity of Returns of each Stock with respect to the Market?
2. What are the Co-Variances among the various Stocks?
3. What would be the Risk of Portfolio consisting of all the three Stocks equally?
4. What is the Beta of Portfolio consisting of equal Investment in each Stock?
5. What is the total Systematic and Unsystematic Risk of the Portfolio in (4)?

Solution:

1. Sensitivity

Security	A	B	C
Standard Deviation (σ)	20.00	18.00	12.00
Correlation to Market Portfolio (ρ_{sm})	0.66	0.95	0.75
Beta (Sensitivity) = $\rho_{SM} \times$ (σ security)/(σ market)	0.88	1.14	0.60

2. Covariance between the securities

Covariance of Returns between the two securities = $Cov_{s1,s2} = \beta_{s1} \times \beta_{s2} \times \sigma_M^2$

$Cov_{AB} = \beta_A \times \beta_B \times \sigma_M^2$	$Cov_{AC} = \beta_A$ x β_B x σ_M^2	$Cov_{BC} = \beta_B \times \beta_C \times \sigma_M^2$
0.88 × 1.14 × 225 = 225.72	0.88 × 0.60 × 225 = 118.80	1.14 × 0.60 × 225 = 153.90

3. Risk of the Portfolio consisting of Equal Investment in each stock

(a) Matrix

Securities		A	B	C
	Weights	$W_A = 1/3$	$W_B = 1/3$	$W_C = 1/3$
A	$W_A = 1/3$	$\sigma_A^2 = 400$	Cov(A,B) = 225.72	Cov(A,C) = 118.80
B	$W_B = 1/3$	Cov(A,B) = 225.72	$\sigma_B^2 = 324$	Cov(B,C) = 153.90
C	$W_C = 1/3$	Cov(A,C) = 118.80	Cov(B,C) = 153.90	$\sigma_C^2 = 144$

(b) Computation of Portfolio Variance (σ_{ABC}^2)

	A	B	C
A	$W_A \times W_A \times \sigma_A^2$ 1/3 × 1/3 × 400 = 44.44	$W_A \times W_B \times Cov_{AB}$ 1/3 × 1/3 × 225.72 = 25.08	$W_A \times W_C \times Cov_{AC}$ 1/3 × 1/3 × 118.80 = 13.20
B	$W_A \times W_B \times Cov_{AB}$ 1/3 × 1/3 × 225.72 = 25.08	$W_B \times W_B \times \sigma_B^2$ 1/3 × 1/3 × 324 = 36.00	$W_B \times W_C \times Cov_{BC}$ 1/3 × 1/3 × 153.90 = 17.10
C	$W_A \times W_C \times Cov_{AC}$ 1/3 × 1/3 × 118.80 = 13.20	$W_B \times W_C \times Cov_{BC}$ 1/3 × 1/3 × 153.90 = 17.10	$W_C \times W_C \times \sigma_C^2$ 1/3 × 1/3 × 144 = 16.00
Variance of the Portfolio (σ_{ABC}^2)			207.20
Standard Deviation (Risk) of the Portfolio (σ_{ABC})			14.3944

4. Beta of the Portfolio consisting of equal Investment in each Stock = (0.88+1.14+0.60)/3 = 0.873

5. Systematic and Unsystematic Risk of the Portfolio [Variance Approach]

Total Risk = 207.20

Systematic Risk

$B_p^2 \times \sigma_M^2 = (0.873)^2 \times 225 = 171.48$

Unsystematic Risk (Balancing figure)

207.20 – 171.48 = 35.72

17. **Illustration on Capital Market Line – Measuring Expected Return**

Portfolio A, a fully diversified Portfolio, has a Standard Deviation of 6%. The NIFTY has yields a Return of 16.5%, with a Standard Deviation of 4%, Ascertain the expected Return of Portfolio A under the following three cases –

1. 5.80% ₹ 100 Central Government guaranteed RBI Bonds is traded at ₹ 116,
2. Market's Attitude towards risk is 3,
3. Risk Free Return is 7%.

Solution:

Expected Return on Portfolio $R_p = R_f + (\lambda \times \sigma_p)$ Where, $\lambda = (R_m - R_f)/\sigma_m$

Particulars	Case 1	Case 2	Case 3
Risk Free Return [R_F]	Return/(Market Price) = (100 × 5.8%)/116 = 5%	4.5% [Note]	7% [Given]
Market's Attitude towards Risk (λ) = $(R_m-R_f)/\sigma_m$	(16.50% - 5%)/(4%) = 2.875	3 [Given]	(16.50% - 7%)/(4%) = 2.375
Expected Return [R_p] = $R_f + (\lambda \times \sigma_p)$	5% + (2.875 × 6%) = 22.25%	4.5% + (3 × 6%) = 22.50%	7% + (3 × 6%) = 25%

Note: Risk Free Return [Case 2]: $(R_m - R_f)/\sigma_m = 3 \rightarrow (16.5 - R_f)/(4\%) = 3 \rightarrow R_f = 16.5 - 12\% = 4.50\%$

18. A Stock costing ₹120 pays no dividends. The possible prices that the Stock might sell for at the end of the year with the respective probabilities are given below. Compute the Expected Return and its Standard Deviation.

Price	115	120	125	130	135	140
Probability	0.1	0.1	0.2	0.3	0.2	0.1

Solution:

Price	Return (R) = P – ₹120	Probability (P)	Expected Return (P × R)	$D = R - \overline{R}$	D^2	$P \times D^2$
115	(5)	0.1	(0.5)	(13.5)	182.25	18.225
120	0	0.1	0.0	(8.5)	72.25	7.225
125	5	0.2	1.0	(3.5)	12.25	2.450
130	10	0.3	3.0	1.5	2.25	0.675
135	15	0.2	3.0	6.5	42.25	8.450
140	20	0.1	2.0	11.5	132.25	13.225
Total			$\overline{R} = 8.5$			50.250

Expected Return on Security = ₹8.5, Risk of Security = $\sigma = \sqrt{\text{Variance}} = \sqrt{50.25}$ = ₹7.09

OR (₹7.09 ÷ ₹120) = 5.91%

19. From the following data pertaining to returns of Shares of Companies A, B & Market for the past 5 years, find Beta (β) of A & B –

Year	1	2	3	4	5
Market	12%	14%	13%	12%	14%
Company A	16%	8%	13%	14%	19%
Company B	14%	17%	15%	20%	19%

Solution:

1. Computation of Factors

Year	R_M	R_A	R_B	$D_M = R_M - \overline{R}_M$	$D_A = R_A - \overline{R}_A$	$D_B = R_B - \overline{R}_B$	D_M^2	$D_M \times D_A$	$D_M \times D_B$
(1)	(2)	(3)	(4)	(5) = (2) – 13	(6) = (3)-14	(7) = (4)-17	(8) = $(5)^2$	(9)= (5)×(6)	(10)=(5)×(7)
1	12	16	14	-1	2	-3	1	-2	3
2	14	8	17	1	-6	0	1	-6	0
3	13	13	15	0	-1	-2	0	0	0
4	12	14	20	-1	0	3	1	0	-3
5	14	19	19	1	5	2	1	5	2
	65	70	85				4	-3	2

2. Computation of Beta

	Market Portfolio	Shares of Company A	Shares of Company B
Mean	$\overline{R}_M = \sum R_M \div n = 65 \div 5 = 13$	$\overline{R}_A = \sum R_A \div n = 70 \div 5 = 14$	$\overline{R}_B = \sum R_B \div n = 85 \div 5 = 17$
Variance & Covariance	$\sigma_M^2 = \sum D_M^2 \div n = 4 \div 5 = 0.80$	$Cov_{MA} = \sum[D_M \times D_A] = -3 \div 5 = -0.60$	$Cov_{MB} = \sum[D_M \times D_B] = 2 \div 5 = 0.40$
Beta		$Cov_{MA} \div \sigma_M^2 = -0.60 \div 0.80 = -0.75$	$Cov_{MB} \div \sigma_M^2 = 0.40 \div 0.80 = 0.50$

20. Shiva Ltd invested at the beginning of Year 1 in certain Equity Shares as below

Name of the Company	No. of shares	Cost (₹)
M Ltd	1,000 (₹100 each)	2,00,000
N Ltd	500 (₹10 each)	1,50,000

In Year 1, 10% Dividend was paid out by M Ltd, and 30% Dividend paid out by N Ltd. At the end of year 1, market quotations showed a value of ₹220 and ₹290 per Share for M Ltd and N Ltd respectively.

At the beginning of year 2, Investment Advisors indicate – (a) that the Dividends from M Ltd and N Ltd for the Year 2 are likely to be 20% and 35% respectively, and (b) that the probabilities of market quotations at the end of Year 2 are as below:

Probability	Price per Share of M Ltd	Price per Share of N Ltd
0.2	220	290
0.5	250	310
0.3	280	330

1. Calculate the Average Return from the Portfolio for the Year 1.
2. Calculate the Expected Average Return from the Portfolio for the Year 2, and
3. Advise Shiva Ltd of the comparative risk in the two Investments by calculating the Standard Deviation in each case.

Solution:

1. Calculation of closing MPS and total Return

EMPS = Expected Market Price per Share, **Gain** = Closing MPS Less Opening MPS, **Div.** = Dividend, **Yield** = Div. + Gain

	M Ltd.						N Ltd.					
Prob.	Clg.	Opg.	Gain	Div.	Yield	MPS×Prob.	Clg.	Opg.	Gain	Div.	Yield	MPS × Prob.
0.2	220	220	0	20	20	44	290	290	0	3.5	3.5	58
0.5	250	220	30	20	50	125	310	290	20	3.5	23.5	155
0.3	280	220	60	20	80	84	330	290	40	3.5	43.5	99
						EMPS=253						EMPS = 312

2. Calculation of return on Portfolio

Particulars	For Year 1		For Year 2	
	M Ltd	N Ltd	M Ltd	N Ltd
Opening Market Price (P_0)	200	300	220	290
Clg. / Exp. Market Price (P_1)	220	290	253	312
Return = (Div+ (P_1-P_0))/P_0	(10+(220-200))/220 = 15%	(3+(290-300))/300 = (2.33%)	(20+(253-220))/220 = 24.09%	(3.50+(312-290))/290 = 8.79%
Weight based on Opg. Value	2,00,000	1,50,000	2,20,000	1,45,000
Weight average Return	(15% × 200/350) – (2.33% × 150/350) =7.57%		(24.09% × 220/365)+ (8.79% × 145/365) =18.01%	

3. Computation of Standard Deviation

R_M = Return of M Ltd., R_N = Return from N Ltd., D_M = Deviation M Ltd, D_N = Deviation of N Ltd.

Prob. (P)	M Ltd.					N Ltd.				
	R_M	$R_F \times P$	$D_M = R_M$-53	D_M^2	$P \times D_M^2$	R_N	$R_N \times P$	$D_N = R_N$-14	D_N^2	$P \times D_N^2$
0.2	20	4	-33	1089	217.80	3.5	0.70	-22	484	96.80
0.5	50	25	-3	9	4.50	23.5	11.75	-2	4	2.00
0.3	80	24	27	729	218.70	43.5	13.05	18	324	97.20
		53	Variance of M Ltd		441.00		25.50	Variance of N Ltd		196.00
	Standard Deviation = $\sqrt{PD^2} = \sqrt{441}$				21	Standard Deviation = $\sqrt{PD^2} = \sqrt{196}$				14

Inference: Shares of M Ltd is more risky as its Standard Deviation is more than the Standard Deviation of N Ltd

21. The rates of return on the Security of company S and Market Portfolio for 10 periods are given below:

Year	1	2	3	4	5	6	7	8	9	10
Return on Security S (%)	20	22	25	21	18	-5	17	19	-7	20
Return on Market Portfolio	22	20	18	16	20	8	-6	5	6	11

1. What is the beta of Security S?
2. What is the Characteristic Line for Security S?
3. What is the Systematic and Unsystematic Risk of Security S?

Solution:

1. Computation of Beta of Security

Period	R_M	R_S	$D_M = (R_M - \overline{R}_M)$	$D_S = (R_S - \overline{R}_S)$	D_M^2	D_S^2	$D_M \times D_S$
(1)	(2)	(3)	(4)=[(2)-12]	(5)=[(3)-15]	(6) = $(4)^2$	(7)=$(5)^2$	(8)=(4)×(5)
1	22	20	10	5	100	25	50
2	20	22	8	7	64	49	56
3	18	25	6	10	36	100	60
4	16	21	4	6	16	36	24
5	20	18	8	3	64	9	24
6	8	-5	-4	-20	16	400	80
7	-6	17	-18	2	324	4	-36
8	5	19	-7	4	49	16	-28
9	6	-7	-6	-22	36	484	132
10	11	20	-1	5	1	25	-5
	120	150			706	1148	357

	Market Portfolio	Security of Company S
Mean	$\overline{R}_M = \sum R_M \div n = 120 \div 10 = 12$	$\overline{R}_S = \sum R_S \div n = 150 \div 10 = 15$
Variance	$\sigma_M^2 = \sum D_M^2 \div n = 706 \div 10 = 70.6$	$\sigma_S^2 = \sum D_S^2 \div n = 1148 \div 10 = 114.8$
Standard Deviation	$\sigma_M = \sqrt{70.60} = 8.40$	$\sigma_S = \sqrt{114.80} = 10.71$

Covariance and Correlation:

Combination	Market and S
Covariance	$Cov_{MS} = \sum[D_M \times D_S] \div n = 357 \div 10 = 35.7$
Beta β_S	$B_S = Cov_{MS}/\sigma_M^2 = 35.7/70.6 = 0.51$

2. Computation of Characteristic Line for Security S

Particulars	Value
$y = \overline{R}_A$	15
β	0.51
$x = \overline{R}_M$ (Expected Return on Market Index)	12

Characteristic Line for Security S = $y = \alpha + \beta x$,

$15 = \alpha + (0.51 \times 12)$

$\alpha = 15 - (0.51 \times 12) = 8.88\%$

Characteristic line for Security S = $8.88 + 0.51\ R_M$

Note: It is assumed that Rates of Return for Market Portfolio and the Security given in the question is returns in excess of Risk Free Rate of Return.

3. Analysis of Risk into Systematic Risk and Unsystematic Risk

Particulars	Standard Deviation Approach	Variance Approach
Total Risk	10.71%	114.80%
Systematic Risk	$\beta \times \sigma_m = 0.51 \times 8.40 = 4.284\%$	$\beta^2 \times \sigma_m^2 = 0.51^2 \times 70.60 = 18.363\%$
Unsystematic Risk [Total Risk - Systematic Risk]	10.71 - 4.284 = 6.426%	= 114.80 - 18.363 = 96.437%

22. **Illustration on Systematic & Unsystematic Risk**

The following are the Returns of Share S and the Market (M) for the Last 6 years –

Year	1	2	3	4	5	6
Return on S (%)	18	9	20	-10	5	12
Return on Market Portfolio	15	7	16	-13	4	7

1. Calculation the Covariance & Correlation Co-efficient of returns
2. Determine the Beta co-efficient for S
3. What is S's Total Risk?
4. How much is the Systematic Risk?

Solution:

1. Computation of Covariance and Correlation Co-efficient

Years	R_M	R_S	$D_M = (R_M - \overline{R}_M)$	$D_S = (R_S - \overline{R}_S)$	D_M^2	D_S^2	$D_M \times D_S$
(1)	(2)	(3)	(4)=[(2)-6]	(5)=[(3)-9]	(6)=(4)^2	(7)=(5)^2	(8)=(4)×(5)
1	15	18	9	9	81	81	81
2	7	9	1	0	1	0	0
3	16	20	10	11	100	121	110
4	-13	-10	-19	-19	361	361	361
5	4	5	-2	-4	4	16	8
6	7	12	1	3	1	9	3
	36	54	0	0	548	588	563

	Market Portfolio	Shares of S
Mean	$\overline{R}_M = \sum R_M \div n = 36 \div 6 = 6$	$\overline{R}_S = \sum R_S \div n = 54 \div 6 = 9$
Variance	$\sigma_M^2 = \sum D_M^2 \div n = 548 \div 6 = 91.33$	$\sigma_S^2 = \sum D_S^2 \div n = 588 \div 6 = 98$
Standard Deviation	$\sigma_M = \sqrt{91.33} = 9.56$	$\sigma_S = \sqrt{98} = 9.90$

2. Computation of Covariance & Corelation

Combination	Market and S	Combination	Market and S
Covariance	$Cov_{MS} = \sum[D_M \times D_S] \div n$ $= 563 \div 6$ $= 93.83$	Corelation	$\rho_{MS} = Cov_{MS}/\sigma_M \times \sigma_S$ $= 93.83/(9.56 \times 9.90)$ $= 0.99$

3. Computation of Beta: Beta of Security = $\beta_S = COV_{MS}/(\sigma_M^2) = 93.83/91.33 = 1.03$

4. Computation of Systematic and Unsystematic Risk

Particulars	Standard Deviation Approach	Variance Approach
Total Risk	9.90	98%
Systematic Risk	$\beta \times \sigma_M = 1.03 \times 9.56 = 9.847\%$	$\beta^2 \times \sigma_M^2 = 1.03^2 \times 9.56^2 = 9.847$ $= 1.061 \times 91.39 = 96.96\%$
Unsystematic Risk = Total Risk Less Systematic Risk	9.90% - 9.847% = 0.053%	98% - 96.96% = 1.04%

Exercise

Theoretical Problems

Multiple Choice Questions

1. Risk of two securities with different expected return can be compared with
   a. Coefficient of variation
   b. Standard deviation of securities
   c. Variance of securities
   d. None of the above
2. A portfolio having two risky securities can be turned risk less if
   a. The securities are completely positively correlated
   b. If the correlation ranges between zero and one
   c. The securities are completely negatively correlated
   d. None of the above
3. Efficient portfolios can be defined as those portfolios which for a given level of risk provides
   a. Maximum return
   b. Average return
   c. Minimum return
   d. None of the above
4. Capital market line is:
   a. Capital allocation line of a market portfolio
   b. Capital allocation line of a risk free asset
   c. Both a and b
   d. None of the above

5. The object of portfolio is to reduce ___________ by diversification

   a. Return

   b. Risk

   c. Uncertainty

   d. Percentage

6. This type of risk is avoidable through proper diversification

   a. Portfolio risk

   b. Systematic risk

   c. Unsystematic risk

   d. Total risk

7. Beta is the slope of

   a. The security market line

   b. The capital market line

   c. A characteristic line

   d. The CAPM

8. A measure of risk per unit of expected return

   a. Standard deviation

   b. Coefficient of variation

   c. Correlation coefficient

   d. Beta

9. The greater the beta, the security involved

    a. Greater the unavoidable risk

    b. Greater the avoidable risk

    c. Less the unavoidable risk

    d. Less the avoidable risk

10. A statistical measure of the Degree to which two variables move together

    a. Coefficient of variation

    b. Variance

    c. Covariance

    d. Certainty equivalent

11. Which theory believes that the investors prefer larger to smaller returns from securities?

    a. Modern

    b. Traditional

    c. Markowitz

    d. Sharpe

12. Modern portfolio theory ____________ the relationship between risk and return

    a. Maximizes

    b. Minimizes

    c. Quantifies

    d. Does not assume

13. Which measures the systematic or non-systematic risk of a security?

    a. Beta

    b. Standard deviation

    c. Variance

    d. Range

14. _______ is the variability in a security's returns resulting from fluctuations in the aggregate market.

    a. Market risk

    b. Inflation risk

    c. Credit risk

    d. Interest rate risk

15. Which model related return to a single factor?

    a. Markowitz

    b. Single index

    c. M.M Approach

    d. Traditional

16. ______ Risk is the possibility that borrowers repay debt ahead of schedule.

    a. Liquidity

    b. Inflation

    c. Prepayment

    d. Investment

17. Which of the following is not a common risk factor?

    a. Market Risk

    b. Promotional Risk

    c. Interest Rate Risk

    d. Inflation Risk

18. ________ step involves determining periodically how the portfolio has performed over the review period.

    a. Portfolio performance evaluation

    b. Portfolio revision

    c. Portfolio construction

    d. Performing security analysis

19. A combination of various investment products like bonds, shares, securities, mutual funds and so on is called as ____________

    a. Portfolio

    b. Investment

    c. Speculation

    d. Gambling

20. The Markowitz model identifies the efficient set of portfolios, which offers the _________.

    a. Highest return for any given level of risk or the lowest risk for any given level of return.

    b. Least-risk portfolio for a conservative, middle-aged investor

    c. Long-run approach to wealth accumulation for a young investor

    d. Risk-free alternative for risk-averse investors

21. A model for optimizing the selection of securities is the ____________ model.

    a. Miller-Orr

    b. Black-Sholes

    c. Markowitz

    d. Gordon

22. Market risk is best measured by the _____________.

    a. Alpha

    b. Beta

    c. Standard deviation

    d. Coefficient of variation

23. The relevant risk for a well-diversified portfolio is ____________.

    a. Interest rate risk

    b. Inflation risk

    c. Business risk

    d. Market risk

24. Company-specific risk is also known as ____________.

    a. Market risk

    b. Systematic risk

    c. Non-diversifiable risk

    d. Idiosyncratic risk

25. Which of the following is true regarding the expected return of a portfolio?

    a. It is a weighted average only for stock portfolios

    b. It can only be positive

    c. It can never be above the highest individual return

    d. All of the above are true.

26. In order to determine the except return of a portfolio, all of the following must be known expect __________.

    a. Probabilities of expected returns of individual assets

    b. Weight of each individual asset to total portfolio value

    c. Expected return of each individual asset

    d. All of the above must be known in order to determine the expected return of a portfolio.

27. ___________ is concerned with the interrelationships between security returns.

    a. Random diversification

    b. Correlating diversification

    c. Friedman diversification

    d. Markowitz diversification

28. Unsystematic risk may arise due to the following reason.

    a. Change in interest rate

    b. Increase in population

    c. Employee strike in the company

    d. Exchange rate fluctuations

29. Total risk includes __________

    a. Systematic risk only

    b. Unsystematic risk only

    c. Both a and b above

    d. Only diversifiable risks

30. A firm has an asset $\beta = 1.3$, equity $\beta = 1.5$. Then, which of the following is true?

    a. The firm is unlevered.

    b. Debt β is also 1.3.

    c. The above data is not possible.

    d. The firm is leveraged and the debt β is lower than the asset β.

31. For a portfolio containing three securities A, B and C, correlation coefficients $\rho AB = +0.4$; $\rho AC = +0.75$; $\rho BC = -0.4$; standard deviation $\sigma A = 9$; $\sigma B = 11$; $\sigma C = 6$; weights $\omega A = 0.2$; $\omega B = 0.5$; $\omega C = 0.3$; the covariance of securities A and B is

    a. 3.96

    b. 24.75

    c. 39.6

    d. 247.5

32. A ₹ 1,000 per value bond bearing a coupon rate of 14% matures after 5 years. The required rate of return on this bond is 10%. The value of the bond (to the nearest rupee) will be:

    a. 1,125

    b. 1,152

    c. 1,512

    d. 862.20

33. The following information is available for a mutual fund: Return 13% Risk (S.D. i.e. σ) 16% Beta (β) 0.90 Risk Free Rate 10% Treynor's Ratio of the mutual fund is:

    a. 3.85

    b. 4.43

    c. 3.33

    d. 3.73

34. The intercept of the Security Market Line (SML) on the y axis is

    a. E(Rm) - Rf

    b. 1/[E(Rm) - Rf]

    c. Rf - E(Rm)

    d. Rf

35. A mutual fund wants to hedge its portfolio of shares worth ₹ 10 crore using the NIFTY Index Futures. The contract size is 100 times the index. The index is currently quoted at 6840. The Beta of the portfolio is 0.8. The beta of the index may be taken as 1. What is the number of contracts to be traded?

    a. 110

    b. 116

    c. 145

    d. 123

36. A project had an equity beta of 1.4 and is to be financed by a combination of 25% Debt and 75% Equity. Assume Debt Beta as zero, R_f = 12% and R_m = 18%. Hence, the required rate of return of the project is

    a. 16.72%

    b. 18.30%

    c. 17.45%

    d. 12.00%

37. Which of the following securities is most liquid?

    a. Money Market instruments

    b. Capital Market instruments

    c. Gilt-edged securities

    d. Index futures

38. While plotting a graph with risk on X-axis and expected return on Y-axis, a line drawn with co-ordinates (0, rf) and (β, rm) is called

    a. Security Market Line

    b. Characteristic Line

    c. Capital Market Line

    d. CAPM Line

39. If the RBI intends to reduce the supply of money as part of anti-inflation policy, it might

    a. Lower the bank rate

    b. Increase the Cash Reserve Ration

    c. Decrease the SLR

    d. Buy Government securities in the open market.

40. Rate of inflation = 5.1%, β = 0.85, Risk premium = 2.295%, Market return = 12%. The real rate of return will be

    a. 4.2%

    b. 11.70%

    c. 6%

    d. 5.95%

41. The following information of a project are given below:

Expected Cash Flow (₹)	Probability
6,000	0.20
16,000	0.80

If certainty equivalent coefficient is 0.7, what will be certain (Risk less) cash flows of the project?

a. ₹ 12,000

b. ₹ 9,800

c. ₹ 9,000

d. ₹ 15,400

42. If the covariance between the returns on a portfolio BC and returns on the market index is 25 and the variance of returns on the market index is 20, what will be the systematic risk of BC under the variance approach?

a. 1.25

b. 1.56

c. 5.45

d. 31.25

43. Which of the following investment avenues has the least risk associated with it?

a. Corporate Fixed Deposits

b. Deposits in commercial banks

c. Public Provident Fund

d. Non-convertible zero coupon bonds

44. A portfolio holding 90% of its assets in CNX Nifty stocks in proportion to their market capitalization and 10% in Treasury Bills is more sensitive to

a. Systematic Risk

b. Unsystematic Risk

c. Interest Rate Risk

d. Index Risk

45. Project X is to be financed by 40% debt (with zero beta) and balance with equity (with 1.3 beta). If the risk free rate is 13% and return on market portfolio is 22%, the return from the project will be

a. 13.07%

b. 13.70%

c. 24.70%

d. 20.02%

46. The probability distribution of security N is given below:

Probability	Return (%)
0.30	30
0.40	20
0.30	10

The risk of the return of the security will be around

a. 60%

b. 8%

c. 20%

d. 24%

47. The intercept of the security market line on the y axis is

a. the risk free return

b. the positive risk premium

c. the beta of the security

d. the expected return when β = 1

48. Security A has a total risk of 'a' and Security B has a total risk of 'b'. a is greater than b. The following is true:

a. If A has a higher systematic risk, B will have a higher unsystematic risk.

b. A has to have a higher systematic risk than B

c. A has to have at least the same amount of systematic risk as B

d. A can have a lower systematic risk than B

49. The following is true of standard deviation of returns of a portfolio under CAPM:

a. Market rewards the investor in proportion to the risk taken in the form of (the standard deviation of the portfolio x(1-ρ), where ρ is the correlation coefficient between the portfolio and market returns

b. Standard deviation of the portfolio is the sum of the standard deviations of the securities in the portfolio

c. Standard deviation is a good measure to compare as it is the deviation per unit of the mean return

d. Standard deviation is greater than the systematic risk of the portfolio

50. An investor invested 40% of her money in Stock A and 60% in Stock B. Stock A has a beta of 1.2 and Stock B has a beta of 1.6. If the risk-free rate is 5% and the expected return on the market is 12%, the expected return of the investor would be the following under Capital Asset Pricing Model:

a. 10.08%

b. 15.08%

c. 14.80%

d. 21.80%

51. An investor has limited funds to invest. The following information of four securities isgiven below:

Particulars	Security A	Security B	Security C	Security D
Standard Deviation	10%	15%	11%	12%
Average Return	12%	20%	17%	15%

The best security to invest in if he wants more safety in relation to the return will be:

a. Security D

b. Security C

c. Security A

d. Security B

52. A buy signal provided by moving average analysis of stock prices is when the stockprice line

a. rises above a falling moving average line

b. falls below a flattening moving average line.

c. falls below a falling moving average line

d. falls below a rising moving average line

53. An investor owns a stock portfolio equally invested in a risk free asset and two stocks. If one of the stocks has a beta of 0.75 and the portfolio is as risky as the market, the beta of the stock in portfolio is

    a. 2.12

    b. 2.25

    c. 2.56

    d. 2.89

54. You are given the following information: required rate of return on risk free security 7%; required rate of return on market portfolio of investment 12%; beta of the firm 1.7. The cost of equity capital as per CAPM approach is

    a. 16.3%

    b. 18.0%

    c. 18.60%

    d. 19%

55. The following is not a systematic risk.

    a. Market Risk

    b. Interest Rate Risk

    c. Business Risk

    d. Purchasing Power Risk

56. The following statement is true: (If ‘r’ denotes the correlation coefficient)

    a. r = +1 implies full diversification of securities in a portfolio

    b. r = -1 implies full diversification of securities in a portfolio

    c. r = 0 implies an ideal situation of zero risk

    d. ‘r’ is independent of diversification. Nothing can be inferred based on r.

57. The following is not a feature of Capital Market Line:

    a. There is no unsystematic risk.

    b. The individual portfolio exactly replicates market portfolio in terms of risk and reward.

    c. Estimates portfolio return based on market return.

    d. Diversification can minimize the individual portfolio risk.

58. Consider the following information regarding of X Ltd. and Y Ltd.

Stock	Return	Variance	Weight of the Portfolio
X Ltd.	14%	441%	0.6
Y Ltd.	11%	256%	0.4

If the variance of the portfolio is 122, what is the coefficient of correlation between the stocks approximately?

    a. 0.45

    b. −0.48

    c. 0.56

    d. 0.67

59. An investor owns a stock portfolio consisting of four stocks. He invested in stock 20% in stock A; 25% in stock B; 30% in stock C and 25% in stock D. The betas of these four portfolios are :0.9; 1.3; 1.2 and 1.7 respectively. The beta of portfolio is-

    a. 1.12

    b. 1.29

    c. 1.45

    d. 1.76

60. Security Market Line (SML) shows the relationship between return on the stock and

    a. Return on the market portfolio

    b. Risk-free rate of return

    c. Beta of the stock

    d. Variance of the stock returns

61. Historically, when the market return changed by 10%, the return on the stock of A Ltd. changed by 16%. If the variance of the market return is 257.81, what would be the systematic risk for A Ltd.?

    a. 320%

    b. 480%

    c. 660%

    d. 720%

62. Residual analysis is a test of

    a. Weak-form of market efficiency

    b. Semi-strong form of market efficiency

    c. Strong form of market efficiency

    d. Super-strong form of market efficiency

63. Securities A and B have a standard deviation of 10% and 15% respectively. The respective average returns are 12% and 20%. Investor X has limited funds. Which is safer security for investment?

    a. A is more secured.

    b. B is more secured.

    c. Both A & B are equally secured.

    d. Incomplete information.

64. Which of the following is on the horizontal axis of the Security Market Line?

    a. Beta

    b. Standard deviation

c. Expected return

d. Required return

65. The beta of stock of A Ltd. is 2.00 and is currently in equilibrium. The required rate of return on the stock is 12% and expected return on the stock is 10%. Suddenly, due to change in the economic conditions, the expected return on the market increases to 12%. Other things remaining the same, what would be new required rate of return on the stock?

a. 15.0%

b. 16.0%

c. 20.0%

d. 22.5%

66. If you invest 60% of your money in B Ltd. and 40% in T Ltd.. Assume that the standard deviation of B Ltd. is 80% and standard deviation of T Ltd. is 30%. The correlation coefficient between B Ltd. and T Ltd. is 0.2. What is the standard deviation of the portfolio?

a. 41.33%

b. 49.50%

c. 51.75%

d. 54.34%

Answer:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
a	c	a	c	b	c	a	b	a	c	a	c	a	a	b	c	b	a	a	a
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
c	b	d	c	c	d	d	c	c	d	c	b	c	d	b	b	c	a	b	a
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
b	a	c	a	d	c	a	d	d	b	b	d	b	a	c	b	d	b	b	c
61	62	63	64	65	66														
c	b	b	a	b	c														

State True or False

1. The most significant benefit of actively managing a portfolio is that it offers an opportunity for fund managers to generate much higher returns than the benchmark and thereby keeping the alpha on a higher side.
2. As passive management of investments does not involve continuous selling and buying of securities; therefore, the cost involved is lesser. Also, it is easy to track the performance as knowing how well the underlying index has performed will give the required insights.
3. Portfolios of investments can be managed in three ways, depending on how actively they are managed.
4. Active assets are not used by a business in its daily or routine business operations for the purpose of revenue production.
5. Systematic risk is a macro in nature as it affects a large number of organisations operating under a similar stream or same domain.
6. Systematic risk can be planned by the organisation.
7. The CML is usually derived on the assumption that there exists a riskless asset available for investment.
8. The CML shows the appropriate measure of risk and the risk-return relationship for efficient portfolios, but it does not show those for inefficient portfolios or individual securities.
9. The efficient frontier is a boncave curve in the risk-return space that extends from the minimum variance portfolio to the maximum return portfolio.
10. Higher risk is associated with greater probability of higher standard deviation

Answer:

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
True	True	False	False	True	False	True	True	False	False

Fill in the Blanks

1. ______ is defined as instruments issued by seekers of funds in the investment market to the providers of funds in lieu of funds.

2. _____ is the employment of funds on assets with the aim of earning income or capital appreciation.

3. ______ is an act of conducting a risky financial transaction, in the hope of substantial profit.

4. Time horizon of speculation is __________

5. Time horizon of Investment is _____________

6. Risk is speculation in __________

7. Time horizon is short term in case of investment as compared to __________

8. _____ is the game of chance in which return is dependent upon a particular event happening.

9. Safety of principal and stability of returns is the motive for ________

10. Risk in security analysis is generally associated with the possibility that the realized returns will be _________ than the returns that were expected.

11. Risk can be both _________ and _____________

12. Those forces that are uncontrollable, external and broad in their effect are called sources of ________.

13. Systematic risk is due to the influence of ________ factors on an organisation.

14. Economic, political and sociological changes are sources of _______________.

15. Unsystematic risk is due to the influence __________ factors prevailing within an organisation.

16. ___ originates from the sale and purchase of securities affected by business cycles, technological changes, etc.

17. ________ arises due to change in the capital structure of the organisation.

18. Total return for any security is defined as ________________

19. ______ is the periodic cash flow (income), such as dividend or interest, generated by the investment.

20. ______ is the price appreciation (or depreciation) divided by the beginning price of the asset.

21. The ________ suggests that every stock has an intrinsic value and the intrinsic value is more than the market value, the fundamentalists recommend buying of the security and vice versa.

22. __________ (ECMH) is based on the assumption that in efficient capital markets prices of traded securities always fully reflect all publicly available information concerning those securities.

23. The ___________ endeavours to predict future price levels of stocks by examining one or many series of past data from the market itself.

Answer:

1	Securities	2	Investment
3	Speculation	4	Short Term
5	Short Term	6	High
7	speculation	8	Gambling
9	fixed income investment	10	Less
11	Systematic risk &Unsystematic risk	12	Systematic risk
13	External	14	Systematic risk
15	Internal	16	Business or liquidity risk
17	Financial or credit risk	18	Total return = Current return + Capital return
19	Current Return	20	Capital Return
21	Fundamental Approach	22	Efficient Capital Market Theory
23	Technical Approach		

Short Essay Type Questions

1. Define Portfolio Management. What are the objectives of Portfolio Management.
2. What are the basic principles of Portfolio Management?
3. What are the factors effecting Portfolio Management?
4. Discuss the various kinds of Systematic and Unsystematic risk.
5. What is risk? How do you distinguish between systematic and unsystematic risk?
6. What are the risk involved in Government Securities?
7. Write short note on: (i) Asset Allocation Strategy (ii) Active and Passive Asset Allocation Strategies.
8. What are the principles of Asset Allocation?
9. What is Markowitz 'efficient frontier'? Explain with illustrations.
10. Write notes on: (a) Capital Market Line, (b) Security Market Line, (c) Beta.

Essay Type Questions

1. Discuss how the risk associated with securities is effected by Government policy.
2. Distinguish between capital market line and security market line.
3. 'Systematic risk cannot be controlled but unsystematic risk can be reduced'. Elaborate.
4. What is financial risk? Is it possible to reduce it while planning an organisation?
5. In what way can the relationship of risk and return be established?
6. Discuss the usefulness of regression equation and correlation in measuring risk.
7. 'Most investors are risk averse'. Elaborate.
8. Why is return an important consideration for investment? Can it be measured?
9. How does Markowitz Theory help in planning an investor's portfolio?
10. Do you think that the effect of a combination of securities can bring about a balanced portfolio? Discuss.
11. Is Sharpe's Model is improvement over Markowitz Portfolio Theory?
12. What statistical techniques would you choose to calculate risk? Why?
13. Discuss the significance of 'Beta' in an individual's portfolio.
14. How can an individual make an analysis of different curves to get the most beneficial portfolio?
15. What is an efficient frontier? How does it establish an optimum portfolio?

Practical Problems

Multiple Choice Questions

1. A portfolio comprises two securities and the expected return on them is 12% and 16% respectively. Determine return of portfolio if first security constitutes 40% of total portfolio.

   a. 12.4%

   b. 13.4%

   c. 14.4%

   d. 15.4%

2. Mr. A invested ₹10,000 in a shares of XYZ Company 10 years ago, and that is shares (including reinvested dividends) are currently worth ₹23,8000. Using this information, calculate total investment return of Mr. A

   a. 100%

   b. 38%

   c. 138%

   d. 238%

3. What is the annualized return of Mr. A based on the data of the above question?

   a. 8%

   b. 9.06%

   c. 10%

   d. 11%

4. Mr. X invested ₹10,000 in shares of XYZ Company 20 years ago, and that his shares (including reinvested dividends) are currently worth ₹18,800. Using this information, calculate total investment return of Mr. A.

   a. 100%

   b. 38%

   c. 58%

   d. 88%.

Answer:

1	2	3	4
c	c	b	d

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1. Chandra. P., Investment Analysis and Portfolio Management, McGarw Hill.

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3. Fisher. & Jordon., Security Analysis and Portfolio Management, Pearson.

4. Graham. & Dodd., Security Analysis, McGarw Hill.

5. Subrata Mukherjee., Security Analysis and Portfolio Management, Vikas Publishing House Private Limited.

6. G. Sekar & B Saravana Prasath., Strategic Financial Management, Commercial Law Publishers (India) Pvt. Ltd.

Asset Pricing Theories 9

This Module Includes:

9.1 Single Factor and Multifactor Asset Pricing Theories: CAPM and APT

9.2 Concepts and Applications (including Levered Beta and Unlevered Beta)

Asset Pricing Theories

SLOB Mapped against the Module

To equip oneself with the knowledge of application of various techniques in security evaluation, building a portfolio, measuring its performance and making revisions to optimise the returns. (CMLO 3a)

Module Learning Objectives:

After studying this module, the students will be able to -

- Understand the meaning and difference between single factor and multi factor asset pricing theories.
- Learn applications of single factor and multi factor asset pricing theories.

Single Factor and Multifactor Asset Pricing Theories: CAPM and APT

9.1

9.1.1 Capital Asset Pricing Model (CAPM) and Its Assumptions

William F. Sharpe and John Linter developed the Capital Asset Pricing Model (CAPM). The model is based on the portfolio theory developed by Harry Markowitz. The model emphasises the risk factor in portfolio theory which is a combination of two risks, systematic risk and unsystematic risk. The model suggests that a security's return is directly related to its systematic risk which cannot be neutralized through diversification. The combination of both types of risks stated above provides the total risk. The total variance of returns is equal to market related variance plus company's specific variance. CAPM explains the behavior of security prices and provides a mechanism whereby investors could assess the impact of proposed securities in such a way that the risk premium or excess return is proportional to systematic risk, which is indicated by the beta coefficient. The model is used for analyzing the risk – return implication of holding securities.

A. Features:

(a) CAPM explains the relationship between the Expected Return, Non-Diversifiable Risk (Systematic Risk) and the valuation of securities.

(b) CAPM is based on the premise that the diversifiable risk of a security is eliminated when more and more securities are added to the Portfolio.

(c) All securities do not have same level of systematic risk and therefore, the required rate of return goes with the level of systematic risk. It considers the required rate of return of a security on the basis of its (Systematic Risk) contribution to the total risk.

(d) Systematic Risk can be measured by Beta which is a function of the following —

- Total Risk Associated with the Market Return,
- Total Risk Associated with the Individual Securities Return,
- Correlation between the two.

B. Assumptions:

(i) With reference to Investors:

- Investment goals of investors are rational. They desire higher return for any acceptable level of risk and lower risk for any desired level of return.
- Their objective is to maximize the utility of terminal wealth.
- Their choice is based on the risk and return of a security.
- They have homogenous expectations of Risk and Return over an identical time horizon.

(ii) With reference to Market:

- Information is freely and simultaneously available to all investors.
- Capital Market is not dominated by any individual investors.
- Investors can borrow and lend unlimited amount at the risk-free rate.
- No taxes, transaction costs, restrictions on short-term rates or other market imperfections.
- Total asset quantity is fixed, and all assets are marketable and divisible.

C. Formula for Computing Expected Return:

$E(R_P)$ $= R_F + \{\beta_P \times (R_M - R_F)\}$

Where $E(R_P)$ = Expected Return on Portfolio

R_F = Risk Free Rate of Interest/ Return

β = Portfolio Beta

R_M = Expected Return on Market Portfolio

Security Market Line (SML) and Capital Market Line (CML)

A. Security Market Line (SML):

Security Market Line (SML) reflects the linear relationship between Systematic Risk and Expected Return in financial markets that result when Expected Returns and Beta Coefficients are plotted across a graph. SML is the relationship between Expected Return and Beta, on which both portfolios and individual securities lie.

Purpose:

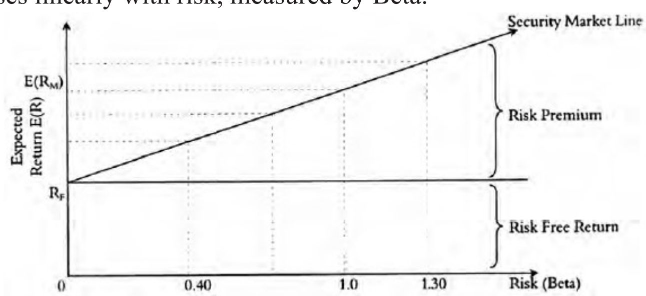
SML helps to determine if the investment is offering a return that is appropriate for its level of risk. Given its risk class, a security's return should be on the SML.

Evaluation based on SML:

Value of a security can be judged based on where the return from such security is plotted with reference to the SML as follows —

Actual Return is	Inference	Systematic variance
Above SML	Stock is yielding a higher return than what can be expected.	Underpriced
On SML	Stock is yielding a return equivalent to can be expected.	Correctly Priced
Below SML	Stock is yielding a lower return than what can be expected.	Overpriced

Graphical Representation (Security Market Line): Security Market Line expresses the basic theme of the CAPM, i.e. expected return increases linearly with risk, measured by Beta.



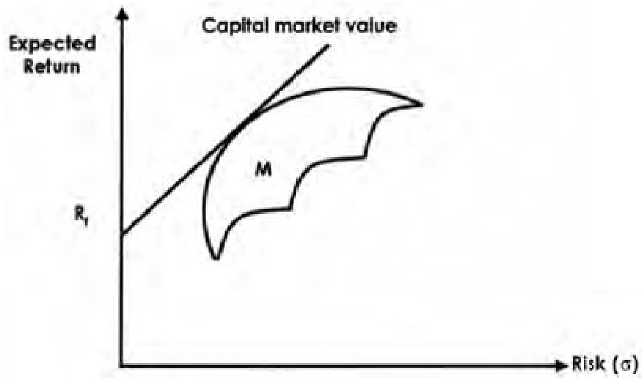
Individual Security vs. Portfolio of Securities:

(a) A major implication of CAPM is that both, an Individual Security and all the Portfolios as well be placed on the Security Market Line.

(b) This is because of an efficient market hypothesis, i.e. all securities are expected to yield returns commensurate with their riskiness, measured by Beta.

B. Capital Market Line (CML):

The Markowitz mean-variance model is modified by introducing into the analysis the concept of risk-free asset. If it is assumed that the investor has access to risk-free securities (for example, Treasury bills) in addition to the universe of risky securities, then he can construct a new set of portfolios as depicted by the line Rt. At point Rt the investor is investing all his investible fund in risk-free securities, whilst at point M he is holding an all –equity portfolio. The combination of risk-free investment and risky investments in portfolio which may be achieved by points between these two limits are termed as lending portfolios. Let us now assume that the investor can lend and borrow funds at the same risk-free interest rate. In such circumstances the efficiency boundary simply becomes the straight line drawn from Rt which is a tangent to the original risky portfolio efficiency boundary. The efficiency boundary that arises out of this assumption of the identical risk free lending and borrowing rates leads to some very important conclusions and is termed as 'Capital Market Line' (CML).



Purpose:

The Capital Market Line (CML) provides the best risk and return tradeoff for an investor. CML enables an investor to estimate the Expected Return from a Portfolio.

Feature:

(i) Portfolio is assumed to be efficient, i.e. exact replication of the market portfolio in terms of risks and rewards.

(ii) CML assumes no unsystematic risk, i.e. all the unsystematic risk is completely taken care off by proper diversification similar to that of market portfolio.

(iii) Capital Market Line estimates the return for a portfolio based on the Total Risk Route, i.e. it assumes existence of perfect correlation between the portfolio return and market return.

(iv) Individual securities does not lie on Capital Market Line. This is because they have some extent of unsystematic risk associated with their returns.

Market Price of Risk: Market Price of Risk of a Portfolio X = $(R_m - R_f) \div \sigma_M$

Where - R_M = Market Return

R_F = Risk Free Rate of Return

σ_M = Standard Deviation of the Market Portfolio

Expectd Return on Portfolio under CML Approach:

$E(R_p) \quad = R_f + \lambda \times \sigma_p$

Where - $E(R_p)$ = Expected Return on Portfolio

R_F = Risk Free Rate of Interest/Return

λ = Market Price of Risk, i.e., Risk Premium per Unit of Market Risk

σ_p = Risk of the Portfolio (Standard Deviation)

C. Differences Between Security Market Line And Capital Market Line:

Aspect	Capital Market Line	Security Market Line
1. Risk Considered	Capital Market Line uses Standard Deviation i.e., Total Risks across the x-axis.	Security Market Line uses Beta or Systematic Risk across the x-axis. (i.e., that part of Total Risk which is common to the whole of the market).
2. Nature of Portfolios	It uses only efficient portfolios, i.e., one which is a perfect replication of the Market Portfolio in terms of risks and rewards.	Security Market Line uses both efficient and non-efficient portfolios.
3. Combination	Every point on the Capital Market Line is a proportional combination between risk free rate of return and market return.	It graphs all portfolios and securities which lie on and off the Capital Market Line.

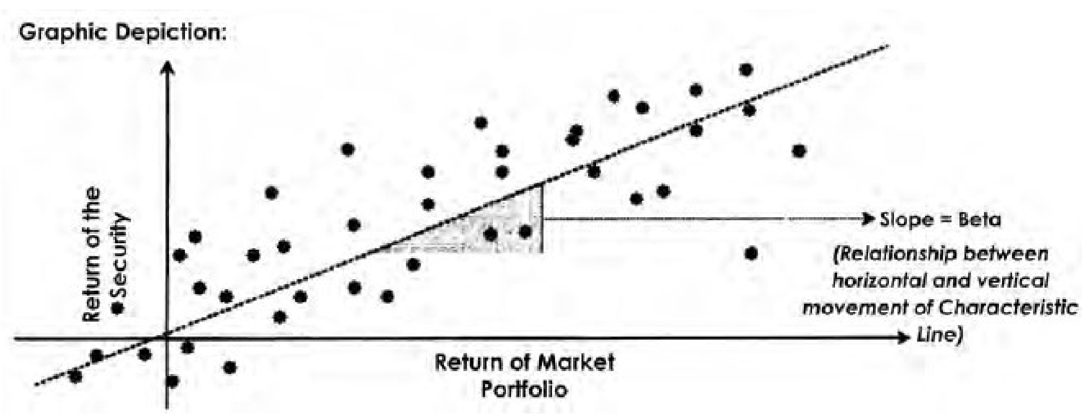
D. Characteristic Line:

Characteristic Line is a graph depicting the relationship between Security' Returns and Market Index Returns. Security Characteristic Line is a time series graph. Return considered for this is the excess return, i.e. expected return over and above the Risk Free Rate of Return.

Purpose:

Security Characteristic Line is used to estimate beta and also to determine how a security return correlates to a market index return.

Beta: Beta estimate comes from the slope estimate of the security characteristic line.



•represents set of return of the Security and Return of the Market at a particular point.
.... represents Characteristic Line (a line which covers most of the dots on the graph)

E. Distinguish between a Security Market Line (SML) and Characteristic Line:

Aspect	Security Market Line	Characteristic Line
Scheme	It represents the relationship between retur and risk (measured in terms of systematic risk) of a security or portfolio.	It represents the relationship between the returns of two securities or a security and the market return, over a period of time.
Nature of Graph	Security Market Line is a cross-sectional graph	Security Characteristic Line is a Time Series Graph
Comparison	Security Market Line graphs beta versus expected return	Characteristic Line graphs time series of security returns versus the Index Returns.
Utility	It is used for estimating the expected return for a security relative to its beta risk	To estimate beta and also to determine how a security return correlates to a market index return

Decision Making on Valuation of A Portfolio / Security

The Capita! Asset Pricing Model (CAPM) is essentially a model for determining the Intrinsic Value or Equilibrium Price of an Asset. The Equilibrium or Intrinsic Price of an Asset is determined using the Expected Return as arrived at using the CAPM. Expected Return is the minimum return that the investors require from the asset in relation to the relative systematic risk of the Asset. Price of an asset is the Present Value of the Future Cash Flows generated by the Asset as discounted by the Expected Return as determined using the CAPM.

	Situation	Inference	Action
1	CAPM Return < Estimated Return	Undervalued Security	BUY
2	CAPM Return = Estimated Return	Correctly Valued Security	HOLD
3	CAPM Return >σ Estimated Return	Overvalued Security	SELL

Risk Return Ratio

Risk Return Ratio is the average return (in excess of the risk-free return) per unit of risk undertaken. It tends to measure the benefit of taking that extra risk. An investor would earn a return at risk-free rate, without assuming any risk. What return did he obtain for taking that extra risk, is measured by Risk-Return Ratio.

Mathematical Notation:

- If Beta is taken as a Measurement of Risk:

  Risk Return Ratio = $\dfrac{R_s - R_f}{\beta_s}$

- If Standard Deviation is taken as risk:

  Risk Return Ratio = $\dfrac{R_s - R_f}{\sigma_s}$

  Where,

  R_s = Return of Security S

  R_f = Risk Free Return

  β_s = Beta of Security S with reference to the Market

  σ_M = Standard Deviation of Market

ARBITRAGE PRICING MODEL (APT)

Unlike the CAPM which is a Single Factor Model, the APT is a Multi Factor Model having a whole set of Beta Values - one for each Factor. Arbitrage Pricing Theory states that the expected return on an investment is dependent upon how that investment reacts to a set of individual Macro-Economic factors (degree of reaction measured by the Betas) and the risk premium associated with each of those macro - economic factors. The Arbitrage Pricing Theory developed by Ross (1976) holds that there are four factors which explain the risk premium relationship of a particular security. Several factors can be identified to have a bearing on the Return expectation of a security. Most factors such as inflation and money supply, interest rate, industrial production and personal consumption are inter- related. It seeks to identify the risk return relationship for each of the factors individually.

According to the Capital Asset Pricing Model,

Expected Return = _ + Pf R R

Where, Rf = Risk Free Rate.

RP = Average Risk Premium considering all factors put together i.e [RM-RF]

In Arbitrage Pricing Theory,

Expected Return = n n f R ....R R R R _ ++ _ +_ +_ +3 3 2 2 1 1

Where, Rn is the risk premium for each of the factors in the model and n _is the measure of sensitivity of the particular security, to each of the factors.

Hedging of Risks Using Risk Free Investments

A. Hedging using Risk free Investments to increase Risk (Increase Portfolio Value)

(i) Object: increase Beta value of the Portfolio

(ii) Action: Buy Stock and Sell Risk free Investments.

(iii) Value of Risk Free Investments to be sold to increase portfolio risk and return:

= Portfolio Value × [Desired Value of Beta – Present Beta of the Portfolio]

(iv) Reasoning:

Desired Beta is the weighted average beta of the risk-free investments and the Beta of the remaining investments. Risk-free Investments do not carry any Beta. By selling Risk-free investments and investing the same in the Portfolio, risk attached to the Portfolio increases, and thereby Portfolio Risk increases and portfolio return also increases.

Example:

Portfolio value is ₹ 1,00,000 and Beta is 1.20. Desired Beta is 2.00. Hence, the value of Risk Free Investments to be sold to increase the level of Risk is ₹ 80,000 [Portfolio Value ₹ 1,00,000 × Desired Beta 2.00 - Portfolio value ₹ 1,00,000 × Existing Beta 1.20]

B. Hedging using Risk free Investments to reduce Risk (Reduce Erosion in Value)

(i) Object: Reduce Beta Value of the Portfolio

(ii) Action: Sell Stock and Buy Risk free Investments.

(iii) Value of Risk Free Investments to be bought:

Portfolio Value × [Present Beta of the Portfolio - Desired Value of Beta]

(iv) Reasoning: Risk free Investments do not carry any Beta. By selling the Portfolio stock, and buying risk-free investments, Risk attached to the Portfolio gets reduced, and thereby Portfolio Risk reduces.

Example: Portfolio value is ₹1,00,000 and Beta is 2.00. Desired Beta is 1.20. Hence, the value of Risk Free Investments to be bought to reduce the level of Risk is ₹ 80,000 [Portfolio Value ₹1,00,000 × Present Beta 2.00 - Portfolio value ₹1,00,000 × Desired Beta 1.20]

Computation of Project Beta

Beta of a project is the weighted average of the Beta of all the Assets and the Projects.

Project Beta: = Beta of Assets = Beta of Liabilities

Beta of Assets = Weighted Average Beta of Equity and Debt Employed in the Project

The Beta Balance Sheet:

(a) Single Project Balance Sheet (Assuming No Taxes):

Liabilitties	Weight	Beta	Assets = Capital Employed	Weight	Beta
Equity (E)	W_E	β_E	Project A	1.00	β_A
Debt (D)	W_D	β_D			
Total	1.00	β_A	Total		β_A

→ Beta of Project A [β_A] = Weighted Average Beta of Sources of Capital

$= W_E \times \beta_E + W_D \times \beta_D$

(b) Two Project Balance Sheet:

(i) (Assuming No Taxes):-

Liabilitties	Weight	Beta	Assets = Capital Employed	Weight	Beta
Equity (E)	W_E	β_E	Project A	W_A	β_A
Debt (D)	W_D	β_D	Project B	W_B	β_B
Total	1.00		Total	1.00	

→ Beta of Assets [β_{Asset}] = Beta of Liabilities [$\beta_{Liabilities}$]

→ Weighted Average Asset Beta = Weighted Average Beta of Sources of Capital

Equal

→ $W_A \times \beta_A + W_B \times \beta_B = W_E \times \beta_E + W_D \times \beta_D$

(ii) If Taxes are Considered : Weight of Debt will be measured as $W_D \times (1 - \text{Tax Rate})$

Formula : Project Beta $\beta_P = \dfrac{\beta_E \times \text{Equity}}{\text{Equity} + \text{Debt}\ (1 - \text{Tax})} + \dfrac{\beta_{Debt} \times \text{Debt} \times (1\text{-Tax})}{\text{Equity} + \text{Debt}\ (1 - \text{Tax})}$

β_E represents the Beta of Equity of the Project.

β_{Debt} represents the Beta of Debt of the Project.

Levered and Unlevered Firms, Proxy Beta

Unlevered Firm: If a Company finances its investments and projects completely with Equity (without leveraging Debt Finance), then the Company is known as an Unlevered Firm.

Levered Firm: Levered Firm is the firm whose Capital Structure includes both the components of Debt and Equity.

Proxy Beta: Proxy Beta is the beta of a Levered Firm, arrived at from the beta of an Unlevered Firm.

Concepts and Applications (including Levered Beta and Unlevered Beta)

9.2

9.2.1 Levered Beta

Levered beta (or geared Beta) takes debt and equity in its capital structure and then compares the risk of a firm to the volatility of the market. Also, it gives tax benefit to the company by adding debt to its capital structure, however, the more debt a company has, the more earnings are used to pay back that debt and this, in turn, increases the risk associated with the stock. So, due to different capital structures and levels of debt, it would desirable to take unlevered beta for effective comparison with the market. Levered beta is a financial calculation that indicates the systematic risk of a stock used in the capital asset pricing model (CAPM). Beta or levered beta is a measure of a firm's systematic risk in relation to the market. A key determinant of beta is leverage, i.e. the level of the firm's debt compared to equity. The systematic risk includes the different types of risk that may affect the stock performance, including macroeconomic factors, political events, etc., and it cannot be leveraged through diversification.

Usually, a beta equal to 1 indicates a stock's risk equal to the market risk; a beta of less than 1 indicates a stock's risk lower than the market risk, and a beta of greater than 1 indicates a stock's risk greater than the market risk. To calculate the leveraged beta, we need to know the unlevered beta and the debt-to-equity ratio. Systematic risk is the risk that affects the overall market. Beta does not take into account the unsystematic risk. Unsystematic risk specifically affects a stock, so it can be reduced by diversifying the portfolio.

The term "levered beta" refers to the systematic risk of a company stock that is primarily used in the computation of the expected rate of return using the capital asset pricing model (CAPM). In other words, levered beta takes into account the impact of the company's debt level compared to its equity on its systematic risk exposure. Levered beta is also known as equity beta.

The formula for the levered beta can be derived by multiplying the unlevered beta with a factor of 1 plus the product of the company's debt-to-equity ratio and (1 – tax rate). Mathematically, it is represented as,

$$\text{Levered Beta} = \text{Unlevered Beta} \times [1 + (1 - \text{Tax Rate}) \times (\text{Debt} / \text{Equity})]$$

9.2.2 Unlevered Beta

It is a risk measurement metric that compares the risk of a company without any debt to the risk of the market. In simple language, unlevered beta is a company's beta without considering the debt. It is also referred to as asset beta because the risk of a firm after removing leverage is because of its assets. Unlevered beta (or ungeared beta) takes only equity in its capital structure and then compares the risk of a firm to the risk of the market. Unlevered beta is useful when comparing companies with different capital structures as it focuses on the equity risk and is also referred to as the "Asset Beta" since its value is determined by the assets (or businesses) owned by the firm, however, unlevering the beta removes beneficial effects gained by adding debt to the firm's capital structure. Generally, the Unlevered beta is lower than the levered beta however, it could be higher in some cases especially when the net debt is negative (meaning that the company has more cash than debt).

Some industries or companies have a high level of debt on their balance sheet. This leverage makes their earnings volatile, and investment in this company becomes risky. Levered beta considers the risk of leverage and its impact on the company's performance. So, levered beta is not an ideal measure to compare two companies with different debt proportions. In such a scenario, you will have to remove the effect of debt by "unlevering" the beta. Unlevered beta will facilitate a better comparison for such companies than levered beta.

$$\text{Unlevered Beta} = \text{Levered Beta} \div 1 + [\,(1 - \text{Tax}) \times (\text{Debt/ Equity})]$$

Illustration 8

Assume for the subject company:

Unlevered beta: 0.90

Tax rate: 0.30

Capital structure: 60% debt, 40% equity

Solution:

$B_L = 0.90(1 + (1 - 0.30)0.60/0.40)$

$= 0.90(1 + 0.70(1.5))$

$= 0.90(2.05)$

$= 1.85$

It is better to use an unlevered beta over a levered beta when a company or investor wishes to measure a publicly-traded security's performance in relation to market movements without the effects of that company's debt factor. A publicly traded security's levered beta measures the sensitivity of that security's tendency to perform in relation to the overall market. Levered beta includes a company's debt in the calculation of its sensitivity. Security with positive levered beta signals that the security has a positive correlation with market performance and security with negative levered beta signals that the security has a negative correlation with market performance.

A levered beta greater than positive 1 or less than negative 1 means that it has greater volatility than the market. A levered beta between negative 1 and positive 1 has less volatility than the market.

Additional Illustrations

1. If the risk free rate of interest (R_f) is 10%, and expected return on market portfolio (R_m) is 15%, ascertain expected return of the portfolio if portfolio betas are — (a) 0.10 and (b) 0.30.

Solution:

1. Rule for determining Expected Return on Portfolio under CAPM

Under Capital Asset Pricing Model (CAPM) $R_p = R_f + [\beta \times (R_m - R_f)]$

Notation	Particulars	Value
R_p	Expected Return on Portfolio	To be computed
R_f	Risk Free Rate of Interest/ Return	10%
β	Portfolio Beta	0.10/0.30
R_m	Expected Return on Market Portfolio	15%

2. Computation of Expected Return on Portfolio

Beta	Expected Return = $R_f + \beta \times (R_m - R_f)$
0.10	= 10% + 0.10(15% -10%) =10.5%
0.30	= 10% + 0.30(15% - 10%) =11.5%

2. Subho has invested in four securities M, N, O and P, the particulars of which are as follows —

Security	M	N	O	P
Amount Invested (₹)	1,25,000	1,50,000	80,000	1,45,000
Beta (β)	0.60	1.50	0.90	1.30

If RBI Bonds carries an interest rate of 8% and NIFTY yields 14%, what is the expected return on portfolio? If investment in Security O is replaced by investment in RBI Bonds, what is the corresponding change in Portfolio Beta and expected return?

Solution:

(i) Computation of Expected Return on Portfolio (Under CAPM)

(a) Computation of Weighted Beta (Beta of the Portfolio)

Security	Amount Invested (₹)	Proportion of Investment to Total Investment	Beta of Investment	Weighted Beta
(1)	(2)	(3) = (2) ÷ 5,00,000	(4)	(5) = (3) × (4)
M	1,25,000	0.25	0.60	0.150
N	1,50,000	0.30	1.50	0.450
O	80,000	0.16	0.90	0.144
P	1,45,000	0.29	1.30	0.377
Total	5,00,000	1.00		1.121

(b) Computation of Expected Return on Portfolio

Expected Return $[E(R_p)] = R_f + [\beta_p \times (R_m - R_f)]$

$= 8\% + [1.121 \times (14\% - 8\%)]$

$= 8\% + [1.121 \times 6\%]$

$= 8\% + 6.726\%$

$= 14.726\%$

(ii) Computation of Expected Return [Investment in O, replaced by RBI Bonds] (CAPM)

(a) Computation of Weighted Beta (Beta of the Portfolio)

Security	Amount Invested (₹)	Proportion of Investment to Total Investment	Beta of Investment	Weighted Beta
(1)	(2)	(3) = (2) ÷ 5,00,000	(4)	(5) = (3) × (4)
M	1,25,000	0.25	0.60	0.150
N	1,50,000	0.30	1.50	0.450
RBI Bonds	80,000	0.16	0.00	0.000
P	1,45,000	0.29	1.30	0.377
Total	5,00,000	1.00		0.977

(b) Computation of Expected Return on Portfolio

Expected Return [E(RP)]

$= R_f + [\beta_p \times (R_m - R_f)]$

$= 8\% + [0.977 \times (14\% - 8\%)]$

$= 8\% + [0.977 \times 6\%]$

$= 8\% + 5.862\%$

$= 13.862\%$

3. The beta coefficient of M Ltd. Is 1.40. The company has been maintaining 8% rate of growth in dividends and earnings. The last dividend paid was ₹4.00 per share. Return on government securities is 12% and return on market portfolio is 18%. The current market price of the share of M Ltd. Is ₹32.00. What will be the equilibrium price per share of M Ltd.?

Solution

Required rate of return as per CAPM = $R_f + (R_m - R_f) \times \beta_i = 12 + (18\text{-}12) \times 1.40 = 20.40\%$.

Equilibrium price $D_1 = 4 \times (1+0.08) = 4 \times 1.08 =$ ₹ 4.32 and G = 0.08 [E.P. = Equilibrium price].

Expected return = $[D_1/\text{E.P.}] + g$ or 20.40 = 4.32/E.P. + 0.08

or (0.2040 - 0.08) E.P. = 4.32

or 0.124 E.P. = 4.32

or E.P. = 4.32 / 0.124 or ₹34.84. or equilibrium price = ₹34.84

4. An investor holds two stocks X and Y. An analyst prepared ex-ante probability distribution for the possible Economic scenarios and the conditional returns for the two stocks and the market index as shown below:

Economic Scenario	Probability	Conditional Returns %		
		X	Y	Market
Growth	0.40	25	20	18
Stagnation	0.30	10	15	13
Recession	0.30	-5	-8	-3

The risk free rate during the next year is expected to be around 9%. Determine whether the investor should liquidate his holdings in stocks X and Y or on the contrary make fresh investments in them. CAPM assumptions are holding true.

Solution:

1. Computation of Expected Returns

Scenario	Prob. P	Return X R_X	Mean $P \times R_X$	Return Y R_Y	Mean $P \times R_Y$	Market Return R_M	Mean $P \times R_M$
Growth	0.4	25	10	20	8.0	18	7.2
Stagnation	0.3	10	3	15	4.5	13	3.9
Recession	0.3	-5	-1.5	-8	-2.4	-3	-0.9
Estimated Returns			11.5		10.1		10.2

2. Computation of Standard Deviation of R_M

R_M	$D_M = R_M - 10.2$	D_M^2	P	PD_M^2
18	7.8	60.84	0.4	24.34
13	2.8	7.84	0.3	2.35
-3	-13.2	174.24	0.3	52.27
Market Variance				78.96

Standard Deviation of the Market = $\sqrt{78.96}$ = 8.89%

3. Computation of Standard Deviation and Covariance of R_X

R_X	$D_X = R_X - 11.5$	D_X^2	P	PD_X^2	$D_X \times D_M$	$P\,D_X \times D_M$
25	13.5	182.25	0.4	72.900	105.3	42.12
10	-1.5	2.25	0.3	0.675	-4.2	-1.26
-5	-16.5	272.25	0.3	81.675	217.8	65.34
				155.25		**106.20**

Standard Deviation of Security X = $\sqrt{155.25}$ = 12.46%

Covariance with the market = 106.20

4. Computation of Standard Deviation and Covariance of R_Y

R_Y	$D_Y = R_Y - 10.1$	D_y^2	P	PD_y^2	$D_Y \times D_M$	$P\,D_Y \times D_M$
20	9.9	98.01	0.4	39.204	77.22	30.89
15	4.9	24.01	0.3	7.203	13.72	4.12
-8	-18.1	327.61	0.3	98.283	238.92	71.68
				144.69		**106.69**

Standard Deviation of Security Y = $\sqrt{144.69}$ = 12.03%

Covariance with the market = 106.69

5. Computation of CAPM Return

A. Beta = Covariance / Variance of the Market

1. Beta of Security X = 106.20/ 78.96 = 1.34
2. Beta of Security Y = 106.69/ 78.96 = 1.35

B. Under CAPM, Equilibrium Return = $R_f + \beta (R_m - R_f)$

Expected Return of Security X = 9% + 1.34 (10.2 - 9) = 10.61%

Expected Return of Security Y = 9% + 1.35 (10.2 - 9) = 10.62%

6. Conclusion and Recommendation

Particulars	Security X	Security Y
Estimated Returns	11.50	10.10
Expected Return under CAPM	10.61	10.62
Estimated Return vs. Expected Returns	Expected Return is Lower. Stock X is underpriced.	Expected Return is Higher. Stock Y is over priced.
Recommendation	Buy /Hold	Sell

5. An investor is holding 1000 shares of X Ltd. Presently the rate of dividend being paid by the company is ₹2.00 per share and the share is being sold at ₹ 25 per share in the market. However, several factors are likely to change during the course of the year as indicated below.

	Existing	Revised
R_f	12%	10%
Market risk premium	6%	4%
Beta value	1.4	1.25
Expected growth rate	5%	9%

In view of the above factors whether the investor should, buy, hold or sell the shares ? And why?

Solution

The return as per existing data:

$$R_x = R_f + \beta(R_m - R_f) = 0.12 + .06 \times 1.4 = 0.204 \text{ or } 20.4\%.$$

Substituting this for k_e in the dividend discount model

$$P = \frac{D_0(1+g)}{k_e - g} \quad \text{or} \quad P = (2\times1.05) / (0.204 - 0.05) \qquad = ₹13.63.$$

Since the share is selling at ₹ 25, it is overpriced. He should sell his shares now.

As per the revised data, we should have

$$R_x = 0.10 + 1.25 \times 0.04 = 15\%$$

Substituting this for k_e in the dividend discount model

$$P = \frac{D_0(1+g)}{k_e - g} \quad \text{we get, } P = (2 \times 1.09) / (0.15 - 0.09) \qquad = ₹\ 36.33.$$

Since the share is selling at ₹ 25.00 it is underpriced, he should hold the shares as per revised data.

6. Sanjiv is contemplating buying/selling the shares of Companies M, N and O. He already holds some shares in each of these Companies. He has the following data in his hand to aid him in his decision —

- Return on NIFTY 16%
- ₹ 500 Treasury Bonds, whose returns are considered risk free, earns its owners a return of ₹35
- Company M has a Beta Factor of 0.95 and investment therein yields a return of 13.5%
- Company N, which is traded at ₹1,200 per shares, earns its investors a sum of ₹246. It has a beta factor of 1.5.

- Company O, price of which is ₹450 has a beta factor of 0.6. Historical data shows that annual share price increase of the Company is around 8%. Last dividend declared was ₹12 per share. Dividend payout is expected to double in the next year.

Sanjiv seeks your guidance on the course of action.

Solution:

1. Market Return (R_M) and Risk Free Return (R_F)

(a) Market Return = Return on NIFTY = 16%

(b) Risk Free Return = Return on Treasury Bonds = Return in ₹/Face Value = ₹35/₹500 =7%

2. Evaluation of Company M

Particulars	Value
Estimated Return (Given) (R_M) **[A]**	13.5%
Expected Return under CAPM [$E(R_M)$] $E(R_M) = R_F + \beta_M \times (R_M - R_F) = 7\% + 0.95 \times (16\% - 7\%)$ **[B]**	15.55%
Estimated Return [A] vs. Expected Return under CAPM [B]	[B] is Higher
Inference	Stock gives lesser than what is should give
Conclusion [Expected Return is higher than Estimated Return] Share is	Overpriced
Recommendation	**SELL**

3. Evaluation of Company N

Particulars	Value
Estimated Return (Given)	₹246
Market Price (Given)	₹1200
Estimated Return (in %) (R_N) [Estimated Return ₹246/Market Price ₹1200]**[A]**	20.50%
Expected Return under CAPM [$E(R_N)$] $E(R_N) = R_F + \beta_N \times (R_M - R_F) = 7\% + 1.50 \times (16\% - 7\%)$ **[B]**	20.50%
Estimated Return [A] vs. Expected Return under CAPM [B]	Equal
Inference	Stock is giving exactly what it should give
Conclusion [Expected Return is **EQUAL** To Estimated Return] Share is	Correctly priced
Recommendation	**HOLD**

4. Evaluation of Company O

Particulars	Value
Capital Appreciation Expected (Market Price of ₹450 × 8%)	₹36
Estimated Dividend Payout (Previous Year's Dividend of ₹12 × 2 Times)	₹24
Total Estimated Return for the year	₹60
Estimated Return (in %) (R_O) [Estimated Return ₹60/Market Price ₹450]**[A]**	13.33%
Expected Return under CAPM [$E(R_o)$] $E(R_O) = R_F + \beta_O \times (R_M - R_F) = 7\% + 0.60 \times (16\% - 7\%)$ **[B]**	12.40%
Estimated Return [A] vs. Expected Return under CAPM [B]	[B] is lower
Inference	Stock gives more than what it should give
Conclusion [Expected Return is **LOWER** than Estimated Return] Share is	**Underpriced**
Recommendation	**BUY**

7. You have chosen a risky market portfolio P, with an expected return of 15% and a standard deviation of 25%. The R_f 0.06.

(a) State the equation for CML for portfolio P

(b) Suppose you prefer to reduce your risk by investing 40% in R_f and balance 60% in portfolio P. What is your expected return now?

(c) What is your risk as per (b) above.

Solution

(a) We know that CML is a graph plotting returns on y axis versus (σ) standard deviation (x axis). It joins R_f, plotted on the y axis and is drawn as a tangent to the maximum variance portfolio (efficient set), joining R_f and any other risky portfolio (in this case portfolio P).

This equation is given by:

$E(R_p) = 0.06 + [(0.15 - 0.06) \div 0.25]\sigma_P$ or $E(R_p) = 0.06 + 0.36\sigma_P$

[Slop = (0.15 - 0.06)/0.25; y intercept = 0.06]

(b) $E(R_p) = 0.40 \times 0.06 \times 0.60 \times 0.15 = 0.024 + 0.09 = 11.4\%$

(c) $\sigma_P = 0.06 \times 0.25 + 0.40 \times 0 = 15\%$.

8. Assume the asset below is correctly priced according to security market line. Device the SML. What is the expected return on an asset with a beta of 2?

$$R_1 = 6\%; \quad R_2 = 12\%; \beta_1 = 0.5; \quad \beta_2 = 1.5$$

Solution

Since the SML is linear, we need only two points:

$R_i = R_f + \beta_i(R_m - R_f)$

$6\% = R_f + 0.5(R_m - R_f) = 0.5R_f + 0.5R_m$

$12\% = R_f + 1.5(R_m - R_f) = -0.5R_f + 1.5R_m$

Adding the equations:

$18\% = 2.0\ R_m$ or $R_m = 9\%$

Thus, $R_f = [6-0.5(9)]/0.5 = 3\%$ [Putting the value in equation (i)]

Hence, the SML is: $\beta_i = 3\% + \beta_i(9 - 3)$ or $3\% + 6\beta_i$

For beta = 2;

$R_i = 3 + 2(6) = 15\%$

9. Tea Ltd., has been enjoying a substantial net cash inflow, and until the surplus funds are needed to meet tax and dividend payments, and to finance further capital expenditure in several months time, they have been invested in a small portfolio of short-term equity investments.

Details of the portfolio, which consists of shares in four UK listed companies, are as follows.

Company	Number of shares held	Beta equity coefficient	Market price per share (₹)	Latest Dividend yield (%)	Expected return on equity in the next year %
A Ltd.	60,000	1.20	4.29	6.10	19.50
B Ltd.	80,000	2.30	2.92	3.40	24.00
C Ltd.	1,00,000	0.85	2.17	5.70	17.50
D Ltd.	1,25,000	1.28	3.14	3.30	23.00

The current market return is 19% a year and the Risk free rate is 11% a year.

Required:

1. On the basis of the data given, calculate the risk of Tea Ltd's short term investment portfolio relative to that of the market.
2. Recommend, with reasons, whether Tea Ltd., should change the composition of its portfolio.

Solution:

(1) Computation of Weighed Beta

Security	No. of shares held	MPS (₹)	Market value of investments	Proportion	Beta	Portfolio Beta
[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7] = [5] × [6]**
A	60,000	4.29	2,57,400	2,57,400 ÷ 11,00,500 = 0.2339	1.20	0.28068
B	80,000	2.92	2,33,600	2,33,600 ÷ 11,00,500 = 0.2123	2.30	0.48829
C	1,00,000	2.17	2,17,000	2,17,000 ÷ 11,00,500 = 0.1972	0.85	0.16762
D	1,25,000	3.14	3,92,500	3,92,500 ÷ 11,00,500 = 0.3567	1.28	0.45658
			11,00,500	**1**	**5.63**	**1.393166**

(2) Comparison with Return under CAPM and Recommended changes in Composition

Security	Valuation under CAPM = $R_F + [\beta\times(R_M - R_F)]$	Expected K_e in the next year %	Evaluation	Strategy
A	11% + 1.20 (19% - 11%) = 20.60	19.50	Overpriced	Sell
B	11% + 2.30 (19% - 11%) = 29.40	24.00	Overpriced	Sell
C	11% + 0.85 (19% - 11%) = 17.80	17.50	Overpriced	Sell
D	11% + 1.28 (19% - 11%) = 21.24	23.00	Under priced	Buy

10. Share of Sharee Limited has a beta factor of 1.8. The NIFTY has yielded a return of 17.5%. 6.75% ₹100 Treasury Bills are traded at ₹108. Ascertain —

(a) Expected Return on Shares of Sharee Ltd under CAPM.

(b) Alpha Factor of Shares of Sharee Ltd if the past 5 Years actual returns on shares of Sharee Ltd are — 23.4%; 27.2%; 26.6%; 24.3% and 28.5%.

Solution:

1. Expected Return on Shares of Sharee Ltd [E(R_S)] (Under CAPM)

(a) Computation of Risk Free Return (R_P)

Particulars	Value
Face Value of Treasury Bills	₹100
Return on Face Value (in %)	6.75%
Return on Treasury Bills (in Value) [₹100 × 6.75%]	₹6.75
Trading Price of Treasury Bills	₹108
Risk Free Return (R_F) as per Market Expectations [Actual Return ₹6.75/Market Price ₹108]	6.25%

(b) Expected Return [E(R_S)]

E(R_S)	$R_F + [\beta_s \times (R_M - R_F)]$		
Risk Free Return	R_F	6.25%	[As per Working Note 1(a)]
Return on Market Portfolio	R_M	17.5%	[Return on NIFTY]
Beta Factor	β_s	1.80	[Given]

$E(R_S) = R_F + [\beta_s \times (R_M - R_F)]$

$= 6.25\% + [1.80 \times (17.5\% - 6.25\%)]$

$= 6.25\% + [1.80 \times 11.25\%]$

$= 6.25\% + 20.25$

$= 26.5\%$

2. Value of Alpha (α_v) for Return on Shares of Sharee Ltd [$E(R_S)$]

Year	Actual Return	Abnormal Return [AR_S]
(1)	**(2)**	**(3) = (2) – $E(R_S)$**
1	23.4	23.4% – 26.50% = (3.10%)
2	27.2	27.2% – 26.50% = 0.70%
3	26.6	26.6% – 26.50% = 0.10%
4	24.3	24.3% – 26.50% = (2.20%)
5	28.5	28.5% – 26.50% = 2.00%
Total		(2.50%)

$\propto S$ $=\sum AR_S \div n$ = (2.50%) ÷ 5 Years = (0.50%)

Inference: Alpha is negative. Therefore, expected return will be less than return under CAPM to the extent of 0.50%.

11. Returns on two portfolios, B and L, for the past 4 years are —

Year	1	2	3	4
Portfolio B	13.00%	13.50%	12.50%	14.00%
Portfolio L	14.35%	11.75%	13.60%	12.90%

Beta factor of the two portfolios are 1.3 and 1.2 respectively. If the market portfolio fetches 12% return and RBI Bonds, which are considered risk free, yield 5% return, which of the above two portfolios will an investor prefer?

Solution:

1. Computation of Expected Rate of Return under CAPM

$E(R_X)$ $R_F + [\beta_X \times (R_M - R_F)]$ [Expected Return on Portfolio X]

Risk Free Return R_F 5% [Treasury Bills]

Return on Market Portfolio R_M 12% [Given]

Expected Return on	Portfolio B	Portfolio L
Beta Factor	1.30	1.20
Expected Return	$E(R_B) = R_F + [\beta_B \times (R_M - R_F)]$ = 5% + [1.30 × (12% - 5%)] = 5% + [1.30 × 7%] = 5% + 9.1% = **14.10%**	$E(R_L) = R_F + [\beta_L \times (R_M - R_F)]$ = 5% + [1.20 × (12% - 5%)] = 5% + [1.20 × 7%] = 5% + 8.4% = **13.40%**

2. Computation of Alpha Factors

Year	Portfolio B		Portfolio L	
	Actual Return	**Abnormal Return [AR_B]**	**Actual Return**	**Abnormal Return [AR_L]**
(1)	**(2)**	**(3) = (2)-E(R_B)**	**(4)**	**(5) = (4)-E(R_L)**
1	13.00%	13.00% - 14.10% = (1.10%)	14.35%	14.35% - 13.40% = 0.95%
2	13.50%	13.50% - 14.10% = (0.60%)	11.75%	11.75% - 13.40% = (1.65%)
3	12.50%	12.50% -14.10% = (1.60%)	13.60%	13.60% - 13.40% = 0.20%
4	14.00%	14.00% -14.10% = (0.10%)	12.90%	12.90% - 13.40% = (0.50%)
		(3.40%)		**(1.00%)**

Alpha Factor:

Portfolio B $\propto_B$ $= \sum AR_B \div n$ = ((3.40%) ÷ 4 Years = (0.85%)

Portfolio L $\propto_L$ $= \sum AR_L \div n$ = ((1.00%) ÷ 4 Years = (0.25%)

3. Expected Return adjusted for Alpha

Alpha Adjusted Return = Return under CAPM + $\propto$

Portfolio B = $E(R_B) + \propto_B$ = 14.10% - 0.85% = 13.25%

Portfolio L = $E(R_L) + \propto_L$ = 13.40% - 0.25% = 13.15%

Conclusion: The Alpha for Security B is higher than L, indicating its better performance relative to L. Hence, an investor should prefer Portfolio B.

12. Estimate the stock return by using CAPM and the APT model by which the particulars are given below:

(a) The expected return of the market is 14 per cent and the equity beta is 1.2. The risk free rate of interest is 6 per cent.

(b)

Factor	Market Price of Risk (%)	Sensitivity Index
Inflation	5	1.2
Industrial Production	1	0.9
Risk Premium	3	1.1
Interest Rate	4	-0.8

What explanations can you offer for the difference in the two estimates?

Solution:

Return as per CAPM

(a) $R_i = R_f + (R_m - R_f) \times \beta_i$

$= 0.06 + (0.14 - 0.06) \times 1.2$

$= 0.06 + 0.096$

$= 0.156$

$= 15.60\%$.

Return under APT Model

(b) R_i $= \lambda_0 + [\lambda_1 \beta_{i1} + \lambda_2 \beta_{i2} + \lambda_3 \beta_{i3} + \lambda_4 \beta_{i4}]$

$= 0.06 + [0.05 \times 1.2 + 0.01 \times 0.9 + 0.03 \times 1.1 + (0.04 \times -0.8)]$

$= 0.06 + [0.06 + 0.009 + 0.033 - 0.032]$

$= 0.06 + [0.07]$

$= 0.13$ or 13%

The rates are different under two models due to the usage of different variables. The rate under APT is much lower because of negative impact of interest rate factor.

13. Mr. Parekh is totally confused whether he should purchase stock of HUL or not. His financial analyst has provided the following information:

$R_f = 5\%$

Factor	λ_i	β_i
Interest Rate Risk	0.90	0.90
Purchasing Power Risk	0.8	1.70
Inflation Risk	1.4	1.50
Market Risk	0.7	-1.60

The probability of getting a return on HUL stock is given below:

Return %	Probability (%)
18	40
20	30
12	20
8	10

Advise Mr. Parekh.

Solution

The expected return on stock of HUL based on APT is

R_i $= \lambda_0 + [\lambda_1\beta_{i1} + \lambda_2\beta_{i2} + \lambda_3\beta_{i3} + \lambda_4\beta_{i4}]$

$= 6 + [0.90 \times 0.90 + 0.80 \times 1.70 + 1.4 \times 1.50 + (0.70 \times -1.60)]$

$= 6 + [0.81 + 1.36 + 2.1 - 1.12]$

$= 6 + 3.15$

$= 9.15\%$

The probable return $= 18 \times 0.40 + 20 \times 0.30 + 12 \times 0.20 + 8 \times 0.10$

$= 7.20 + 6.00 + 2.40 + 0.80 = 16.40\%$

As probable return is much higher, Mr. Parekh should buy HUL stock.

14. The estimated factor sensitivities of ITC to the five macroeconomic factors are given below along with market risk premium to each of these factors.

	Factor Sensitivity	Risk Premium (%)
Default risk	0.25	2.60
Inflation risk	0.32	-0.70
Business cycle risk	1.60	1.80
Time horizon risk	0.40	-0.75
Market-timing risk	0.90	3.17

Use the APT model to calculate the required rate of return for ITC assuming that treasury bill rate is 4.5%.

Solution

Return under five factor APT model will be:

$E(R_i)$ = R_f + (Default risk sensitivity × Risk premium) + (Inflation risk sensitivity × Risk premium) + (Business cycle risk sensitivity × Risk premium) + (Time horizon sensitivity × Risk premium) + (Market timing sensitivity × Risk premium)

$E(R_f)$ = 4.5 + (0.25 × 2.60) + (0.32) × (-0.70) + (1.60 × 1.80) + (0.40 × -0.75) + (0.90 × 3.17)

= 4.5 + [0.65 - 0.224 + 2.88 - 0.30 + 2.853]

= 4.5 + 5.859

= 10.36%

Solved Case Studies

1. A portfolio management services manages a stock fund consisting of five stocks with the following market values, betas and expected returns:

Stock	Market value (₹)	Beta	Expected Return
A	2,00,000	1.10	15%
B	1,00,000	0.75	14%
C	1,50,000	0.90	15%
D	2,50,000	1.20	16%
E	3,00,000	1.40	17%

If risk free rate of return is 9% and expected return on market is 15%:

(a) What is the portfolio expected return as per CAPM?

(b) Which stocks are undervalued or overvalued?

Solution

In order to calculate the fund's expected return with CAPM, we need the fund's beta. This can be determined with the following equation.

$\beta_p = W_i B_i$

W_i is the weight for the 'i'th security and B_i, is the beta co-efficient of the 'i'th security.

W_A = 2,00,000/10,00,000 =	0.20
W_B = 1,00,000/10,00,000 =	0.10
Wc= 1,50,000/10,00,000 =	0.15
W_D = 2,50,000/10,00,000 =	0.25
W_E=3,00,000/10,00,000 =	0.30
	1.00

β_p = (0.20) (1.1) + (0.10) (0.75) + (0.15) (0.90) + (0.25) (1.20) + (0.30) (1.40)

= 0.22 +0.075 +0.135 +0.3 +0.42 = 1.15

$E(R_p) = R_f + [(ER_m - R_f)] \times ß_p = 9 + (15 - 9) \times 1.15 = 15.90\%$.

(b) To find whether the stock is undervalued or overvalued we should first determine the return for each stock that is consistent with equilibrium using the CAPM.

$E(R_i) = R_f + (R_m - R_f) \times ß_i$

$E(R_A)$ = 9 + (15-9) × 1.10 = 15.60% (overvalued)

$E(R_B)$ = 9 +(15-9) × 0.75 = 13.50% (undervalued)

$E(R_C)$ = 9 +(15-9) × 0.90 = 14.40% (undervalued)

$E(R_D)$ = 9 +(15-9) × 1.20 = 16.20% (overvalued)

$E(R_E)$ = 9 +(15-9) × 1.40 = 17.40% (overvalued)

Securities A, D and E are overvalued because the expected return is less than the equilibrium return, whereas securities B and C are undervalued because their equilibrium return is less than their expected value.

2. XYZ Ltd pays no taxes and is entirely financed by equity shares. The equity share has a beta of 0.6, a price-earnings ratio of 5 and is priced to offer an expected return of 20%. XYZ Ltd. now decides to buy back half of the equity shares by borrowing an equal amount. If the debt yields a risk free return of 10%, calculate:

(a) The beta of the equity shares after buy back.

(b) The required return and risk premium on the equity shares before the buy back.

(c) The required return and risk premium on the equity shares after buy back.

(d) The required return on debt.

(e) The percentage increase in expected earnings per share.

(f) The new price-earnings multiple.

Assume that operating profit of the firm is expected to remain constant in perpetuity.

Solution:

Before buy back – Beta = 0.6; P/E = 5; $E_R(i)$ = 20%; R_f = 10%

(a) Beta of equity share after buy back

$$\beta_A = [\beta_E \times \frac{E}{D+E}] \times [\beta_D \times \frac{D}{D+E}]$$

Or, 0.6 = 0.5 × β_E + 0.5 × 0.

Or, β_E = 1.20.

(b) Calculation of required return and the risk premium on the equity shares before the buyback.

Since the entire financing is in equity, its expected return would be 20%

$E(R_{(i)}) = R_f + ß(R_m - R_f)$. Let X be the risk premium

0.20 = 0.10+ 0.60 × X

X = 0.10/0.6 = 16.67%.

(c) Calculation of required return and the risk premium on the equity shares after buyback

$$R_A = [R_A \times \frac{E}{D+E}] \times [R_D \times \frac{D}{D+E}]$$

Or 0.20 (0.5 × R_E) + (0.5 × 0.10) or R_E = 30%.

$E(R_i) = R_f + \beta(R_m - R_f)$.

Let X be the risk premium

0.30 = 0.10 + 1.2X or X= 16.67%.

(d) The required return on debt is 10%.

(e) Calculation of percentage increase in EPS

Particulars	Before Buyback	After Buyback
Equity	100	50
Debt @ 10%	0	50
Total	100	100
EBIT@20%	20	20
Interest	0	5
EBT	20	15
Tax	0	0
EAT	20	15
No. of shares	100	50
EPS	0.2	0.3
P/E ratio	5	3.3

Percentage increase in EPS = 50%

(f) The new P/E multiple is 3.33.

3. Mr. Shiva has estimated probable returns under different macroeconomic conditions for the following three stocks.

Name of the stocks	Current market price (₹)	Rates of return under different macroeconomic scenarios (%)		
		Recession	Moderate growth	Boom
X	10	-12	15	35
Y	30	20	12	-5
Z	80	18	20	15

Mr. Shiva is exploring if it is possible to make any arbitrage profits from the above information.

Using the above information construct an arbitrage portfolio and show the payoffs under different economic scenarios.

Solution:

The rates of return under different scenarios have been changed to rupee payoffs per share as indicated below:

Name of the stocks	Current market price (₹)	Rates of return under different macroeconomic scenarios		
		Recession	Moderate growth	Boom
X	10	10(1 - 0.12) = 8.800	10(1 + 0.15) = 11.50	10(1 + 0.35) = 13.50
Y	30	30(1 + 0.20) = 36.00	30(1 + 0.12) = 33.60	30(1 - 0.05) = 28.50
Z	80	80(1 + 0.18) = 94.40	80(1 + 0.20) = 96.00	80(1 + 0.15) = 92.00

Construction of an arbitrage portfolio requires formation of a net zero investment portfolio.

Second, essential condition is that portfolio return must be a positive one.

If we short sell 2 shares of X and Y and long one share of Z it will be = 10 × (-2) + 30 × (-2) + 80 × 1 = 0

The payoffs from this arbitrage portfolio under different market conditions are stated below:

Stocks	Price (₹)	No of shares	Cash flow	Rates of return under different macroeconomic scenarios		
				Recession	Moderate growth	Boom
X	10	-2	-20	-17.60	-23.00	-27.00
Y	30	-2	-60	-72.00	-67.20	-57.00
Z	80	+1	+80	+94.40	+96.00	+92.00
Net Payoff				+4.80	+5.80	+8.00

Net payoff from the portfolio, it is clear that there is an arbitrage profit under all the market conditions.

Exercise

Theoretical Problems

Multiple Choice Questions

1. Arbitrage portfolio

   (a) Offers profit potential with an amount of additional investment and risk.

   (b) Offers profit potential without an amount of additional investment and risk.

   (c) Is the most diversified portfolio.

   (d) Is the most undiversified portfolio.

2. APT can be used in

   (a) Active management strategy of the portfolios.

   (b) Passive management strategy of the portfolios.

   (c) Identifying the mispriced securities

   (d) All of (a) and (c) above.

3. In contrast to the CAPM, arbitrage pricing theory:

   (a) Requires that markets be in equilibrium

   (b) Uses risk premiums based on micro variables

   (c) Specifies the number and identifies specific factors that determine expected returns.

   (d) Does not require the restrictive assumptions concerning the market portfolio.

4. The feature of the general version of the arbitrage pricing theory (APT) that offers the greatest potential advantage over the simple CAPM is the:

   (a) Identification of anticipated changes in production, inflation, and term structure of interest rates as key factors explaining the risk return relationship.

   (b) Superior measurement of the risk free rate of return over historical time periods.

   (c) Variability of coefficients of sensitivity to the APT factors for a given asset over time.

   (d) Use of several factors instead of a single market-index to explain the risk-return relationship.

5. Which of the following is a valid comparison between the APT and CAPM?

   (a) The CAPM applies to only well-diversified portfolios.

   (b) The CAPM dominates the APT and econometric concerns appear to favor it

   (c) The APT gets us to the expected return-beta relationship without requiring many of the unrealistic assumptions of the CAPM.

   (d) Both theories differ on the expected return-beta relationship.

6. The sum of an asset's systematic variance and its non-systematic variance of returns is equal to the asset's:

   (a) Beta.

   (b) Total risk.

   (c) Total variance.

   (d) None

7. The slope of the security characteristic line is an asset's:

   (a) Beta.

   (b) Excess return.

   (c) Risk premium.

   (d) None

8. With respect to the capital asset pricing model, the primary determinant of expected return of an individual asset is the:

   (a) Asset's beta.

   (b) Market risk premium.

   (c) Asset's standard deviation.

   (d) None

9. With respect to the capital asset pricing model, which of the following values of beta for an asset is most likely to have an expected return for the asset that is less than the riskfree rate?

   (a) 20.5.

   (b) 0.0.

   (c) 0.5.

   (d) None

10. The intercept of the best fit line formed by plotting the excess returns of a manager's portfolio on the excess returns of the market is best described as Jensen's:

    (a) Beta.

    (b) Ratio.

    (c) Alpha.

    (d) None

11. With respect to capital market theory, the average beta of all assets in the market is:

    (a) Less than 1.0.

    (b) Equal to 1.0.

    (c) Greater than 1.0.

    (d) None

12. Which of the following types of risk is most likely avoided by forming a diversified portfolio?

    (a) Total risk.

    (b) Systematic risk.

    (c) Non-systematic risk.

    (d) None

13. The capital market line, CML, is the graph of the risk and return of portfolio combinations consisting of the risk-free asset and:

    (a) Any risky portfolio.

    (b) The market portfolio.

    (c) The leveraged portfolio.

    (d) None

14. With respect to the pricing of risk in capital market theory, which of the following statements is most accurate?

    (a) All risk is priced.

    (b) Systematic risk is priced.

    (c) Non-systematic risk is priced.

    (d) None

15. With respect to return-generating models, the slope term of the market model is an estimate of the asset's:

    (a) Total risk.

    (b) Systematic risk.

    (c) Non-systematic risk.

    (d) None

Answers:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
b	d	d	d	c	c	a	a	a	c	b	c	b	b	b

State True or False

1. One can estimate the beta of a company (or a division or a project) by using accounting earnings rather than traded prices.
2. The greater the financial leverage, the higher the beta is likely to be.
3. Corporate growth and beta are not correlated.
4. The larger the size of a company, the smaller the beta is likely to be.
5. Betas vary significantly across industries. These differences are primarily attributable to variations in business risks across industries.
6. A company's beta may not change over time.
7. Theoretically, the return on a zero-beta portfolio is the best estimate of the risk-free rate.
8. Accounting earnings are generally smoothed out, relative to the value of the company. This results in betas which have a downward bias (for risky firms) or upward bias (for safer firms).
9. The standard approach to estimating betas requires information on market prices.
10. The commonly followed procedure for testing the CAPM involves two steps. In the first step, security betas are estimated. In the second step, the relationship between security beta and return is examined.

Answers:

1	2	3	4	5	6	7	8	9	10
True	True	False	True	True	False	True	True	True	True

Fill-in the Blanks

1. Levered beta (commonly referred to as just beta or equity beta) is a measure of _______________
2. Generally, the unlevered beta is _______________ than the levered
3. Since a security's _______________ is naturally lower than its levered beta due to its debt, its unlevered beta is more accurate in measuring its volatility and performance in relation to the overall market.
4. Levered beta takes into consideration the company's debt, which generally results in a beta value closer to _______________ as due to tax advantages.

5. If a company has more debt than equity, then it's considered to be highly______________

6. When calculating ______________, the formula consists of multiplying the unlevered beta by 1 plus the product of (1 – tax rate) and the company's debt/equity ratio.

7. To determine the risk of a company without debt, we need to ________ the beta (i.e., remove the debt impact).

8. Levered beta measures the ______________ of a security's or portfolio's tendency to perform in line with the market or against the market. Levered beta includes the company's debts in the calculation.

9. Levered beta takes into consideration the company's debt, which generally results in a beta value closer to zero (showing lower volatility) due to ______________

10. Calculation of the _________ offers investors additional information necessary to make investment decisions.

Answers:

1	Market risk	2	Lower
3	Unlevered beta	4	zero
5	Leveraged	6	Levered beta
7	Un-lever	8	Sensitivity
9	Tax advantages.	10	Beta value

Short Essay Type Questions

1. What are the basic assumptions of CAPM?
2. Features of CAPM.
3. What is the difference between CML and SML?
4. What are the uses of CAPM?
5. What are the basic assumptions behind the Arbitrage Pricing Theory?
6. What are the advantages and disadvantages of the APT over the CAPM?
7. Describe the basic two-factor model of APT.
8. What is Levered Beta?
9. What is Unlevered Beta?
10. What are the analysis of Beta?

Essay Type Questions

1. Is the relationship between risk and return for efficient portfolios?

2. What is the difference between CML and SML?

3. Explain the difference between a security characteristic line and the capital market line.

4. Under the CAPM, what is the efficient set called? If there is any buying and selling of a risk free asset, what happens to the efficient set?

5. What factors influence market risk premium?

6. In the context of CAPM with unlimited borrowing and lending at the risk free rate of interest, explain the meaning of capital market line.

7. What is the empirical evidence on the CAPM?

8. Discuss the relationship of Asset beta & equity beta with an example.

9. How can an investor earn risk-free arbitrage? Can the arbitrage exist in the market forever?

10. Describe how the APT may be utilized in practical investment management.

Practical Problems

Multiple Choice Questions

1. The security market line's first point is riskless asset with a beta of zero and the second point on the line is beta of

   (a) 1

   (b) 1.5

   (c) 2.0

   (d) 0.5

2. The beta of equity is 1.2. The debt equity ratio of the company is 0.8. Calculate the beta of the assets of the firm. (Assume no taxes)

   (a) 0.95

   (b) 0.75

   (c) 0.67

   (d) 1.60

3. Mr. Pandey has formed a portfolio and the characteristics of his portfolio are given below:

Security	Cipla	Ranbaxy	Treasury bill	Index fund
Weight (W_i)	0.07	0.25	0.25	0.43
Beta (β_i)	1.72	0.89	?	?

Beta of his Portfolio is

(a) 0.8512

(b) 0.9539

(c) 0.7729

(d) 1.5067

4. The risk of the whole market as measured by beta is

(a) 1

(b) 0

(c) -1

(d) Greater than

5. Consider the information given below:

Rate of inflation = 5.1%

Beta = 0.85

Real rate of return = 4.2%

And market return = 12.6%

The risk premium for the above security will be-

(a) 2.5%

(b) 2.65%

(c) 2.805%

(d) 2.95%

6. Covariance between a stock and a market index and the variance of the market index were found to be 33.56 and 19.15 respectively. The beta of the stock is:

   (a) 1.55

   (b) 1.75

   (c) 1.85

   (d) 2.05

7.

Portfolio	$E(r_i)$	Rish (β_i)
X	10.0	0.95
Y	13.5	1.15
M	17.0	1.00

   From the above data it is obvious that

   (a) Portfolio Y offers disproportionate return to the underlying risk.

   (b) Portfolio M offers disproportionate return to the underlying risk.

   (c) Portfolio X is fully diversified,

   (d) Portfolio X is a market portfolio.

8. Assume that both A and B are well diversified portfolios and the risk free rate is 8%

Portfolio	Expected return (%)	Beta
A	16	1.00
B	12	0.25

   In this situation you would conclude that portfolios A and B.

   (a) Are in equilibrium?

   (b) Offer an arbitrage opportunity?

   (c) Are both underpriced?

   (d) Are both fairly priced?

Answers:

1	2	3	4	5	6	7	8
a	c	c	a	c	b	b	b

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Portfolio Performance Evaluation and Portfolio Revision

10

This Module includes:

10.1 Conventional Performance Evaluation

10.2 Market Timing and Style Analysis

Portfolio Performance Evaluation and Portfolio Revision

SLOB Mapped against the Module

To equip oneself with the knowledge of application of various techniques in security evaluation, building a portfolio, measuring its performance and making revisions to optimise the returns. (CMLO 3a)

Module Learning Objectives:

After studying this module, the students will be able to –

- Understand various techniques of evaluation of portfolio performance.
- Learn about market timing and style analysis to assess the performance of fund managers.

Conventional Performance Evaluation 10.1

10.1.1 Performance Evaluation of Portfolios

After investing in the fund managed by efficient and experienced portfolio managers, the investors are interested to know the exact position of their fund compared with other funds and the market rate of return during a certain time period. Evaluation of the portfolio managers is required from the point of view of the investor to verify whether superior returns are attributable to the portfolio managers or not. Secondly, to monitor whether the investment strategy that has been adopted is compatible with the investor's objectives or not.

10.1.2 Measures of Return (Without Risk)

There are two methods which are widely used for calculating realized rate of return, namely:

(a) Money (rupee) weighted rate of return (MWROR)

(b) Time weighted rate of return (TWROR)

(a) Money weighted rate of return (MWROR): The money-weighted rate of return (MWROR) is a measure of the performance of an investment. The money-weighted return accounts for the money invested and provides the investor with information on the actual return he earns on her investment. The MWROR is calculated by finding the rate of return that will set the present values (PV) of all cash flows equal to the value of the initial investment. MWROR is simply the internal rate of return over the period

Two factors influence the money weighted rate of return. These are as follows:

(a) The beginning and the ending market values of the fund.

(b) The timing of the net contributions to the fund, i.e. cash flows.

Calculating the Money-Weighted Rate of Return:

The formula for the MWROR is as follows:

$$F_T = F_0(1+i)^T + C_{t_1}(1+i)^{T-t_1} + C_{t_2}(1+i)^{T-t_2} + ... + C_{t_n}(1+i)^{T-t_n}$$

Where,

T = Total number of period

F_T = End value of fund at time T

F_0 = Value of Fund at time 0

C_{t_n} = Net cash flows at times t_1, t_2 .... t_n

i = The effective annual rate of interest earned by the fund in the interval [0, T]

Alternatively:

$$PVO = PVI = CF_0 + \frac{CF_1}{(1+IRR)} + \frac{CF_2}{(1+IRR)^2} + ... + \frac{CF_n}{(1+IRR)^n}$$

Where,

PVO = Present Value of Outflows

PVI = Present Value of Inflows

CF_0 = Initial cash outlay or investment

CF_1, CF_2 ...... CF_n = Cash flows (inflows and outflows) at time peirod 1, 2 ...... n

n = Number of periods

IRR = Internal rate of return or money weighted rate of return

Illustration 1

Fund A has the following market value at the end of some successive years.

Period (Years)	Market Value (₹)	Cash Flows (net) (₹)
0	1,000	—
1	1,100	100
2	1,200	150
3	1,300	80
4	1,500	—

Calculate Money Weighted Rate of Returns.

Solution:

Money Weighted Rate of Returns is actually internal rate of return. It is calculated as follows:

$$F_0(1+i)^T + C_{t_1}(1+i)^{T-t_1} + C_{t_2}(1+i)^{T-t_2} = F_T$$

$$1000\ (1+i)^4 + 100\ (1+i)^3 + 150\ (1+i)^2 + 80\ (1+i) = 1500$$

By using the iterative process and substituting different values for 'i', it is found that 'i' lies between 3% and 4%. By using the technique of interpolation, it is found that the true value of 'i' is 3.46%. Hence, the MWROR for the fund is 3.46%. MWROR is a satisfactory measure of the individual fund's performance taken in isolation. But as a test of fund manager's investment skill, it is not meaningful as it is strongly influenced by the timing and magnitude of the cash flows, which are often beyond the control of the fund manager.

(b) Time-weighted Rate of Return (TWROR): Time-weighted Rate of Return (TWROR) is a method for calculating the compound growth rate of an investment portfolio. The TWROR is used to calculate the annualised compound growth rate of an investment over a specific time period, by geometrically linking the holding period returns. TWROR seeks to eliminate the distorting effects of cash flows so that more valid comparisons of fund manager's investment skills can be made. The method is dependent on the market value of the fund being available whenever there is a cash flow. The first step in calculating the TWROR is to split the period under review into a number of shorter periods. Each period starts when there is a cash flow. Rate of return (based on the ratios of successive valuation) for these shorter periods are then combined to give TWROR for the whole period.

Calculating the Time-Weighted Rate of Return:

The Time-Weighted Rate of Return is calculated using the formula:

$$\text{TWROR} = \left[\frac{F_{t_1}}{F_{t_0}+C_{t_0}} \times \frac{F_{t_2}}{F_{t_1}+C_{t_1}} \times \ldots\ldots \times \frac{F_T}{F_{t_n}+C_{t_n}}\right]^{1/T} - 1$$

Where,

T = Total number of period

F_{t_0} or F_{t_1} = Value of the fund at t_0, or Value of the fund at t_1

C_{t_0} or C_{t_1} = Cash flow (if any) at time t = 0, or Cash flow (if any) at time t =1

F_T = Value of the fund at T period

Alternatively,

$$\textbf{TWROR} = [(1 + R_1) \times (1 + R_2) \times \ldots \times (1 + R_n)]^{1/T} - 1$$

Where,

T = Total number of period

R_n = Holding period return

To illustrate the calculation of TWROR, consider the data provided for fund A in Illustration 1. The TWROR is calculated as follows:

$$i = \left[\frac{1{,}100}{1{,}000} \times \frac{1{,}200}{1{,}200} \times \frac{1{,}300}{1{,}350} \times \frac{1{,}500}{1{,}380}\right]^{1/4} - 1$$

$$i = (1.1514)^{1/4} - 1$$

$$i = 3.56\%$$

Note that this is higher than MWROR of 3.46% calculated earlier.

Illustration 2

Shares of ABC Ltd. Pay a dividend of ₹2.00 at the end of March every year. An investor buys 2 shares of the stock on January 1 at a price of ₹20.00, sells one of those shares for ₹22.00 a year later on January 1, and sells the second share at the end of the 2nd year at ₹19.00 per share. Find the time and rupee weighted rates of return on the 2-year investment:

Solution:

Time	Action	Cash Flow
t = 0	Buys 2 shares	–40
t = 1	Collects dividends, sells one of the shares	4 + 22
t = 2	Collects dividend on one share and sells it	2 + 19

(a) Rupee (Money) Weighted Rate of Return:

$$\mathbf{CF_0 + \frac{CF_1}{(1+IRR)} + \frac{CF_2}{(1+IRR)^2} = 0} \qquad \textbf{or,}\ -40 + \frac{26}{1+r} + \frac{21}{(1+r)^2} = 0 \qquad \textbf{or,}\ r = 11.91\%$$

(b) Time Weighted Rate of Return:

TWROR = $[(1+R_1)\times(1+R_2)]^{1/T}-1$

The rates of return on the stock in 2 years were:

$$r_1 = \frac{2+(22-20)}{20} = 0.20$$

$$r_2 = \frac{2+(19-22)}{22} = -0.045$$

$i = [(1+r_1)(1+r_2)]^{1/2} - 1$

$i = [(1+0.20)(1-0.045)]^{1/2} - 1$

$i = (1.15)^{1/2} - 1$

$i = 1.0723 - 1$

$i = 7.23\%$

Illustration 3

A mutual fund starts the year with ₹ 50 million. By 1st year it has appreciated to ₹60 million, at which point it receives cash amounting to ₹ 20. In the second year, the fund appreciates by another 50%.

(a) What is the annual MWROR?

(b) What is the annual TWROR?

(c) Suppose that the fund has a 1st year cash outflow of ₹ 20 million rather than an inflow. Would this increase or reduce the TWROR?

Solution:

The data has been provided

Time (Years)	Market Value of Fund	Cash Flows (Net)
0	50	0
1	60	20
2	120	—

(a) Calculation of MWROR => $F_0(1+i)^T + C_{t_1}(1+i)^{T-t_1} + C_{t_2}(1+i)^{T-t_2} = F_T$

=> $50(1+i)^2 + 20(1+i) = 120$

By using the iterative process and substituting different values for 'i', it is found that 'i' lies between 35% and 37%. By using the technique of interpolation, it is found that the true value of 'i' is 36.2%. Hence, the MWROR for the fund is 36.2%.

(b) Calculation of TWROR:

$i = [(60/50) \times (120/80)]^{1/2} - 1$

Solving i = 34.1%

(c) In case 1st year outflow is there, instead of an inflow, then

$i = [(60/50) \times (120/40)]^{1/2} - 1$

Solving i = 89.74%

Thus, the outflow increases the TWROR.

We have considered the returns only with due weightage of timing of cash flows but we have not considered the **risk element** to generate the return. Without considering the risk element, it is impossible to evaluate the performance of the fund as well as the performance of the fund mangers

10.1.3 Various methods have been used to evaluate the performance of portfolios, out of which the following methods are the most important and commonly used

1. Sharpe's measure
2. Treynor's measure
3. Jensen's Alpha

The above risk-adjusted performance evaluation using mean-variance criteria came to light after capital asset pricing model had been staged.

1. Sharpe's Measure:

Sharpe's measure evaluates the performance of a portfolio as excess return of the portfolio over risk-free return divided by the total risk or standard deviation of the portfolio. It measures the reward to total volatility trade off.

$$S = \frac{\bar{R}_p - \bar{R}_f}{\sigma_p} = \frac{\text{Average return of the portfolio} - \text{Average risk - free rate of returns}}{\text{Standard deviation of the portfolio}}$$

$\bar{R}_p$ = Average return of the portfolio

$\bar{R}_f$ = Average rate of risk-free return

σ_p = Standard deviation of the portfolio

We place bars over R_f and R_p to denote that risk-free return may not be constant over the time period, we are taking a sample average for both R_f and R_p. It will be sample average of excess returns.

It is actually the risk premium of the portfolio divided by the total risk or standard deviation of the portfolio.

Illustration 4

Mr. Mukherjee has been managing the portfolio of a large fund for the last 3 years. He found that his portfolio had earned a return of 40% with a standard deviation of 22%. During the same period, the market generated a return of 24% with a standard deviation of 16%. The risk-free rate of return during the same period was 8%. Determine the return of the fund using the Sharpe's measure as compared to the return of market.

Solution:

The performance appraisal of Mr. Mukherjee is: $(\bar{R}_p - \bar{R}_f) = (40\% - 8\%) = 32\%$

Return of fund per unit of risk or $(S) = \frac{32}{22}$ or 1.45 (Sharpe's measure)

Performance of the market return = (24% – 8%) or 16%

Return of market per unit of risk = $\frac{16}{16}$ or 1.0

∴ Performance of Mr. Mukherjee is better than the market.

Return should have been as per $CML = R_i = R_f + \{[R_m - R_f]/\sigma_m\}\ \sigma_i = 8 + \{[24 - 8]/16\} \times 22 = 8 + 22 = 30\%$

It indicates return of the fund should have been as per CML = 30%, but the actual return of the fund is 40% hence, performance of the fund is better.

We portray the situation graphically, following the return on the vertical axis and total risk (σ) on the horizontal axis. The line joining the risk-free rate to the market return is the capital market line. It indicates the relationship between returns and total risk for a well-diversified portfolio. It is seen from the figures that Mr. Mukherjee's portfolio lies above CML, indicating that it has earned more than what is required for its level of total risk.

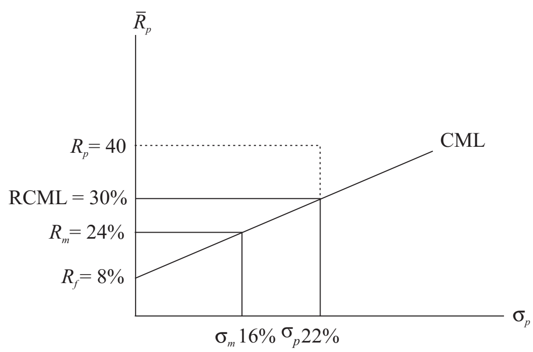

Figure 10.1: Return vs. Total Risk

2. Treynor's Measure: While Sharpe has considered the total risk, Treynor considers the systematic risk or beta of the portfolio.

$$\text{Treynor's ratio} = \frac{\bar{R}_p - \bar{R}_f}{\beta_p}$$

where, $\bar{R}_p$ = Average return of the portfolio, $\bar{R}_f$ = Average risk-free rate of return, β_p = Beta of the portfolio.

Illustration 5

Mr. Singh has been managing the portfolio of a large mutual fund for the last 3 years. He found that his portfolio had earned a return of 40% and the portfolio had a beta of 1.2. During the same period the market return has been 25%. The risk-free rate of return is 8%. Compare the Return of the Portfolio with the market return using Treynor's Measure.

Solution:

The Treynor ratio is calculated as follows: Risk premium (40% – 8%) or 32%. The Treynor's measure is therefore: T = 32 ÷ 1.2 = 26.67%.

Market return is 25% and we know beta of the market is 1.00. Thus, return per unit of beta is (25 ÷ 1) or 25%. RSML = $R_f + (R_m - R_f) \times \beta = 8 + (25 - 8) \times 1.2 = 28.4\%$. It indicates the return of the fund should have been 28.4% as per revised security market line of the fund. Excess return = (40% – 28.4%) or 11.6%.

Performance of Mr. Singh is better than the market or he has outperformed the market.

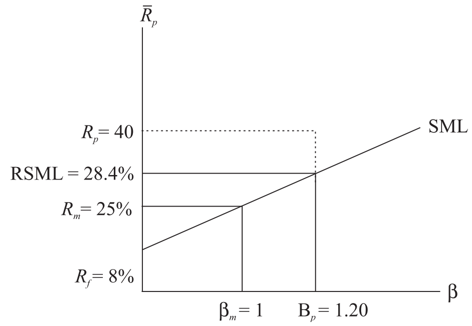

Figure 10.2: Return vs. Systematic Risk

3. Jensen's Differential Return

The Sharpe and Treynor ratios measure the relative performance of various portfolios on a risk-adjusted basis. Jensen's measure provides absolute performance of the portfolios on a risk-adjusted basis with respect to definite standard against which performance of the various funds can be calculated. In simple terms, we can say that we are trying to assess if more than expected return can be earned at the particular level for the portfolio's risk.

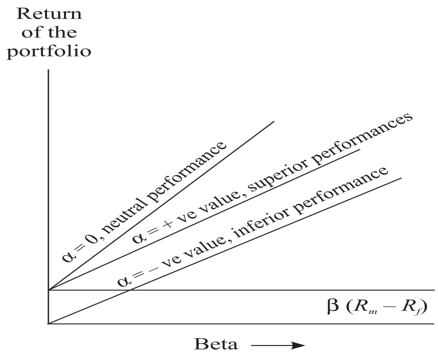

Figure 10.3: Effect of alpha on performance

The Jensen performance index is sometimes referred to as Jensen's alpha model because we calculate the value of alpha or differential return for the measurement of the portfolio's performance. This model is based on the CAPM model.

It is the difference between the realized average return of the portfolio over the predicted provided by CAPM, given the portfolio's beta and the average market return. Jensen's measurement of the portfolio's alpha (α) value is

$$\alpha_p = r_p - [r_f + \beta_p (r_m - r_f)]$$

There may be three situations of alpha (α), as depicted in Figure 10.3.

While in Sharp's and Treynor's models the intercept can beat any point but in the case of Jensen's model it can be at the origin too. The position of the intercept explains the performance of a fund manager. Intercept above the origin will indicate superior stock selection of the fund manager whereas the intercept below the origin gives an indication of under performance by the fund manager. It may be recalled that Treynor's mesure assumes a fully diversified portfolio. Similarly, the Jensen's model assumes the portfolio to be fully diversified.

Name of the Funds	Return (%)	Risk-Free return (%)	Market Return (%)	Standard Deviation (%)	Beta (β_i)	$R_i - R_f$ (%)	$R_m - R_f$ (%)	$B(R_m - R_f)$ (%)	Sharpe's Measure (%)		Treynor's Measure (%)		Jensen's Measure (Alpha)* (%)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
						(= 2 – 3)	(= 4 – 3)	(= 6 × 8)	$\frac{R_i - R_f}{\sigma}$ $\left(=\frac{7}{5}\right)$	Rank	$\frac{R_i - R_f}{\beta_i}$ $\left(=\frac{7}{6}\right)$	Rank		Rank
P	18.5	6.00	15.00	24.05	1.2	12.5	9	10.8	0.5198	4	10.4167	2	1.7	2
Q	16.3	6.00	15.00	22.37	1.1	10.3	9	9.9	0.4604	5	9.3636	4	0.4	4
R	9.0	6.00	15.00	14.59	0.9	3	9	8.1	0.2056	7	3.3333	7	-5.1	7
S	21.25	6.00	15.00	28.10	1.3	15.25	9	11.7	0.5427	3	11.7308	1	3.55	1
T	16.80	6.00	15.00	19.58	1.05	10.8	9	9.45	0.5516	2	10.2857	3	1.35	3
U	12.25	6.00	15.00	16.00	0.8	6.25	9	7.20	0.3906	6	7.8125	6	-0.95	6
Market	15.00	6.00	15.00	13.40	1	9	9	9	0.6716	1	9	5	0	5

Jensen's Alpha = $R_i - [R_f + \beta_i (R_m - R_f)]$ Column (2) – [3 + 9] P = 18.5 – (6 + 10.8) = 1.7; Q = 16.3 – (6 + 9.9) = 0.4

P = 9.0 – (6 + 8.1) = – 5.1; S = 21.25 – (6 + 11.7) = 3.55

T = 16.80 – (6 + 9.45) = 1.35; U = 12.25 – (6 + 7.20) = – 0.95

Illustration 6

Based on the data provided below, compare the performance of the portfolios using the Jensen model of the differential return.

Portfolio	Realized Return on Portfolio (%)	Portfolio (β)
1	14.5	1.2
2	9.5	0.8
3	18.0	1.4

Return on market portfolio, $R_m = 12\%$

Risk-free rate of interest = 6%

Solution:

Required return based on CAPM for the three portfolios would be:

Portfolio 1: $6\% + (12\% - 6\%) \times 1.2 = 13.2\%$

Portfolio 2: $6\% + (12\% - 6\%) \times 0.8 = 10.8\%$

Portfolio 3: $6\% + (12\% - 6\%) \times 1.4 = 14.4\%$

The difference between actually realized return and return under CAPM is portfolio alpha (α) and they are as follows:

Portfolio 1 $(\alpha) = 14.5 - 13.2 = +1.30\%$

Portfolio 2 $(\alpha) = 9.5 - 10.8 = -1.30\%$

Portfolio 3 $(\alpha) = 18.0 - 14.4 = +3.60\%$

The best performance is of the portfolio manager 3 having the highest value of positive alpha. The next best is portfolio 1. Portfolio 2 is underperforming as its alpha value is negative.

Illustration 7

A mutual fund analyst has collected the following past performance report of 6 funds and the sensex:

Name of Fund	Return (%)	Standard Deviation (%)	Beta
P	18.50	24.05	1.20
Q	16.30	22.37	1.10
R	9.0	14.59	0.90
S	21.25	28.10	1.30
T	16.80	19.58	1.05
U	12.25	16.00	0.80
Market	15.00	13.40	1.00

Risk-free rate of return is 6%. Based on the above information, you are required to rank the funds in a tabular form for (i) Sharpe's measure, (ii) Treynor's measure, and (iii) Jensen's alpha.

Solution:

Sharpe's measure $= \dfrac{R_i - R_f}{\sigma_i}$

Treynor's measure $= \dfrac{R_i - R_f}{\beta_i}$

Jensen's alpha (α) = $R_i - R_f + [(R_m - R_f) \times \beta_i]$ = Total return – Return as per CAPM.

Performance Attribution Analysis

The main goal of performance attribution analysis is to find the impact of all decisions made with respect to the management of the portfolio which includes asset allocation and selection decisions. A commonly followed method of performance attribution have four stages:

(a) The first stage is to establish a benchmark level of performance called the bogey.

(b) Asset allocation choice across the three broad asset classes, viz, stocks, bonds and cash.

(c) Sector choice within each asset class.

(d) Security selection within each sector.

The difference between the return on index or benchmark or bogey portfolio with the managed portfolio will reflect the performance either in the form of asset allocation or security selection. To illustrate it, consider the following:

Illustration 8

Let us consider the following Benchmark index and the managed portfolio M

Asset Class	Benchmark Portfolio (Month)		Managed Portfolio (Month)	
	Weight	Returns	Weight	Returns
Stocks (Nifty)	0.55	0.028	0.60	0.034
Bonds (ISEC)	0.40	0.014	0.30	0.021
Cash equivalent (money market)	0.05	0.002	0.10	0.003

Solution:

Return on benchmark portfolio = (0.55 × 0.028) + (0.40 × 0.014) + (0.05 × 0.002)

= (0.0154 + 0.0056 + 0.0001) = 0.0211

Return on managed portfolio = (0.60 × 0.034) + (0.30 × 0.021) + (0.10 × 0.003)

= 0.0204 + 0.0063 + 0.0003 = 0.0270

Excess return on managed portfolio = (0.0270 – 0.0211) or = 0.0059

This excess return may again be classified into two basic performance attributions, namely (a) asset allocation and (b) performance allocation.

Contribution of performance due to asset allocation.

Table-A

Asset Class	Actual Weight (Managed)	Benchmark Weight	Excess Weight	Index Return	Contribution Towards Performance
(1)	**(2)**	**(3)**	**(4) = (2) – (3)**	**(5)**	**(6) = (4) × (5)**
Stock	0.60	0.55	0.05	0.028	0.0014
Bond	0.30	0.40	(0.10)	0.014	(0.0014)
Cash	0.10	0.05	0.05	0.002	0.0001
					0.0001

Out of Total 59 basis points: 0.0001 basis points due to asset allocation and balance points due to selection asset which is stated in Table B.

Table-B

Asset Class	Portfolio Performance Managed	Index Performance	Excess Performance	Portfolio Weight Managed	Contribution Towards Asset Selection
(1)	(2)	(3)	(4)	(5)	(6) = (4) × (5)
Stock	0.034	0.028	0.006	0.60	0.0036
Bond	0.021	0.014	0.007	0.30	0.0021
Cash	0.003	0.002	0.001	0.10	0.0001
					0.0058

$\therefore$ Total = 0.0001 + 0.0058 = 0.0059 or 59 basis points.

Market Timing and Style Analysis 10.2

Measurement of portfolio performance of a portfolio manager is an important thing and a complete evaluation of portfolio performance also involves style analysis and performance attribution. **Style analysis** seeks to determine the detailed investment style adopted by a money manager. **Performance attribution** analyses the reasons why a properly constructed benchmark with complete risk adjustment; in effect, it seeks to determine, after the fact, why a particular portfolio had a given return over some specified time period and, therefore, why success or failure occurred.

10.2.1 Style Analysis

Style analysis considers a style box such as Morning Star or Value Line etc. A style box classifies a fund into one of nine cells in the box depending upon the market capitalization of the portfolio's stocks and whether they are growth or value stocks, or a blend. Such a classification reflects a portfolio manager's "**style**" characteristics. For example, a manager who invests in small growth stocks would be classified at the intersection of these two characteristics (small cap and growth) in the style box. The style box provides an analysis of the stocks in the portfolio based on their size and value/growth characteristics.

The style box does not resolve all issues. This is because almost all portfolios differ from each other with regard to securities held and/or proportion of the portfolio invested in each security. For example, among equity funds, a fund may describe itself as a large growth fund and still show a performance that differs from other funds in the same category. Style analysis can be used to determine why these funds differ in their results.

A portfolio manager constructs the portfolio based on his or her investment philosophy, resulting in a unique portfolio. This causes the portfolio's returns to behave accordingly. We can describe this behaviour as the style of the portfolio. Style analysis seeks to identify the investing style of a portfolio in terms of asset classes, equity styles, or index returns.

Example: Consider a mid-cap stock fund whose manager emphasizes stocks that are currently out of favour with investors. The manager believes that recent events have caused these stocks to sell for less than their intrinsic value. To identify these stocks, the manager screens the mid-cap database for stocks with low price to book ratios and low P/E ratios. These value criteria will cause the portfolio to have a unique returns behaviour that relates directly to the manager's style. Such a style will differ from that of another mid-cap fund manager who emphasized growth when selecting stocks.

There are two approaches to style analysis, returns based and holding based:

- Returns-based style analysis compares a portfolio's return to the returns generated by a set of market indexes, each of which tracks a specific investment style such as large cap growth or small-cap value.
- Holdings -based style analysis uses the stocks in a portfolio to describe a fund's allocation among asset classes or equity styles. As noted, Morningstar uses a holdings-based approach to style analysis.

Sharpe developed returns-based style analysis using an asset class factor model (think of it as similar to a regression model). Sharpe is in favour of using factor model instead of factor analysis. His analysis used multiple asset classes, ranging from treasury bills to several bond indexes to even more stock indexes, and also a mortgage-related securities index. Equities are divided into four mutually exclusive groups using the indexes developed: large cap value stocks, large-cap growth stocks, medium-cap stocks and small-cap stocks. This type of style analysis typically requires at least 30-40 months of returns data.

Using a returns-based style analysis, a manager's style reflects only an analysis of the components of the portfolio's actual return behaviour, making it an objective method for determining risk exposure. Sharpe's analysis produces a "style benchmark", or customized benchmark which reflects an individualized weighting of a set of indexes that document the manager's style. Many portfolio managers prefer style benchmarks to single index benchmarks.

One problem with style analysis is **style** "**consistency**". One estimate is that over a five-year period less than half the domestic mutual funds maintain their style consistency. Standard and Poor has conducted a study of consistency and found that large-cap growth funds maintained a consistency level of about 70 percent over a five-year period while small cap blend funds maintained a consistency of only 18 percent. All mid-cap funds have a consistency of only 31 percent, and all small-cap funds had a consistency of less than 40 percent. Taken together, all large-cap funds had a consistency over five-years of only 54 percent.

10.2.2 Performance Attribution

The purpose of performance attribution is to decompose the total performance of a portfolio into specific components that can be associated with specific decisions made by the portfolio manager.

Typically, performance attribution is a top-down approach; it looks first at the broad issues and progress by narrowing the investigation. It often begins with the policy statement that guides the management of the portfolio. The portfolio normally would have a set of portfolio weights to be used. If the manager uses a different set, this will account for some of the results. In effect, the asset allocation decision referred earlier. If the manager chooses to allocate the portfolio funds differently than the weights that occur in the benchmark portfolio, what are the results?

After this analysis, performance attribution might analyse sector (industry) selection and security selection. Did the manager concentrate on, or avoid, certain sectors, and if so what were the results? Security selection speaks for itself.

Part of the process involves identifying a benchmark of performance (bogey) to use in comparing the portfolio's results. This bogey is designed to measure passive results, ruling out both asset allocation and security selection decisions. Any differences between the portfolio's results and the bogey must be attributable to one or more of these decisions made by the portfolio manager.

Another way to think about performance attribution is to recognise that performance different from a properly constructed benchmark comes from one of the two sources, or both:

1. Market timing
2. Security selection

Techniques are available to decompose the performance of a portfolio into these two components.

Stock Selectivity and Market Timing - Conceptual Overview

Stock selection ability (or Stock Selectivity) : It can be defined as the application of knowledge and professional skills to make necessary preditions in regard to the movement of prices of stocks and classification of the stock whose prices are overrated and underrated. It can also be stated as the management work which aims at choosing individual stock which is in profitable situation than choosing an entire set of stocks. Thus, stock selection helps to narrow down the available options and find the best stock which may deliver higher systematic risk adjusted returns. Stock selection is based on company specific events.

Market Timing: It is the act of the mutual fund managers to foresee the market and make necessary predictions regarding the future progress of market based on which the portfolios can be prepared and placed. In other works, it is the act of moving your funds in and out of the market or switching among the various asset classes to earn higher return than a portfolio which remains invested in the market. This is done based on the predictions about bullish and bearish phases of the market using either technical indicators or available economic data.

Thus, while stock selection involves micro forecasting (company specific), market timing essentially required a macro forecasting (economy specific). However, both these skills are equally important in generating positive or excess risk adjusted returns.

Additional Illustrations

1. Ram, investor is planning to invest in two mutual funds out of the four selected by him, advise Mr. Ram for his selection with respect to Sharpe's performance measure. Current risk-free interest rate is 7%.

Funds	W	X	Y	Z
Average return (%)	16.0	17.5	20.5	18.0
Standard deviation (%)	18	22.0	18.0	15.6

Solution:

Using Sharpe's index: $\frac{\overline{R}_i - R_f}{\sigma_i}$

For fund W $= \frac{16.0-7}{18} = 0.500$

For fund X $= \frac{17.5-7}{22} = 0.477$

For fund Y $= \frac{20.5-7}{18} = 0.75$

For fund Z $= \frac{18.0-7}{15.6} = 0.705$

Ram is advised to invest in funds Y and Z.

2. Consider the average return of the four funds same as problem 1 and if the beta values are 1.20, 0.90, 1.02 and 1.10, respectively, rank the performance of the funds according to Treynor method.

Solution:

Using Treynor's Ratio: $\frac{R_i - R_f}{\beta_i}$

		Rank
For fund *A*	$= \frac{16-7}{1.20} = 7.5$	IV
For fund *B*	$= \frac{17.5-7}{0.90} = 11.67$	II
For fund *C*	$= \frac{20.5-7}{1.02} = 13.24$	I
For fund *D*	$= \frac{18.0-7}{1.10} = 10.00$	III

Under Treynor method, the performance of fund C and B is better.

3. Consider the following information of 3 funds and the market, find out the performance of the 3 funds and rank them using Jensen's alpha.

Name of the Fund	Mean Return (%)	Standard Deviation (%)	Beta
M	15	16	1.12
N	14	14	0.98
O	10	12	1.05
Market	11.5	18	1.00

Risk-free rate of return is 6%

Solution:

$$\alpha = R_i - [R_f + (R_m - R_f)\,\beta_i]$$

∴ For fund M, $\alpha = 15 - [6 + (11.5 - 6) \times 1.12]$

$\alpha = 15 - [6 + 6.16] = 2.84\%$

For fund N, $\alpha = 14 - [6 + (11.5 - 6) \times 0.98]$

$\alpha = 14 - 11.39 = 2.61\%$

For fund O, $\alpha = 10.0 - [6 + (11.5 - 6) \times 1.05]$

$\alpha = 10 - 11.775 = -1.775\%$

Rank I — M

Rank II — N

Rank II — O (negative)

4. A fund had a value of ₹1000 on 1st January 2022. A net cash flow of ₹170 was received on 1st January 2023 and a further ₹500 on 1st January 2024. The value of the fund on 31st December 2022 was ₹1030 and on 31st December 2023 it was ₹1200.

   (a) Using the fund value on 1st January 2022, calculate the value of the fund on 31st December 2024 so that the MWROR earned on the fund between 1st January 2022 and 31st December 2024 is 3% per annum.

   (b) Calculate the TWROR between the 1st January 2022 and 31st December 2024. Assume that the value of the fund on 31st December was ₹1788.08.

Solution:

(a) Value of the fund on 31st December 2024 (F_T):

$$F_T = F_0(1+i)^T + C_{t_1}(1+i)^{T-t_1} + C_{t_2}(1+i)^{T-t_2} + ... + C_{t_n}(1+i)^{T-t_n}$$

$$F_T = 1000\ (1.03)^3 + 170\ (1.03)^2 + 500\ (1.03)$$

$$F_T = (1.0927 \times 1000) + (170 \times 1.0609) + 515$$

$$F_T = 1092.73 + 180.35 + 515$$

$$F_T = ₹1788.08$$

(b) Calculation of TWROR:

$$i = \left[\frac{1030}{1000} \times \frac{1200}{1030+170} \times \frac{1788.08}{1200+500}\right]^{1/3} - 1$$

Solving i = 2.7%

5. Consider the following data on four mutual funds:

Funds	Alpha (%)	Systematic Risk (%)	Unsystematic Risk (%)	Correlation Matrix				
				W	X	Y	Z	Market
A	(4)	4	3	1	0.5	0.8	0.3	0.75
B	9	3	7	–	1.0	0.7	0.5	0.60
C	0	2	2	–	–	1	0.6	0.89
D	(12)	5	3	–	–	–	1.0	0.72

The market return during the period was 15% with a variance of 25%. The risk-free interest is 7%. Calculate Treynor, Sharpe and Jensen alpha and rank them.

Solution:

Name of the Funds	Correlation with Market	Standard Derivation	Systematic Risk	Unsystematic Risk	Beta
1	2	$3 = \sqrt{(4) + (5)}$	4	5	6
A	0.75	$\sqrt{7} = 2.65$	4	3	0.40
B	0.60	$\sqrt{10} = 3.16$	3	7	0.38
C	0.89	$\sqrt{4} = 2.00$	2	2	0.36
D	0.72	$\sqrt{8} = 2.83$	5	3	0.41

$$\text{Beta} = r \times \frac{\sigma_F}{\sigma_m}$$

Where r = correlation coefficient of funds with market

σ_F = Standard derivation of fund

σ_M = standard derivation of market

$\beta_A = 0.75 \times \dfrac{2.65}{5} = 0.40$; $\beta_B = 0.60 \times \dfrac{3.16}{5} = 0.38$; $\beta_C = 0.89 \times \dfrac{2}{5} = 0.36$

$\beta_D = 0.72 \times \dfrac{2.83}{5} = 0.41$

Return of A = $(R_A) = \alpha + R_f + (R_m - R_f) \times \beta_i = (4) + 7 + (15 - 7) \times 0.40 = 6.2\%$

Return of B = $(R_B) = 9 + 7 + [(15 - 7) \times 0.38] = 19.04\%$

Return of C = $(R_C) = 0 + 7 + [(15 - 7) \times 0.36] = 9.88\%$

Return of D = $(R_D) = (12) + 7 + [(15 - 7) \times 0.41] = -1.72\%$

Funds	Return (%)	Excess Return * $(R_i - R_f)$	Treynor Ratio **	Rank Under Treynor	Sharpe Ratio	Rank Under Sharpe	Jensen's Alpha Rank
A	6.20	–0.80	–2.0	3	–0.30	3	3
B	19.04	+12.04	31.68	1	3.81	1	1
C	9.88	+2.88	8.00	2	1.44	2	2
D	1.72	–8.72	–21.26	4	–3.08	4	4

*$R_i - R_f = (6.20 - 7.00) = -0.80$

** Excess return/Beta (for A) = – 0.80 / 0.40

$$\text{Sharpe ratio} = \frac{\text{Excess return}}{\text{S.D. of the respective fund}}$$

$$= \frac{R_i}{\sigma_i}$$

$$\text{For A} = -\frac{0.80}{2.65} = -0.302$$

Ranking under all the methods are same.

6. Consider the following results of five reputed funds, calculate the Sharpe's and Treynor measure of performances of the mutual fund and rank them assuming risk-free rate of return = 7%; market return = 13.5% and standard deviation of the market = 25%.

Fund	Alpha	Beta	Residual Variance (%)
Reliance	3.72	0.99	9.35
ICICI	0.60	1.27	5.92
Aditya Birla	0.41	0.96	9.79
Kotak Mahindra	(0.22)	1.21	5.36
SBI	0.45	0.75	4.52

Solution:

Fund	Beta	β^2	σ^2_m	$\beta^2\sigma^2_m$	Total risk Note (1)	$\frac{R_i - R_f}{\text{Total Risk}}$ (note 3÷note 1)	Rank as per Sharpe	$\frac{R_i - R_f}{\beta_i}$	Rank as per Treynor
Reliance	0.99	0.9801	625	612.5626	621.9125	0.4044	1	10.1869	1
ICICI	1.27	1.6129	625	1008.0625	1013.983	0.3374	2	8.4606	2
Aditya Birla	0.96	0.9216	625	576.000	585.79	0.2632	4	6.6354	4
Kotak Mahindra	1.21	1.4641	625	915.0625	920.4225	0.3004	3	7.5331	3
SBI	0.75	0.5625	625	351.5625	356.0825	0.1895	5	4.7667	5

Systematic risk = $\beta^2\sigma^2_m$

Note 1

Total risk = Systematic risk + Unsystematic risk

$$\text{Reliance} = 612.5625 + 9.35 = 621.9125;\ \sigma = \sqrt{621.9125} = 24.9381$$

$$\text{ICICI} = 1008.0625 + 5.92 = 1013.983;\ \sigma = 31.84309$$

Aditya Birla = 576.000 + 9.79 = 585.79; σ = 24.2031

Kotak Mahindra = 915.0625 + 5.36 = 920.4225; σ = 30.3384

SBI = 351.5625 + 4.52 = 356.0825; σ = 18.8701

Note 2

Returns of the fund: Alpha + $\beta_i R_m$

Reliance = 3.72+13.5×0.99=17.085%

ICICI = 0.60+13.5×1.27=17.745%

Aditya Birla = 0.41+13.5×0.96=13.37%

Kotak Mahindra = (0.22)+13.5×1.21=16.115%

SBI = 0.45+13.5×0.75=10.575%

Exercise

Theoretical Problems

Multiple Choice Questions

1. Sharpe's measure of the portfolio performance is based on

   (a) Systematic risk of the portfolio

   (b) Unsystematic risk of the portfolio

   (c) Total risk of the portfolio

   (d) Market risk of the portfolio

2. Which of the following is the more appropriate measure of portfolio performance if you have only one mutual fund in your investment portfolio?

   (a) Jensen measure

   (b) Sharpe measure

   (c) Treynor measure

   (d) Information ratio

3. Sharpe measure is best applicable when

   (a) Evaluating a portfolio to be mixed with a position in the passive benchmark portfolio

   (b) Choosing among portfolios competing as the optional risky position

   (c) Comparing with the desired performance based on a benchmark portfolio with actual performance

   (d) Ranking many portfolios that will be mixed to form the optional risky portfolio

Answer:

1	2	3
c	b	b

State True or False

1. Market timing is the act of moving investment money in or out of a financial market—or switching funds between asset classes—based on predictive methods.

2. If investors can predict when the market will go up and down, they can make trades to turn that market move into a profit.

3. While feasible for traders, portfolio managers, and other financial professionals, market timing can be difficult for the average individual investor.

4. Market timing is sometimes considered to be the opposite of a long-term buy-and-hold investment strategy.

5. Timing the market is not a strategy that involves buying and selling stocks based on expected price changes.

6. Investors often make investment decisions based on emotions.

7. Market timing is not the act of moving investment money in or out of a financial market—or switching funds between asset classes—based on predictive methods.

8. Many investors, academics, and financial professionals believe it is impossible to time the market.

9. When a fund is valued at regular intervals and is valued each time, the actual returns is given by money weighted rate of return.

10. Treynor's measure of portfolio performance is based on market risk.

11. Jensen's measure of the portfolio performance is absolute measure.

12. According to Treynor Index, a steep slope would indicate the fund is yielding higher returns.

13. Blue diamond fund has a variance of return as 36%, the return is 20% and the risk-free rate is 6%. The sharpe index is 2.33

Answer:

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
True	True	True	True	False	True	False	True	False	True	True	False	True

Fill in the blanks

1. Market timing refers to an investing strategy through which a market participant makes buying or selling decisions by predicting the ________________ of a financial asset in the future.
2. The market timing strategy can be used to enter or exit markets or to choose between ________________ or asset classes while making trading decisions.
3. ____________________ provided success for professional day traders, portfolio managers and other financial professionals who can devote considerable time to analyze economic forecasts and effectively predict market shifts with such consistency.
4. Market timing includes the timely buying and selling of financial assets based on expected price ___________
5. While performing_________________, an analyst takes into account certain assumptions regarding variables that affect buying and selling decisions.
6. Market timing is used to maximize profits and offset the associated risks with high gains. It is the classic _____________ trade-off that exists with respect to investment – the higher the risk, the higher the return.
7. An investor who succeeds in _____________ and selling high must incur tax consequences on their gain.
8. Strategies related to market timings may be based on fundamental analysis or_____________
9. When _____________ do not believe in the fruitfulness of market timing strategies, they tend to use a technique known as buy-and-hold.
10. The mutual funds that are listed in the stock exchange are ————————.
11. The sharpe index assigns the high value to funds that have ————————.
12. A typical performance attribution system decomposes performance into ————————.
13. When short sales are ________________ and a portfolio alpha is _______________, you can sell it short and turn the alpha to _____________.

Answer:

1.	price movements	2.	different assets
3.	Market timing’s	4.	Fluctuations
5.	fundamental analysis	6.	risk-return
7.	buying low	8.	technical analysis
9.	Investors	10.	Closed-end funds
11.	Higher risk adjusted returns	12.	Broad asset allocation, industry choice and security choice
13.	Allowed; negative; positive		

Short Essay Type Questions

1. What Is market timing?
2. What Is Sharpe ratio?
3. What Is Treynor's ratio?
4. What Is Jensen's Alphs?

Essay Type Questions

1. What are the different measures of return? Discuss.
2. Discuss various risk adjusted measures of performance evaluation.

Practical Problems

Multiple Choice Questions

1. The portfolio's risk premium is 12% and the standard deviation of market and the portfolio are 4 and 3, respectively. The fund's beta value is 1.5. The Treynor index is

   (a) 3.0

   (b) 8.0

   (c) 4.0

   (d) 12

2. A portfolio manager realized an average annual return of 12%. The beta of the portfolio is 1.1 and the standard deviation of returns is 30%. The average annual return for the market index is 10% and the standard deviation of the market returns is 25%. The r_f is 5%. Calculate Jensen's alpha for the portfolio.

   (a) 0.5%

   (b) – 0.5%

   (c) 1.5%

   (d) – 1.5%

3. A portfolio manager realized an average annual return of 15%. The beta of the portfolio is 1.2 and the standard deviation of return is 25%. The average annual return for the market index was 11% and the standard deviation of the market returns is 20%. The risk-free rate is 4%. Calculate the Sharpe ratio for the portfolio.

   (a) 0.16

   (b) 0.44

   (c) 0.55

   (d) 0.64

4. A portfolio manager realized an average annual return of 10%. The beta of the portfolio is 0.8 and the standard deviation of returns is 20%. The average annual return for the market index is 12% and the standard deviation of the market returns is 25%. The r_f rate is 3%. Calculate the Treynor ratio.

   (a) 7.00

   (b) 8.75

   (c) 11.25

   (d) 12.50

5. In a recent year, a portfolio manager earned a return of 9.5% by making the following investments:

	Weight	Rates of Return
Bonds	0.30	6%
Stocks	0.70	11%

The relevant data for the bogey are as follows:

	Weight	Rates of Return
Bonds (Bond Index)	0.20	5%
Stocks (Nifty)	0.80	10%

The total excess return for the managed portfolio was ___________ and the contribution of security selection within asset classes to the total excess return was _______.

(a) 1.5% and 0%

(b) 0.5% and 1.0%

(c) – 0.5% and 0%

(d) – 0.5% and 1%

Answer:

1	2	3	4	5
b	b	b	b	b

References:

1. Chandra. P., Investment Analysis and Portfolio Management, McGarw Hill.
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3. Fisher. & Jordon., Security Analysis and Portfolio Management, Pearson.
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Efficient Market Hypothesis 11

This Module Includes:

11.1 Definition

11.2 Forms of Market Efficiency

11.3 Implications

Efficient Market Hypothesis

SLOB Mapped against the Module

To equip oneself with the knowledge of application of various techniques in security evaluation, building a portfolio, measuring its performance and making revisions to optimise the returns. (CMLO 3a)

Module Learning Objectives:

After studying this module, the students will be able to -

- Understand the concept of efficient markets.
- Appreciate various forms of market efficiency.
- Understand the implications of market efficiency.

Definition

11.1

Eugene Fama, a Noble Laureate in 2013, first introduced the concept of 'efficient' capital market and observed that tremendous competition in the capital market leads to 'fair pricing' of debt and equity securities. Before Mr. Fama, **Mr**. **Maurice Kendall**, a noted statistician first observed that the movement of stock and commodity price changes are independent and not at all related to the previous price changes. Put differently, successive price changes are independent of one another. It means that stock price changes are at random which states that price changes are independent and normally distributed. This is the famous **random walk theory**.

The empirical evidences are in favour of existence of random walk theory. What is the economic process that produces a random walk? They all concluded that randomness of stock prices was the result of an efficient market. They also discovered the following links:

(a) Information is the key to the determination of stock prices and therefore is the central issue.

(b) All known information, including past information such as last quarter's earnings or last year's results as well as all current information or event that have been announced but are still forthcoming such as stock split, etc.

(c) Current price changes have no relation to previous price changes.

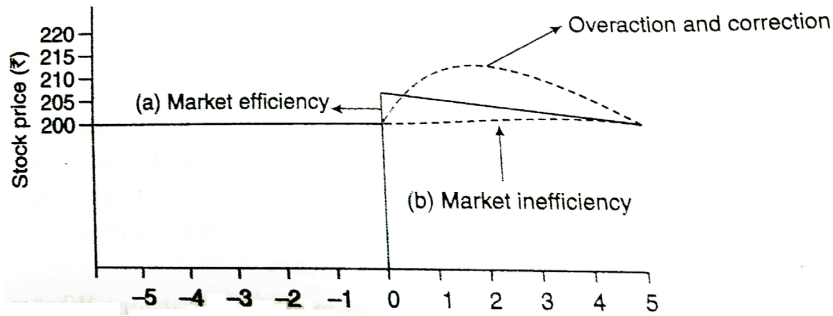
(d) New information can't predict in advance so future forecast also can't predict in advance, so theory of 'random walk' exists.

(e) It is believed that due to severe competition amongst investors and particularly institutional investors all available information will reflect instantly into stock prices. The stock price thus reflects the intrinsic value.

11.1.1 Efficient Market

Efficient market is defined as one in which the prices of all securities quickly and fully reflect all available information about the financial assets. This concept postulates that investor will assimilate all relevant information into prices in making their buy and sell decisions. The important question arises, since on average investors are clearly not fully informed about all security and perhaps not about even a single security, how could the market reach a state in which the prices of all securities fully reflect all information that is both relevant and available? The answer to this question is that prices are not established by the consensus of all investors. Prices are set by these marginal investors who actively trade in stock.

The concept that markets are efficient does not claim, or require, a perfect adjustment in price following the new information. Rather the correct statement involved with this concept is that the adjustment in prices resulting trade information is "unbiased" (this means that the expected value of the adjustment error is zero). The new price does not have to be the new equilibrium price, but only an unbiased estimate of the final equilibrium price that will be established after investors have fully assessed the input of the information.



Days relative to announcement/day (Day ‘0’) of information

Figure 11.1: The adjustment of stock prices to information: (a) If market is efficient (b) One possibility if the market is inefficient.

Figure 11.1 indicates the market efficiency for one company for which a significant event occurs that has an effect on its expected profitability. The stock is trading at ₹200 on the announcement date of the significant event-Day “0” in figure 11.1 is the announcement date for the event. If the market is fully efficient, the price of a stock always reflects all available information. Investors will very quickly adjust a stock’s price to its intrinsic (fair) value. Assume that the new fair value for the stock is ₹205. In an efficient market, an immediate increase in the price of the stock to ₹205 will occur, as represented by the solid line in Figure 11.1. Since, in our example, no additional new information occurs, the price of the stock will continue at ₹205.

If the market adjustment process is inefficient, a lag in the adjustment of the stock prices to the new information will occur and is presented by the dotted line. The price eventually adjusts to the new fair value of ₹205 as brokerage houses disseminate the new information and investors revise their estimates of the stock’s fair value. Please note that the time it would take is just an assumption.

11.1.2 Efficient Market Hypothesis

The share prices appear to follow a random walk is an interesting result and proving it or attempting to disprove it occupied many researchers. But what remained to be shown was why share prices followed a random walk. There was plenty of evidence, but the formal theory was missing. What was needed a model of share price behavior to explain the random walk. This gap was filled by a more general model based on the concept of efficiency of the markets in which shares are traded is the efficient market hypothesis (EMH). The EMH is a theory that capital markets operate to a high degree of perfection. Its roots lie in the random walk hypothesis, which postulates the share price changes are of a random, rather than correlated, nature. The EMH put forth the argument that, since the market efficiently prices all the stocks on an ongoing basis, any opportunities for excess returns derived from fundamental or technical analysis will be almost immediately used away by the market participants. The EMH theorists assume that efficient capital markets exist – markets with a large number of rational investors and speculators who are trying to maximize profits by predicting future earnings, dividends, and value of shares. Here, it is assumed, information is known freely to all investors, spontaneously transmitted to the markets to establish share prices. The price established tends to be fair price. As the market is efficient, the adjustment process tend to allow prices to vary randomly around the competitive norms. As new information is learnt, prices move, and because of the adjustment process, the movement will be up and down depending upon the stimulus. As investors or speculators over react the adjustment process becomes random in character. Whenever any new event occurs, it too is transmitted to a market place that has no memory – one where each price is independent of the previous one. This theory suggests that chartists are wrong.

Characteristics of Efficient Market

An efficient market for securities possessing the following characteristics:

(a) Timely and accurate information on the price and volume of past transactions and on prevailing supply and demand.

(b) Liquidity, meaning an asset can be sold or bought quickly at a price close to the price of the previous transaction assuming no new information has been received.

(c) Low transaction cost, meaning that all aspects of the transaction entail low costs, including the cost of reaching the market, the actual brokerage cost involved in the transaction and the cost of transferring the security.

(d) Quick adjustment of prices of securities to the new information.

Assumption of EMH

The basic assumption is that in an efficient capital market, prices of traded securities always fully reflect all publicly available information concerning the securities. For market efficiency there are three conditions:

(a) all available information is costless to all market participant's;

(b) there is no transaction costs; and

(c) all investors take similar views on the implications of available information for current prices and distribution of future prices of each security.

11.1.3 Fair Game Concept

It can be seen from the EMH that the ability of investors to pick winners and make excess returns using new information is directly related to the speed and efficiency of a market at absorbing that information. So, efficiency can be considered in terms of the 'fair game' concept. A market can be regarded as efficient with respect to particular set of information if investors using that information are faced with fair game, that is, they receive on average the return expected for the risk involved and make no consistent abnormal returns. The fair game for investors is an outcome of a market being efficient. If a market is efficient, then investing is a fair game. This fair game concept is useful in that it allows the different levels of the EMH to be tested.

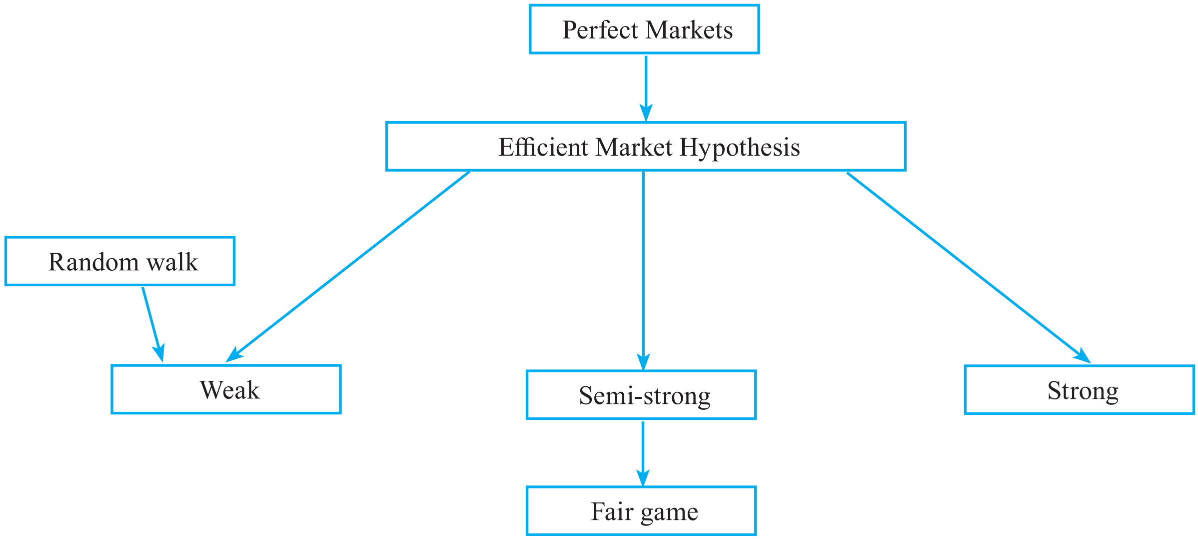


Figure 11.2: Efficient Market Hypothesis

It is seen from figure 11.2 that EMH is a more comprehensive model of share price behavior than random walk theory, referring not just to past share price movements but to all information pertaining to the share. It is a model which helps us to understand how markets operate in practice and how closely they approximate to theoretically perfect markets.

Forms of Market Efficiency

11.2

Forms of the Efficient Market Hypothesis

Fama (1970) decided to define different market in terms of their level of efficiency, where the level reflected the type or scope of information which was quickly and fully reflected in price. He defined three levels of efficiency, each level designed to correspond with the different types of 'picking winners' investment strategies which were used in practice to try to achieve excessive returns.

Efficient Market Hypothesis
Prices fully reflect all available information

Weak Form
Prices fully reflect past prices

Semi-strong Form
Prices fully reflect all publicly available information

Strong Form
Prices fully reflect all information

Figure 11.3: shows the three different 'strengths' of the EMH corresponding to different levels of efficiency

- **Weak Form** – In the weak form of efficiency, each share price is assumed to reflect fully the information content of all past share prices.
- **Semi-strong Form** – In the semi-strong form, the information impounded is assumed to include not only that given by all past share prices which are of course public knowledge, but all publicly available information relevant to the share value. This includes, for example, company announcements, brokers reports, industry forecasts and company accounts.
- **Strong Form** – The strong form of the EMH requires all known information to be impounded in the current share price, whether publicly and generally available or not. The strong form will thus include what is known as 'insider' information, for example details of an impending takeovers bid known only to senior management of both parties to the bid.

11.2.1 Weak-form Hypothesis

The weak-form hypothesis asserts that stock prices already reflect all information that can be derived by examining market trading data such as the history of past services, trading volume or short interest. This version of the hypothesis implies that trend analysis is fruitless. Past stock price data are publicly available and virtually free of cost to obtain. The weak-form hypothesis holds that if such data ever conveyed reliable signals about future performance, all investors already would have learned to exploit the signals. Ultimately, the signals lose their value as they become widely known because a buy signal, for instance, would result in an immediate price increase.

11.2.2 Semi-Strong Evidence

Weak-form tests of both the statistical and the trading rule types are numerous and almost unanimous in their findings (after necessary corrections and adjustments have been made). Semi-strong tests, on the other hand, are also numerous but more diverse in their findings. Although most of these studies support the proposition that the market adjusts to new public information very rapidly, some do not.

Semi-strong form tests are tests of the speed of price adjustments of publicly available information. The question is whether investors can use publicly available information to earn excess returns after proper adjustments. As noted earlier, **Fama** has changed the traditional notion of semi-strong-form efficiencies to studies of announcements of various types, which involves event studies.

This empirical research often involves an event study, which means that a company's stock returns are examined to determine the impact of a particular event on the stock price. This methodology uses an index model of stock returns. An index model states that security returns are determined by a market factor (index) and a unique company factor.

Company unique returns are the residual error terms representing the difference between the security's actual return and that given by the index model. In other words after adjusting for what the company's return should have been given the index model, any remaining portion of the actual return is an abnormal return representing the impact of a particular event.

$$\text{Abnormal return, } AR_{it} = R_{it} - ER_{it}$$

where AR_{it} = abnormal rate of return for security *'i'* during the period *'t'*

R_{it} = actual rate of return on security *'i'* during the period *'t'*

$E(R_{it})$ = expected rate of return for security *'i'* during the period *'t'* based on market model relationship.

The cumulative abnormal return (CAR) is the sum of the individual returns over the period of time under examination and is calculate as

$$\text{CAR}_i = \sum_{t=1}^{n} AR_{it}$$

where CAR_i = the cumulative abnormal return for stock *'i'*

Response of a Stock Price to the Announcement of a Stock Split: Fama, Fisher, Jensen and Roll (1969) were the first to employ this methodology. They used monthly data to study the reaction of stock prices to the event of a stock split. They studied most of the splits that occurred on the New York Stock Exchange between 1929 and 1959.

Why should the stock price react to a split when the split does nothing more than divide the corporate pie up into more pieces? If the stock splits two for one, shouldn't the price of each share halve? Why should there by any effect on the rate of return, adjusted for the split?

It was the observation that stocks witnessed good rally of around 25-30% within a span of two months before the actual split took place. The stock split is considered as a leading indicator in the world of future market prediction. Stock split leads to advance rally in the stocks since upon stock split the tradability in the stock increases.

The evidence indicates that new issues purchased at their offering price yield abnormal returns to the fortunate investors who are allowed to buy the initial offering. This is attributed to underpricing by the underwriters. Investors buying shortly after the initial offering, however, are not able to earn abnormal profits, because price adjusts very quickly to the true values.

Reactions to Economic News and World Events: Investors are constantly given a wide range of information concerning both large-scale events and items about particular companies. Each of these types of announcements has been examined for the effects on stock prices.

One form of announcements involves economic news, such as money supply, real economic activity, inflation and RBI monetary policy. A study of these announcements found no impact on stock prices that lasted beyond the announcement day. Even an analysis of hourly stock price reactions to surprise announcements of money supply and industrial production found that any impact was accounted for within one hour. A study of public takeover rumours found that the market is efficient at responding to published takeover rumours. Excess returns could not be earned on average by buying or selling rumoured takeover targets at the time the rumour appeared. No significant excess returns occurred on the day takeover appeared in well-established financial magazine, although a positive cumulative excess returns of approximately 7% occurs in the calendar month before the rumour appears in the newspaper.

Announcements of Accounting Changes: Numerous studies have analysed the impact of announcements of accounting changes on stock prices. In efficient markets, security prices should react quickly and predictably to announcement of accounting changes that affect the economic value of the firm. An accounting change that affects reported earnings but has no economic significance should not affect stock prices. For example, when a firm changes its depreciation accounting method for reporting purposes from written down value method to straight line, the firm experience an increase in reported earnings, but there is no economic consequence. An analysis of stock price movements surrounding this specific accounting change supported EMH because there were no positive price changes following the change. In fact, there were some negative price changes because firms making such an accounting change are typically performing poorly.

Exchange Listing: A significant economic event for a firm is listing its stock on a national exchange like NSE or BSE. Such a listing is expected to increase the market liquidity of the stock and add to its prestige. An important question is: Can an investor derive abnormal returns from investing in the stock when a new listing is announced or around the time of the actual listing? The result regarding abnormal returns from such investing were mixed. All the studies agreed that (1) the stock prices increased before any listing announcements and (2) stock prices consistently declined after the actual listing. The crucial question is: What happens between the announcement of the application for listing and the actual listing (a period to 4 to 6 weeks)? A study by McConnel and Sanger points towards profit opportunities immediately after the announcement that a firm is applying for listing and there is the possibility of excess returns from price declines after the actual listing. Finally, studies that have examined the impact of listing on the risk of the securities found no significant change in systematic risk or the firm's cost of equity.

In summary, because listing studies provide evidence of short-run profit opportunities for investors using public information, these studies would not support the semi-strong form EMH.

Price-earnings Ratios: Several studies beginning with Basu (1977) have examined the relationship between the historical price-earnings (P/E) ratios for stocks and the returns on the stocks. Some have suggested that low P/E stocks will outperform high P/E stocks because growth companies enjoy high P/E ratios, but the market tends to overestimate the growth potential and thus overvalues these growth companies, while undervaluing low growth firms with low P/E ratios. A relationship between the historical P/E ratios and subsequent risk adjusted market performance would constitute evidence against semi-strong EMH, because it would imply that investors could use publicly available information regarding P/E ratios to predict future abnormal returns.

Performance measures that consider both return and risk indicated that low P/E ratio stocks experienced superior risk-adjusted results relative to the market, whereas high P/E ratio stocks had significantly inferior risk-adjusted results. Subsequent analysis concluded that publicly available P/E ratios possess valuable information regarding future returns, which is inconsistent with semi-strong efficiency.

The Size Effect: Banz (1981) examined the impact of size (measured by total market value) on the risk adjusted rate of return. The risk-adjusted returns for extended periods (20 to 35 years) indicated that the small firms consistently experienced significantly larger risk adjusted returns than the larger firms. Reninganum (1981) contended that it was the size, not the P/E ratio, that caused the results discussed in the prior subsection, but this contention was disputed by Basu (1983). In summary, firm size is a major efficient market anomaly. The two strongest explanations are higher risk measurements due to infrequent trading and the higher transaction costs. Depending on the frequency of trading, these two factors may account for much of the differential. Keim (1983) also related it to seasonality. These results indicate that the size effect must be considered in any event study that considers long time periods and contains a sample of firms with significantly different market values.

11.2.3 Strong-Form Evidence

The strong form of the EMH states that the stock prices quickly adjust to reflect all information including private information. Thus, no group of investors has information that allows them to earn abnormal profits consistently, even those investors with monopolistic access to information. Note that investors are prohibited not from possessing monopolistic information but from profiting the use of such information. Thus, it is an important point in light of the studies of insider trading reported as follows.

One way to test strong form efficiency is to examine the performance of groups presumed to have access to 'true' non-public information. If such groups can consistently earn above-average risk-adjusted returns, at least an extreme version of the strong form will not be supported. We will consider, corporate insiders, a group that presumably falls into that category of having monopolistic access to information.

Another aspect of the strong form is the ability of any investor to earn excess returns as a results of using information in a superior manner. In other words, can an investor or group of investors, use the value of the information contained in an announcement to earn excess return? If not, the market is strong form efficient. This aspect of the strong form has been examined in several ways, including analyzing the returns of the professional money managers such as these of mutual funds and pension funds and examining the value of what security analysts do.

11.2.4 Corporate Insiders

Insider trading is the trading of a public company's stock or other securities (such as bond or stock options) by individuals with access to non-public information about the company. A corporate insider is an officer, director or major stockholder of a corporation who might be expected to have valuable inside information. In USA, the Securities and Exchange Commission (SEC) requires insiders (officers, directors and owners of more than 10% of a company's stock) to report their monthly purchase and sale transactions to the SEC by the tenth of the next month. This information is made public in the SEC's monthly publication, official summary of Security Transaction and Holdings (official summary).

Information is often said to be the most famous commodity on Wall Street and even Dalal Street and the competition for it is intense. Sometimes the quest for a competitive advantage can tip over into a search for illegal inside information. In 2011, Raj Rajaratnam, the head of the Galleon Group hedge fund which once managed $6.5 billion was convicted on insider trading charges for soliciting tips from a network of corporate insiders and traders.

Insider Trading in India – Rules made by SEBI

Only relevant portions are mentioned as follows:

(a) An insider means a person who is (i) a connected person or (ii) in possession of having access to unpublished price sensitive information.

(b) An insider should not communicate/provide/allow access to any price sensitive information relating to a company, its listed/proposed to be listed securities to any person including other obligations

(c) Every promoter, key managerial personnel and director of a listed company should disclose his holding of securities of the company. Every person on appointment as a key managerial personnel/director or upon becoming a promoter should disclose his holdings as on the date of appointment/becoming a promoter to the company within seven days

(d) Every promoter, employee, director should disclose to the company the number of such securities acquired or disposed of within two trading days of the transaction if the value of the securities traded, over any calendar quarter, aggregate to a traded value in excess of ₹10 lakh or a SEBI-specified value. Every company should notify the particulars of such trading to the concerned stock exchange within two trading days of receipt of the disclosure or from becoming aware of such information.

11.2.7.1 Portfolio Management with Superior Analysts

A portfolio manager with access to superior analysts who have unique insights and analytical ability should follow their recommendations. The superior analysts should be encouraged to concentrate their efforts in mid-cap and small-cap stocks that possess the liquidity required by institutional portfolio managers. But because these stocks typically do not receive the attention given by the top tier stocks, the markets for these neglected stocks may be less efficient than the market for large well-known stocks that are being analyzed by numerous analysts.

Recall that capital market is expected to be efficient because many investors receive new information and analyze its effect on security values. If the number of analysts following a stock differ, one could conceive of differences in the efficiency of the market. New information on top tier stocks is well publicized and rigorously analyzed so the price of these securities should adjust rapidly to reflect the new information. In contrast, mid-cap and small-cap stocks receive less publicity and fewer analysts follow these firms, so prices may differ from intrinsic value for one of the two reasons. First, because of less publicity, there is less information available on these firms. Second, there are fewer analysts following these firms so the adjustment to the new information is slowed. Therefore, the possibility of finding temporarily undervalued securities among these neglected stocks is greater. Again, in line with the cross-section study results, these superior analysts should pay particular attention to B/V to M/V ratio, to the size of stocks being analyzed, and to the monetary policy environment.

11.2.7.2 Portfolio Management Without Superior Analysts

A portfolio manager (or investor) who does not have access to superior analysts should proceed as follows:

(a) Determine and quantify the risk preferences.

(b) Construct the appropriate risk portfolio by dividing the total portfolio between risk free assets and a risky asset portfolio.

(c) Diversify completely on a global basis to eliminate all unsystematic risks.

(d) Maintain the specified risk level by rebalancing when necessary.

(e) Minimize total transaction costs.

11.2.8 Book-Market Value Ratio

This ratio relates the book value (BV) of a firm's equity to the market value (MV) of its equity. Rosenberg, Reid and Lanstein (1985) found a significant relationship between current values for this ratio and future stock returns and contended that such a relationship between available public information on the BV/MV ratio and future returns was evidence against the EMH.

11.2.9 The Rationale and Use of Index Funds and Exchange Traded Funds

Efficient capital markets and a lack of superior analysts imply that many portfolios should be managed passively to match the performance of the aggregate market, minimizing the costs of research and trading. In response to this demand, several institutions have introduced index funds, which are security portfolios designed to duplicate the composition and performance of a selected market index series.

When financial planners want a given asset class in their portfolios, they often use index funds or ETFs to fulfull this need. Index funds or ETFs are less costly in terms of research and commissions, and they, generally provide the same or better performance than the majority of the active portfolio managers. An innovation suggested by Amolt, Hsu and West (2008) is to weigh the stocks in an index based on fundamentals such as earnings, cash flow, and/or dividends rather than market values.

11.2.10 Some Conclusions about Market Efficiency

Considering the evidence of market efficiency discussed previously what conclusions can be drawn? In reality, no definitive conclusion about the market efficiency can be drawn. The evidence in support of market efficiency has convinced many market observers because of the large amount of research done over the years by investigators. And almost certainly the widespread availability of information and data on the internet along with the numerous investment tools provide there has made the market even more efficient. It is the belief by many technicians and fundamentalists that they can really outperform the market considering over the cost element.

Some anomalies do exist and the reasons why these anomalies exist remain unsettled. The quantity and quality of the research in this area has undermined the extreme view that the market is so perfectly efficient that no opportunities for excess returns could possibly exist. The anomalies that have been reported are not conclusive proof of market inefficiencies. It may be that better testing procedures and/or better data may explain some of those anomalies away. Eugena Fama, a long time proponent of market efficiency, argues that the evidence on anomalies does not disprove the efficient market proposition. He believes that many of the studies showing anomalies contain statistical problems. He also believe that over-reaction and under reaction are about equally likely to be found which suggests that markets are efficient because this behaviour can be attributable to chance.

Implications

11.3

The Efficient Markets Hypothesis (EMH) is an investment theory primarily derived from concepts attributed to Eugene Fama's research, "Efficient Capital Markets: A Review of Theory and Empirical Work."

Fama put forth the basic idea that it is virtually impossible to consistently "beat the market" – to make investment returns that outperform the overall market average as reflected by major stock indexes such as the S&P 500 Index. Fama's investment theory – which carries essentially the same implication for investors as the Random Walk Theory – is based on a number of assumptions about securities markets and how they function. The assumptions include the one idea critical to the validity of the efficient markets hypothesis: the belief that all information relevant to stock prices is freely and widely available, "universally shared" among all investors.

As there are always a large number of both buyers and sellers in the market, price movements always occur efficiently (i.e., in a timely, up-to-date manner). Thus, stocks are always trading at their current fair market value. The efficient market hypothesis is associated with the idea of a "random walk," which is a term loosely used in the finance literature to characterize a price series where all subsequent price changes represent random departures from previous prices. The logic of the random walk idea is that if the flow of information is unimpeded and information is immediately reflected in stock prices, then tomorrow's price change will reflect only tomorrow's news and will be independent of the price changes today, but news is by definition unpredictable and, thus, resulting price changes must be unpredictable and random. As a result, prices fully reflect all known information, and even uninformed investors buying a diversified portfolio at the tableau of prices given by the market will obtain a rate of return as generous as that achieved by the experts.

The major conclusion of the theory is that since stocks always trade at their fair market value, then it is virtually impossible to either buy undervalued stocks at a bargain or sell overvalued stocks for extra profits. Neither expert stock analysis nor carefully implemented market timing strategies can hope to average doing any better than the performance of the overall market. If that's true, then the only way investors can generate superior returns is by taking on much greater risk.

Exercise

Theoretical Questions

Multiple Choice Questions

1. Which of the following statement defines an efficient market?
   (a) Information is fully reflected in the stock prices
   (b) The stock exchange is fully automated
   (c) The market is monitored by the regulatory authorities
   (d) Free entry and exit of investors
2. In a weakly efficient market, the stock price reflects
   (a) The company's financial performance
   (b) The past price of the scrip
   (c) The demand for the scrip
   (d) The past price and traded volume
3. In the strong form of efficient market
   (a) All available information is reflected in prices
   (b) All published information is reflected in prices
   (c) Stock price reflects past price
   (d) All information including insider information is reflected in prices
4. If markets are efficient, the security price provides
   (a) Inadequate return for taking up risk
   (b) Normal return for the level of risk taken
   (c) High return for the level of risk taken
   (d) Both (b) and (c)
5. A run in the stock price is
   (a) A sequence of either a fall or rise in stock prices
   (b) An uninterrupted sequence of either a rise or fall in stock prices
   (c) An alternate sequence of stock price and volume movements
   (d) A sequence of fall in price
6. The efficient market hypothesis suggests that investors should
   (a) Adopt an active portfolio management strategy
   (b) Adopt a passive portfolio management strategy
   (c) Use technical analysis as the basis for investment decisions
   (d) Use fundamental analysis as the basis for investment decisions

7. The small-firm-in-January effect refers to the phenomenon that portfolios of small-firm stocks (compared to portfolios of large firm stocks) have

   (a) A tendency to underperform the stock market

   (b) High returns in December and January

   (c) Abnormal positive returns, primarily in January

   (d) Returns in January that are positively correlated with return in December

8. In an efficient market, portfolio management:

   (a) Plays an important role in terms of diversification and risk management

   (b) Is relevant only for high tax bracket investors

   (c) Is relevant only in the management of bond portfolios

   (d) Does not require emphasis on diversification

9. Which of the following most appears to contradict the proposition that the stock market is weakly efficient? Explain.

   (a) Over 25% of mutual funds outer perform the market on average

   (b) Insiders earn abnormal trading profits

   (c) Every January, the stock market earns abnormal return

   (d) Over 50% mutual funds outperformed the market on average

10. Which of the following sources of market inefficiency would be most easily exploited?

    (a) A stock price drops suddenly due to a large sale by an institution

    (b) A stock is overpriced because traders are restricted form short sales

    (c) Stocks are overvalued because investors are exuberant over increased productivity in the economy

    (d) None of the above

11. Which of the following statements are true if the efficient market hypothesis holds?

    (a) It implies that future events can be forecast with perfect accuracy

    (b) It implies that prices reflect all available information

    (c) It implies that security prices change for no discernible reason

    (d) It implies that prices do not fluctuate

12. Which of the following would be a viable way to earn abnormally high trading profits if markets are semi strong form efficient?

    (a) Buy shares in companies with low P/E ratios

    (b) Buy shares in companies with recent above average price changes

    (c) Buy shares in companies with recent below average price changes

    (d) Buy shares in companies for which you have advance knowledge of an improvement in the management team

Answer:

1	2	3	4	5	6	7	8	9	10	11	12
a	d	d	b	b	b	c	a	c	a	b	d

State True or False

1. According to EMH, the stock price moves in trend
2. If the changes in stock prices are not affected by the previous changes in stock prices, then the auto co relationship is zero
3. The NSE has carried out auto correlation test on NSE S & P Nifty Index
4. One of the statements given below provides evidence for the semi-strong efficient form of the market the size effect
5. A mutual fund portfolio manager decides on the asset allocation
6. The semi-strong form of the efficient market hypothesis asserts that stock prices fully reflect all publicity available information
7. Assume that a company announces an unexpectedly large cash dividend to its shareholders. In efficient market without information leakage, one might expect no abnormal price change before or after the announcement
8. Low P/E stocks tend to have positive abnormal returns over the long run provide evidence against the semi-strong form of the efficient market theory
9. According to the efficient market hypothesis high beta stocks are consistently overpriced
10. A 'random walk' occurs when future price changes are uncorrelated with past price changes

Answer:

1	2	3	4	5	6	7	8	9	10
False	True	True	False	False	True	False	True	False	True

Fill in the blanks

1. The book to market effect refers to the finding that firms with high ratios of book value to market value tend to have annual returns _______ returns for firms with lower ratios
2. If stock returns exhibit positive but small serial co relation, this means that ___ returns tend to follow _________ returns
3. Empirical findings generally show that a typical common stock mutual fund has a _______
4. The _____ form of the efficient market hypothesis implies that there is little or nothing to be gained from technical analysis
5. Empirical study of a strong form EMH indicates that _______ are generally able to achieve superior returns
6. Proposed explanations of market anomalies, such as the P/E effect and the small-firm effect, include all of the following, except ________

Answer:

1	Greater than	2	Positive, Positive
3	Zero alpha	4	Weak form
5	Company insiders	6	These effects demonstrate effective commercial activity

Short Essay Type Questions

1. What is meant by an efficient market?
2. Define and discuss the weak-form EMH. Describe the two sets of tests used to examine the weak-form EMH.
3. What is meant by the term abnormal rate of return?
4. Assume you want to test the EMH by comparing alternative trading rules to a buy and hold policy. Discuss the three common mistakes that can bias the results against the EMH.
5. Describe the results of a study that supported the semi-strong form EMH. Discuss the nature of the test and specifically why the results support the hypothesis.

Essay Type Questions

1. For many of the EMH tests, it is really a test of a "joint hypothesis." Discuss what is meant by this concept. What are the joint hypotheses being tested?
2. Describe the results of a study that did support the strong-form EMH. Discuss the test involved and specifically why these results support the hypothesis.
3. What advice would you give to your superior analysts in terms of the set of firms to analyze and variables that should be considered in the analysis? Discuss your reasoning for this advice.

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SECTION - C

FINANCIAL RISK MANAGEMENT

Risks in Financial Market 12

This Module Includes:

12.1 Concept of Risk

12.2 Type of Risks

12.3 Concept of Risk Management

12.4 Financial Risk Assessment and Mitigation

Risks in Financial Market

SLOB Mapped against the Module

To develop a detail understanding of the sources and impact of risks to which an organisation is exposed to in a dynamic business environment and the techniques for managing the same to sustain competitive advantages. (CMLO 3b, 3c)

Module Learning Objectives:

After studying this module, the students will be able to -

- Understand the meaning of risk and importance of risk management.
- Obtain a preliminary understanding of various types of risks.
- Develop an idea over the various risk mitigating techniques.

Concept of Risk

12.1

Introduction

Risk is an integral element of a business. An organisation faces various types of risks, some of which are controllable while others are not. These risks essentially create an impact on the organisation which very often lead to negative consequences. Thus, for an organisation, management of risks is imperative to survive and grow. A systematic approach towards risk management enables an organisation to convert challenges into opportunities.

Among various types of risks to which an organisation is exposed to, financial risk demands greater consideration as they impact the bottom-line almost directly. Hence, a detail understanding of various elements of financial risk, their impact and possible mitigation strategies is of utmost importance.

According to Oxford English Dictionary 'risk' refers to 'a chance or possibility of danger, loss, injury or other adverse consequences' and the definition of 'at risk' is 'exposed to danger'. In this context, risk is used to signify negative consequences. However, taking a risk can also result in a positive outcome.

Accordingly, CIMA's Official Terminology defines 'risk' as a condition in which there exists a quantifiable dispersion in the possible outcomes from an activity.

The International Federation of Accountants (IFA) defines risk as 'Uncertain future events which could influence the achievement of the organisation's strategic, operational and financial objectives.'

Thus, risk may be defined as the uncertainty of an event the outcome of which may lead to either a positive or a negative impact on the organisation's objectives.

Note: Although the terms 'risk' and 'uncertainty' are often used interchangeably, they are, in fact, not synonymous. Risk is the situation when there are a number of specific, probable outcomes, and though the actual outcome is unknown their probabilities of occurrence can be determined based on past experience. Uncertainty is where even the probabilities of possible outcomes are unknown. It reflects a total lack of knowledge of what may happen. Thus, while risk is measurable, uncertainty is not.

Types of Risks

12.2

Risks have been classified by different experts and professional institutions in different ways. According to CIMA Official Terminology (2005), risks can broadly be classified as follows:

a. **Operational Risk:** This risk is related to activities carried out within an organization, arising from structure, systems, people, products or processes. In other words, operational risk refers to potential losses that can occur due to inadequate systems, management failure, faulty controls, fraud, or human errors.

b. **Financial Risk:** Financial risk is related to the financial operations of an entity. It is an outcome of financial transactions undertaken by the organization with the outside world.

c. **Country Risk:** It is associated with undertaking transactions with, or holding assets in, a particular country. Risk might be political, economic or stem from regulatory instability.

d. **Environmental Risk:** These risks may occur due to political, economic, socio-cultural, technological, environmental and legal changes.

e. **Reputational Risk:** this is damage to an entity's reputation as a result of failure to manage other risks.

f. **Strategic Risk:** These are risks stemming from the entity's strategy and pose the greatest threat to the achievement of the strategy.

Again, based on controllability or ability to diversify, risks can be systematic and non-systematic.

a. **Systematic risk:** It is also referred to as non-diversifiable risk. Systematic risk is the fluctuations in the returns on securities that occur due to macroeconomic factors. These factors could be the political, social or economic factors that affect the business. Systematic risk can be caused due to unfavorable reasons such as an act of nature like a natural disaster, changes in government policy, international economic components, changes in the nation's economy, etc.

b. **Unsystematic Risk:** The fluctuations in returns of a company arising due to firm specific factors are termed as unsystematic risks. These risk factors exist within the company and can be avoided if necessary action is taken. The risk factors can include the production of undesirable products, labor strikes, etc.

Concept of Risk Management

12.3

Risks to which an organisation is exposed may bring serious consequences for the organisation inform of decline in profitability, loss of customers, decline in shareholders' wealth and reputation. Again, if properly handled they may offer rewards such as increased market share, higher revenue growth and improved profitability. Thus, managing risk is not only important for successful survival of a firm in cut throat competition but also to emerge as a market leader.

Risk management is the process by which risks are identified, assessed, measured, and managed in order to create economic value. It is an iterative process used by organizations to support the identification and management of risk (or uncertainty) and reduce the changes and/or effects of adverse events while enhancing the realization of opportunities and the ability to achieve company objectives such as profit, value creation etc.

The process or approaches towards risk management have been explained by various experts and associations in different ways. However, a generic approach towards risk management must include the following steps:

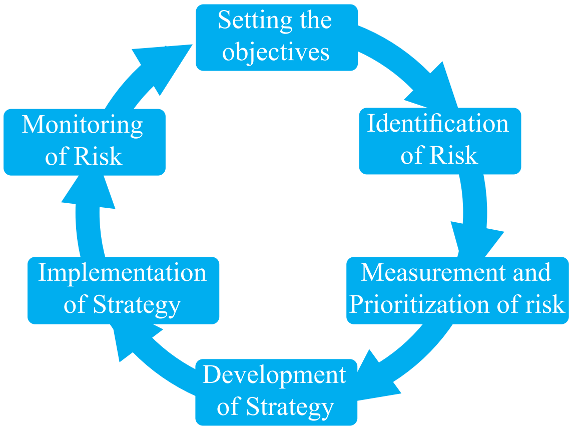


Figure 12.1: Risk Management Process

(i) Setting the Objectives:

Determination of objectives is essential step in the risk management. The objective may be to protect/enhance profits or to develop competitive advantage. The objectives must be decided by the management and in this process company's risk tolerance must be taken into account. Risk tolerance is the level of risk that the company is able and willing to take on. The ability to handle risk is primarily driven by the company's financial health and depends on its level of earnings, cash flows, and equity capital.

(ii) Identification of Risk

The next step in the risk management process is identification of risk. Every firm faces different types of risks - based on its organizational structure, nature of business, the economic conditions, social and political factors, the status of the industry it operates. Any risk needs to be identified initially and then categorized as per its nature and character. Risk identification is usually based on a firm's exposure on various aspects. It can be either identified by top level or middle level management.

(iii) Measurement and Prioritization of Risk

Once the risks are identified, they need to be evaluated for ascertaining their significance. The significance of a particular risk depends upon the size of the loss (expected severity of consequences) that it may result in, and the probability of the occurrence of such loss (or, expected frequency). On the basis of these two factors, various risks faced by a company need to be classified as critical risks, important risks and not-so-important risks. Critical risks are those that may result in bankruptcy of the firm. Important risks are those that may not result in bankruptcy, but may cause severe financial distress, if they are not dealt properly. The not-so-important risks are those that may result in losses, which the firm may easily bear in the normal course of business. This may be termed as risk prioritization. The severity is measured by using various risk measures. There are certain basic measures in form of absolute value (number of transactions, size of the debtors), ratios (percentage of individual debtor to total debtors to measure concentration risk) or trends (percentage decline in sales); some common measures such as financial measures (anticipated forex income and expenditure), market changes (GDP growth rate), production level (actual vs. BEP) etc. as well as some specific measures such as Credit rating and Expected Loss for Credit Risk, Value at Risk for market risk, labour turnover ratio for operational risk. After measurement, the same must be reported to the appropriate authority.

(iv) Development of Strategy

Strategy setting is an important task in managing risk, as it sets a direction for the business as a whole. A strategy is essentially an action plan, which specifies the nature of risk to be managed and the timing. It also specifies the tools, techniques and instruments that can be used to manage these risks. Besides, it also deals with tax and legal problems.

Responses to risk generally fall into the following categories:

Risk avoidance: action is taken to halt the activities giving rise to risk, such as a product line, a geographical market or a whole business unit.

Risk reduction: action is taken to mitigate the risk of likelihood or impact or both, generally via internal controls.

Risk sharing or transfer: action is taken to transfer a portion of the risk through insurance, outsourcing or hedging.

Risk acceptance: no action is taken to affect likelihood or impact.

(v) Implementation of Strategy

Once the policies and strategies are in place, they need to be implemented for actually managing the risks; where actual execution of risk management takes place. This includes finding the best deal in case of risk transfer, providing for contingencies - in case of risk retention, designing and implementing risk control programs, etc. It also includes eyeing for operational details, like the back-office work, to ensure compliance controls.

(vi) Monitoring Risk

Risk monitoring is the last major element of risk management - but certainly not the least important. The function of risk management needs to be reviewed periodically, depending on the costs involved. The factors that affect the risk management decisions keep changing, thus necessitating the need to monitor the effectiveness of the decisions taken previously and to change the risk response it need to arises. Obviously, for this, the process of risk management has to be flexible.

Risk management is a process or cycle which works continuously and in a repetitive manner. After monitoring the risk, the process of risk identification is done because risk keeps on changing its form as various new requirements come periodically.

Financial Risk - Assessment and Mitigation 12.4

In an organisation, the financial risk is of paramount importance. As mentioned earlier, financial risk arises due to financial transactions undertaken by the organization with the outside world.

Financial risk can best be thought of as the variability in earnings or cash flows and market values caused by unpredictable changes in commodity prices, security prices, interest rates and exchange rates, or due to non-fulfillment of obligations by counterparties in financial transactions. Financial risk caused by unfavorable movements of market prices of financial variables is referred to as market risk, while that arising due to non-fulfillment of contractual obligations is known as credit risk, and liquidity risk.

These are discussed in detail as follows.

A. Market Risk

Market risk or price risk is the risk of uncertain movements and adverse fluctuations in the financial market variables like security prices, commodity prices, interest rates and exchange rates. Price is a market driven measure of value. A buyer's intention is to pay the least possible price for the security or commodity it wants to sell and hence fears a potential rise in prices at the time of purchase. On the other hand, a seller's intention is to sell the security or commodity for the highest possible price and fears a potential fall in prices at the time of sale. Thus, the possibility of not realizing the desired price is known as price risk.

In short, the possibility for an investor to experience losses due to factors that affect the overall performance of the financial markets is market risk. The risk that a major natural disaster will cause a decline in the market as a whole is an example of market risk, other examples of market risk are recessions, political turmoil, changes in interest rates and terrorist attacks, credit policy etc. Market risk is the risk of losses in positions arising from movements in market prices.

Types of Market Risk

Market risk is further divided into the following types of risk:

a. **Equity Risk:** It is the risk associated with a common stock which is interpreted in terms of the variability of its return.

b. **Interest Rate Risk:** Interest rate risk is the variability in a security's return resulting from changes in the level of interest rates. Other things being equal, security prices move inversely to interest rates.

c. **Inflation Rate Risk:** Change in the inflation rates changes the purchasing power. Change in inflation rate also changes interest rates and results into decline in the value of securities.

d. **Commodities Risk:** When the demand and supply of the commodity are not at equilibrium level, the commodity price fluctuations may be expected. This is known as commodity risk.

e. **Currency Risk:** Currency risk arises when the organization is involved in international operations and goods and services are invoiced at foreign currency. Appreciation or depreciation of foreign currency against the home currency results into fluctuations in the value of foreign currency denominated assets and liabilities. with each other.

Assessing and Mitigating Market Risk

As with other forms of risk, the potential loss amount due to market risk may be measured in a number of ways or conventions. Traditionally, one convention is to use Value at Risk (VaR). The conventions of using Value at risk are well established and accepted in the short-term risk management practice. However, it contains a number of limiting assumptions that constrain its accuracy. The first assumption is that the composition of the portfolio measured remains unchanged over the specified period. Over short time horizons, this limiting assumption is often regarded as reasonable. However, over longer time horizons, many of the positions in the portfolio may have been changed. The Value at Risk of the unchanged portfolio is no longer relevant.

The Variance Covariance and Historical Simulation approach to calculate Value at Risk also assumes that historical correlations are stable and will not change in the future or breakdown under times of market stress.

In addition, care has to be taken regarding the intervening cash flow, embedded options, changes in floating rate interest rates of the financial positions in the portfolio. They cannot be ignored if their impact can be large.

Market risk cannot be eliminated through diversification, though it can be hedged against.

Market risk can at least partially be moderated by diversification. The returns from different assets are highly unlikely to be perfectly correlated and the correlation may sometimes be negative. However, share prices are driven by many factors, such as the general health of the economy which will increase the correlation and reduce the benefit of diversification. If one constructs a portfolio by including a wide variety of equities, it will tend to exhibit the same risk and return characteristics as the market as a whole, which many investors see as an attractive prospect. However, history shows that even over substantial periods of time there is a wide range of returns that an index fund may experience; so an index fund by itself is not “fully diversified”. Greater diversification can be obtained by diversifying across asset classes; for instance a portfolio of many bonds and many equities can be constructed in order to further narrow the dispersion of possible portfolio outcomes.

B. Credit Risk

Credit risk refers to the risk that an obligor will default, either wilfully or due to incapacity on any type of debt by failing to make payments which it is obligated to do. The risk is primarily with that of the lender and includes lost principal and interest, disruption to cash flows, and increased collection costs. The loss may be complete or partial and can arise in a number of circumstances.

Types of Credit Risk

There are three primary types of credit risk:

a. **Default Risk:** Is the chance of failing of an issuer to meet its obligations. Default risk can also be sub-divided into different forms of transaction such as non-payment of principal or interest in case of loan, default of obligations in case of treasury operation by counterparties, default while settlement in case of securities trading, or default arising from the flow of foreign exchange due to restrictions or limitations imposed on remittances out of the country in the case of cross border obligations.

b. **Credit Spread Risk:** Is the chance that the spread between the risky bond and risk-free securities will vary after purchase.

c. **Downgrade Risk:** Is a chance that a rating agency will lower its rating on the issuer or the probability of loss from a fall in issuers rating because of deterioration in its financial condition.

In addition, there may be the following two types of credit risk.

a. **Concentration risk**: It is the risk associated with any single exposure or group of exposures with the potential to produce large enough losses to threaten a lender's core operations. It may arise in the form of single firm concentration or industry concentration.

b. **Country risk** - The risk of loss arising from sovereign state freezing foreign currency payments (transfer/ conversion risk) or when it defaults on its obligations (sovereign risk).

Assessing and Mitigating Credit Risk

Significant resources and sophisticated programs are used to analyze and manage credit risk. Some companies run a credit risk department whose task is to assess the financial health of their customers, and decide whether to extend credit (or not). They may use in-house programs to advice on avoiding, reducing and transferring risk. They also use third party provided intelligence. Companies like Standard & Poor's, Moody's, Fitch Ratings, and Dun and Bradstreet provide such information for a fee. Most lenders employ their own models (credit scorecards) to rank potential and existing customers according to credit risk, and then apply appropriate strategies. With products such as unsecured personal loans or mortgages, lenders charge a higher price for higher risk customers and vice versa. With revolving products such as credit cards and overdrafts, risk is controlled through the setting of credit limits. Some products also require security, most commonly in the form of property.

Credit scoring models also form part of the framework used by banks or lending institutions to grant credit to clients. For corporate and commercial borrowers, these models generally have qualitative and quantitative sections outlining various aspects of the risk including, but not limited to, operating experience, management expertise, asset quality, and leverage and liquidity ratios, respectively. Once this information has been fully reviewed by credit officers and credit committees, the lender provides the funds subject to the terms and conditions presented within the contract (as outlined above).

C. Liquidity Risk

Liquidity risk can be of two types – Market Liquidity Risk and Funding Liquidity Risk.

In finance, 'market liquidity risk' is the risk that a given security or asset cannot be traded quickly enough in the market at the desired price to prevent a loss (or make the required profit). This risk reflects the inability to sell an asset due to lack of liquidity in the market. Market liquidity risk becomes particularly important to parties who are about to hold or currently holding an asset, since it affects their ability to trade.

On the other hand, 'funding liquidity risk' refers to the inability of a firm in meeting its contractual liabilities / obligations as and when they fall due thereby making it difficult for the firm to roll over its funds at reasonable cost. An institution might lose liquidity if its credit rating falls, it experiences sudden unexpected cash outflows, or some other event causes counterparties to avoid trading with or lending to the institution. A firm is also exposed to liquidity risk if markets on which it depends are subject to loss of liquidity.

Relationship between Funding and Market Liquidity Risks and between Liquidity Risk and Other Types of Risks

Market and funding liquidity risks compound each other as it is difficult to sell when other investors face funding problems and it is difficult to get funding when the collateral is hard to sell. Liquidity risk also tends to compound other risks. If a trading organization has a position in an illiquid asset, its limited ability to liquidate that position at short notice will compound its market risk. Suppose a firm has offsetting cash flows with two different counterparties on a given day. If the counterparty, that owes it a payment, defaults, the firm will have to raise cash from other sources to make its payment. Should it be unable to do so, it too will default. Here, liquidity risk is compounding credit risk.

Assessing and Mitigating Liquidity Risk

A position can be hedged against market risk but still entail liquidity risk. This is true in the above credit risk example — the two payments are offsetting, so they entail credit risk but not market risk. Accordingly, liquidity risk has to be managed in addition to market, credit and other risks. Because of its tendency to compound other risks, it is difficult or impossible to isolate liquidity risk. In all but the simplest of circumstances, comprehensive metrics of liquidity risk do not exist. Certain techniques of asset-liability management can be applied to assess liquidity risk. A simple test for liquidity risk is to look at future net cash flows on a day-by-day basis. Any day that has a sizeable negative net cash flow is of concern. Such an analysis can be supplemented with stress testing.

Analyses such as these cannot easily take into account contingent cash flows, such as cash flows from derivatives or mortgage-backed securities. If an organization's cash flows are largely contingent, liquidity risk may be assessed using some form of scenario analysis. A general approach using scenario analysis might entail the following high-level steps:

(i) Construct multiple scenarios for market movements and defaults over a given period of time.

(ii) Assess day-to-day cash flows under each scenario.

Because components of balance sheets differ so significantly from one organization to the next, there is little standardization in how such analyses are implemented.

Solved Case Study

X Ltd. is a multinational corporation having its headquarters in U.S.A. It has a subsidiary in India. The management of X Ltd. identified the following exposures which they feel are the potential sources of risks.

a. The purchase manager has imported a raw material for which the payment has to be made in US dollar after 3 months.

b. The bank rate has been raised by RBI.

c. X Ltd. has an investment of the company in Y Ltd. recently Y Ltd. has become delisted.

d. The Rating Agencies have downgraded Z Ltd. from which X Ltd. was supposed to receive Rs.1 lakh in two months.

e. X Ltd. has huge unsold stock of goods in its current assets.

The management wants to categorize the exposures in different types of risks with as much detailing as possible, so that appropriate risk response can be undertaken. You have been appointed as an expert risk manager. Advise the management in identifying the type of risk.

Solution:

The exposures can be categorised into the following specific types of risks.

Exposures	Type of risks
a. The purchase manager has imported a raw material for which the payment has to be made in US dollar after 3 months.	a. Foreign Currency Risk
b. The bank rate has been raised by RBI.	b. Interest Rate Risk
c. X Ltd. has an investment of the company in Y Ltd. recently Y Ltd. has become delisted.	c. Market Liquidity risk
d. The Rating Agencies have downgraded Z Ltd. from which X Ltd. was supposed to receive Rs.1 lakh in two months.	d. Downgrade Risk within Credit Risk
e. X Ltd. has huge unsold stock of goods in its current assets.	e. Funding Liquidity Risk

Exercise

Theoretical Problems

Multiple Choice Questions

1. Risk management is the process which includes –
   A. Risk identification
   B. Risk assessment
   C. Risk measurement
   D. All of the above
2. Which of the following is not a part of Financial Risk?
   A. Operational Risk
   B. Market Risk
   C. Credit Risk
   D. Liquidity Risk
3. Which of the following is not a part of Market Risk?
   A. Equity risk
   B. Inflation Risk
   C. Downgrade Risk
   D. Interest Rate Risk
4. Which of the following is not a part of Credit Risk?
   A. Default risk
   B. Downgrade risk
   C. Concentration risk
   D. Liquidity risk
5. Responses to risk includes –
   A. Risk avoidance
   B. Risk reduction
   C. Risk transfer
   D. All of the above

Answer:

1	2	3	4	5
D	A	C	D	D

State True or False

1. In Risk sharing or transfer action is taken to transfer a portion of the risk through insurance.
2. Operational risk refers to potential losses that can occur due to inadequate systems, management failure, faulty controls, fraud, or human errors.
3. Systematic Risk is also referred to as diversifiable risk.
4. Currency risk arises when the organisation is involved in international operations and goods and services are invoiced at home currency.
5. Country Risk is associated with undertaking transactions with, or holding assets in, a particular country.

Answer:

1	2	3	4	5
True	True	False	False	True

Fill in the Blanks

1. Risk as a condition in which there exists a ______________ dispersion in the possible outcomes from an activity.
2. The fluctuations in returns of a company arising due to firm specific factors are termed as __________.
3. Financial risk can best be thought of as the ___________ in earnings or cash flows and market values.
4. ______________ are not diversifiable.
5. Credit risk refers to the risk that an _________ will default, either wilfully or due to incapacity on any type of debt.

Answer:

1	quantifiable	2	unsystematic risks
3	variability	4	Systematic risks
5	obligor		

Short Essay Type Questions

1. What do you mean by the terms ‘risk’ and ‘risk management’?
2. What are the basic steps in risk management?
3. Discuss various types of credit risk.
4. How do funding liquidity and market liquidity risks have a compounding effect?
5. How will you assess and mitigate the liquidity risk?

Essay Type Questions

1. What do you understand by 'market risk'? What are its basic types? How would you assess and mitigate market risk?
2. Briefly discuss 'credit risk' and explain how one can assess and mitigate such risk.
3. Write a brief note on 'liquidity risk' and examine its relationship with the other types of risks.
4. Discuss the risk management process in detail.

Unsolved Case Study

Y Ltd. is a multinational corporation having its headquarters in UK. It has a subsidiary in India. The management of Y Ltd. has adopted a few risk responses against certain risk exposures as follows:

a. A derivative contract has been entered into to buy US dollar after 3 months at a specified price.

b. The company diversifies its portfolio by including new stock having negative correlation with the existing stocks.

c. An insurance policy has been taken to cover the risk of theft of valuable raw materials.

d. Provision for doubtful debt has been charged @5% for credit sales to customers.

e. The company avoided setting up a plant in Nigeria due to political unrest prevailing in the country.

You have been appointed as an expert risk manager. Define, with reasons, the above responses in technical terms so that a formal report can be prepared and presented before the management for framing long term risk response policy.

Answer:

a-risk transfer/sharing;

b-risk reduction;

c-risk transfer;

d-risk acceptance;

e-risk avoidance.

References:

1. Jorion; Financial Risk Management Handbook Plus Test Bank; Wiley
2. Hopkin; Fundamentals of Risk Management; IRM
3. Allen; Financial Risk Management a Practitioners Guide to Managing Market and Credit Risk; John Wiley
4. Hull; Risk Management and financial Institutions; Wiley

Financial Derivatives – Instruments for Risk Management

13

This Module Includes:

13.1 Introduction to Financial Derivatives

13.2 Forward and Futures – Meaning and Difference, Pricing, Stock Futures, Index based Futures, Hedging through Futures

13.3 Options

13.4 Swaps

13.5 Interest Rate Derivatives – Forward Rate Agreement, Interest Rate Futures and Options, Caps, Floors and Collars

Financial Derivatives – Instruments for Risk Management

SLOB Mapped against the Module

To develop a detail understanding of the sources and impact of risks to which an organisation is exposed to in a dynamic business environment at national and international level and the techniques for managing the same to sustain competitive advantages. (CMLO 3b, 3c)

Module Learning Objectives:

After studying this module, the students will be able to -

- Understand the meaning of financial derivatives and their role in risk management.
- Develop an understanding of forward and future pricing and hedging using futures.
- Acquire in-depth knowledge of option pricing and developing option strategies for hedging and speculation.
- Understand the process of designing swap deals in interest rate swaps.
- Develop an idea about other interest rate derivatives and their uses in risk management.

Introduction to Financial Derivatives 13.1

13.1.1 Concept of Derivatives

In financial literature, the term 'derivative' refers to a contract which has no independent value but whose value is entirely derived from the value of the underlying asset. The underlying asset can be securities, commodities, bullion, currency, livestock or anything else. These are essentially financial products.

13.1.2 Functions of the Derivative Market

The derivatives market performs a number of economic functions. These are -

a. **Price Discovery:** Prices in an organized derivatives market reflect the perception of the market participants about the future and lead the prices of underlying to the perceived future level. The prices of derivatives converge with the prices of the underlying at the expiration of the derivative contract. Thus, derivatives help in discovery of future as well as current prices.

b. **Risk Transfer:** The derivatives market helps to transfer risks from those who have them but do not like them to those who have an appetite for them.

c. **Liquidity and Volume Trading:** Derivatives, due to their inherent nature, are linked to the underlying cash markets. With the introduction of derivatives, the underlying market witnesses higher trading volumes. This is because of participation by more players who would not otherwise participate for lack of an arrangement to transfer risk.

d. **More Participation:** An important incidental benefit that flows from derivatives trading is that it acts as a catalyst for new entrepreneurial activity. The derivatives have a history of attracting many bright, creative, well-educated people with an entrepreneurial attitude. They often energize others to create new businesses, new products and new employment opportunities, the benefit of which are immense.

13.1.3 Financial Derivatives

- **Concept of Financial Derivatives**

  Derivatives are broadly classified into two categories – Financial Derivatives and Commodity Derivatives.

  Financial derivatives, as the name suggest, are instruments whose value depends, or derives from, one or more underlying financial assets. The underlying assets include financial securities, security indexes, reference rates, and some combination of them.

- **Features of Financial Derivatives**

  A financial derivative shares the basic features of derivatives contract with an added specification that the underlying, in this case, is essentially a financial instrument or financial asset. These basic features of a derivative are as follows:

a. A derivative instrument relates to the future contract between two parties. It means there must be a contract-binding on the underlying parties and the same to be fulfilled in future.

b. The derivative instruments have the value which derived from the values of other underlying assets.

c. In general, the counter parties have specified obligation under the derivative contract.

d. The derivatives contracts can be undertaken directly between the two parties or through the particular exchange like financial futures contracts.

e. In general, the financial derivatives are carried off-balance sheet. The size of the derivative contract depends upon its notional amount. The payoff of derivative products differs from the payoff that their notional amount might suggest.

f. Usually, in derivatives trading, the taking or making of delivery of underlying assets is not involved; rather underlying transactions are mostly settled by taking offsetting positions in the derivatives themselves.

g. Derivatives are also known as deferred delivery or deferred payment instrument. It means that it is easier to take short or long position in derivatives in comparison to other assets or securities.

h. Derivatives are mostly secondary market instruments.

i. Though exchange traded derivatives are more popular, over-the-counter (OTC) traded derivatives are still in existence.

- **Benefits of Using Financial Derivatives**

The general benefits of using financial derivatives are as follows:

a. A prudent use of financial derivatives can provide a new mechanism to manage or reduce various business risks at low transaction costs.

b. The innovative use of financial derivatives can greatly help end-users on cut their financing cost.

c. Financial derivatives can provide more access to financial markets, especially to unfamiliar ones at lower costs. Put another way, they can create more complete markets to investors.

d. Financial derivative instruments play an important role in asset management due to their lower transaction costs relative to the spot market instruments.

e. The users of financial derivatives can expect to be offered opportunities on taking advantage of asymmetries in tax and regulatory requirements across different countries, markets or securities.

f. Financial derivatives can be used to speculate and make profits by assuming certain risks, probably with suitable degree.

Types of Financial Derivatives

Financial derivatives can be categorized based on the nature of the contract as well as based on the underlying assets.

A. Based on the Nature of the Contract

According to the nature of the contract, financial derivatives can be classified into basic and complex derivatives.

I. Basic Derivatives

The most commonly used derivatives contracts are –

(a) **Forwards:** A forward contract is a customized contract between two entities, where settlement takes place on a specific date in the future at today's pre-agreed price. Forwards are very popular in foreign exchange market.

(b) **Futures:** A futures contract is an agreement between two parties to buy or sell an asset at a certain time in the future at a certain price. Futures contracts are special types of forward contracts in the sense that the former are standardized exchange-traded contracts. Unlike forward contracts, the counterparty to a futures contract is the clearing corporation on the appropriate exchange.

(c) **Options:** An option represents the right (but not the obligation) to buy or sell a security or other asset during a given time for a specified price (the "strike price"). Options are of two types - calls and puts.

(d) **Swaps:** Swaps are private agreements between two parties to exchange cash flows in the future according to a prearranged formula. They can be regarded as portfolios of forward contracts. Swaps generally are traded OTC through swap dealers, which generally consist of large financial institution, or other large brokerage houses.

II. Complex Derivatives:

These are derivatives which are built up from two or more other derivatives. Some examples include –

(a) **Warrants:** Options generally have lives of up to one year, the majority of options traded on options exchanges having a maximum maturity of nine months. Longer-dated options are called warrants and are generally traded over-the-counter.

(b) **LEAPS:** The acronym LEAPS means Long-term Equity Anticipation Securities. These are options having a maturity of up to three years.

(c) **Baskets:** Basket options are options on portfolios of underlying assets. The underlying asset is usually a moving average of a basket of assets. Equity index options are a form of basket options.

(d) **Swaptions:** Swaptions are options to buy or sell a swap that will become operative at the expiry of the options.

B. Based on the Underlying Assets

Based on the underlying assets, financial derivatives can be of the following types:

(a) **Equity Derivatives:** Equity derivatives are financial instruments whose value is derived from price movements of the underlying asset, where that asset is a stock or stock index. These are generally stock and index futures and option contracts.

(b) **Interest Rate Derivatives:** Interest Rate Derivative ae financial derivative contracts whose value is derived from one or more interest rates, prices of interest rate instruments, or interest rate indices. In India, popular interest rate derivatives include Interest Rate Futures or Interest Rate Options.

(c) **Foreign Exchange Derivatives:** A foreign currency derivative is a financial derivative whose payoff depends on the foreign exchange rates of two (or more) currencies. These instruments are commonly used for hedging foreign exchange risk or for currency speculation and arbitrage. Specific foreign exchange derivatives include: foreign currency forward contracts, foreign currency futures, foreign currency swaps, currency options, and foreign exchange binary options.

(d) **Credit Derivatives:** A credit derivative is a contract whose value depends on the creditworthiness or a credit event experienced by the entity referenced in the contract. Credit derivatives include credit default swaps, collateralized debt obligations, total return swaps, credit default swap options, and credit spread forwards.

Forward and Futures – Meaning and Difference, Pricing, Stock Futures, Index based Futures, Hedging through Futures

13.2

13.2.1 Forward Contracts

Concept of Forward Contract

A forward contract is a simple tailor-made contract between two parties to buy or sell an asset at a certain time in the future for a pre-determined price. Unlike future contracts, they are not traded on an exchange, rather traded in the over-the-counter market, usually between two financial institutions or between a financial institution and one of its clients.

Consider the following example of a forward contract in foreign exchange market.

An Indian company buys computer parts from USA with payment of ten million dollar due in 90 days. The importer, thus, owes dollars for future delivery. Suppose present price of dollar is ₹68. Over the next 90 days, however, dollar might rise against ₹68. The importer can hedge this exchange risk by negotiating a 90-days forward contract with a bank at a price ₹70. According to forward contract in 90 days the bank will give importer ten million dollar and importer will give the bank 700 million rupees hedging a future payment with forward contract. On the due date importer will make a payment of ₹700 million to bank and the bank will pay ten million dollar to importer, whatever rate of the dollar is after 90 days. So, this is a typical example of forward contract on currency.

Features of Forward Contract

The basic features of a forward contract are given in brief here as under:

a. Forward contracts are bilateral contracts, and hence, they are exposed to counter-party risk. There is risk of non-performance of obligation either of the parties.

b. Each contract is custom designed, and hence, is unique in terms of the asset type, quality, contract size and expiration date etc.

c. In forward contract, one of the parties takes a long position by agreeing to buy the asset at a certain specified future date. The other party assumes a short position by agreeing to sell the same asset at the same date for the same specified price.

d. The pre-determined specified price in a forward contract is referred to as the delivery price. The forward price for a particular forward contract at a particular time is the delivery price that would apply if the contract were entered into at that time. Thus, both are equal at the time the contract is entered into but, as time passes, the forward price is likely to change whereas the delivery price remains the same.

e. In the forward contract, derivative assets can often be contracted from the combination of underlying assets, such assets are often known as synthetic assets in the forward market.

f. In the forward market, the contract has to be settled by delivery of the asset on expiration date.

g. In the forward contract, covered parity or cost-of-carry relations are relation between the prices of forward and underlying assets. Such relations further assist in determining the arbitrage-based forward asset prices.

h. Forward contracts are very popular in foreign exchange market as well as interest rate bearing instruments.

Types of Forward Contract

Based on the underlying asset, forward contracts can be classified into –

a. Commodity Forwards – Here the underlying is any commodity like Gold.

b. Currency Forwards – Here the underlying is the foreign exchange.

c. Equity Forwards – Here the underlying is an individual stock, a stock portfolio or a stock index.

d. Interest Rate Forwards - Here the underlying is the interest rate itself.

According to Forward Contracts (Regulation) Act, 1952, forward contracts are of the following three major categories.

a. Hedge Contracts

b. Transferable Specific Delivery Forward Contracts

c. Non-transferable Specific Delivery Forward Contrcat

Forward Market Mechanism

A forward contract is an effective tool for hedging and is similar to an insurance policy, as it protects a trader from unfavourable movements in the asset prices. The trading mechanism of forward contracts can be better understood with the help of the following example.

Suppose, Mr. X has imported certain automobile parts from USA for which it requires to pay the exporter one million US $ in 3 months. The current rupee-dollar exchange rate is ₹75/US$. Mr. X apprehends that the rate may go up to ₹78/US$. In order to protect himself from the adverse movement in exchange rate, Mr. X will enter into a forward buying contract to buy one million US $ after 3 months at a forward price, say ₹76/US $. If after 3 months, on the date of maturity of the contract, the rate moves beyond ₹76/US $, Mr. X will still be able to buy US $ at ₹76/US $ and thereby will hedge his loss.

Forward Terminology

a. Underlying Asset: This refers to the asset on which forward contract is made.

b. Long Position: The party that agrees to buy an underlying asset (e.g., stock, commodity, stock index, etc.) in a future date is said to have a long position.

c. Short Position: The party that agrees to sell an underlying asset (e.g., stock, commodity, indices, etc.) in future date is said to have a short position.

d. Spot Position: It refers to the quoted price of the underlying asset for buying and selling at immediate delivery.

e. Future Spot Price: This is the spot price of the underlying asset on the date of expiration of the forward contract.

f. Delivery Price: It is the pre-specified price of the underlying assets at which the forward contract is settled.

Profit Profile of Buyer and Seller

The buyer of the underlying commodity or asset is referred to as the long side whereas the seller is the short side. The obligation to buy the asset at the agreed price on the specified future date is referred to as the long position. A long position profits when prices rise. The obligation to sell the asset at the agreed price on the specified future date is referred to as the short position. A short position profits when prices go down.

Let T denote the expiration date, K denote the forward price, and PT denote the spot price (or market price) at the delivery date. Then –

a. For the long position: the payoff of a forward contract on the delivery date is PT - K

b. For the short position: the payoff of a forward contract on the delivery date is K - PT

Accordingly, the pay-off profile of Long Forward and Short Forward will be as follows.

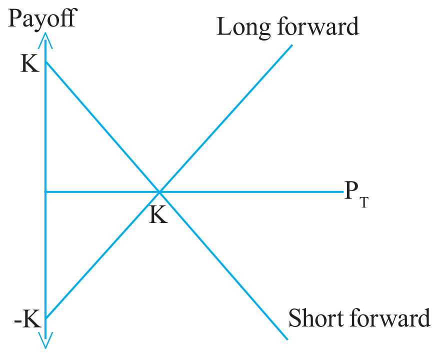


Figure 13.1: Pay-off Profile Forward Buyer and Seller

From the above diagram, it may be seen that both the long and short forward payoff positions break even when the spot price is equal to the forward price. Moreover, long forward's maximum loss is the forward price whereas the maximum gain is unlimited. For a short forward, the maximum gain is the forward price and the maximum loss is unlimited. Pay-off diagrams show the pay-off of a position at expiration only.

Consider the following illustration.

Illustration 1

An investor sells 10 million yen forward at a forward price of \$0.0090 per yen. At expiration, the spot price is \$0.0083 per yen.

(a) What is the long position payoff?

(b) What is the short position payoff?

Solution:

(a) At the expiration date, the long position's payoff is (0.0083 – 0.009) × 10 = (–) \$ 0.007 million i.e., a loss of \$ 0.007 million.

(b) The short position's payoff is a profit of \$ 0.007 million.

Advantages and Disadvantages of Forward Contract

The advantages of Forward Contracts include the following:

(a) These are used to hedge the price for purchase or sale of commodity or financial asset on the future commitment date.

(b) Forward contracts do not require any upfront premium. So, they do not involve initial cost.

(c) These contracts are tailor-made. Therefore, price risk exposure can be hedged up to 100%, which may not be possible in futures or options as these are standardized.

However, Forward Contracts suffer from some limitations also. The major disadvantages of Forward Contracts are:

(a) There is lack of centralized trading system like Futures. These are 'Over the Counter (OTC)' derivatives.

(b) As these do not have an organized secondary market, these are illiquid.

(c) Due to absence of any recognized exchange as the intermediary, these contracts involve substantial amount of counterparty risk.

13.2.2 Future Contracts

- **Concept of Future Contract**

A future contract is a standardized agreement between the buyer and seller of the contract traded on a futures exchange, to buy or sell a specified underlying asset at a certain date in future, at a pre-set price. The future date is called the delivery date or final settlement date. The pre-set price is called the futures price. The price of the underlying asset on the delivery date is called the settlement price.

Thus, a future contract is a standard contract in which the seller is obligated to deliver a specified asset (security, index, commodity or foreign exchange) to the buyer on a specified date in future and the buyer is obligated to pay the seller the then prevailing futures price upon delivery.

- **Characteristics of a Future Contract**

Following are the characteristics of a future contract.

(a) Exchange Traded: Future contracts are exchange traded. This provides a ready liquid market in which futures can be bought and sold. Some of these exchanges are Chicago Mercantile Exchange, Philadelphia Board of Trade, London International Financial Futures Exchange (LIFFE), Tokyo International Financial Futures Exchange (TIFFE), Sydney Futures Exchange, and Singapore International Monetary Exchange (SIMEX). In India, currency futures are sold at BSE and NSE.

(b) Selective Assets: The underlying of Financial Futures may be a security, index or foreign exchange. However, these are not available on all assets under a given category. For example, Stock Futures in NSE are available on 196 selected securities. Similarly, Index Futures are available on Nifty 50, Nifty Bank, Nifty Midcap Select, Nifty Financial Services. Currency futures, also, are not available on all foreign currencies.

(c) Standardisation: The contract is standardised as to quantity, date and month of delivery and the minimum amount by which price would move. A brief explanation follows:

- **Quantity:** Each deal has a market lot. Thus, if you want to enter into a futures contract in Reliance stock, you will have to buy 100Reliance, or in multiples thereof. Also referred to as the size of the contract, it specifies the quantity of the asset to be delivered for on contract.

- **Quality:** If you have entered into a futures contrast to sell 100 Infosys stock futures you will have to deliver 100 Infosys shares and not 100WIPRO shares.

- **Date and month of delivery:** The date and month of delivery is determined by the exchange. As of now the exchange has fixed the last Thursday of the month for settlement and delivery. You cannot enter into a futures contract to deliver on say a Friday or a Wednesday. Further, if you have contracted to deliver in October, you have to deliver in October and cannot have it postponed to November.

- **Units of price quote:** The minimum, and sometimes the maximum amount by which the price would change, is specified.

Thus "Reliance October stock futures" becomes a standard asset like any other asset that can be traded in the market.

d) **Clearing House:** In case of futures contracts, buyers and sellers do not come face-to-face. They operate through the clearing house. Clearing house is an entity that acts as counterparty to each transaction on futures market. Clearing house has the responsibility of maintaining accounts, margin payments and settlement of deliveries. A clearing house serves as the third party to all transactions. That is, the buyer of a futures contract effectively buys from the clearing house and the seller of a futures contract sells to the clearing house. This reduces the counterparty risk.

e) **Settlement Price:** Since the futures contracts are performed through a particular exchange, so at the close of the day of trading, each contract is marked-to-market (will be discussed in detail later in this section). For this the exchange establishes a settlement price. This settlement price is used to compute the profit or loss on each contract for that day. Accordingly, the member's accounts are credited or debited.

f) **Daily Settlement and Margin:** Another feature of a futures contract is that when a person enters into a contract, he is required to deposit funds with the broker, which is called as margin. The exchange usually sets the minimum margin required for different assets, but the broker can set higher margin limits for his clients which depend upon the credit-worthiness of the clients. The basic objective of the margin account is to act as collateral security in order to minimize the risk of failure by either party in the futures contract.

g) **Cash Settlement:** Most of the futures contracts are settled in cash by having the short or long to make cash payment on the difference between the futures price at which the contract was entered and the cash price at expiration date. This is done because it is inconvenient or impossible to deliver sometimes, the underlying asset such as in case of Index Futures.

h) **Delivery:** The futures contracts are executed on the expiry date. The counter parties with a short position are obligated to make delivery to the exchange, whereas the exchange is obligated to make delivery to the longs. The period during which the delivery will be made is set by the exchange which varies from contract to contract.

i) **Regulation:** Since Futures are exchange traded, they are well regulated by the market regulators. In India, RBI is empowered to regulate the interest rate derivatives, foreign currency derivatives and credit derivatives. Regulation of other types of derivatives comes under the purview of SEBI.

⊙ Types of Future Contracts

On the basis of the underlying asset, Futures contracts can be classified into the following types:

a. **Stock Futures:** These are Futures Contract on individual securities or stock. A stock futures contract is a commitment to buy or sell the financial exposure equivalent to a specific number of shares of the underlying stock at a predetermined price on a specified future date.

b. **Index Futures:** A stock index futures contract is a contract to buy or sell the face value of the underlying stock index where the face value is defined as being the value of index multiplied by the specified monetary amount. This device makes it possible to equate the value of the stock index with that of a specific basket of shares.

c. **Currency Futures:** A Currency Futures Contract is a commitment to either to buy or to sell a specified amount of a foreign currency on a future date at a specified exchange rate. They are extremely standardized in terms of available currencies, delivery dates, contract size.

d. Interest Rate Futures: An Interest Rate Futures contract is "an agreement to buy or sell a debt instrument at a specified future date at a price that is fixed today." At NSE the underlying security for Interest Rate Futures is either Government Bond or T-Bill. Exchange traded Interest Rate Futures on NSE are standardized contracts based on 6 year, 10 year and 13 year Government of India Security (NBF II) and 91-day Government of India Treasury Bill (91DTB). All futures contracts available for trading on NSE are cash settled.

Future Contract Terminology

a. Spot price: The price at which an underlying asset is traded in the spot market.

b. Futures price: The price that is agreed upon at the time of the contract for the delivery of an asset at a specific future date.

c. Contract cycle: It is the period over which a contract is traded.

d. Expiry date: It is the date on which the final settlement of the contract takes place.

e. Contract size: The amount of asset that has to be delivered for one contract. This is also called as the lot size.

f. Basis: Basis is defined as the futures price minus the spot price. There will be a different basis for each delivery month for each contract. In a normal market, basis will be positive. This reflects that futures prices normally exceed spot prices.

Forward Contracts vs. Future Contracts

Following are the major differences between Forward Contracts and Future Contracts:

Criteria		Forwards	Futures
1.	Standardization	Not standardization but negotiated	Standardized.
2.	Trading	Over the Counter	Exchange Traded
3.	Mode of Delivery	Cash settled or delivery	Normally cash settled.
4.	Transaction cost	Bid-ask spread	Includes brokerage fee
5.	Liquidity	Not liquid	Highly liquid
6.	Frequency of Physical Delivery	90% of all forward contracts are settled by actual delivery.	Very few future contracts are settled by actual delivery
7.	Margin	Not required	Required
8.	No. of contracts	Any number	Fixed annually
9.	Settlement	On expiry	Daily settlement

Marking to Market

Marking to market essentially means that at the end of the trading session (day), all outstanding contracts are repriced at the settlement price of that session (daily closing price). Margin account of those who made losses at debited and of those who gained are credited. The daily settlement reduces the default risk of futures contract relative to forward contracts.

Suppose, an investor takes a long position (i.e., agreed to buy) in an ACC futures contract with lot size 250 that matures on Thursday afternoon. The agreed upon price is. ₹2,100 per share. At the close of trading on Tuesday, the futures price has increased to ₹2,150. Due to the daily settlement feature, three things will occur.

First, the investor will receive his cash profit of ₹12,500. Second, the existing futures contract with price of ₹2,100 will be cancelled and third the investor will receive a new futures contract with the prevailing price of ₹2,150.

- **Margin Requirement**

Before entering into a futures contract, the prospective trader (investor) must deposit some funds with his broker which serve as a good faith deposit. In other words, an investor who enters into a futures contract is required to deposit funds with the broker called a margin. The basic objective of margin is to provide a financial safeguard for ensuring that the investors will perform their contract obligations.

In a futures market, there are three types of margin requirements – Initial (Minimum) Margin and Maintenance Margin.

(a) **Initial Margin:** The initial margin is the original amount that must be deposited into account to establish futures position. It varies from stock to stock. To determine the initial margin, the exchange usually considers the degree of volatility of price movements in the past of the underlying the asset. After that, the exchange sets the initial margin so that the clearing house covers losses on the position even in most adverse situation. The initial margin approximately equals the maximum daily price fluctuation permitted by the exchange for that underlying asset.

(b) **Maintenance Margin:** The maintenance margin is the minimum amount which must be remained (kept) in a margin account. If the balance of margin account falls below the maintenance margin level, the broker will make a margin call and ask the investor to deposit the amount so that the balance again reach the initial margin level.

If a margin call is made additional money is deposited by the trader/investor, to bring the account to the level of initial margin. This amount is called as the variation margin. In short variation margin is the amount needed to restore the initial margin once a margin call has been issued. The variation margin may change depending on how far the margin account has fallen below the maintenance margin level.

For example, assume that the initial margin on a futures contract is ₹ 5,000 and the maintenance margin ₹3,750 (75% of the initial margin). The next day assume that the party has sustained a loss of ₹1,000, reducing the balance in margin to ₹4,000. Further assume that on the next day the price decreased and sustained loss is ₹500. Thus, the balance remained in the margin account to ₹3,500, below the maintenance margin. In this situation, the broker will make a call (margin call) to replenish the margin account to ₹5,000, the level of initial margin.

Consider the following illustration.

Illustration 2

On June 15, Mr. X establishes a long position in 200 shares of Tata Steel on July 1 at a futures price ₹ 600 per share. Initial margin for contract is ₹30,000 and maintenance margin is ₹20,000. Future prices on June 16, 17, 18, 19, 21, 22, 23, 24 are ₹550, ₹650, ₹600, ₹605, ₹590, ₹580, ₹600, ₹620. Calculate his daily profit and loss, margin contribution/withdrawal and balance in the margin account.

Solution:

Calculation of daily profit/loss, margin contribution/ withdrawal and margin account balance (Contract Size 200 shares)

Day	Future Price (₹)	Daily gain/losses	Margin Contributions (+) Withdrawal (–)	Balance in Margin Account
June 15	600	–	–	30,000
June 16	550	(–) 10,000	–	20,000
June 17	650	+ 20,000	(–) 10,000	30,000
June 18	600	(–) 10,000	+ 10,000	30,000
June 19	605	+ 1,000	(–) 1,000	30,000
June 21	590	(–) 3,000	+ 3,000	30,000
June 22	580	(–) 2,000	+ 2,000	30,000
June 23	600	+ 4,000	(–) 4,000	30,000
June 24	620	+4,000	(–) 4,000	30,000

- **Concept of Continuous Compounding**

The concept of continuous compounding is closely associated with the calculation of theoretical forward and future prices. The concept is an extension of general periodical compounding.

We know that, if a sum P carrying r rate of interest p.a. for n years is compounded annually, then the compounded value will be, $A = P(1+r)^n$.

For example, a sum of ₹10,000 compounded at 10% p.a. for 2 years becomes

$$A = P(1+r)^n = 10{,}000\,(1+0.10)^2 = ₹12{,}100$$

Now, if the compounding is done for semi-annually, quarterly or monthly, then the compounded value of P with say, 'm' no. of compounding per year, will be

$$A = P\left(1+\frac{r}{m}\right)^{mn}$$

Where m = 2 for semi-annually, 4 for quarterly and 12 for monthly compounding. Similarly, for daily compounding m = 365.

If the compounding frequency is increased further, it can be shown mathematically that the compounded value of P with r rate of interest continuously compounded for n years will be

$$A = P \times e^{nr}$$

Similarly, for continuous discounting, the PV factor $\frac{1}{(1+r)^n} = (1+r)^{-n}$ can be replaced by e^{-nr}.

Thus, in our example, after 2 years, ₹10,000 with interest rate 10% p.a. continuously compounded will become

$$A = P \times e^{nr} = 10{,}000 \times e^{0.10 \times 2} = ₹12{,}214$$

Pricing of Financial Forward and Futures

The financial forward and futures contracts are priced using the Cost of Carry Model. With varying degrees of success, the model can also be used to value some non-financial contracts such as Gold.

The pricing is done in such a way that no arbitrage opportunities arise. Arbitrage refers to a trade which leads to a risk-free profit with no cash outlay. It is not expected to be present in the markets operating well, but market imperfections, such as transactions costs, etc., do allow arbitrage opportunities and, therefore, the actual prices may deviate from their theoretical values that are calculated by the model.

- **Assumptions of the Model**

  The Cost of Carry Model is based on certain fundamental assumptions.

  a. The markets are perfect.

  b. There are no transaction costs.

  c. All the assets are infinitely divisible.

  d. Bid-ask spreads do not exist so that it is assumed that only one price prevails.

  e. There are no restrictions on short selling. Also, short sellers get to use full proceeds of the sales.

  f. Traders are ready to take advantage of arbitrage opportunities as and when arise.

- **Notations Used**

  Following are the notations to be used in the model:

  T = Time remained up to delivery date in the contract

  S = Price of the underlying asset at present, also called as spot or cash or current

  K = Delivery price in the contract at time T

  F* = Theoretical Forward or future price today = TFP

  F = Actual Forward or Future price today = AFP

  r = Risk free rate of interest per annum today

- **The Model**

  The carry pricing model stipulates that the forward or futures price, defined as the value of one unit of the asset underlying the contract, is equal to the sum of the spot price and the carrying costs incurred by buying and holding on to the deliverable asset, less the carry return, if any. Thus, Forward (or Futures) Price = Spot Price + Carry Costs – Carry Return

  Here, Spot Price is the current price of one unit of the deliverable asset in the market. Carry Costs refer to the holding costs, including the interest charges on borrowing the cash to buy (or the opportunity cost of using one's own funds) the asset. In case of physical commodities, the carrying costs also include costs such as insurance, obsolescence, storage, etc. Carry Return refers to the income, such as dividends on shares, which may accrue to the investor.

- **Pricing of Forward Contracts (on Investment Assets i.e., Securities)**

  A. For Securities Providing No Income

  This is the easiest forward contract to value, and is exemplified by a share which is not expected to pay any dividend, or by discount bonds. In order that there be no arbitrage opportunities, the forward price should be:

$$TFP = F^* = S_0\, e^{rt}$$

  Here, S_0 is the spot price of the asset underlying the contract, r is the risk-free rate of interest per annum with continuous compounding, and t is the time to maturity.

  Now, if TFP(F) > AFP(F*), then the arbitrageur can buy the asset and will go for short forward contract on the asset.

  But, if TFP(F) < AFP(F*), then he can short the asset and go for long forward contract on it.

  Consider the following illustration.

Illustration 3

Mr. X is long on a forward contract to purchase a non-dividend paying share in 3 months. The current market price of the share is ₹70 and the three-month risk-free rate of interest is 6% p.a. continuously compounded. Calculate the theoretical forward price. Is there any arbitrage opportunity if the actual forward price is (i) ₹73 and (ii) ₹71?

Solution:

Given, S_0 = ₹70; r = 6% p.a.c.c; t = 3 months = 3/12 years.

So, theoretical forward price,

$F^* = S_0\ e^{rt} = 70 \times e^{0.06 \times 3/12} = 70 \times 1.0202 =$ ₹71.41

(i) When the three months forward price is ₹73, the arbitrageur can borrow ₹70 @ 6% for three months, buy one share at ₹70 and short a forward contract for ₹71.41. At the end of three months, the arbitrageur sells the share for ₹73, repay the loan amount of ₹71.41 and make a profit of ₹(73 – 71.41) = ₹1.59

(ii) If the three-month forward price is ₹71, the arbitrageur can short one share, invest the proceeds of the short sale at 6 percent per annum for three months, and have a long position in a three-month forward contract. The proceeds of short sales will grow to ₹71.41 at the end of three months. The arbitrageur will pay ₹71 and take the delivery of the share under forward contract, and uses it to close its short sale position. His net gain is ₹ (71.41 – 71) = ₹0.41.

B. For Securities Providing a Known Cash Income

Let the present value of the known cash income = I, then, the forward price should be:

$$F^* = (S_0 - I).\ e^{rt}$$

Now, if that F > F*, an arbitrageur can short a forward contract, borrow money and buy the asset. When the income is received, the same is used to partly repay the loan. At maturity, the asset is sold for F and the outstanding loan of is repaid. This result in a net profit of $(S_0 - I)e^{rt}$. On the other hand, if F< F*, then an arbitrageur can short the asset, invest the proceeds, and take a long position in a forward contract. This operation will yield net gain of $[(S_0 - I)\ e^{rt} - F]$ at maturity.

Consider the following illustration.

Illustration 4

A 6-month forward contract on 100 shares with a price of ₹38 each is available. The risk-free rate of interest (continuously compounded) is 10% per annum. The share in question is expected to yield a dividend of ₹1.50 in 4 months from now. Determine the forward price.

Solution:

Given, S_0 = ₹38; r = 10% p.a.c.c; t = 6 months = 6/12 years.

I = PV of dividend = $1.50 \times e^{-0.10 \times 4/12} = 1.4508$

So, theoretical forward price,

$F^* = (S_0 - I)e^{rt} = (38 - 1.4508) \times e^{0.10 \times 6/12} =$ ₹38.4231

So, the forward price should be ₹38.4231.

C. For Securities Providing a Known Yield

Instead of a known cash income, securities may provide a certain yield. Stock indices may be regarded as such securities. The shares included in the portfolio comprising the index are expected to return dividends in the course of time which may be expressed as a percentage of their prices, termed as yield, and thus be related to the index. Theoretically, it is assumed to be paid continuously at a rate of y per annum.

In such a case, the forward price will be calculated as follows:

$$F^* = S_0\, e^{(r-y)}\, t$$

Consider the following illustration.

Illustration 5

Consider a 6-month forward contract on a security where 4% p.a. continuous dividend is expected. The risk-free rate of interest is 10% p.a. continuously compounded. The asset's current price is ₹25. Determine the forward price.

Solution:

Given, S_0 = ₹25; r = 10% p.a.c.c; t = 6 months = 6/12 years; y = 4% p.a

So, theoretical forward price,

$F^* = S_0\, e^{(r-y)\,t}$

$= 25 \times e^{(0.10-0.04)\times 6/12}$ = ₹25.76

Note: Value of a Forward Contract

On the basis of generalization in different situations, the value of a forward contract can be determined. The value of a forward contract at the time it is first written (entered) into is zero. However, at later stage, it may prove to have a positive or negative value. In general, the value of a long forward contract can be determined as follows:

$$f = (F^* - K)e^{-rt}$$

where, f = value of the forward contract, F* = Forward price, K = delivery price

Similarly, the value of a short forward contract can be determined as follows:

$$f = (K - F^*)e^{-rt}$$

Consider the following illustration.

Illustration 6

Consider a 6 month long forward contract on a non-dividend paying stock. The risk-free rate of interest is 6% p.a. continuously compounded. The current stock price is ₹60 and the delivery price is ₹56. Compute the value of the forward contract.

Solution:

Given, S_0 = ₹60; r = 6% p.a.c.c; t = 6 months = 6/12 years; K = ₹56

So, $F^* = S_0\, e^{rt} = 60 \times e^{0.06 \times 6/12}$ = ₹61.80

Value of the long forward contract = $f = (F^* - K)e^{-rt} = (61.80 - 56)e^{-0.06 \times 6/12}$ = ₹5.62

Pricing of Futures Contracts (Stock and Index Futures)

Comparable forward and futures prices tend to be practically the same. In fact, it may be shown that in a perfect market where the interest rates remain unchanged, the futures prices would equal the forward prices, with the marking to the market having no impact on the prices. However, when interest rates are variable, the two may be different. Broadly speaking, if movements in the futures prices are positively correlated to the interest rates, then the futures prices are likely to be higher than the forward prices. As futures' prices increase, long positions on futures are profitable. If the interest rates also rise simultaneously (a positive correlation), then the marking to market cash inflows can be reinvested at higher rates. Similarly, if interest rates fall when futures prices fall (still a positive correlation) then losses that long position holders incur can be offset by borrowing at lower interest rates. Consequently, the futures prices tend to be bid higher in relation to the forward prices. The reverse happens when the futures prices and interest rates are negatively correlated. That is to say, when interest rates tend to decline with an increase in the futures prices, then the cash flows resulting from marking to the market would be reinvested at lower interest rates, while increased interest rates associated with falling futures prices would imply that losses to long position on futures have to be offset by borrowing at higher rates of interest. This has the effect of bidding lower futures prices than those of forward contracts.

However, these results tend to hold in case of perfect markets. In the imperfect real world, markets, this does not work so well - the presence of transactions costs, indivisibilities and taxes tend to weaken these propositions. Accordingly, the futures prices may be reasonably taken to be the same as forward prices derived from the cost of carry model.

A. Pricing of Stock Futures

The formula for determining the future price of a stock future is exactly similar to that of the forward price. So, it will not be discussed separately.

B. Pricing of Index Futures

With reference to the previous discussion on forward pricing, the theoretical futures price under three situations can be determined as follows:

a. When the securities included in the index are not expected to pay any dividends during the life of the contract

$$F^* = S_0\, e^{rt}$$

b. When dividend is expected to be paid by one or more of the securities included in the index during the life of the contract.

$$F^* = (S_0 - I).\, e^{rt}$$

c. When dividend on the securities included in the index is assumed to be paid continuously during the life of the contract. (i.e., dividend yield is known)

$$F^* = S_0\, e^{(r-y)\,t}$$

Where, F* is the future price.

Consider the following illustration.

Illustration 7

Tripti has two investment opportunities, M and N, carrying an yield of 15% p.a. the tenor of both these investments is 3 years.

M offers continuous compounding facility, whereas N offers yield on the basis of monthly compounding. Which offer will Tripti opt for?

If continuous compounding facility comes at a price of ₹180 p.a. per lakh of deposit (chargeable at the end of the period), what will be the position?

At what price, will Tripti be indifferent to Continuous Compounding Facility and Monthly Compounding?

Solutions:

1. Return on Investment

Particulars	Investment M	Investment N
Investment (assumed)	₹20,00,000	₹20,00,000
Amount receivable on Maturity (A)	$A = P \times e^{r \times t}$ $= ₹20,00,000 \times e^{0.15 \times 3}$ $= ₹20,00,000 \times e^{0.45}$ = ₹20,00,000 × 1.5683 = ₹31,36,600	$A = P \times (1 + r/m)^{n \times m}$ $= ₹20,00,000 \times (1 + 0.15/12)^{3 \times 12}$ $= ₹20,00,000 \times (1 + 0.0125)^{36}$ $= ₹20,00,000 \times (1.0125)^{36}$ = ₹20, 00,000 × 1.563944 = ₹31,27,888
Charges payable at ₹180 p.a. per lakh	20 × ₹180 p.a. × 3 years = ₹10,800	Nil
Net Amount Receivable upon Maturity	₹31,36,600 – ₹10,800 = ₹31,25,800	₹31,27,888 – Nil = ₹31,27,888

2. Evaluation of Investments

Case A (No charges for continuous compounding): Investment M is preferable, as it offers a higher return on maturity.

Case B (Charges for Continuous Compounding): Investment N is preferable, as amount receivable is higher than net amount receivable in Investment M.

3. Indifference Point

Tripti will be indifferent to Investment M and N, if

Amount Receivable under Maturity in Investment N	=	Amount Receivable under Maturity in Investment M	Less	Charges for Continuous Compounding

⇨ ₹31,27, 888 = ₹31,36,600 Less Charges

⇨ Charges = ₹31,36,600 Less ₹31,27,888 = ₹8,712

⇨ Chagres per Lakh per Annum = ₹8,712 ÷ (3 Years × 20)

= ₹8,712 ÷ 60

= ₹145.20

Conclusion: the price payable for Investment M is ₹145.20 per lakh per annum for Tripti to be indifferent to both the investment alternatives.

Illustration 8

Theoretical Forward Price - No Dividends, No Carrying Cost Compute the theoretical forward price of the following securities for 1 month, 3 months and 6 months –

Securities of	DD Ltd.	EE Ltd.	FF Ltd.
Spot price [S_o]	₹160	₹2,600	₹600

You may assume a risk free interest rate of 9% p.a. and 12% p.a.

Solution:

1. Theoretical Forward Price

Theoretical Forward Price of Security × $[F_x] = S_x \times e^{rt}$

Where, S_x = Current Spot Price of Security X

r = Rate of Interest

t = Period in Years

2. Forward Price of Securities of the Companies

a) DD Ltd.

Period (t)	r = 9% p.a. or 0.09	r = 12% p.a. or 0.12
1 Month or 1/12 year i.e. 0.0833	F_A = ₹160 × $e^{0.09\times0.0833}$ = ₹160 × $e^{0.0075}$ = ₹160 × 1.007528 = ₹161.20	F_A = ₹160 × $e^{0.12\times0.0833}$ = ₹160 × $e^{0.01}$ = ₹160 × 1.01005 = ₹161.608
3 Months or 3/12Year i.e. 0.25	F_A = ₹160 × $e^{0.09\times0.25}$ = ₹160 × $e^{0.0225}$ = ₹160 × 1.022755 = ₹163.641	F_A = ₹160 × $e^{0.12\times0.25}$ = ₹160 × $e^{0.03}$ = ₹160 × 1.030456 = ₹164.873
6 Months or 6/12 i.e. 0.50	F_A = ₹160 × $e^{0.09\times0.50}$ = ₹160 × $e^{0.045}$ = ₹160 × 1.046028 = ₹167.3645	F_A = ₹160 × $e^{0.12\times0.50}$ = ₹160 × $e^{0.06}$ = ₹160 × 1.061837 = ₹169.8939

(b) EE Ltd.

Period (t)	r = 9% p.a. or 0.09	r = 12% p.a. or 0.12
1 Month or 1/12 year i.e. 0.0833	F_A = ₹2,600 × $e^{0.09\times0.0833}$ = ₹2,600 × $e^{0.0075}$ = ₹2,600 × 1.007528 = ₹2,619.573	F_A = ₹2,600 × $e^{0.12\times0.0833}$ = ₹2,600 × $e^{0.01}$ = ₹2,600 × 1.01005 = ₹2,626.13
3 Months or 3/12Year i.e. 0.25	F_A = ₹2,600 × $e^{0.09\times0.25}$ = ₹2,600 × $e^{0.0225}$ = ₹2,600 × 1.022755 = ₹2659.163	F_A = ₹2600 × $e^{0.12\times0.25}$ = ₹2600 × $e^{0.03}$ = ₹2600 × 1.030456 = ₹2,679.186
6 Months or 6/12 i.e. 0.50	F_A = ₹2,600 × $e^{0.09\times0.50}$ = ₹2,600 × $e^{0.045}$ = ₹2,600 × 1.046028 = ₹2,719.673	F_A = ₹2600 × $e^{0.12\times0.50}$ = ₹2600 × $e^{0.06}$ = ₹2600 × 1.061837 = ₹2,760.776

(c) FF Ltd.

Period (t)	r = 9% p.a. or 0.09	r = 12% p.a. or 0.12
1 Month or 1/12 year i.e. 0.0833	F_A = ₹600 × $e^{0.09×0.0833}$ = ₹600 × $e^{0.0075}$ = ₹600 × 1.007528 = ₹604.517	F_A = ₹600 × $e^{0.12×0.0833}$ = ₹600 × $e^{0.01}$ = ₹600 × 1.01005 = ₹606.03
3 Months or 3/12 Year i.e. 0.25	F_A = ₹600 × $e^{0.09×0.25}$ = ₹600 × $e^{0.0225}$ = ₹600 × 1.022755 = ₹613.653	F_A = ₹600 × $e^{0.12×0.25}$ = ₹600 × $e^{0.03}$ = ₹600 × 1.030456 = ₹618.274
6 Months or 6/12 i.e. 0.50	F_A = ₹600 × $e^{0.09×0.50}$ = ₹600 × $e^{0.045}$ = ₹600 × 1.046028 = ₹627.617	F_A = ₹600 × $e^{0.12×0.50}$ = ₹600 × $e^{0.06}$ = ₹600 × 1.061837 = ₹637.102

Illustration 9

Shares of Sandeep Ltd. are being quoted at ₹600. 3-Months Futures Contract Rate is ₹ 636 per share for a lot size of 500 shares. If the Sandeep Ltd. Is not expected to distribute any dividend in the interim, risk free rate of return is 9%, what is the recommended course of action for a trader in shares?

If the 3-Months Futures Contract Rate is 600, what should be the action?

Solution:

1. Computation of Theoretical Forward Rate [TFP]

Particulars	Value
Spot Price [S_x]	₹600
Risk Free Interest Rate [r]	9% or 0.09
Period [t]	3 Months or 3/12 yrs i.e. 0.25
Theoretical Forward Rate [TFP_x] = S_x × e^{rt} = ₹600 × $e^{0.09 \times 0.25}$ = ₹600 × $e^{0.0225}$ = ₹600 × 1.022755	613.653

2. Evaluation and Suggested Course of Action

Particulars	Case A	Case B
3-Months Futures Contract Rate [AFP_x]	₹636	₹600
TFP_x Vs. AFP_x	AFP_x is Higher	AFP_x is Lower
Valuation in Futures Market	Overvalued	Undervalued
Action	Buy Spot. Sell Future	Sell Spot. Buy Future

Illustration 10

Compute the theoretical forward price of the following securities for 2 month, 3 months and 4 months —

Securities of	A Ltd.	B Ltd.	D Ltd.
Spot Price [S_0]	₹4,550	₹360	₹900
Dividend Expected	₹50	₹20	₹50
Dividend Receivable in	2 Months	3 Months	4 Months
6 Month's Futures Contract Rate	₹4600	₹390	₹920

You may assume a risk-free interest rate of 9% p.a.

What action should follow to benefit from futures contract?

Solution:

Securities of	A Ltd.	B Ltd.	D Ltd.
Spot Price [S_0]	₹4,550	₹360	₹900
Dividend Expected [D_F]	₹50	₹20	₹50
Dividend Receivable in [t]	2 Months or 1/6 Year or 0.1667	3 Months or 1/4 Year or 0.25	4 Months or 1/3 year or 0.333
Risk Free Interest Rate [r]	9% or 0.09	9% or 0.09	9% or 0.09
Present Value of Dividend [I]	$D_F \times e^{-rt}$	$D_F \times e^{-rt}$	$D_F \times e^{-rt}$
	$= 50 \times e^{-0.09 \times 0.1667}$	$= 20 \times e^{-0.09 \times 0.25}$	$= 50 \times e^{-0.09 \times 0.333}$
	= ₹49.256	= ₹19.555	= ₹48.522
Adjusted Spot Price [$S_0 - I$]	₹4550 – ₹49.256	₹360 – ₹19.555	₹900 – ₹48.522
	= ₹4500.744	= ₹340.445	= ₹851.478
Theoretical Forward Price [TFP]	$= 4500.744 \times e^{0.09 \times 0.50}$	$= 340.445 \times e^{0.09 \times 0.50}$	$= 851.478 \times e^{0.09 \times 0.50}$
	$= 4500.744 \times e^{0.045}$	$= 340.445 \times e^{0.045}$	$= 851.478 \times e^{0.045}$
	$= 4500.744 \times 1.04603$	$= 340.445 \times 1.04603$	$= 851.478 \times 1.04603$
	= ₹4707.91	= ₹356.312	= ₹890.672
6 Months Futures Contract Rate [AFP]	₹4600	₹390	₹920
TFP Vs. AFP	AFP_X is Lower	AFP_X is Higher	AFP_X is Higher
Valuation in Futures Market	Undervalued	Overvalued	Overvalued
Recommended Action	Sell Spot. Buy Future.	Buy Spot. Sell Future.	Buy Spot. Sell Future.

Illustration 11

A four month European call option on a dividend paying stock is currently selling for ₹5. The stock price is ₹66, the strike price is ₹60, and a dividend of ₹0.80 is expected in one month. The risk free interest rate is 12% per annum for all maturities. Do you have arbitrage?

Solution:

Particulars	Amount
Spot Price [S_0]	₹66
Dividend Expected [D_F]	₹0.80

Dividend Receivable in [t]	1 Month or 1/12 Year or 0.0833
Risk Free Interest Rate [r]	12% or 0.12
Present Value of Dividend [I]	DF × e^{-rt}
	= ₹0.80 × $e^{-0.12\times1/12}$
	= ₹0.80 × $e^{-0.01}$
	= ₹0.80 ÷ 1.01005 = ₹0.7920
Adjusted Spot Price = $S_0 - I$	₹66 - ₹0.7920 = ₹65.208
Theoretical Forward Price = TFP	= $(S_0 - I)\, e^{rt}$
	= 65.208 × $e^{0.12\times4\div12}$
	= 65.208 × $e^{0.04}$
	= 65.208 × 1.0408 = ₹67.868

Illustration 12

The price of Compact Stock of a face value of ₹10 on 31st December, 2024 was ₹414 and the futures price on the same stock on the same date i.e., 31st December, 2024 for March, 2025 was ₹444.

Other features of the contract and the related information are as follows:

- Time to expiration 3 months (0.25 year)
- Annual dividend on the stock of 30% payable before 31.3.2025.
- Borrowing Rate is 20 % p.a.

Based on the above information, calculate future price for Compact Stock on 31st December, 2024. Please also explain whether any arbitrage opportunity exists.

Solution:

Calculation of Future Price

Particulars	Remarks
Spot Price [S_0]	₹414
Expected rate of Dividend [y]	30% or 0.30
Borrowing Rate	20%
Tenor / Time Period [t] in Years	3 Months or 0.25 Year
Present Value of Dividend [I]	= (30% × 10) × $e^{-0.20\times0.25}$
	= (30% × 10) ÷ 1.05127
	= 3 ÷ 1.05127 = 2.8537
Adjusted Spot Price [Spot Price- Present Value of Dividend] [$S_0 - I$]	= 414 - 2.8537 = ₹ 411.1463
Theoretical Forward Price [TFP] TFP = [$S_0 - I$] × $e^{(r-y)\times t}$	= ₹411.1463 × $e^{0.20\times0.25}$
	= ₹411.1463 × $e^{0.05}$
	= ₹411.1463 × 1.05127 = ₹432.23
3-Months Futures Contract Rate [AFP]	₹ 444

TFP Vs. AFP	AFP is Higher
Inference	AFP is overvalued
Recommended Action	Buy Spot. Sell Future.

Cash Flows to Gain on the Arbitrage Opportunity

Activity Flow:

(a) Borrow ₹414 for a period of 3 months at the rate of 20% p.a.

(b) Buy the Stock at ₹414 at T_0

(c) Receive the Dividend at the time of 3 months [₹10 × 30% = ₹3].

(d) Sell the Index Futures at the Forward Price at the end of 3 months [₹444].

(e) Repay the amount of Loan with Interest at the end of the period.

Cash Flows arising out of the activities to gain on the Arbitrage:

Sl. No.	Particulars	₹
(a)	Borrow for a period of 3 months and Buy Stock at T_0	414
(b)	Receive the Dividend at the end of 3 months	3
(c)	Sell the Futures at the Forward Price at the end of 3 months	444
(d)	Repay the amount of borrowing together with Interest = [$414 \times e^{0.20\times0.25}$]	(435.23)
(e)	Net Cash Inflow [(b + c) – d]	11.77

Illustration 13

Super Polycarbons Ltd. has the following information about LDPE and HDPE granules (raw material used for Manufacturing Plastic films, Polyfilms and Plastic Sheets) –

Stock Item	LDPE Granules	HDPE Granules
Current Market Price i.e. spot price [S_0]	₹75 per Kg	₹85 per Kg
Carrying Cost	4% p.a. [continuous compounding]	₹100 per Quintal per quarter (payable after 2 months)
3-Month's Futures Contract Rate (500 Kgs)	₹38,500	₹44,600

Risk free interest rate is at 12% p.a. Advise Super Polycarbons on the course of action to be taken?

Solution:

1. Evaluation of futures Contract Option for LDPE Granules

Inventory / Commodity	LDPE Granules
Spot Price [S_x]	₹75 per kg
Storage costs [rate] [C]	4% or 0.04

Tenor / time Period [t] in years	3 Months or 0.25 Year
Risk free Interest rate [r]	12% or 0.12
Theoretical Forward Price [TFP_x] per kg $TFP_x = S_x \times e^{(r+c)\times t}$ $= ₹75 \times e^{(0.12 + 0.04) \times 0.25}$ $= ₹75 \times e^{0.16\times0.25}$ $= ₹75 \times e^{0.04}$ $= ₹75 \times 1.0408$	₹78.06
TFP_x per lot size of 500kg [500kgs × ₹78.06 per kg]	₹39,030
3-Months Futures Contract rate [AFP_x]	₹38,500
TFP_x Vs. AFP_x	AFP_x is Lower
Valuation is Futures Market	Undervalued
Recommended Action	Buy Future. Sell Spot

2. Evaluation of Futures Contract Option for HDPE Granules

Inventory / Commodity	HDPE Granules
Spot Price [S_x]	₹85 per kg or ₹42,500 per Lot of 500 kgs
Storage Costs [rate] [C] (payable after 2 months)	₹100 per Quintal (i.e. 100 kgs) per quarter or ₹500 per lot of 500 kgs.
Tenor / Time Period [t] in Years	2 Months or 0.1667 Year
Risk Free Interest Rate [r]	12% or 0.12
Present Value of Storage Costs [C_p] $C_F = e^{-rt}$ or $C_F \div e^{rt}$ $= ₹500 \div e^{0.12 \times 0.16667}$ $= ₹500 \div e^{0.02}$ $= ₹500 \div 1.0202$	₹490.10
Adjusted Current Spot Price of HDPE Granules S_{Adj} [Spot Price ₹42,500 + Present Value of Storage Costs C_p ₹490.10]	₹42,990.10
Theoretical Forward Price [TFP_x] per kg $TFP_x = S_{Adj} \times e^{rxt}$ $= ₹42,990.10 \times e^{0.12\times0.25}$ $= ₹42,990.10 \times e^{0.03}$ $= ₹42,990.10 \times 1.03045$	₹44.299.15
3-Months Futures Contract Rate [AFP_x]	₹44,600
TFP_x Vs. AFP_x	AFPx is Higher
Valuation in Futures Market	Overvalued
Recommended Action	Buy Spot. Sell Future

Illustration 14

The following data relates to DCB Ltd's share prices:

Current Price per share	₹170
Prices per share the futures market - 6 months	₹190

It is possible to borrow money in the market for securities transactions at the rate of 12% p.a.

Required –

(a) Calculate the theoretical minimum price of 6 month-futures contract.

(b) Explain if any arbitraging opportunities exist.

Solution:

a. Theoretical Futures Price

Particulars	Value
6-months Futures Price	₹190
Current Stock Price [S_x]	₹170
Borrowing Rate (r)	12% or 0.12
Time (in years)	6/12 = 0.5 year
Theoretical Futures Price [F_x]	$= S_x \times e^{rt}$ $= ₹170 \times e^{0.12\times0.5}$ $= ₹170 \times e^{0.06}$ $= ₹170 \times 1.0618$ $= ₹180.506$

Inference: Since the Theoretical Futures Price is less than the Expected Futures Price, the recommended action would be to sell in the Futures Market.

b. Cash Flows to gain from Arbitrage Opportunity Activity Flow:

Arbitrageur can borrow the amount required to buy the shares at the current market price i.e. ₹170 at the rate of 12% p.a. for 6 months

1. Enter into a Futures Contract to sell Shares at the rate of ₹190
2. On the expiry date, sell the shares at the 6-month Futures rate of ₹190.
3. Pay the amount of Borrowing together with Interest i.e. [$170 \times e^{0.12\times0.5}$] = ₹180.506.

Particulars	Time	₹
1. Borrow at the rate of 12% for 6 months	T_0	170
2. Enter into a Futures Contract to sell Shares	T_0	-
3. On the expiry Date, sell the shares at 6-months Forward Rate	T_1	190
4. Repay the amount of borrowing together with interest [$170 \times e^{0.12\times0.5}$] = [170 × 1.0618]	T_1	180.506
5. Net Gain made [(3) – (4)]	T_1	9.494

Divergence of Future Price and Spot Price – The Basis

The difference between the futures price and the spot price is known as Basis. In other words,

Basis = Future Price − Spot Price

In a "normal market", the futures price would be greater than the spot price and, therefore, the basis will be positive, while in an "inverted market", the reverse holds. In an inverted market, the basis is negative since the spot price exceeds the futures price in such a market. The futures price is expected to be higher than the spot price because of the carrying costs. However, as the delivery month approaches, the basis declines until the spot and futures prices are approximately the same. This phenomenon is known as convergence.

1. Normal backwardation
2. Contango
3. Expectation principle

Normal Backwardation: According to this hypothesis, the expected basis is negative as the futures price tends to be a downward estimate of its spot price in the cash market at the contract's maturity date.

Contango: This hypothesis assumes the other possibility—the hedgers generally buy the contracts, while the speculators generally sell the contracts. It contends the speculators, because of their knowledge and expertise about the futures market, and the inefficiencies of the market, are largely willing to assume the price risk in anticipation of earning profits. In view of the anticipated profits, they bid up the prices of the commodity contracts, which results in a positive basis.

Expectation Principle: This theory postulates that the expected basis would be equal to zero. This is based on the argument that futures prices are an unbiased estimate of expected future spot prices, as would be expected in an efficient market. Thus, there is no room for any excess returns for either the hedgers or the speculators.

⊙ Hedging through Futures

Hedge means to protect or lock in a value. In order to perform a hedge we need two assets. We need another asset to protect the one which we are holding and for which we are trying to create a hedge.

The behaviour of the two assets is the key in deciding the hedge. The asset chosen to hedge the existing asset can be positively correlated with the existing asset or it can be negatively correlated. If the asset chosen for the purpose of hedging is positively correlated with our existing asset, then we sell the asset else we buy that asset. The reason being when the asset prices fall, both the assets would lose value. In such a scenario, the asset which we have sold would give gains thereby offsetting the loss in the existing asset. On the same lines, when asset prices rise, the asset used for hedging would lose value, since we have sold them and again it would offset the gains of the existing asset. Thus, in both the scenarios, both the assets put together gives us net zero gains. In other words, the existing asset retains its original value i.e., original value is locked.

Hedging is adopted when we believe that the existing assets are likely to lose value and our intention is to protect the existing value. In other words, we expect the unfavourable event to occur. What happens if the original view (i.e., unfavourable event) does not materialize? The hedge does not provide any benefit; it simply locks in a value that existed when the hedge was initiated. Therefore, hedge is not adopted if unfavourable event is not expected to happen. Hedging is not aimed to make gains or reduce losses; it is aimed at locking a value of a commodity, stock or portfolio.

The goal of a hedge transaction is to create a position that, once added to an investor's portfolio, will offset the price risk of another. A hedge can be so constructed that one can have partial protection say to the extent of 50% or 75% etc. In that case we would have only that much protection and in an unfavourable situation we would be losing 50% or 25% respectively.

a. Hedging while having stocks in the portfolio

If a Fund Manager, wishes to hedge a stock or portfolio position with stock futures or index futures, the basic hedging strategy would be to take an equal and opposite position in the futures market. The second pertinent point is to know the extent of hedging required. If 100% hedging is required then, the desired futures position (value) would equal the portfolio or stock position already held; else proportionate value of futures would be sold. Then the last valid point to be remembered is to account for beta of the stock or portfolio that is being hedged. If the stock is hedged using same stock futures, then the beta is irrelevant as both would have same beta. However, if the portfolio/stock is hedged using index futures then beta is relevant, because the portfolio/stock may have beta less or more than that of market (index futures represents market as a whole). In order to ensure the portfolio position is perfectly hedged it is essential to sell beta times the value of index futures position. Here we say that beta is the hedge ratio. A point to note here would be that, if the market rallies, the opportunity to gain from it will be lost but the portfolio can be protected from a market sell-off, which was the original intent.

Example 1: Consider Mr. X, a portfolio manager managing a portfolio (beta 1.5) whose current market value of ₹ 67.50 Crores. It is expected that the markets are likely to correct downwards and hedging needs to be adopted using NIFTY index futures. Currently index futures are quoted at 4500 with each contract underlies 100 units. Let us examine a situation when markets correct 10% down and also a possibility market trend upwards by 10% against the belief of Mr. X. Let us assume that Mr. X hedged 100% of his portfolio. Each NIFTY index contract is worth ₹ 4,500 × 100 = ₹4,50,000. Value of the portfolio is = ₹ 67.50 Crores Value of Index Futures required to be hedged = Beta times value of portfolio = 1.5 × 67.50 Crores = ₹101.25 Crores Number of NIFTY index contracts to be sold (Since we hold (bought) assets, hedging using other asset should be opposite i.e., sell) = 101.25 Crores /450000 = 2250.

	Market Change	Portfolio Gain	Index Futures	Net Gain / Loss
Pessimistic	–10%	1.5 times 10% i.e., 15% fall in portfolio value = –10.125 Crores	10% gain in futures = +10.125 Crores	Nil
Optimistic	+10%	1.5 times 10% i.e., 15% gain in Portfolio value = +10.125 Crores	10% loss in futures = –10.125 Crores	Nil

Had Mr. X hedged only 50% of his portfolio value, the net gain or loss would not be nil. He would have got only 50% of protection in case of market fall. Thus, when market falls by 10%, against his loss of ₹10.125 Crores, he would have gained only ½ of ₹10.125 Crores in the futures market, since he would have hedged only 50%.

b. Hedging while having money in the account

Having money in the account and not investing in stocks, owing to absence of enough research inputs would not make sense, especially if it is known that the market is likely to rally. In such cases it is prudent to buy Index Futures and participate in the rally and liquidate the futures position, once the rally is over or stocks are ready to be purchased. Another advantage is for buying futures; only around 10% of the total value would be deposited as margin, enabling the fund/ person to deploy the balance to earn money market returns. Had the market not rallied he would have bought the stocks cheaper than originally decided.

Example 2: Consider Mr. Y, a portfolio manager who have been informed that there is an inflow of ₹100 Crores in his new scheme launched this month. While his research department is busy in preparation of final list of stocks that can be bought as part of his portfolio, it is learnt that further one month would pass before the final stock list is provided to Mr.Y. Meanwhile Mr. Y learns that market is set to rally in the next one month. By parking money in cash and money market instruments for one month is not going to help him in a big way as returns are going to be far less as compared to market returns. The best thing Mr. Y can do is to buy Index futures now and ride the rally and sell off at the end of month. By the end of month research department would have prepared the final list. Though the stocks in general would have inched up, the gains from futures would have compensated sufficiently. Stock index futures allow investors to hedge systematic (market) risk. This is desirable for investors attempting to earn the unique part of a stock's return while avoiding market risk. The futures contract helps to protect the portfolio against market fluctuations. Speculators buy or sell futures contracts in an attempt to earn a return. They are willing to assume the risk of price fluctuations, hoping to profit from them.

c. To modify systematic risk

A fund manager can decrease or increase the systematic risk (market risk) of the portfolio by selling or buying appropriate number of index futures, so that the following equation is satisfied:

Original Portfolio Value × Original Beta ± Futures Position = Original Portfolio Value × Desired Beta.

Selling Futures position reduces the overall systematic risk and vice versa. Consider the same example of Mr. X, discussed under Example 1. The portfolio beta is 1.5 and the current market value is ₹67.50 Crores. Since the markets are expected to correct downwards and in such a situation if he wants to reduce beta of his portfolio, he can do so by adding another asset whose beta is lower and have a combined portfolio with lower beta, which will protect him from market fall. Let us assume that Mr. X wants to reduce the beta to 1.00. Two strategies can be adopted. (a) Mr. X can stay in cash (beta = 0) say to the extent of 20%, by selling the stocks, but in times of sudden fall in the market opportunity to sell is seldom available. (b) Mr. X can use NIFTY index futures just enough to bring the overall beta to the desired level. Mr. X would sell index futures to achieve this objective. The following equation would have to be satisfied.

Original Portfolio Value × Original β – Futures Position = Original Portfolio Value × Desired β

= 67.50 Crores × 1.5 – X = 67.50 Crores × 1.0 i.e., X = 33.75 Crores.

This means Mr. X would sell NIFTY index futures worth ₹33.75 Crores, by selling 33.75 Crores / 4.5 lakhs = 750 Contracts.

	Market Change	Portfolio Gain	Index Futures	Net Gain / Loss
Pessimistic	–10%	1.5 times 10% i.e., 15% fall in portfolio value = –10.125 Crores	10% gain in futures = +3.375 Crores	–6.75 Crores*
Optimistic	+10%	1.5 times 10% i.e., 15% gain in portfolio value = + 10.125 Crores	10% loss in futures = –3.375 Crores	+6.75 Crores*

*Had Mr. X's portfolio beta was 1, then his ₹67.50 Crore portfolio would have lost just 10%, with the market fall of 10% and vice versa. A higher beta portfolio has been swiftly turned to the desired beta level by selling appropriate index futures.

Consider another illustration.

Illustration 15

A high net worth individual (Mr. Z) is holding the following portfolio in ₹ Crores:

Investment in diversified equity shares	80.00
Cash and Bank Balances	20.00
Total	100.00

The Beta of the portfolio is 1.2. The index future is selling at 5500 level. Mr. Z wants to reduce the beta of the portfolio, for he believes that the market would go down from the current level. How many index futures he should buy/sell so that the beta is decreased to 0.80? One index future consists of 100 units.

Solution:

One can reduce or increase the systematic risk (market risk) of the asset/ portfolio by selling or buying appropriate number of index futures, so that the following equation is satisfied:

Original Portfolio Value × Original Beta ± Futures Position = Original Portfolio Value × Desired Beta

In this case, since beta has to decrease Mr. Z would go short (sell - by selling Nifty or index futures, we are decreasing the market risk - thus beta overall would fall) the appropriate number of index futures. The formula to calculate the number of contracts can be given by:

$$\text{Number of contracts} = (\beta^* - \beta) \times \frac{\text{Portfolio Value}}{\text{Value of the futures contract}}$$

The portfolio value given is = ₹100 Crores, β = 1.2 and β* = 0.8 (desired) and each future contract is

= 5500 × 100 = ₹5,50,000. Substituting we get, number of contracts for the desired beta of 0.8 as:

$$(0.8 - 1.2) \times 100 \text{ crores}/550000 = -727 \text{ contracts}$$

Hedge Ratio

A hedger has to decide the number of futures contracts that provide the best hedge for his/her risk profile. The hedge ratio allows the hedger to determine the number of contracts that must be employed in order to minimize the risk of the combined cash-futures position. We can define hedge ratio "as the number of futures contracts to hold for a given position in the underlying asset".

Hr = Futures Position ÷ Underlying asset position.

As explained earlier, for a perfect hedge, in case of a stock/ portfolio position hedged with an index futures position, the hedge ratio is the beta of stock or portfolio. Else, if it is hedged using stock futures position, the hedge ratio is one. If the hedger wants to hedge his stock/ portfolio position partially, then the hedge ratio would be less than one. On the other hand, if his future hedge position is more than that of his current position, we say that the hedge ratio is more than one.

Now, by definition,

$$\beta = \frac{\sigma_{SM}}{\sigma^2_M}$$

We can assume index futures as proxy for markets. We denote index futures as 'F'. Therefore, we have,

$$\beta = \frac{\sigma_{SF}}{\sigma^2_F}$$

$$\text{or, } \beta = \frac{\rho_{SF}\,\sigma_S\,\sigma_F}{\sigma_F}$$

$$\text{or, } \beta = \frac{\rho_{SF}\,\sigma_S}{\sigma_F}$$

or, β = Correlation of underlying with market (i.e., index futures) × proportion of standard deviation of underlying and market.

Accordingly, based on situation, hedge ratio may be equal to, less than or more than the β value.

Consider the following Example.

Example 3

Consider Mr. Y holding an equity portfolio of ₹50 Crores. His portfolio beta is 1.2. He has decided to hedge his portfolio using NIFTY index futures. For various scenarios hedge ratio (as shown in column 2 i.e., Value of futures / Value of underlying) would change as given in the table.

Future s Sold	$\frac{\text{Value of Futures}}{\text{Value of the Underlying}}$	% Hedge Adopted	Remarks
₹60 Crores	1.2	100%	Hedge Ratio = Beta of Portfolio
₹30 Crores	0.6	50%	Hedge Ratio ≠ Beta of Portfolio
₹120 Crores	2.4	200%	Hedge Ratio ≠ Beta of Portfolio

- **Cross Hedge**

Cross Hedge refers to hedging a position in a Stock in the Cash Market, by taking an opposite position in the Futures Market (Derivative Market) in a different stock or index. Cross Hedge concept applies, when the stock to be hedged does not have a Futures Market.

Basis Risk is inherent in a Cross Hedge, i.e., Spot Price of the Commodity and the Futures Price do not converge, because the Commodity for Futures and the Commodity in the Stock market are not the same.

Consider the following example.

Example 4: Ms. A is holding 1000 Shares of KK Software Solutions Ltd, which she wants to sell. She wants to hedge her position by buying KKS Futures. However, KK Software is not traded in the Futures Market. To hedge her position, she can buy Infosys Futures or Wipro Futures or Software Index Futures.

a. Cross-Hedge Ratio

Cross-Hedge Ratio is the same as Hedge Ratio. However, the futures price considered is not of the corresponding stock's future price, but a closely related index or stock.

$$\text{Hedge Ratio} = \frac{\sigma_S}{\sigma_F}\rho_{SF}$$

Where,ρ

σ_S = Standard Deviation of Change in Spot Price of the Asset to be hedged (Eg: KK Software Solutions)

σ_F = Standard Deviation of Change in Futures Price of the Underlying Asset (Eg: Wipro Futures, Infosys Futures etc.)

ρ_{SF} = Correlation between Change in Spot Price of the Asset to be hedged and Futures Price of the Underlying Asset

b. No. of Futures Contract to be Traded

$$\text{No. of Futures Contracts} = \text{Hedge Ratio} \times \frac{\text{Units of spot position requiring hedging}}{\text{No. of units underlying one futures contract}}$$

In Example 4, if the Hedge Ratio is 1.2, and Ms. A wants to cross hedge her position using Software Index Futures (each Index Future contract has 100 Units), then number of contracts required is –

= 1.20 × Shares of KK Software Solution Ltd. (1,000)/ No. of Units in Software Index Future (100)

= 1.20 × 1,000/100 = 12 contracts

c. Choice of Appropriate Cross Hedge Futures

In case of alternatives in the Futures Market in a Cross Hedge situation, the appropriate Futures Contract should be chosen based on the extent of correlation between the asset's price movements and the underlying asset's futures price movements. Higher the correlation, better the choice.

d. Perfect Hedge and Imperfect Hedge

(i) Perfect Hedge: Perfect Hedge is one which completely eliminates the risk. At the time of taking an opposite position in Derivatives Market, Perfect Hedge would mean covering the risk involved in the Cash Market Position completely, i.e., 100%.

(ii) Imperfect Hedge: When the position in cash market is not completely hedged or not hedged to 100%, then such hedge is called Imperfect Hedge.

The hedging strategies using Futures can be summarized in the following diagram.

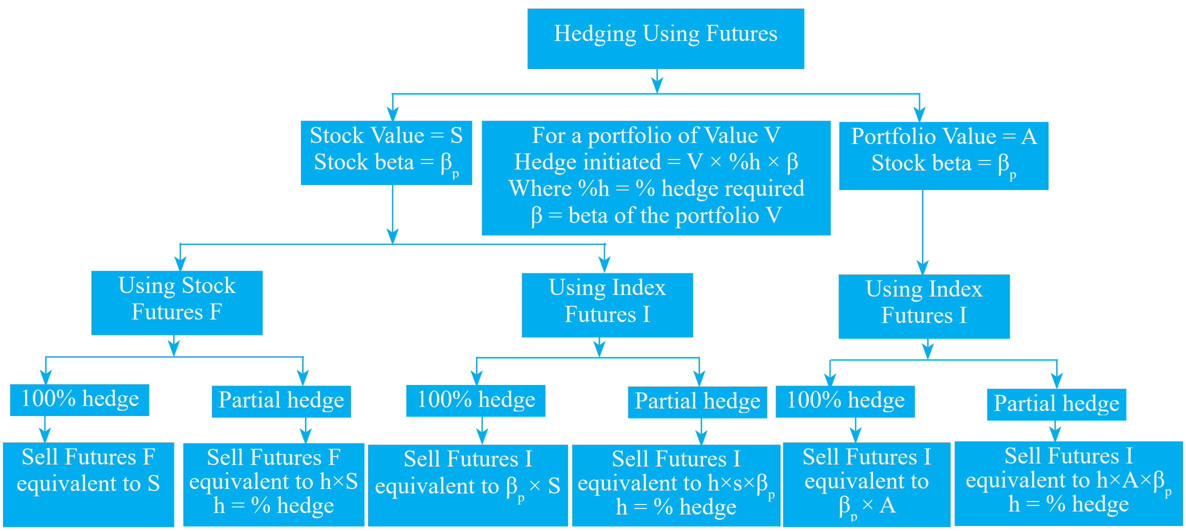


Figure 13.2: Hedging Strategies Using Futures

Consider the following illustrations.

Illustration 16: Cross Hedge

Given the following information

BSE Index	50,000
Value of Portfolio	₹1,01,00,000
Risk Free Interest Rate	9% p.a.
Dividend Yield on Index	6% p.a.
Beta of Portfolio	2.0

We assume that a futures contract on the BSE index with 4 months maturity is used to hedge the value of portfolio over next 3 months. One future contract is for delivery of 50 times the index. Based on the information, calculate

(a) price of future contract,

(b) The gain on short futures position if index turns out to be 45,000 in 3 months.

Solution:

a. Computation of price of Futures Contract

Securities of	R Ltd.
Spot price [S_x]	₹50,000
Dividend yield Expected [Y]	6% or 0.06
Tenor / Time period [t] in Years	4 Months or 0.3333 Year
Risk Free interest Rate [r]	9% or 0.09
Price of Futures Contract [TFP_x] $TFP_x = S_x \times e^{(r-y)\times t}$	$= ₹50{,}000 \times e^{(0.09 - 0.06) \times 0.3333}$ $= ₹\ 50{,}000 \times e^{0.03\times 0.3333}$ $= ₹50{,}000 \times e^{0.01}$ $= ₹50{,}000 \times 1.0101$ $= ₹50{,}505$

Therefore, price of the Futures Contract is ₹50,505 or ₹50,500 (Approx)

b. Gain on short Futures Position

(i) Computation of No. of Contracts to be entered into:

Particulars	Value
Portfolio Value	₹1,01,00,000
4-Month's futures Price per Unit of BSE Index	₹50,500
No. of Units per BSE Index Futures Contract	50
Value per BSE Index futures Contract [50 Units × 50,500 per unit]	₹25,25,000
No. of Contract to be entered [Portfolio Value × Beta of Portfolio w.r.t Index ÷ Value per BSE Index futures Contract] = [₹1,01,00,000 × 2.0 ÷ ₹25,25,000]	8 Contracts

(ii) Computation of Gain on Short Futures Position

Particulars	Value
Position	SELL
Contracted Sale Price per Unit of BSE Index	₹50,500
Less: Index Position in 3-Months	₹45,000
Gain per Unit of BSE Index Future	₹5,500
No. of Units per Contract	50
Gain per Contract [₹5,500 × 50 Units]	₹2,75,000
No. of Contract entered into	8

Total Gain [8 Contracts × ₹2,75,000 per contract]	₹22,00,000

Total Gain on Short Futures Position in 3 Months is ₹22,00,000

Illustration 17

Hedging of risks – Futures Rate Not Available - Choice of Cross Hedge.

Bharat Investments Ltd is long on 25,000 shares of Trinayan Earth Moving Equipment Ltd (TEEL). Its shares are currently quoted at ₹180 per share. Bharat fears fall in prices of TEEL. It therefore wants to hedge its risk under the Futures Contract route. However, future rate is not available for TEEL. Therefore, Bharat is looking for cross hedge and the following particulars are made available -

Related index	NIFTY	Infrastructure Index	Iron and Steel Index	Bank Index
Beta of TEEL Related Index	0.8	1.1	1.3	1.0
Correlation of TEEL with Related Index	0.6	0.8	0.6	0.3
No. of Units of TEEL underlying every Futures Contract of Index	1000	500	1000	1250

Bharat contemplating taking a cross hedge in either Iron and Steel Index, because it has the highest Beta value. Consequently requiring less no. of Futures Contract or Bank Index as it has the perfect Beta Value.

Advice Bharat

Solution:

1. Choice of Index for Cross Hedge

(a) Basis / Reasoning:

- **Object of Hedging:** Hedging through Futures Contract is done to mitigate or eliminate price related risks. The object is to eliminate uncertainty about the future price movements and freeze the impact of price movement at a particular point.
- **Relevance of Beta Value:**
  - (i) Beta value is the sensitivity of the stock to be hedged (TEEL) to the changes in value of the indices. It is an indication of volatility of the stock with reference to the movement in index.
  - (ii) It is also equal to the number of units of Index Future required to hedge one unit of the stock.
  - (iii) High Beta or Low Beta value is not the sale factor determining the choice of a cross hedge. If however, transaction costs are high, and a low beta index may be preferred.
- **Correlation:** Choice of the perfect cross hedge should be based on the correlation between the price of the stock to be hedged and the index used as a cross hedge. Higher the correlation with the index, better the index for cross hedging.
- **Beta vs. correlation:**
  - (i) An index which is highly correlated with stock to be hedged should be preferred over an index with a lower correlation.

(ii) Where two indexes carry the same Beta Index, one with the higher correlation should be preferred.

(iii) Where two index carry the same correlation, index with a lower Beta may be preferred.

(b) Evaluation of Different Indices

Related Index [I]	NIFTY	Infrastructure Index	Iron and Steel Index	Bank Index
Beta of TEEL [β_{TL}]	0.8	1.1	1.3	1.0
Correlation of TEEL [ρ_{TL}]	0.6	0.8	0.6	0.3
No. of Units of MEEL underlying every Futures Contract of Index	1000	500	1000	1250
Ranking based on Correlation [Most correlated Index]	2	1	3	4

Note: NIFTY vs. Iron and Steel Index: Though both have the same correlation, Beta W.r.t NIFTY is nearer to 1 than beta w.r.t to Iron and Steel Index. Therefore, NIFTY edges over Iron and Steel Index.

Conclusion: Therefore, Bharat Investments should prefer to cross hedge using Infrastructure Index.

2. Course of Action

i. Basis: Bharat is long in the cash market i.e. buy in the cash market. Therefore, it should take the opposite position in the Futures Market of Infrastructure Index.

ii. Activity: It should sell Infrastructure Index Futures. Therefore it should enter into Futures Contract for selling Infrastructure Index Futures after a specified period.

iii. No. of contracts: No. of Infrastructure Contracts to be sold

$$= \text{Hedge Ratio} \times \frac{\text{Units of spot position requiring hedging}}{\text{Units in one Futures Contract of Infra Index}}$$

$$= \text{Hedge Ratio [Beta of Changes in price w.r.t metal Index]} \times \frac{\text{Units of TEEL required by Trinayan}}{\text{Units in one Future Contract of Infra Index}}$$

$= 1.10 \times 25000 \text{ Units} \div 1000 \text{ Units}$

$= 1.10 \times 25 = 27.5$ Future Contracts

Bharat should sell 27.5 Infrastructure Index Futures.

Illustration 18

In February, Pepper future traded at 16.80, the February ₹18.00 call at ₹0.45 and the February ₹18.00 put at ₹0.58. both are options on the February future. Find out whether any arbitrage opportunity exists.

Solution:

(a) Cost of future = ₹16.80

(b) Cost of Pepper = Present Value of Exercise Price + Value of Call – Value of put = ₹18 + ₹0.45 – ₹0.58 = ₹17.87

(c) Conclusion: Since there is difference between spot price and Futures price. Arbitrage opportunity exists.

Illustration 19: Stock Index – Futures

A portfolio manager owns 3 stocks

Stock	Shares owned	Stock price (₹)	Beta
1	2 lakh	800	1.1
2	4 lakh	600	1.2
3	6 lakh	200	1.3

The spot Nifty Index is at 2700 and futures price is 2704. Use stock index future to (a) decrease the portfolio beta to 0.8 and (b) Increase the portfolio beta to 1.5. Assume the index factor is ₹100. find out the number of contracts to be bought or sold of stock index futures.

Solution:

Computation of existing Portfolio Beta

Security	Market value of security (₹ Lakhs)	Proportion	Beta of the Security	Weighted Beta
1	1,600	4/13	1.1	0.34
2	2,400	6/13	1.2	0.55
3	1,200	3/13	1.3	0.30
	5,200			1.19

Value per Futures Contract

= Index Price per unit × Lot Size per Futures Contract

= ₹2700 × 100 = ₹2,70,000

a. Activity to Reduce Portfolio Beta to 0.8

(i) Object: Reduce portfolio Beta

(ii) Activity: Sell Index Futures

- Beta of Existing Portfolio = β_1 = 1.19
- Desired beta of the New Portfolio = β_N = 0.8
- Contract Size = 100 units
- Value per Futures Contract in NIFTY = V_F = ₹2,700 × 100 = ₹2,70,000
- Value of the portfolio = V_P = ₹5,200 Lakhs
- No. of Futures contract to be sold:

$$= \text{Portfolio Value} \times \frac{[\text{Beta of the Portfolio} - \text{Desired Value of Beta}]}{\text{Value of a Futures Contract}}$$

$$= V_P \times \frac{\beta_1 - \beta_N}{V_F}$$

= ₹5,200 Lakhs × [(1.19 – 0.8) ÷ ₹2,70,000] = 751 Contracts

b. Activity to Increase the portfolio Beta to 1.5

(i) Object : Increase portfolio Beta

(ii) Activity: Buy Index futures

- Beta of Existing portfolio = β_1 = 1.19
- Desired Beta of the New portfolio = β_N = 1.5
- Value per Futures contract in NIFTY = V_F = ₹2,700 × 100 = ₹2,70,000
- Value of the portfolio = V_P = ₹5,200 Lakhs
- No of futures Contract to be bought:
- $$= \text{Portfolio Value} \times \frac{[\text{Desired Value of Beta} - \text{Beta of the Portfolio}]}{\text{Value of a Futures Contract}}$$

$$= V_P \times \frac{\beta_N - \beta_1}{V_F}$$

= ₹5,200 Lakhs × [(1.50 – 1.19) ÷ ₹2,70,000] = 597 Contracts

Illustration 20: Headging with Index Futures

A Unit trust wants to hedge its portfolios of shares worth ₹10 million using the BSE-Sensex index futures. The contract size is 100 times the index. The index is currently quoted at 6,840. The beta of the portfolio is 0.8. the beta of the index may be taken as 1. What is the number of contracts to be traded?

Solution:

- Beta of Portfolio = β_1 = 0.8
- Beta of Index = B_N = 1
- Value per futures contract V_F = ₹6,840 × 100 = ₹6.84 Lakhs
- Value of the portfolio = V_P = ₹100 Lakhs
- Hedge Ratio = Beta of the portfolio ÷ Beta of the Index = 0.8 ÷1 = 0.8
- No. of Futures Contract to be traded:

$$= \text{Portfolio Value} \times \frac{\text{Hedge Ratio}}{\text{Value of a Futures Contract}}$$

$$= V_P \times \frac{\text{Hedge Ratio}}{V_F}$$

= ₹100 Lakhs × [0.8 ÷ 6.84 Lakhs] = 11.70 i.e. 12 Contracts

Illustration 21

Which position on the index future gives a speculator, a complete hedge against the following transitions:

(a) The share of Yes Limited is going to rise. He has a long position on the cash market of ₹100 Lakhs on the Yes Limited. The beta of the Yes Limited is 1.25.

(b) The share of No Limited is going to depreciate. He has a short position on the cash market of ₹50 Lakhs on the No Limited. The beta of the No Limited is 0.90

(c) The share of Fair Limited is going to stagnant. He has short position on the cash market of ₹40 Lakhs of the Fair Limited. The beta of the Fair Limited is 0.75.

Solution:

1. Value to be traded in Futures [Index Value] = Hedge Ratio × Amount of Portfolio
2. Principles for deciding the Position on Index Futures [Opposite Position in relation to Stock]

Expectation on Stock Price	Action in Stock Market	Position in Index Futures
Rise	Buy / Long	Sell/Short
Fail	Sell/Short	Buy/Long

3. **Position on the Index Futures**

Sl. No.	Co.	Trend	Amount(₹)	Beta /Hedge Ratio	Index Value (₹)	Position
(a)	Yes Ltd.	Rise	100 Lakhs	1.25	1,25,00,000 [100 Lakhs × 1.25]	Short
(b)	No Ltd.	Depreciate	50 Lakhs	0.90	45,00,000 [50 Lakhs × 0.90]	Long
(c)	Fair Ltd.	Stagnant	40 Lakhs	0.75	30,00,000 [40 Lakhs × 0.75]	Long

Illustration 22

Fill up the blanks in the following matrix-

Case	Portfolio Value	Existing Beta	Outlook	Activity	Desired Beta	No. of Futures Contacts
M	?	1.20	Bullish	?	1.8	90
N	₹3,60,00,000	?	?	Buy Index Futures	2.3	45
O	₹2,00,00,000	1.60	?	?	1.2	?
P	₹6,40,00,000	1.10	Bullish	?	?	48
Q	₹2,50,00,000	1.40	Bearish	?	1	?
R	₹5,00,00,000	?	Bearish	Sell Index Futures	1.25	45

S&P index is quoted at 4000 and the lot size is 100.

Solution:

Case	Portfolio Value	Existing Beta	Outlook	Activity	Desired Beta	No. of Futures Contracts
M	₹6,00,00,000	1.20	Bullish	Buy Index Futures	1.8	90
N	₹3,60,00,000	1.80	Bullish	Buy Index Futures	2.3	45
O	₹2,00,00,000	1.60	Bearish	Sell Index Futures	1.2	20
P	₹6,40,00,000	1.10	Bullish	Buy Index Futures	1.4	48
Q	₹2,50,00,000	1.40	Bearish	Sell Index Futures	1	25
R	₹5,00,00,000	?	Bullish	Sell Index Futures	1.25	45

Value per Futures Contract = Index Price per Unit × Lot Size per Futures Contract = ₹ 4000 × 100 = ₹4 Lakhs

1. Case M

(a) Inference: Outlook is Bullish and the desired Beta is more than the existing Beta. Therefore, Index Futures Contract should be bought.

(b) Number of Futures Contract = Portfolio Value × $\frac{\text{Desired Value of Beta – Beta of the Portfolio}}{\text{Value of a Futures Contract}}$

$\rightarrow N_F \quad = V_p \times \frac{\beta_N - \beta_E}{V_F}$

$\rightarrow 90 \quad = V_P \times (1.80 – 1.20)$ / ₹4 Lakhs

$\rightarrow 0.60\ V_P = 90 \times$ ₹4 Lakhs

$\rightarrow V_P =$ ₹3.60 Crores ÷ 0.60 = ₹600 Lakhs.

2. Case N

(a) Inference: Activity is to Buy Index Futures. Therefore, outlook is bullish. Therefore, existing Beta should be lower

(b) Number of Futures Contract = Portfolio Value × $\frac{\text{Desired Value of Beta – Beta of the Portfolio}}{\text{Value of a Futures Contract}}$

$\rightarrow N_F \quad = V_p \times \frac{\beta_N - \beta_E}{V_F}$

$\rightarrow 45 \quad =$ ₹3.60 Cr. × $(2.30 – \beta_E)$ ÷ ₹4 Lakhs

$\rightarrow 45 \times$ ₹4 Lakhs = ₹3.60 Cr. × $(2.30 - \beta_E)$

$\rightarrow 2.30 – \beta_E =$ ₹1.80 Crores ÷ ₹3.60 Crores

$\rightarrow 2.30 – \beta_E \ = 0.50$

$\rightarrow \beta_E \quad = 2.30 – 0.50 = 1.80$

3. Case O

(a) Inference: Desired Beta is lower than existing Beta. Therefore, Outlook is bearish and apt activity is to sell index futures.

(b) Number of Futures Contract = Portfolio Value × $\frac{\text{[Beta of the Portfolio – Desired Value of Beta]}}{\text{Value of a Futures Contract}}$

$\rightarrow N_F = V_p \times \frac{\beta_E - \beta_N}{V_F}$

$\rightarrow N_F$ = ₹2.00 Cr. × (1.60 – 1.20)/₹4 Lakhs

$\rightarrow N_F$ = ₹2.00 Cr. × 0.40/₹4 lakhs

$\rightarrow N_F$ = ₹80 Lakhs/₹4 Lakhs = 20 contracts

4. Case P

(a) Inference: Desired Beta is lower than existing Beta. Therefore, Outlook is bearish and apt activity is to buy index futures.

(b) Number of Futures Contract = Portfolio Value × $\frac{\text{Desired Value of Beta – Beta of the Portfolio}}{\text{Value of a Futures Contract}}$

$\rightarrow N_F = V_p \times \frac{\beta_N - \beta_E}{V_F}$

$\rightarrow 48$ = ₹6.40 Cr. × (β_N – 1.10) / ₹4 Lakhs

$\rightarrow 48 = 1.60 \times (\beta_N - 1.10)$

$\rightarrow 48/160 = \beta_N - 1.10$

$\rightarrow 0.30 = \beta_N - 1.10$

$\rightarrow \beta_N = 1.10 + 0.30 = 1.40$

5. Case Q

(a) Inference: Desired Beta is lower than existing Beta. Therefore, apt activity is to sell index futures.

(b) Number of Futures Contract = Portfolio Value × $\frac{\text{[Beta of the Portfolio – Desired Value of Beta]}}{\text{Value of a Futures Contract}}$

$\rightarrow N_F = V_p \times \frac{\beta_E - \beta_N}{V_F}$

$\rightarrow N_F$ = ₹2.50 Cr. × (1.40 – 1.00) / ₹4 Lakhs

$\rightarrow N_F$ = ₹2.50 Cr. × 0.40 / ₹4 Lakhs

$\rightarrow N_F$ = ₹1 Cr. / ₹4 Lakhs = 25 Contracts

6. Case R

(a) Inference: Outlook is bearish and the activity is to sell Index Futures. Therefore, Existing Beta should be higher than desired Beta.

(b) Number of Futures Contract = Portfolio Value × $\frac{\text{[Beta of the Portfolio – Desired Value of Beta]}}{\text{Value of a Futures Contract}}$

$\rightarrow N_F = V_p \times \frac{\beta_E - \beta_N}{V_F}$

$\rightarrow 45$ = ₹5 Cr. × (β_E – 1.25) / ₹4 Lakhs

$\rightarrow 45 = 125 \times (\beta_E - 1.25)$

$\rightarrow \beta_E - 1.25 = 45/125$

$\rightarrow \beta_E - 1.25 = 0.36$

$\rightarrow \beta_E = 0.36 + 1.25 = 1.61.$

Options

13.3

13.3.1 Meaning, Features and Types of Options, Option vs. Forward and Futures, Profitability of Option, Profit Profile of Buyer and Seller, Value of Option, Determination of Option Premium

⊙ Concept of an Option

An option is a contractual agreement to buy or to sell a specified amount of the underlying asset at a future specified date at a pre-determined rate where the option buyer has the right, but not the obligation to execute the contract. Upon exercise of the right by the option holder, an option seller is obligated to deliver the specified instrument at the specified price.

⊙ Features of an Option

The important features of options are as follows:

a. The buyer has the right to buy or sell the asset. The seller, on the other hand, has a potential commitment to sell or buy the asset if the buyer exercises his right on the option.

b. To acquire the right of an option, the buyer of the option must pay a price to the seller. This is called the option price or the premium. Option premium is payable even if the option is not exercised.

c. The price at which an option is exercised i.e., the underlying asset is bought or sold, is called the Exercise Price or the Strike Price. The exercise price is determined at the time of entering into the option contract.

d. The option is to be exercised on a future specified date known as the expiry of the option.

e. In case of exchange traded options, the contract size is specified and not negotiable.

f. Each option has a pre-determined tenure (1 month, 3 months etc.).

⊙ Features of an Exchange Traded Option

Though option contracts can be 'over-the-counter' contracts which are tailor made or negotiated, options are normally exchange traded. In other words, options are traded in recognized stock exchanges which act like an intermediary. An exchange traded contract is standardized in terms of the features mentioned earlier. The specification may be discussed as follows.

a. Strike Price / Exercise Price is fixed by the Stock Exchange, and not by the Writer or Holder of an option. The Stock Exchange fixes a series of prices spaced at appropriate price intervals for an underlying asset. An investor can choose his preferred Strike Price from such a range of prices.

   For example, the Strike Prices for June 2022 options on shares of Reliance on NSE expiring on 30.06.2022 are available as —₹2,520, ₹2,540, ₹2560, ₹2580, ₹2,600, ₹2,620 etc. An investor can choose to buy an option with an Exercise Price of ₹2,600, while another might choose ₹2,540.

b. Premium is the price at which the options contracts for an asset with a given expiry date and strike price is traded. It is paid by the Buyer to the Writer / Seller of the option. The writer keeps the premium whether or not the option is exercised. In an exchange traded contract, option premium is market determined, i.e., based on the demand for the options with a given strike price. Premium payable on an options contract depends upon various factors like Strike Price, Expiry Date, price of the underlying in the spot market etc.

c. Expiry date in an exchange traded options contract is also exchange determined. Generally, options contract on any security is traded based on its strike price and the expiry date.

   For example, in June 2022, the following two option contracts on shares of Reliance on NSE with Strike Price of ₹2,620 are available: Expiry on 30.06.2022 and 28.07.2022.

d. The contract size is also standardized in case of exchange traded options. For example, the stock option on the shares of Reliance on NSE has a lot size of 250 shares. So, one option contract will be of 250 shares of Reliance.

Forward vs. Futures vs. Options

The distinguishing feature of options vis-à-vis forward and futures is the 'right but not the obligation' clause. In other words, futures and forwards create obligations for both the buyer as well as the seller. However, option contracts provide the buyer the right but not the obligation to execute the contract and hence, in case of an unfavorable situation (where option holder/buyer is incurring losses on exercise the contract), the buyer may simply not execute the contract and avoid the loss. The option seller, however, does not have any right to refuse execution of the contract.

Other differences between Forwards, Futures and Options (exchange traded)[1] are listed below.

Aspect	Forward Contracts	Futures Contracts	Option Contracts
Trading Place	No specific place. Can be traded like any commodity.	Traded on Stock Exchanges.	Traded on Stock Exchanges.
Settlement/ Cash Flow	At the time of delivery of asset, i.e., at the end of the contract period.	Profit/Loss is settled on a daily basis based on movement in Current Futures Price.	Option writer collects premium at the inception of the contract.
Closure of Contract	Delivery is must.	Possible exit routes are: • Physical Delivery • Payment of price differential • Taking an opposite position, and cancelling out the contract.	Possible exit routes are: • Physical Delivery • Payment of price differential • Taking an opposite position, and canceling out the contract.
Price Fixation	Negotiated between parties to the contract.	Determined by the market forces i.e., based on Demand and Supply.	Exercise Price / Strike Price is fixed by the Stock Exchange. Premium is market determined.
Nature	Contracts are not standardized. These are customized.	Contracts are standardized.	Contracts are standardized.

Obligation to Perform	Both parties are under obligation to perform.	Both parties are under obligation to perform.	Only the Writer / Seller of the option is under obligation to perform.
Timing	Contracts can be entered into for any period at any time.	Exchange would fix the expiry date. Contracts can be entered into any time for periods up to the expiry date for that contract.	Exchange would fix the expiry date. Contracts can be entered into any time for periods up to the expiry date for that contract.
Guarantee of Performance	Performance is not guaranteed. There is liquidity risk and counterparty risk.	Stock Exchange will ensure performance. There is little or no liquidity risk and counterparty risk.	Stock Exchange will ensure performance. There is little no liquidity risk and counterparty risk.

⊙ Advantages and Disadvantages of Options

The advantages and disadvantages of option contracts are as follows:

Feature	Advantage	Disadvantage	Effect on Holder/ Writer
Cost	Options are an inexpensive way to gain access to the underlying investment without having to buy stock.	As a form of insurance, an option contract may expire worthless. The greater the extent to which the option is out of the money and the shorter the time until expiration, the higher is the risk.	Holder may be disadvantaged due to expiry. Writer would be advantaged as he/she needs not make delivery once the option has expired.
Leverage	Options enable investors to stump up less money and obtain additional gain.	Investors should realize that options' leverage can impact performance on the down side as well.	Writers of naked calls[2] are exposed to unlimited risk.
Marketability	Options trade on an exchange and as such are standardized.	Regulatory intervention can prevent exercise which may not be desirable.	Both parties to an options transaction benefit from standardized and enforceable terms.
Hedging	Options may be used to limit losses.	The investor may end up being incorrect as to the direction and timing of a stock's price and may implement a less than perfect hedge.	Both the holder and the writer may be (dis)advantaged depending upon which side of the trade they assume and the ultimate direction of the underlying security.
Return enhancement	Options may be used to enhance a portfolio's return.	The investor may end up being incorrect as to the direction and timing of a stock's price, rendering the attempt at enhanced portfolio return worthless.	Both the holder and the writer may be (dis)advantaged depending upon which side of the trade they assume and the ultimate direction of the underlying security.

Diversification	One can replicate an actual stock portfolio with the options on those very stocks.	Diversification cannot eliminate systematic risk.	
Regulation	Terms of listed options are regulated.	Restrictions upon exercise may occur by regulatory fiat (OCC, SEC, court, other regulatory agency).	While in some cases necessary, regulatory fiat can disrupt what may be a profitable trade, affecting holder and writer alike.

- **Parties to an Option**

An option contract has two parties associated with it – buyer or holder and seller.

A buyer or holder of an option is the person who has agreed to buy or sell the underlying at a specified rate (Strike Price) on a future date.

On the other hand, a seller or writer of an option is a person who has agreed to sell or buy the underlying as per the option in case the holder of the option exercises his option.

- **Types of Options**

Option contracts may be classified based on nature, possibility to exercise before the expiry date and underlying assets as follows:

A. Based on Nature

Based on nature, options can be either Call Option or Put Option.

Call Option	Put Option
Option which gives the holder the right to BUY an asset, but not an obligation to buy.	Option which gives the holder the right to SELL an asset, but not an obligation to sell.
Seller / Writer is under an obligation to sell the underlying asset if the Buyer exercises his option to buy the shares/ stock.	Seller/Writer is under an obligation to buy the underlying asset if the Buyer exercises his option to sell his shares/ stock.

B. Based on the possibility to exercise before the expiry date

Based on the possibility to exercise before the expiry date, options can be either American Option or European Option.

American Option	European Option
Option under which holder can exercise his right at any time before expiry date.	Option under which holder can exercise his right only on the expiry date.

C. Based on the underlying assets

Based on the underlying asset, options can be of following types –

a. **Stock Options:** Here the underlying is an individual stock.

b. **Index Options:** Here the underlying is any index like Nifty 50.

c. **Currency Options:** Here the underlying is any foreign exchange.

d. **Interest Rate Options:** Here, the underlying is the interest rate itself.

Profitability of an Option Contract

From the perspective of an option buyer, there can be the following three positions of an option contract –

a. **In the Money (ITM) Option:** It is a situation where exercising the option would be advantageous and will result in gain or profit for the option buyer.

b. **At the Money (ATM) Option:** It is a situation where exercising the option would neither result in any profit nor any loss to the option buyer.

c. **Out of the Money (OTM) Option:** It is a situation where exercising the option would result into a loss to the option buyer.

Since, options can be either Call Option or Put Option, the above three positions can be explained with respect to the two types of options as follows:

[Let Spot Price = S_T and Exercise Price = X]

Situation	Call Option		
	Position	**Action**	**Resulting Profit/Loss**
$S_T < X$	Out-of-the-money	Option will not be exercised.	Loss will be equal to the call premium already paid
$S_T = X$	At-the-money	Option buyer will be indifferent	Loss will be equal to the call premium already paid
$S_T > X$	In-the-money	Option will be exercised.	$(S_T - X) - C$
Situation	**Put Option**		
	Position	**Action**	**Resulting Profit/Loss**
$S_T > X$	Out-of-the-money	Option will be exercised.	Loss will be equal to the put premium already paid
$S_T = X$	At-the-money	Option buyer will be indifferent	Loss will be equal to the put premium already paid
$S_T < X$	In-the-money	Option will not be exercised.	$(X - S_T) - P$

Note: Here, C = Call Premium and P = Put Premium

Further, under an in-the-money position, an option buyer may have partial recovery of premium when the difference between the spot price and exercise price is lower than the premium already paid. He may get a net profit when the spot price and exercise price is higher than the premium already paid. Finally, he attains a break-even when the spot price and exercise price is exactly equal to the premium already paid.

Thus, for a Call Option, the Break-even Price = X + C and for a put option, the Break-even Price = X – P.

Accordingly, the risk of an option buyer (call or put) is limited to the premium paid on the contract as when exercising the option is not advantageous, he loses only the premium paid. At this situation, the option seller's profit is equal to the premium. However, when an in-the-money option is exercised the profit potential of the buyer is unlimited while the potential loss of the option seller is also unlimited.

Illustration 23

On 29.06.2022, a trader buys a July 28, 2022 European Call Option on Reliance shares with a strike price of ₹2,620 at ₹330. Determine his profit or loss if the spot price of shares prevailing on expiry is ₹2390, ₹2620, ₹2,850, ₹2950, ₹3050. Also determine the break-even price.

Solution:

Calculation of Profit or Loss of the Call Option Buyer

Expected Spot Price (S_T) (₹)	Exercise Price (X) (₹)	Premium (C) (₹)	Position	Gross gain (₹) = (S_T -X)	Net Profit (₹) = (S_T -X) - C
2,390	2,620	330	Out of the Money	---	---
2,620	2,620	330	At the Money	---	---
2,850	2,620	330	In the Money	230	–100
2,950	2,620	330	In the Money	330	Nil
3,050	2,620	330	In the Money	430	+100

The break-even price = X + C = 2,620 + 330 = ₹2,950

Illustration 24

On 29.06.2022, a trader buys a July 28, 2022 European Put Option on Infosys shares with a strike price of ₹1,380 at ₹25. Determine his profit or loss if the spot price of shares prevailing on expiry is ₹1,410, ₹1,380, ₹1,360, ₹1,355, ₹1,345. Also determine the break-even price.

Solution:

Calculation of Profit or Loss of the Put Option Buyer

Expected Spot Price (S_T) (₹)	Exercise Price (X) (₹)	Premium (C) (₹)	Position	Gross gain (₹) = (X - S_T)	Net Profit (₹) = (X - S_T) - P
1,410	1,380	25	Out of the Money	---	---
1,380	1,380	25	At the Money	---	---
1,360	1,380	25	In the Money	20	– 5
1,355	1,380	25	In the Money	25	Nil
1,345	1,380	25	In the Money	35	+10

The break-even price = X − P = 1,380 − 25 = ₹1,355

Profit Profile of Option Buyer and Option Writer

In financial derivatives terminology, we often use two terms – ‘long’ and ‘short’. Long position with respect to an asset or a derivative contract means that the person has bought the asset/contract while short position with respect to an asset or a derivative contract means that the person has sold the asset/contract. Accordingly, in option trading, there may be following four basic positions:

A. Long Call: It refers to a position where a person has bought a call option and paid the premium. Generally, an option trader buys a call when he expects the price of the underlying asset to increase in future.

Consider the following illustration.

Illustration 25

Mr. A buys a July call option with a strike price of ₹3,500 at ₹50. Show his profit profile at alternative spot prices on expiration.

Solution:

Calculation of net profit

Spot Price (₹)	Strike Price (₹)	Premium (i.e., Price) (₹)	Status	Net Payoff (₹)
3,000	3,500	50	OTM	(–) 50
3,400	3,500	50	OTM	(–) 50
3,500	3,500	50	ATM	(–) 50
3,520	3,500	50	ITM	(–) 30
3,550	3,500	50	ITM	Nil (BEP)
3,600	3,500	50	ITM	+ 50

Note: OTM = Out of the Money; ATM = At the Money; ITM = In the Money

Thus, the maximum possible loss of the option buyer = ₹50 while his profit potential is unlimited. BEP = Strike Price + Premium = 3,500 + 50 = ₹3,550

The graph of the long call will be as follows:

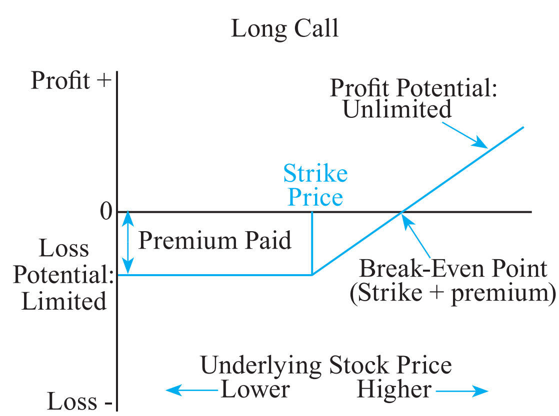


Figure 13.3: Payoff Profile for Long Call

B. Short Call: It refers to a position where a person has written a call option and received the premium. Generally, an option trader writes a call option when he expects the price of the underlying asset to decrease in future or remain unchanged. When he writes a call option without owning the underlying asset, it is called a naked call.

Consider the following illustration.

Illustration 26

Mr. B writes a July call option with a strike price of ₹3,500 at ₹50. Show his profit profile at alternative spot prices on expiration.

Solution:

Calculation of net profit

Spot Price (₹)	Strike Price (₹)	Premium (i.e., Price) (₹)	Status	Net Payoff (₹)
3,000	3,500	50	OTM	+ 50
3,400	3,500	50	OTM	+ 50
3,500	3,500	50	ATM	+ 50
3,520	3,500	50	ITM	+ 30
3,550	3,500	50	ITM	Nil (BEP)
3,600	3,500	50	ITM	(–) 50

Thus, the maximum possible gain of the option writer = ₹50 while his loss potential is unlimited.

The graphical representation of a short call payoff profile will be as follows.

Short Call

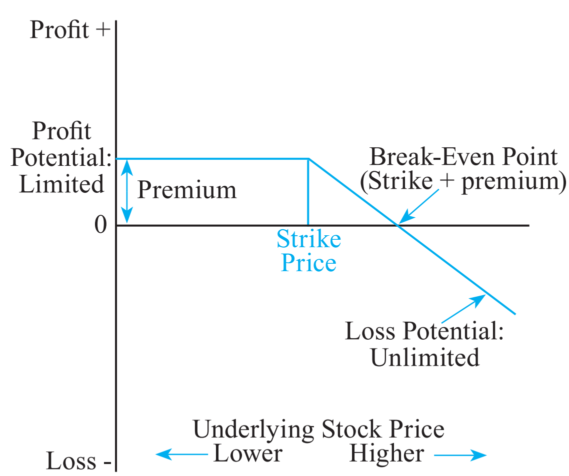


Figure 13.4: Payoff Profile for Short Call

C. Long Put: It refers to a position where a person has bought a put option and paid the premium. Generally, an option trader buys a put option when he expects the price of the underlying asset to decrease in future.

Consider the following illustration.

Illustration 27

Mr. C buys a July put option with a strike price of ₹3,500 at ₹50. Show his profit profile at alternative spot prices on expiration.

Solution:

Calculation of net profit

Spot Price (₹)	Strike Price (₹)	Premium (i.e., Price) (₹)	Status	Net Payoff (₹)
3,700	3,500	50	OTM	(–) 50
3,600	3,500	50	OTM	(–) 50
3,500	3,500	50	ATM	(–) 50
3,480	3,500	50	ITM	(–) 30
3,450	3,500	50	ITM	Nil (BEP)
3,400	3,500	50	ITM	+ 50

Thus, the maximum possible loss of the option buyer = ₹50 while his profit potential is unlimited.

BEP = Strike Price - Premium = 3,500 – 50 = ₹3,450.

The graphical representation of a long put payoff profile will be as follows.

Long Put

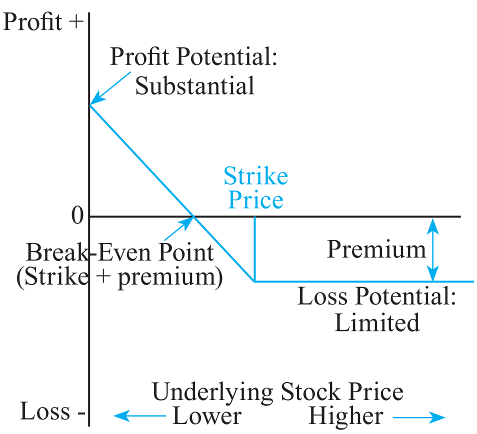


Figure 13.5: Payoff Profile for Long Put

D. Short Put: It refers to a position where a person has written a put option and received the premium. Generally, an option trader writes a put option when he expects the price of the underlying asset to increase in future.

Consider the following illustration.

Illustration 28

Mr. D writes a July put option with a strike price of ₹3,500 at ₹50. Show his profit profile at alternative spot prices on expiration.

Solution:

Calculation of net profit

Spot Price (₹)	Strike Price (₹)	Premium (i.e., Price) (₹)	Status	Net Payoff (₹)
3,400	3,500	50	OTM	(–) 50
3,450	3,500	50	OTM	Nil (BEP)
3,480	3,500	50	ATM	+ 30
3,500	3,500	50	ITM	+ 50
3,600	3,500	50	ITM	+ 50
3,700	3,500	50	ITM	+ 50

Thus, the maximum possible gain of the option writer = ₹50 while his loss potential is unlimited.

Short Put

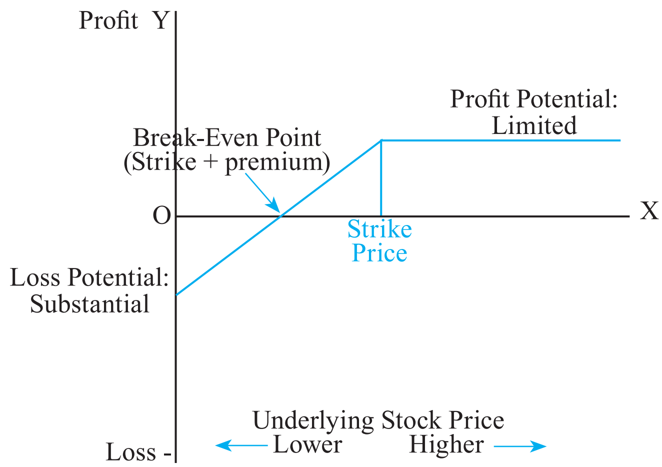


Figure 13.6: Payoff Profile of Short Put

Intrinsic Value and Time Value of an Option

The value of an option (also known as price or premium) is comprised of two components: Intrinsic Value and Time Value. The intrinsic value of an option is the gain to the holder on immediate exercise of the option. It is therefore the amount by which the option is in-the-money. An out of the money option and an at the money option has no intrinsic value at all.

In other words, Intrinsic Value of a call option is -

IV = $(S_T - X)$ when $S_T > X$; and

= 0 Otherwise

Similarly, for a put option, the intrinsic value is given by -

IV = $(X - S_T)$ when $S_T < X$; and

= 0 Otherwise

For example, the intrinsic value of a call option on Infosys shares with an exercise price of ₹1,380 and spot price of ₹1,350 would be ₹30. However, the concept of intrinsic value is real only in case of an American option. In case of a European option, this concept is only notional.

Time value is the amount by which the price of an option exceeds its intrinsic value. Also referred to as extrinsic value, time value decays over time. In other words, the time value of an option is directly related to how much time an option has until expiration. The more time an option has until expiration, the greater is the possibility that the option will become in-the-money. That is, an out of the money option can move into-the-money or one already in-the-money option can become more so. Consequently, the time value of an option is always positive for an out of the money option and is usually positive for an in the money option. Moreover, the more time that remains until an option expires, the higher the time value tends to be. However, at expiration an option would have only intrinsic value and no time value.

For an exchange traded option, therefore, the price (or premium) that is paid to buy the same is equal to the sum of intrinsic value and time value. For in-the-money option the time value is option price less the intrinsic value while for at-the-money and out-of-the money option, the price is equal to the time value only as intrinsic value is zero for such an option.

For example, suppose, the July, 2022 call option on Infosys shares having an exercise price of ₹1,380 is currently trading at ₹20. Now, if the current spot price for Infosys shares is ₹1,390, the intrinsic value of the option will be = 1,390 – 1,380 = ₹10 and time value will be = 20 – 10 = ₹10. In this situation, the option is already in-the-money. However, if the current spot price is ₹1,350, the option will be out-of-the-money and in that case the intrinsic value will be zero. Thus, the price of ₹20 will represent only time value.

When an investor purchases an OTM or ATM option, whose premium is equal to its time value, there is a greater risk that the option will be worthless at its expiration date, since it is already out of or at the money, but the time to expiration also presents the opportunity that it will become in the money. This is why, it is important to understand the time value as a part of an option's premium. Due to the greater risk of the option having no value, OTM and ATM options have lower premiums than ITM options on the same underlying asset. However, this greater risk also comes with greater reward as OTM and ATM have larger percent gains in profit than ITM options.

Maximum and Minimum Value of Options

Since an American option can be exercised prior to the expiration date, the maximum and minimum values are as follows:

Maximum and Minimum Value of American Options

Particulars	Maximum Value	Minimum Value
American Call	$C_{Max} = S_T$	$C_{Min} = \text{Max}(0, S_T - X.\, e^{-rt})$
American Put	$P_{Max} = X$	$P_{Min} = \text{Max}(0, X - S_T)$

Since, a European option can be exercised only at expiration, the maximum and minimum values are as follows:

Maximum and Minimum Value of European Options

Particulars	Maximum Value	Minimum Value
European Call	$C_{Max} = S_T$	$C_{Min} = \text{Max}(0, S_T - X.\, e^{-rt})$
European Put	$P_{Max} = X.\, e^{-rt}$	$P_{Min} = \text{Max}(0, X.\, e^{-rt} - S_T)$

Consider the following illustration.

Illustration 29

A stock is selling at ₹500. If the risk-free rate of interest is 10% p.a. continuously compounded, then calculate the minimum and maximum value of the following option contract.

a. A European call option with strike price of ₹ 450 maturing in 1 month, 2 month and 3 month.

b. A European put option with strike price of ₹ 450 maturing in 1 month, 2 month and 3 month.

Solution:

a. Calculation of C_{Min} = Max (0, S_T – X. e^{-rt}) for European Call

Strike Price (X) (₹)	Time (t)	C_{Min} = Max (0, S_T – X. e^{-rt}) (₹)
450	1	Max (0, 500 – 450 × $e^{-0.10 \times 1/12}$) = Max (0, 53.77) = 53.77
500	2	Max (0, 500 – 500 × $e^{-0.10 \times 2/12}$) = Max (0, 8.26) = 8.26
550	3	Max (0, 500 – 550 × $e^{-0.10 \times 3/12}$) = Max (0, –36.42) = 0

b. Calculation of C_{Min} = Max (0, S_T – X. e^{-rt}) for European Put

Strike Price (X) (₹)	Time (t)	P_{Min} = Max (0, X. e^{-rt} – S_T) (₹)
450	1	Max (0, 450 × $e^{-0.10 \times 1/12 - 500}$) = Max (0, – 53.77) = 0
500	2	Max (0, 500 × $e^{-0.10 \times 2/12 - 500}$) = Max (0, – 8.26) = 0
550	3	Max (0, 550 × $e^{-0.10 \times 3/12 - 500}$) = Max (0, 36.42) = 36.42

Determinants of Option Premium

The factors on which the level of premium depends are —

(a) Exercise price: Exercise Price or Strike Price refers to the price at which the contract is agreed upon. When buying an Option, an investor can choose from a set of Strike Prices, for which Options can be bought/sold. Based on Strike Price chosen, the Option Premium will vary as follows —

Exercise Price	Call Option Premium is —	Put Option Premium is —
High	LOW	HIGH
	As the Exercise Price goes up, the value of the Option i.e., (S_T − X) goes down. Therefore, it becomes less valuable and its price i.e., premium declines	As the Exercise Price goes up, the value of the Option i.e., (X − S_T) goes up. Therefore, it becomes more valuable and its price or premium increases.
Low	HIGH	LOW
	As the Exercise Price goes down, the value of the Option i.e., (S_T − X) goes up. Therefore, it becomes more valuable and its price or premium increases.	As the Exercise Price goes up, the value of the Option i.e., (X − S_T) goes down. Therefore, it becomes less valuable and its price i.e., premium declines

(b) Current Price of the Underlying Asset: Other things remaining constant, if the current market price of the asset goes up, value of the call option increases (since the possibility of exercising the call also increases) and put option decreases. If the current market price decreases, value of put option increases (as the possibility of exercising the put option also increases), and value of call option decreases.

(c) Maturity or Expiry Date: Longer the time to maturity, higher the period of uncertainty, and hence higher the option premium. Therefore, an option with 3 months to maturity will have a higher premium than an option with 1 month to maturity.

(d) **Volatility of stock prices:** Volatility of stock price in the spot market (Cash Market) also contributes to premium. Higher volatility would mean prices hitting the extremes, and the buyer of option would exercise his option, which would result in a higher obligation on the part of the seller of the option. Therefore, the values of both calls and puts increase as volatility increases. Greater the volatility, higher will be the premium, and vice-versa.

(e) **Interest Rate Movement:** As interest rates increases, the expected return required by the investors on the stock also increases. Therefore, the present value of the future returns decreases. If the interest rate decreases, the expectations also go down.

(f) **Market Factors:**

(i) Liquidity in the market i.e., extent of money available for investment.

(ii) Dividend expectations i.e., if a large dividend is expected from a stock, the call option will be priced less, since dividend when declared and distributed, the prices will fall down. When cash market prices fall, the value of a call option also goes down.

13.3.2 Option Strategies

Options can be used as an effective hedging tool for risk management and also for speculative motive. Various options strategies which are used for these purposes are discussed below.

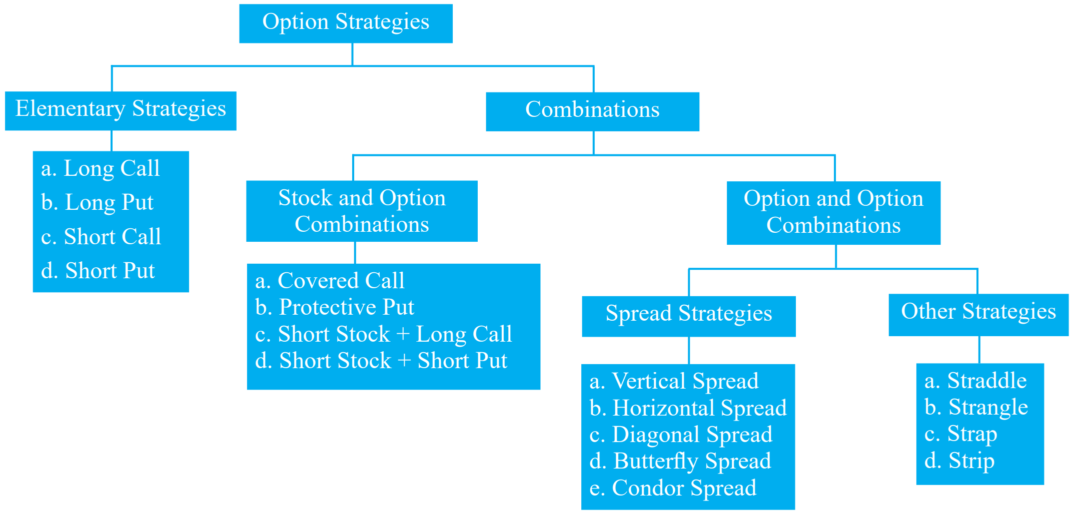


Figure 13.7: Option Strategies- at a Glance

I. Elementary Strategies

There are four elementary strategies associated with options. They are –

a. Long Call i.e., buying a call option

b. Long Put i.e., buying a put option

c. Short Call i.e., writing a call option

d. Short Put i.e., writing a put option

These have already been discussed in this Module.

In case of Short Call, if the writer of the call option does not own the underlying asset, it is called Uncovered Call or Naked Call option. In this case, if the price of the underlying asset rises, the call writer has no protection, and would be required to buy the asset in the open market and deliver the same to the option holder. Accordingly, his loss will be unlimited.

Similarly, in case of short put, if the writer of the put option does not sell the underlying asset in the Cash Market (either his own asset or borrowed asset), it is called Uncovered Put or Naked Put option. If the price of the underlying asset falls, the put writer will not have any protection but to buy the stock at a very high price. Accordingly, his loss will be unlimited.

II. Combinations

A. Stock and Option Combinations

Options are useful hedging instruments and may be used efficiently to protect loss. For example, when an investor holds a long position in stock (i.e., already had bought stock), he may resort to option contracts. Similarly, when he has a short position in stock and apprehends a price rise, he may also resort to option contracts.

There are two popular strategies in this context.

a. Covered Call

Strategy	Long Stock + Short Call
Apprehension or Expectation	Decline in stock price/ gain from small price increase.
Mechanism	As price declines, loss on stock increases but option gets OTM. So, the gain on writing option i.e., premium helps to recover the loss on stock. In case of small price rise up to strike price, option remains OTM and hence premium received is the gain, but for large price increase, option becomes ITM and loss on option consumes the gain on stock.
When Effective	Small decline or small rise in price.

Consider the following illustration.

Illustration 30

Mr. B has bought shares of XYZ Ltd. @ ₹3,850 per share. In order to protect himself from possible price decline he has written a call option with strike price of ₹4,000 for 3 months at a premium of ₹80. He expects that the price rise, if at all, won't be beyond ₹4,000. Show his expiration day payoff within a range of ₹3,500 to ₹4,500.

Solution:

Expiration day pay-off of Mr. B

Spot Price (S_T) ₹	Pay-off on Stock (₹)	Status of Short Call (₹)	Pay-off on Short Call (₹)	Total Pay-off (₹)
(1)	(2)	(3)	(4)	(5) = (2) +(4)
3,500	(–)350	OTM	+ 80	(–) 270
3,600	(–)250	OTM	+ 80	(–) 170
3,700	(–)150	OTM	+ 80	(–) 70
3,740	(–)110	OTM	+ 80	(–) 30
3,770	(–)80	OTM	+ 80	Nil
3,800	(–)50	OTM	+ 80	+ 30
3,900	+ 50	OTM	+ 80	+ 130
4,000	+ 150	ATM	+ 80	+ 230
4,200	+ 350	ITM	(–) 120	+ 230
4,500	+ 650	ITM	(–) 420	+ 230

Note: Pay-off on short call includes premium received.

It can be seen that small price fall up to ₹3,770 is protected while small price increases up to ₹4,000 has given additional income. However, large price increase opportunities could not be realized as the gain was capped to ₹230 only.

b. Protective Put

Strategy	Long Stock + Long Put
Apprehension or Expectation	Decline in stock price/ participate in the bull run.
Mechanism	As price declines, loss on stock increases but option becomes profitable. So, profit on put option offsets the loss on stock.
When Effective	Moderate to sharp decline in stock price.

Consider the following illustration.

Illustration 31

Mr. C has bought shares of P Ltd. @ ₹310 per share. In order to protect himself from possible price decline he has bought a put option with strike price of ₹270 per share for 3 months at a premium of ₹2 per share. He expects that the price will fall sharply. Show his expiration day pay-off within a price range of ₹240 to ₹340.

Solution:

Expiration day pay-off of Mr. C

Spot Price (S_T) ₹	Pay-off on Stock (₹)	Status of Long Put (₹)	Pay-off on Long Put (₹)	Total Pay-off (₹)
(1)	(2)	(3)	(4)	(5) = (2) +(4)
240	(–) 70	ITM	+ 28	(–) 42
260	(–) 50	ITM	+ 8	(–) 42
270	(–) 40	ATM	(–) 2	(–) 42
280	(–) 30	OTM	(–) 2	(–) 32
300	(–) 10	OTM	(–) 2	(–) 12
320	+ 10	OTM	(–) 2	+ 8
340	+ 30	OTM	(–) 2	+ 28

Note: Pay-off on long put is after deduction of premium paid.

His loss is restricted to ₹42. Moreover, as price starts rising beyond ₹310 (i.e., the purchase price), it starts earning profit.

c. Short Position in Stock with Long Call

Strategy	Short Stock + Long Call
Apprehension	Increase in stock price.
Mechanism	As price rises, loss on short stock is covered by profit on long call.
When Effective	Large price appreciation.

Consider the following illustration.

Illustration 32

Mr. C sells short the shares of Q Ltd. at ₹300 per share. In order to hedge the loss against possible price increase, he buys a call option with a strike price of ₹350 per share. He pays a premium of ₹5 per share. Show his expiration day pay-off within a price range of ₹280 to ₹380.

Solution:

Expiration day pay-off of Mr. C

Spot Price (S_T) ₹	Pay-off on Stock (₹)	Status of Long Call (₹)	Pay-off on Long Call (₹)	Total Pay-off (₹)
(1)	(2)	(3)	(4)	(5) = (2) +(4)
280	+ 20	OTM	(–) 5	+ 15
290	+ 10	OTM	(–) 5	+ 5
300	0	OTM	(–) 5	(–) 5
320	(–) 20	OTM	(–) 5	(–) 25
340	(–) 40	OTM	(–) 5	(–) 45
350	(–) 50	ATM	(–) 5	(–) 55
360	(–) 60	ITM	+ 5	(–) 55
380	(–) 80	ITM	+ 25	(–) 55

Note: Pay-off on long call is after deduction of premium paid.

It can be seen that his loss is limited in case of large price appreciation.

d. Short Position in Stock with Short Put

Strategy	Short Stock + Short Put
Apprehension	Increase in stock price.
Mechanism	As price rises, loss on short stock is covered by profit on short put.
When Effective	Small price decline.

Consider the following illustration.

Illustration 33

Mr. D sells short the shares of R Ltd. at ₹300 per share. As he expects a small price decline, he writes a put option with a strike price of ₹270 per share. He pays a premium of ₹5 per share. Show his expiration day pay-off within a price range of ₹250 to ₹330.

Solution:

Expiration day pay-off of Mr. D

Spot Price (S_T) ₹	Pay-off on Stock (₹)	Status of Short Put (₹)	Pay-off on Short Put (₹)	Total Pay-off (₹)
(1)	(2)	(3)	(4)	(5) = (2) +(4)
250	+ 50	ITM	(–) 15	+ 35
260	+ 40	ITM	(–) 5	+ 35
270	+ 30	ATM	+ 5	+ 35
280	+ 20	OTM	+ 5	+ 25
290	+ 10	OTM	+ 5	+ 15

300	0	OTM	+ 5	+ 5
310	(–) 10	OTM	+ 5	(–) 5
330	(–) 30	OTM	+ 5	(–) 25

Note: Pay-off on short call includes premium received.

It can be seen that he makes additional gain for small price fall up to ₹270, thereafter his gain is limited for further price decline.

B. Combination of Options

➤ Spread Strategies

In options trading, an option spread is created by the simultaneous purchase and sale of options of the same class on the same underlying security but with different strike prices and/or expiration dates. Any spread that is constructed using calls can be referred to as a call spread. Similarly, put spreads are spreads created using put options.

Option buyers can consider using spreads to reduce the net cost of entering a trade. Naked option sellers can use spreads instead to lower margin requirements so as to free up buying power while simultaneously putting a cap on the maximum loss potential.

The three basic classes of spreads are the vertical spread, the horizontal spread and the diagonal spread. They are categorized by the relationships between the strike price and expiration dates of the options involved.

Vertical spreads are constructed using options of the same class, same underlying security, same expiration month, but at different strike prices.

Horizontal or calendar spreads are constructed using options of the same underlying security, same strike prices but with different expiration dates.

Diagonal spreads are created using options of the same underlying security but different strike prices and expiration dates.

a. Vertical Spread

(i) Bull Spread

➤ With Call Options (Bull Call Spread)

Strategy	Buy a Call with a lower strike (ITM) + Sell a Call with a higher strike (OTM).
Risk	Limited to any initial premium paid in establishing the position. Maximum loss occurs where the underlying falls to the level of the lower strike or below.
Reward	Limited to the difference between the two strikes minus net premium cost. Maximum profit occurs where the underlying rises to the level of the higher strike or above.
When Effective	Investor is moderately bullish.
BEP	Strike Price of Purchased call + Net Debit Paid

Consider the following illustration.

Illustration 34

Mr. PQR buys a Nifty Call with a Strike price ₹ 4,100 at a premium of ₹ 172.45 and he sells a Nifty Call option with a strike price ₹4,400 at a premium of ₹37.40. The net debit here is ₹135.05 which is also his maximum loss. Show his pay-off profile on expiration within a price range of ₹3,800 to ₹4,500

Solution:

Expiration day pay-off of Mr. PQR

Spot Price (S_T) ₹	Pay-off on Long Call (₹)	Pay-off on Short Call (₹)	Net Pay-off (₹)
(1)	(2)	(3)	(4) = (2) + (3)
3,800	(–) 172.45	37.40	(–) 135.05
3,900	(–) 172.45	37.40	(–) 135.05
4,000	(–) 172.45	37.40	(–) 135.05
4,100	(–) 172.45	37.40	(–) 135.05
4,200	(–) 72.45	37.40	(–) 35.05
4,235.05	(–) 37.40	37.40	0
4,300	27.55	37.40	64.95
4,400	127.55	37.40	164.95
4,500	227.55	-62.60	164.95

The strategy has produced limited gain in a moderately bullish market.

- **With Put Options (Bull Put Spread)**

Strategy	Sell a Put with a higher strike (OTM) + Buy a Put with a lower strike (Further OTM).
Risk	Limited. Maximum loss occurs where the underlying falls to the level of the lower strike or below.
Reward	Limited to the net premium credit. Maximum profit occurs where underlying rises to the level of the higher strike or above.
When Effective	When the investor is moderately bullish.
BEP	Strike Price of Short Put – Net Premium Received

Consider the following illustration.

Illustration 35

Mr. XYZ sells an ABC Ltd. Put option with a strike price of ₹4,000 at a premium of ₹21.45 and buys a further OTM ABC Ltd. Put option with a strike price ₹3,800 at a premium of ₹3.00 when the current market price of ABC Ltd. shares is at ₹4,191.10, with both options expiring on 31st July.

Show his pay-off profile on expiration within a price range of ₹3,500 to ₹4,200

Solution:

Expiration day pay-off of Mr. XYZ

Spot Price (S_T) ₹	Pay-off on Long Put (₹)	Pay-off on Short Put (₹)	Net Pay-off (₹)
(1)	(2)	(3)	(4) = (2) + (3)
3,500	297	(–) 478.55	(–) 181.55
3,600	197	(–) 378.55	(–) 181.55
3,700	97	(–) 278.55	(–) 181.55
3,800	(-) 3	(–) 178.55	(–) 181.55
3,900	(-) 3	(–) 178.55	(–) 181.55

3,981.55	(-) 3	3	0
4,000	(-) 3	21.45	18.45
4,100	(-) 3	21.45	18.45
4,200	(-) 3	21.45	18.45

Note: Net premium received = 21.45 – 3 = ₹18.45

The strategy earns a net income for the investor as well as limits the downside risk of a Put sold.

(ii) Bear Spread

- **With Call Options (Bear Call Spread)**

The Bear Call Spread strategy can be adopted when the investor feels that the stock / index is either range bound or falling. The concept is to protect the downside of a Call Sold by buying a Call of a higher strike price to insure the Call sold.

Strategy	Sell a Call with a lower strike (ITM) + Buy a Call with a higher strike (OTM).
Risk	Limited to the difference between the two strikes minus the net premium.
Reward	Limited to the net premium received for the position i.e., premium received for the short call minus the premium paid for the long call.
When Effective	When the investor is mildly bearish on market.
BEP	Lower Strike + Net credit

Consider the following Illustration

Illustration 36

Mr. ABC is bearish on Reliance. He sells an ITM call option with strike price of ₹ 2,600 at a premium of ₹154 and buys an OTM call option with strike price ₹2,800 at a premium of ₹49. Show his pay-off profile on expiration within a price range of ₹2,400 to ₹3,200.

Solution:

Expiration day pay-off of Mr. ABC

Spot Price (S_T) ₹	Pay-off on Short Call (₹)	Pay-off on Long Call (₹)	Net Pay-off (₹)
(1)	(2)	(3)	(4) = (2) + (3)
2,400	154	(–) 49	105
2,500	154	(–) 49	105
2,600	154	(–) 49	105
2,700	54	(–) 49	5
2,705	49	(–) 49	0
2,800	(–) 46	(–) 49	(–) 95
2,900	(–) 146	51	(–) 95
3,000	(–) 246	151	(–) 95
3,100	(–) 346	251	(–) 95
3,200	(–) 446	351	(–) 95

The strategy earns a net income for the investor as well as limits the downside risk of a Call sold.

With Put Options (Bear Put Spread)

This strategy requires the investor to buy an in-the-money (higher) put option and sell an out-of-the-money (lower) put option on the same stock with the same expiration date.

Strategy	BUY A PUT with a higher strike (ITM) + SELL A PUT with a lower strike (OTM).
Risk	Limited to the net amount paid for the spread. i.e., the premium paid for long position less premium received for short position.
Reward	Limited to the difference between the two strike prices minus the net premium paid for the position.
When Effective	When you are moderately bearish on market direction.

Consider the following illustration.

Illustration 37

Nifty Bank is presently at 2694. Mr. ABC expects Nifty Bank to fall. He buys one Nifty Bank ITM Put with a strike price ₹2,800 at a premium of ₹132 and sells one Nifty Bank OTM Put with strike price ₹2,600 at a premium ₹52. Show his pay-off profile on expiration within a price range of ₹2,400 to ₹3,000.

Solution:

Expiration day pay-off of Mr. ABC

Spot Price (S_T) ₹	Pay-off on Long Put (₹)	Pay-off on Short Put (₹)	Net Pay-off (₹)
(1)	(2)	(3)	(4) = (2) + (3)
2,400	268	(−) 148	120
2,500	168	(−) 48	120
2,600	68	52	120
2,700	(−) 32	52	20
2,800	(−)132	52	(-) 80
2,900	(−) 132	52	(-) 80
3,000	(−) 132	52	(-) 80

The strategy also has limited gains and is therefore ideal when markets are moderately bearish.

(iii) Box Spread

The box spread, or long box, is a common arbitrage strategy that involves buying a bull call spread together with the corresponding bear put spread, with both vertical spreads having the same strike prices and expiration dates.

The long box is used when the spreads are underpriced in relation to their expiration values.

Box spread Construction

Buy	1	ITM	Call
Sell	1	OTM	Call
Buy	1	ITM	Put
Sell	1	OTM	Put

Essentially, the arbitrageur is simply buying and selling equivalent spreads and as long as the price paid for the box is significantly below the combined expiration value of the spreads, a riskless profit can be locked in immediately.

Expiration Value of Box = Higher Strike Price – Lower Strike Price

Risk-free Profit = Expiration Value of Box – Net Premium Paid

Consider the following example.

Example

Suppose XYZ stock is trading at ₹45 in June and the following prices are available:

- JUL 40 put – ₹1.50
- JUL 50 put – ₹6
- JUL 40 call – ₹6
- JUL 50 call – ₹1

Buying the bull call spread involves purchasing the JUL 40 call for ₹600 and selling the JUL 50 call for ₹100. The bull call spread costs: ₹600 – ₹100 = ₹500

Buying the bear put spread involves purchasing the JUL 50 put for ₹600 and selling the JUL 40 put for ₹150. The bear put spread costs: ₹600 – ₹150 = ₹450

The total cost of the box spread is: ₹500 + ₹450 = ₹950

The expiration value of the box is computed to be: (₹50 – ₹40) × 100 = ₹1,000.

Since the total cost of the box spread is less than its expiration value, a risk-free arbitrage is possible with the long box strategy. It can be observed that the expiration value of the box spread is indeed the difference between the strike prices of the options involved.

If XYZ remain unchanged at ₹45, then the JUL 40 put and the JUL 50 call expire worthless while both the JUL 40 call and the JUL 50 put expires in-the-money with ₹500 intrinsic value each. So, the total value of the box at expiration is: ₹500 + ₹500 = ₹1000.

Suppose, on expiration in July, XYZ stock rallies to ₹50, then only the JUL 40 call expires in-the-money with ₹1,000 in intrinsic value. So, the box is still worth ₹1,000 at expiration.

What happens when XYZ stock plummets to ₹40? A similar situation happens but this time it is the JUL 50 put that expires in-the-money with ₹1,000 in intrinsic value while all the other options expire worthless. Still, the box is worth ₹1,000.

As the trader had paid only ₹950 for the entire box, his profit comes to ₹50.

b. Horizontal/Time Spread and Calendar Spread

Calendar spread consists of opposing positions in two options of the same kind (call or put) where both have same strike price but different time to expire.

A common example of a calendar spread is to sell a call option with shorter maturity and buy a call option with longer maturity but both at the same exercise price. The longer the maturity, the more expensive is the option. Hence, a calendar spread requires an initial investment.

c. Diagonal Spread

A diagonal spread can be created by using similar options with different strike prices and also different time to expire.

For example, one can create a diagonal spread by using a call with lower exercise price with longer maturity and selling a call with higher exercise price with shorter maturity.

d. Butterfly Spread

Butterfly Spread is an option strategy which combines a Bull Spread and Bear Spread and involves three different strike prices.

Butterfly spread is taken up if investors are of the view that the underlying security is not highly volatile and there is not going to be a substantial rise or fall in its prices.

A butterfly spread involves positioning in options with three different strike prices (X_1, X_2, and X_3) where X_2 is the halfway between X_1 and X_3.

There are two possible butterfly spread strategies as follows:

(i) Long Call Butterfly

Strategy	Sell 2 ATM Call, buy 1 ITM Call Option and buy 1 OTM Call Option
Risk	Net debit paid.
Reward	Difference between adjacent strikes minus net debit.
When Effective	When the investor is neutral on market direction and bearish on volatility.
Upper BEP	Strike Price of Higher Strike Long Call - Net Premium Paid
Lower BEP	Strike Price of Lower Strike Long Call + Net Premium Paid

Consider the following illustration.

Illustration 38

Nifty is at 9200. Mr. P expects very little movement in Nifty. He sells 2 ATM Nifty Call Options with a strike price of ₹9,200 at a premium of ₹97.90 each, buys 1 ITM Nifty Call Option with a strike price of ₹9,100 at a premium of ₹141.55 and buys 1 OTM Nifty Call Option with a strike price of ₹9,300 at a premium of ₹64. The Net debit is ₹9.75. Show his pay-off profile on expiration within a price range of ₹8,900 to ₹9,600.

Solution:

Expiration day pay-off of Mr. P

Spot Price (S_T) ₹	Payoff from 2 ATM Calls Sold (₹)	Payoff from 1 ITM Call purchased (₹)	Payoff from 1 OTM Call purchased (₹)	Total Pay-off (₹)
(1)	(2)	(3)	(4)	(5) = (2) + (3) +(4)
8,900	195.80	(–) 141.55	(–) 64	(–) 9.75
9,000	195.80	(–) 141.55	(–) 64	(–) 9.75
9,100	195.80	(–) 141.55	(–) 64	(–) 9.75
9,109.75	195.80	(–) 131.80	(–) 64	0
9,200	195.80	(–) 41.55	(–) 64	90.25

9,290.25	15.30	48.70	(−) 64	0
9,300	(−) 4.20	58.45	(−) 64	(−) 9.75
9,400	(−) 204.20	158.45	36	(−) 9.75
9,500	(−) 604.20	258.45	136	(−) 209.75
9,600	(−) 804.20	358.45	236	(−) 209.75

(ii) Short Call Butterfly

Strategy	Buy 2 ATM Call, sell 1 ITM Call Option and sell 1 OTM Call Option
Risk	Limited to the net difference between the adjacent strikes (₹100 in this example) less the premium received for the position.
Reward	Limited to the net premium received for the option spread.
When Effective	When the investor is neutral on market direction and bullish on volatility. Neutral means that you expect the market to move in either direction - i.e., bullish and bearish.
Upper BEP	Strike Price of Highest Strike Short Call − Net Premium Received
Lower BEP	Strike Price of Lowest Strike Short Call + Net Premium Received

Consider the following illustration.

Illustration 39

Nifty is at 9200. Mr. P expects large volatility in the Nifty irrespective of which direction the movement is, upwards or downwards. Mr. XYZ buys 2 ATM Nifty Call Options with a strike price of ₹9,200 at a premium of ₹97.90 each, sells 1 ITM Nifty Call Option with a strike price of ₹9,100 at a premium of ₹141.55 and sells 1 OTM Nifty Call Option with a strike price of ₹9,300 at a premium of ₹64. The Net Credit is ₹9.75. Show his pay-off profile on expiration within a price range of ₹8,900 to ₹9,600.

Solution:

Expiration day pay-off of Mr. P

Spot Price (S_T) ₹	Payoff from 2 ATM Calls Purchased (₹)	Payoff from 1 ITM Call Sold (₹)	Payoff from 1 OTM Call Sold (₹)	Total Pay-off (₹)
(1)	(2)	(3)	(4)	(5) = (2) + (3) +(4)
8,900	(−) 195.80	141.55	64	9.75
9,000	(−) 195.80	141.55	64	9.75
9,100	(−) 195.80	141.55	64	9.75
9,109.75	(−) 195.80	131.80	64	0
9,200	(−) 195.80	41.55	64	(−) 90.25
9,290.25	(−) 15.30	(−) 48.70	64	0
9,300	4.20	(−) 58.45	64	9.75
9,400	204.20	(−) 158.45	(−) 36	9.75
9,500	604.20	(−) 258.45	(−) 136	209.75
9,600	804.20	(−) 358.45	(−) 236	209.75

e. Condor

A condor spread is a non-directional options strategy that limits both gains and losses while seeking to profit from either low or high volatility. There are two types of condor spreads. A long condor seeks to profit from low volatility and little to no movement in the underlying asset. A short condor seeks to profit from high volatility and a sizable move in the underlying asset in either direction.

III. Other Strategies

a. Straddle

One of the least sophisticated option strategies that can accomplish a market neutral objective with a lot less hassle is known as a straddle. A straddle involves a call and a put option with the same exercise price and same expiration date. There are two types of straddles as follows:

(i) Long Straddle: The long straddle is designed around the purchase of a put and a call at the exact same strike price and expiration date. The long straddle is meant to take advantage of the market price change by exploiting increased volatility. The strategy is helpful when the investor expects a large movement in stock price but does not know in which director the price will move.

Strategy	Buy Put + Buy Call with same strike price and expiration date
Risk	Limited to the initial premium paid.
Reward	Unlimited
When Effective	When the investor thinks that the underlying stock / index will experience significant volatility in the near term.
Upper BEP	Strike Price of Long Call + Net Premium Paid
Lower BEP	Strike Price of Long Put – Net Premium Paid

(ii) Short Straddle: The short straddle is designed around the sale of a put and a call at the exact same strike price and expiration date. This strategy works well when market is in a sideway pattern.

Strategy	Sell Put + Sell Call with same strike price and expiration date
Risk	Unlimited
Reward	Limited to the premium received.
When Effective	When the investor thinks that the underlying stock / index will experience very little volatility in the near term.
Upper BEP	Strike Price of Short Call + Net Premium Received
Lower BEP	Strike Price of Short Put – Net Premium Received

b. Strangle

A Strangle is a slight modification to the Straddle to make it cheaper to execute. This strategy involves the simultaneous buying of a slightly out-of-the-money (OTM) put and a slightly out-of-the-money (OTM) call of the same underlying stock / index and expiration date. For a Strangle to make money, it would require greater movement on the upside or downside for the stock / index than it would for a Straddle. Strangles can also be of two types.

(i) Long Strangle

Strategy	Buy OTM Put + Buy OTM Call
Risk	Limited to the premium received
Reward	Unlimited
When Effective	When the investor thinks that the underlying stock / index will experience very high levels of volatility in the near term.
Upper BEP	Strike Price of Long Call + Net Premium Paid
Lower BEP	Strike Price of Long Put – Net Premium Paid

(ii) Short Strangle

Strategy	Sell OTM Put + Sell OTM Call
Risk	Unlimited
Reward	Limited to the premium received
When Effective	This options trading strategy is taken when the options investor thinks that the underlying stock will experience little volatility in the near term.
Upper BEP	Strike Price of Short Call + Net Premium Received
Lower BEP	Strike Price of Short Put – Net Premium Received

c. Strap

Strap Strategy is similar to Long Straddle, the only difference is the quantity traded. A trader will buy two Call Options and one Put Options.

d. Strip

Strip Strategy is the opposite of Strap Strategy. When a trader is bearish on the market and bullish on volatility then he will implement this strategy by buying two ATM Put Options and one ATM Call Option, of the same strike price, expiry date and underlying asset.

13.3.3 Put-Call Parity Relationship, Valuation of Options using Binomial Tree Approach and Black-Scholes Model, The Greeks

⊙ Put-Call Parity Relationship

Put-call parity shows the relationship that has to exist between European put and call options that have the same underlying asset, expiration, and strike prices. The concept says that the price or value of the European call option with a certain strike price and expiration date can be derived from the value of a European put option with same strike price and expiration date and vice-versa. The relationship is based on a 'no arbitrage' assumption.

As per Put-Call Parity, $C + PV(X) = P + S_T$.

Where, C is the call price (or premium), P is the put price (or premium), S_T is the spot price and PV(X) = the present value of the strike price (X).

Here, $PV(X) = X.\ e^{-rt}$ where, r = risk free rate of interest continuously compounded and t = time to expiration.

Therefore, $C + X.\ e^{-rt} = P + S_T$

Or, $C = P + S_T - X.\ e^{-rt}$

Or, $P = C + X.\ e^{-rt} - S_T$

The concept is, however, not applicable in case of American option.

Consider the following illustration.

Illustration 40

A stock is currently trading at ₹500. A call option with 3 months to maturity at an exercise price of ₹550 is available on the stock at a premium of ₹12. What should be the price of the put option on the same stock with same strike price and expiration? The risk-free rate of interest is 8% p.a. continuously compounded.

Solution:

Given, C = ₹12; K = ₹550, r = 8% p.a. and t = 3 months = 3/12 year

Using the Put-Call Parity Relationship,

$P = C + X.\ e^{-rt} - S_T = 12 + 550 \times e^{-0.08 \times 3/12} - 500$

Or, P = 12 + 539.11 – 500

Or, P = 51.11

So, the price of the put option will be ₹51.11.

Option Valuation/Pricing Models

The term option valuation is used to convey two meanings:

(i) The value of the option at the time of its maturity. It is the amount that the option buyer receives from the option writer on exercising the option

(ii) The value of the option at the time of its writing. This is also referred to as option premium or option price. The three major methods of option valuation are as follows:

A. Binomial Method

B. Black-Scholes Model

These are discussed below.

A. Binomial Model of Option Pricing

This model assumes that the underlying asset can have only two values at the time of maturity of an option. One will be higher than the strike price and the other will be lower than the strike price.

The option premium calculated under this method provides risk-free rate of return, at either of the two prices, on the investment made by option writer. (In case the option writer uses borrowed funds, the return at risk free rate will be provided on borrowed funds.)

Following are the factors considered in valuing / pricing an option under the Binomial Tree Approach —

(a) Current Spot Price of the underlying asset (S_T or SP_0);

(b) Exercise Price under the Options Contract (X or EP);

(c) Set of Expected Future Spot Prices - one above the Exercise Price and one below the Exercise Price (FP_1 and FP_2 respectively);

(d) Risk Free Rate of Return (r);

(e) Period to Expiry (t).

This model requires construction of a tree to include alternative possibilities of upward and downward movement and to evaluate each node for the possible values. Binomial model can again be single stage model or multi-stage model. The general steps of Binomial Model are –

(a) Construct a binomial tree.

(b) Calculate implied volatility

(c) Calculate expected pay-off

(d) Discount the expected pay-off

Here, implied volatility is the probability of asset prices going upwards. It is calculated by the formula $p = \frac{f-d}{u-d}$

Where, u = 1 + % increase in stock price or FP_1/SP_0;

and, d = 1 + % increase in stock price or FP_2/SP_0

So, Probability of asset prices going downwards. It is calculated by the formula $= 1 - p = \frac{u-f}{u-d}$

Now, expected pay-off from a call option $= C_u \times p + C_d \times (1-p) = C_u\left[\frac{f-d}{u-d}\right] + C_d\left[\frac{u-f}{u-d}\right]$

Value of a call option = Present value of expected pay-off

Value of a call Option $= \dfrac{C_u\left[\frac{f-d}{u-d}\right] + C_d\left[\frac{u-f}{u-d}\right]}{f}$

where, f = future value factor $= e^{rt}$ (for continuously compounded risk-free rate of return).

Similarly, value of a put option $= \dfrac{P_u\left[\frac{f-d}{u-d}\right] + P_d\left[\frac{u-f}{u-d}\right]}{f}$

Consider the following illustrations.

Illustration 41 (Single Stage Model)

A stock is currently trading at ₹50. It can either go up or down by 20% in a period of 3 months. If the risk-free rate of return is 8% p.a. continuously compounded, calculate the value of call and put option with strike price of ₹50 and maturity of 3 months using Single Stage Binomial Option Pricing Model.

Solution:

		Spot Price (SP_0)	Exercise Price (EP)	Long Call Pay-off	Long Put Pay-off
	+20%	60	50	$C_u = 10$	$P_u = 0$
50					
	-20%	40	50	$C_d = 0$	$P_d = 10$

Here, u = 1 + 20% = 1.20 and d = 1 – 20% = 0.80 and $f = e^{rt} = e^{0.08 \times 3/12} = 1.02$

Then, $p = \frac{f-d}{u-d} = \frac{1.02 - 0.80}{1.2 - 0.8} = 0.55$ and $1 - p = 0.45$

So, value of call Option $= \dfrac{C_u\left[\frac{f-d}{u-d}\right] + C_d\left[\frac{u-f}{u-d}\right]}{f} = \dfrac{10 \times 0.55 + 0 \times 0.45}{1.02} =$ ₹5.39

Value of a put option $= \dfrac{P_u\left[\frac{f-d}{u-d}\right] + P_d\left[\frac{u-f}{u-d}\right]}{f} = \dfrac{0 \times 0.55 + 10 \times 0.45}{1.02} =$ ₹4.41

Illustration 42 (Two Stage Model)

A stock is currently trading at ₹50. It can either go up or down by 20% in a period of 6 months. If the risk-free rate of return is 8% p.a. continuously compounded, calculate the value of call and put option with strike price of ₹45 and maturity of 3 months using Two Stage Binomial Option Pricing Model.

Solution:

		Spot Price (SP_0)		Spot Price (SP_0)	Exercise Price (EP)	Long Call Pay-off	Long Put Pay-off
			+ 20%	72	45	27	0
	+ 20%	60					
50			-20%	48	45	3	0
			+20%				
	(-) 20%	40			45	0	13
			-20%	32			

Here, $u = 1 + 20\% = 1.20$ and $d = 1 - 20\% = 0.80$ and $f = e^{rt} = e^{0.08 \times 3/12} = 1.02$

$$p = \frac{f - d}{u - d} = \frac{1.02 - 0.80}{1.2 - 0.8} = 0.55 \text{ and } 1-p = 0.45$$

$$\text{Value of Call (at Node 60)} = \frac{27 \times 0.55 + 3 \times 0.45}{1.02} = 15.89$$

$$\text{Value of Call (at Node 40)} = \frac{3 \times 0.55 + 0 \times 0.45}{1.02} = 1.62$$

However, at Node 40, the option is OTM and hence not exercised. So, its value = 0.

$$\text{Value of Call (at Node 50)} = \frac{15.89 \times 0.55 + 0 \times 0.45}{1.02} = 8.57$$

Similarly,

Value of Put (at Node 60) = 0 (as OTM)

$$\text{Value of Put (at Node 40)} = \frac{0 \times 0.55 + 13 \times 0.45}{1.02} = 5.73$$

$$\text{Value of Put (at Node 50)} = \frac{0 \times 0.55 + 5.73 \times 0.45}{1.02} = 2.52$$

B. Black-Scholes Option Pricing Model

Fisher Black and Myron Scholes provided the first ever closed form of solution for pricing the European calls in 1973 and published the path-breaking paper titled “The pricing of options and corporate liabilities” in Journal of Political Economy. Prof. Scholes and Prof. Merton were awarded the Nobel Prize for their contributions in option pricing.

The pricing intuition involves constructing a replicating hedge portfolio comprising a long position in stock and a short position in a zero-coupon bond. The hedge portfolio will be constituted in such a way that at any given point of time its value will always be equal to the option’s price at that time. If the option’s price differs from the hedge portfolio’s value, then arbitrageurs’ actions will bring back the equilibrium relationship. The proportion of stocks and bonds will be determined by the Black-Scholes formula.

The model is based on the following assumptions:

a. The underlying asset does not pay any dividend.

b. The market is efficient.

c. There is no transaction costs or taxes.

d. Risk free rate of interest is constant during the life of the option and it is known.

e. Stock returns are log-normally distributed.

f. European exercise terms are used.

As per the model, the value of call option is given by –

$C = S.\ N(d_1) - X.\ e^{-rt}.\ N(d_2)$

$P = X.\ e^{-rt}.\ N(-d_2) - S.\ N(-d_1)$

Where, $d_1 = \dfrac{Ln(\frac{S}{X}) + (r + \frac{\sigma^2}{2}) \times t}{\sigma\sqrt{t}}$ and $d_2 = d_1 - \sigma.\sqrt{t}$

N = Cumulative normal distribution function

Ln = Natural logarithm,

S = Spot price of the stock,

X = Exercise price of the option,

r = Annual risk-free rate of return,

t = Time to expiry of the option, and

σ = Annual volatility of the stock.

Consider the following illustration.

Illustration 43

The current price of a stock is ₹90 per share. The risk-free interest rate is 8% (annualized, continuous compounding). If the volatility of the stock is 23% p.a., what is the price of the ₹80 call option expiring in 6 months?

Solution:

S = Spot price of the stock = ₹90

X = Exercise price of the option = ₹80

r = Annual risk-free rate of return = 8% p.a.

t = Time to expiry of the option = 6 months = 6/12 years = 0.5 years

σ = Annual volatility of the stock = 23%

$$\text{Now, } d_1 = \frac{n(\frac{S}{X}) + (r + \frac{\sigma^2}{2}) \times t}{\sigma\sqrt{t}} = d_1 = \frac{Ln(\frac{90}{80}) + (0.08 + \frac{0.23^2}{2}) \times 0.5}{0.23\sqrt{0.5}} = \frac{0.1178 + 0.1064 \times 0.5}{0.1626} = 1.0517$$

$$d_2 = d_1 - \sigma \times \sqrt{t} = 1.0517 - 0.23 \times \sqrt{0.5} = 0.8891$$

N (1.0517) = 0.8535 and N (0.8891) = 0.8130

$C = S.\ N(d_1) - X.\ e^{-rt}.\ N(d_2)$

$= 90 \times 0.8535 - 80 \times e^{-0.08 \times 0.5} \times 0.8130$ = ₹14.33

$P = X.\ e^{-rt}.\ N(-d_2) - S.\ N(-d_1)$

$= 80 \times e^{-0.08 \times 0.5} \times (1 - 0.8130) - 90 \times (1 - 0.8535)$ = ₹1.19

The Greeks

In options trading, you may notice the use of certain Greek alphabets when describing risks associated with various positions. They are known as "the Greeks" and we shall discuss the four most commonly used ones. They are delta, gamma, theta and vega.

a. Delta:

Delta of a Stock Option is the ratio of the change in the price of the stock option to the change in the price of the underlying stock. It measures the sensitivity of Options Price to the movement in the prices of the underlying asset.

Deltas of Call Option and put Option:

(a) Delta of a Call Option is always positive.

(b) Delta of a Put Option is always negative.

Formula:

$$\text{Delta } (\Delta) = \frac{\text{Change in Option Price i.e., Option Premium}}{\text{Change in Stock Price}} = \frac{\text{CI. Option Price} - \text{Op. Option Price}}{\text{CI. Stock Price} - \text{Op. Stock Price}}$$

Example: On 01.12.2024, when the trade opens, the stock price of Amitech Castings is ₹240. It rises to ₹250. The December 2024 Call Option on Amitech Castings started at ₹20. It moved to ₹23.

Delta of Call Options of Amitech Castings is computed as under —

$$\text{Delta } (\Delta) = \frac{\text{CI. Option Price} - \text{Op. Option Price}}{\text{CI. Stock Price} - \text{Op. Stock Price}} = \frac{23 - 20}{250 - 240} = 0.30$$

Application: Value of Delta is the number of units of the underlying stock which an investor should hold for each option sold in order to create a riskless hedge.

Delta Hedging: Creating a Riskless Hedge using Options and Underlying Stock, is called Delta Hedging.

Rebalancing: Since Delta changes, the investor's position remains delta hedged (or delta neutral) for only a relatively short period. The hedge should be adjusted periodically. This is called re-balancing.

Delta Values:

Option position is	Value of Delta
In the Money [Extreme beneficial CMP]	Almost Equal to ± 1 [Never beyond than ± 1]
At the Money	Approximately equal to ± 0.50
Out of Money [Extreme beneficial CMP]	Near to Zero.

b. Gamma:

The gamma of an option is defined as the rate of change of the option's delta with respect to the price of the underlying, when all else remains the same. It's the second partial derivative of the option price with respect to the underlying price. In other words, gamma is the rate at which delta will change. The delta captures the extent of change and the gamma measures the pace of the change. It is also called as Curvature.

Gamma is also called as the Second Derivative of an Option Premium since it measures the sensitivity of Delta, which is the first measure of sensitivity of Option's Price to Market Price of the Underlying Asset.

Evaluation based on Gamma Values:

(a) If Gamma is small, delta changes slowly, and re-balancing act (i.e., adjustments to keep a portfolio delta neutral) needs not be done on a frequent basis.

(b) If Gamma value is high, delta is highly sensitive to the price of the underlying asset. This situation requires the re-balancing to be done on a frequent basis.

c. Vega or Lambda:

Vega of the option measures the sensitivity of option price with respect to the volatility of the price of the underlying asset. It considers both movement in price and also decrease in period to expiry of an option. It is calculated as change in the option premium for a unit change in the volatility of the price of the underlying asset. For both call and put options, Vega lies between zero and infinity. Vega is maximum for at the money options with long term to expiration. High Vega reflects the higher chances of an option going "In-the-money" at any point in time during the currency of the contract. So, options with high Vega are attractive to the option buyer Vega is positive for Option Buyer and negative for Option Seller.

d. Theta:

Theta measures the sensitivity of the option's price with respect to its time to expiry i.e. Time Value of an Option. It measures the change of the price of the option with the passage of time. It is also referred to as the time decay of the stock or portfolio. Theta Values for both the Call and the Put Option lies between Zero and the Total Value of the Option. It will be positive or negative based on the nature of the investor (holder or writer). Value of Theta is generally measured on per day basis, and therefore, value of Theta would vary for every trading day, based on the movement in Stock Prices. When Option Contract approaches the expiry date, option tends to become less valuable. Since the Stock Price and the option price move in tandem, the value of theta remains same or uniform towards the end of the options contract.

e. Rho

Rho is the last and the least used Greek. Rho helps us to understand the change in option premium, which are not linked to the underlying stock movement. For instance, interest rates changes may cause a change in option premium.

Rho indicates the change in option value for a one percentage change in the interest rate.

Example: A Rho of 1.50 indicates the option's theoretical value will increase by 1.50 if the interest rate is decreased by 1%.

An increase in interest rates increases the value of calls and decreases the value of puts. A decrease in interest rates decreases the value of calls and increases the value of puts. The range of the Rho Value also depends on the position that a person holds in the Option. Long calls and short puts have positive Rho. Short calls and long puts have negative Rho.

Illustration 44

Kiran, who trades in shares in the spot market, follows the rule "When prices are rising - Buy; When prices are falling –sell". She ensures that her portfolio is intact at the end of every three months, even if she buys or sells in between.

She is a first timer to the options market and wishes to apply the above rule in the options market, where she understands that buy equates to call option and sell equals put option. For a three-month horizon, the following information is available for 5 securities (of which Kiran holds sufficient quantities):-

Scrip	Spot Price (₹)	Outlook	Exercise Price (₹)
Greaves Cotton Ltd	345	Increase by 15%	400
NDTV	395	Increase by 10%	430
Punj Loyd	260	Decrease by 5%	250
ITC Ltd	160	Increase by 5%	170
TCS Ltd	1120	Decrease by 10%	1000

If the expectations translates into actual, and Kiran follows her spot market rule in options market as well, how much she would have earned in the options market? You may assume that she will deal only in 100 units of scrip at a time and exercises her option, come what may.

What would have been the position if she had opted for potions, not based on spot market rules, but based on option market rules i.e. Exercise Price > Expected Price = Put Option; Expected Price > Exercise Price = Call Option?

What is the lesson to be learnt? Ignore transaction costs, time value of money and cost of options.

Solution:

1. Choice of Option – Spot Market Rules

(a) Choice of Option and Expected Price

Scrip	Expectation for the next 3 Months	Option Chosen	Spot Price (₹)	Expected Price after 3 Months (₹)
Greaves	Increase by 15%	Call	345	345 +15% = 397
NDTV	Increase by 10%	Call	395	395 + 10% = 434
Punj Loyd	Decrease by 5%	Put	260	260 – 5% = 247
ITC Ltd	Increase by 5%	Call	160	160 + 5% = 168
TCS Ltd	Decrease by 10%	Put	1,120	1,120 – 10% = 1,008

(b) Gain / Loss Statement on Options Contracts

Scrip	3- Month' Spot Price (₹)	Strike Price (₹)	Option Chosen	Action	No. of Scripts	Gain/Loss [Sale Value less Buy cost] (₹)
Greaves	397	400	Call	Buy under option at Strike Price. Sell spot at Spot Price.	100	Loss (300) [100 × (397 – 400)]
NDTV	434	430	Call	Buy under option at Strike Price. Sell spot at Spot Price.	100	Gain 400 [100 × (434 – 430)]
Punj Loyd	247	250	Put	By spot at Spot Price. Sell under option at Strike Price.	100	Gain 300 [100 × (250 – 247)]
ITC Ltd	168	170	Call	Buy under option at Strike Price. Sell spot at Spot Price.	100	Loss (200) [100 × (168 – 170)]
TCS Ltd	1,008	1,000	Put	By spot at Spot Price. Sell under option at Strike Price	100	Loss (800) [100 × (1000 – 1008)]
						Total = Loss (600)

Note: If Kiran had chosen not to exercise the option for loss inflicting scrips, she would have earned ₹1,300.

2. Choice of Option – Option Market Rules

(a) Choice of Option and Expected Price

Scrip	Spot Price (₹)	Expectation for the next 3 Months	Expected Price after 3 Months [EP] (₹)	Strike Price [SP] (₹)	EPvs.SP [Higher]	Option Chosen
Greaves	345	Increase by 15%	345 + 15% = 397	400	SP	Put
NDTV	395	Increase by 10%	395 + 10% = 434	430	EP	Call
Punj Loyd	260	Decrease by 5%	260–5% = 247	250	SP	Put
ITC Ltd	160	Increase by 5%	160 + 5% = 168	170	SP	Put
TCS Ltd	1,120	Decrease by 10%	1,120–10% = 1,008	1,000	EP	Call

(b) Gain / Loss statement on Options Contracts

Scrip	3-Months' Spot Price (₹)	Strike Price (₹)	Option Chosen	Action	No. of Scrips	Gain / Loss [Sale Value Less Buy Cost] (₹)
Greaves	397	400	Put	By spot at Spot Price. Sell under option at Strike Price.	100	300 [100 × (400–397)]
NDTV	434	430	Call	By under option at Strike Price. Sell spot at Spot Price	100	400 [100 × (434–430)]
Punj Loyd	247	250	Put	By spot at Spot Price. Sell under option at Strike Price.	100	300 [100 × (250–247)]
ITC Ltd	168	170	Put	By spot at Spot Price. Sell under option at Strike Price.	100	200 [100 × (170–168)]
TCS Ltd	1,008	1,000	Call	Buy under option at Strike Price. Sell spot at Spot Price.	100	800 [100 × (1008–1000)]
						Total = Gain 2,000

Inference:

(a) In the cash market, movement in the prices is relevant. In the options market, the expected price on the date of expiry and the strike price are relevant.

(b) Gain or loss under options is based on the Exercise Price and the spot price on the date of expiry and not on the basis of direction of movement in strike price.

(c) In a rising market, buying a Call Option may still not yield return if the expected spot price is less than the exercise price. Call options and put options can be bought both under a bearish market as well as a bullish market.

Illustration 45

Sundar Ramalingam had entered into 5 Put Options and 5 Call Options in different securities, the particulars of which are given below, along with their exercise price and actual market price on the date of exercise-

Call Options			Put Options		
Security	Exercise Price (₹)	Actual Market Price (₹)	Security	Exercise Price (₹)	Actual Market Price (₹)
P	370	376	A	118	122
Q	450	444	B	758	758
R	1790	1700	C	350	340
S	135	140	D	65	69
T	953	953	E	230	220

What is his position on the date of exercise and what would he do?

Solution:

1. Put Options [Right to Sell]

Security	Exercise Price (EP) (₹)	Actual Market Price (AMP) (₹)	AMP vs. EP [Higher]	Position	Action
A	118	122	AMP	Out of Money	Lapse
B	758	758	Equal	At the Money	No Action
C	350	340	EP	In the Money	Exercise
D	65	69	AMP	Out of Money	Lapse
E	230	220	EP	In the Money	Exercise

2. Call Option [Right to Buy]

Security	Exercise Price (EP)(₹)	Actual Market Price (AMP) (₹)	AMP vs. EP [Higher]	Position	Action
P	370	376	AMP	In the Money	Exercise
Q	450	444	EP	Out of Money	Lapse
R	1790	1700	EP	Out of Money	Lapse
S	135	140	AMP	In the Money	Exercise
T	953	953	Equal	At the Money	No Action

Illustration 46

Given the following: Amount (₹)

Strike price	200
Current stock price	185
Risk free rate of interest	5% p.a

(a) Calculate the theoretical minimum price of a European put option after 6 months.

(b) If European put option price is ₹5, then how can an arbitrageur make profit.

Solution:

1. Computation of Theoretical Minimum Price

Particulars	Value
Exercise price	₹200
Current Stock Price	₹185
Risk Free Rate of Return (r)	5% or 0.05
Time (in years)	$6 \div 12 = 0.5$
Theoretical Minimum Price	= Present Value of Exercise Price − Current Stock Price $= 200 \times e^{-rt} - 185$ $= 200 \div e^{0.05\times0.5} - 185 = (200 \div 1.02532) - 185$ $= 195.0611 - 185 = 10.0611$

Inference: Since the Value of Put Option is more than the price of the Put Option, it is under priced and the recommended action will be to Buy the Put Option.

2. Cash Flows to make Profit for the Arbitrageur Activity Flow:
   (i) Arbitrageur can borrow the amount required to buy the Put Option and Stock at the rate of 5% p.a. for 6 months.
   (ii) Buy Put Option.
   (iii) Take the opposite position and buy stock at spot price.
   (iv) At the end of six months, exercise the Put option and realise the receipts.
   (v) Pay the amount of Borrowing together with Interest.

Particulars	Time	₹
1. Borrow at the rate of 5% for 6 months [185+5]	T_o	190
2. Buy Put Option	T_o	(5)
3. Buy Stock at Spot Price	T_o	(185)
4. Exercise the Put Option and realise the Sale Proceeds	T_1	200
5. Repay the amount of Borrowing together with Interest [$190 \times e^{0.05\times0.5}$] = [$190 \times 1.02532$]	T_1	194.81
6. Net Gain made [(4) – (5)]	T_1	5.19

Note: The amount of gain is the minimum amount and will Increase with every Increase in Spot

Price as on the Exercise Date.

Illustration 47

Stock of Swarup Air Cargo Ltd is currently quoted at ₹112. Ascertain the Time Value and Intrinsic Value of Option from the following particulars available in relation to derivatives market-

Put Options		
Situation	Exercise Price	Premium (₹)
A	98	10
B	103	11
C	109	11
D	112	11
E	116	12
F	120	12
G	124	13
H	128	13

Call Options		
Situation	Exercise Price	Premium (₹)
A	125	9
B	122	10
C	119	10
D	115	11
E	112	11
F	109	11
G	106	12
H	103	12

Solution:

1. Put Options [Right to Sell]

Situation	Exercise Price (EP) (₹)	Current Market Price (CMP) (₹)	Premium (₹)	Intrinsic Value [Maximum of (EP-CMP), 0] (₹)	Time Value [Maximum of (Premium - Intrinsic Value), 0] (₹)
(1)	(2)	(3)	(4)	(5) = Max [(2) − (3), 0]	(6) =Max [(4) − (5), 0]
A	98	112	10	0	10
B	103	112	11	0	11
C	109	112	11	0	11
D	112	112	11	0	11
E	116	112	12	4	8
F	120	112	12	8	4
G	124	112	13	12	1
H	128	112	13	16	0

2. Call Options [Right to Buy]

Situation	Exercise Price (EP) (₹)	Current Market Price (CMP) (₹)	Premium	Intrinsic Value [Maximum of (CMP-EP), O] (₹)	Time Value [Maximum of (Premium- Intrinsic Value), 0] (₹)
(1)	(2)	(3)	(4)	(5) = Max [(3)–(2), 0]	(6) =Max [(4)–(5), 0]
A	125	112	9	0	9
B	122	112	10	0	10
C	119	112	10	0	10
D	115	112	11	0	11
E	112	112	11	0	11
F	109	112	11	3	8
G	106	112	12	6	6
H	103	112	12	9	3

Illustration 48

Determine the value of option, both call and put, on expiry for the stock of Nirmal Spice Foods (NSF) Ltd. from the following information-

- Exercise Price – ₹510
- Spot Price on Exercise Date Ranges between ₹495 and ₹525, with interval of ₹5.

Also state what will be the action on the above range of prices for both the options.

Solution:

1. Call Option (Right to Buy)

Situation	Exercise Price (EP) (₹)	Spot Price on Expiry Date (SP_E) (₹)	Value of Call [Maximum of (SP_E - EP), 0] (₹)	Action
(1)	(2)	(3)	(4) =Max [(3)– (2), 0]	(5)
A	510	495	495 – 510 = – 15 → 0	Lapse
B	510	500	500 – 510 = – 10 → 0	Lapse
C	510	505	505 – 510 = – 5 → 0	Lapse
D	510	510	510 – 510 = 0 → 0	Lapse
E	510	515	515 – 510 = 5 → 5	Exercise
F	510	520	520 – 510 = 10 → 10	Exercise
G	510	525	525 – 510 = 15 → 15	Exercise

2. Put Option (Right to Sell)

Situation	Exercise Price (EP) (₹)	Spot Price on Expiry Date (SPE) (₹)	Value of Put [Maximum of (EP - SPE -), 0] (₹)	Action
(1)	(2)	(3)	(4) =Max [(2)– (3), 0]	(5)
A	510	495	510 – 495 = 15 → 15	Exercise
B	510	500	510 – 500 = 10 → 10	Exercise
C	510	505	510 – 505 = 5 → 5	Exercise
D	510	510	510 – 510 = 0 → 0	Lapse
E	510	515	510 – 515 = –5 → 0	Lapse
F	510	520	510 – 520 = –10 → 0	Lapse
G	510	525	510 – 520 = –15 → 0	Lapse

Illustration 49

CMC Ltd. shares are presently quoted at 100. 3-Month's call option carries a premium of ₹15 for a strike price of ₹120, and 3-Month's put option carries a premium of ₹20 for a strike price of ₹120.

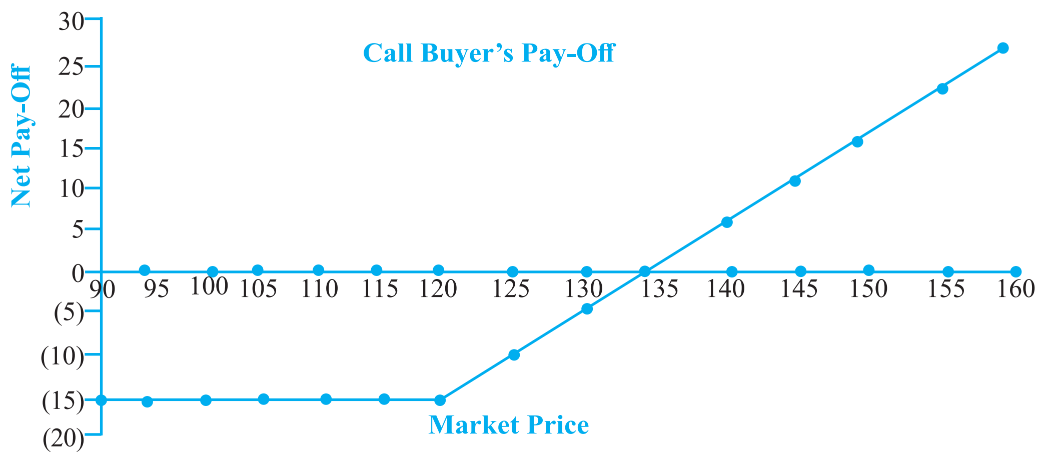
If the spot price on the expiry date is in the range of ₹90 to ₹160, with intervals of ₹5, prepare Net Pay-Off Graph for both Call Option and Put Option, from both the buyer's perspective and the option writer's perspective.

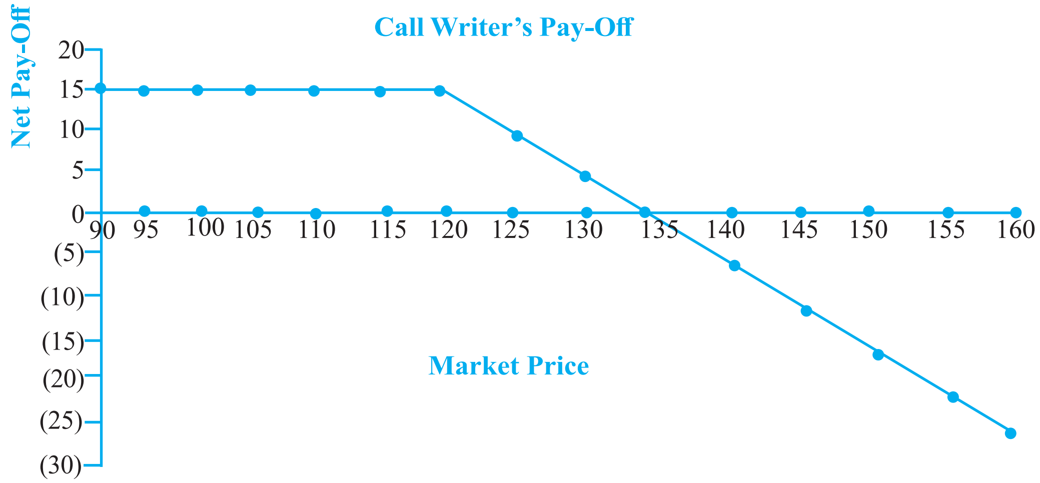
Solution:

1. Net Pay-Off [Call Option] = Buyer and Writer of Call Option

Spot Price on Expiry Date (SP_E) ₹	Exercise Price (EP) (₹)	Value of Call [Gross Profit] [Maximum of (SP_E - EP), 0] (₹)	Action (₹)	Option Premium (₹)	Net Pay-Off [Call Holder] (₹)	Net Pay-Off [Call Writer] (₹)
(1)	(2)	(3) = Max[(l)–(2),0]	(4)	(5)	(6) = (3)–(5)	(7) = (5)–(3)
90	120	90 – 120 = – 30 → 0	Lapse	15	0–15 = (15)	15–0=15
95	120	95 – 120 = – 25 → 0	Lapse	15	0–15 = (15)	15–0=15
100	120	100 – 120 = – 20 → 0	Lapse	15	0–15 = (15)	15–0=15
105	120	105 – 120 = – 15 → 0	Lapse	15	0–15 = (15)	15–0=15
110	120	110 – 120 = – 10 → 0	Lapse	15	0–15 = (15)	15–0=15
115	120	115 –120 = – 5 → 0	Lapse	15	0–15 = (15)	15–0=15
120	120	120 – 120 = 0 → 0	Lapse	15	0–15 = (15)	15–0=15
125	120	125 – 120 = 5 → 5	Exercise	15	5–15= (10)	15–5=10
130	120	130 – 120 = 10 → 10	Exercise	15	10–15=(5)	15–10= 5
135	120	135 – 120 = 15 → 15	Exercise	15	15–15=0	15–15=0
140	120	140 – 120 = 20 → 20	Exercise	15	20–15=5	15–20 = (5)
145	120	145 – 120 = 25 → 25	Exercise	15	25–15=10	15–25 = (10)
150	120	150 – 120 = 30 → 30	Exercise	15	30–15=15	15–30=(15)
155	120	155 – 120 = 35 → 35	Exercise	15	35–15=20	15–35 = (20)
160	120	160 – 120 = 40 → 40	Exercise	15	40–15=25	15–40 = (25)

2. Pay-Off Graph [Call Option]

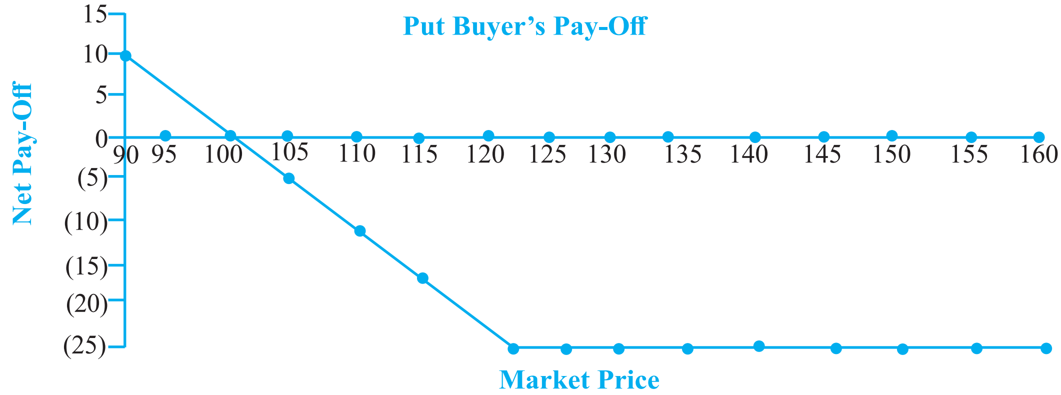




3. Net Pay-Off [Put Option] = Buyer and Writer of Put Option

Spot Price on Expiry Date (SP_E) (₹)	Exercise Price (EP) (₹)	Value of Put [Gross Profit] [Maximum of ($EP-SP_E$), 0]	Action (₹)	Option Premium (₹)	Net Pay-Off [Call Holder] (₹)	Net Pay-Off [Call Writer] (₹)
(1)	(2)	(3) = Max [(2) − (1),0]	(4)	(5)	(6)=(3) − (5)	(7) =(5) − (3)
90	120	120–90 = 30 → 30	Exercise	20	30– 20= 10	20–30 = (10)
95	120	120–95 = 25 → 25	Exercise	20	25–20= 5	20–25 = (5)
100	120	120–100=20 → 20	Exercise	20	20–20= 0	20–20 = 0
105	120	120–105 = 15 → 15	Exercise	20	15–20 = (5)	20–15 = 5
110	120	120–110= 10 → 10	Exercise	20	10–20 = (10)	20–10 = 10
115	120	120–115 = 5 → 5	Exercise	20	5–20 = (15)	20–5 = 15
120	120	120–120 = 0 → 0	Lapse	20	0–20 = (20)	20–0 = 20
125	120	120–125 = –5 → 0	Lapse	20	0–20 = (20)	20–0 = 20
130	120	120–130 = –10 → 0	Lapse	20	0–20 = (20)	20–0 = 20
135	120	120–135 = –15 → 0	Lapse	20	0–20 = (20)	20–0 = 20
140	120	120– 140 = –20 → 0	Lapse	20	0–20 = (20)	20–0 = 20
145	120	120–145 = –25 → 0	Lapse	20	0–20 = (20)	20–0 = 20
150	120	120–150 = – 30 → 0	Lapse	20	0–20 = (20)	20–0 = 20
155	120	120–155 = –35 → 0	Lapse	20	0–20 = (20)	20–0 = 20
160	120	120–160 = –40 → 0	Lapse	20	0–20 = (20)	20–0 = 20

4. Pay-off Graph [Put Option]



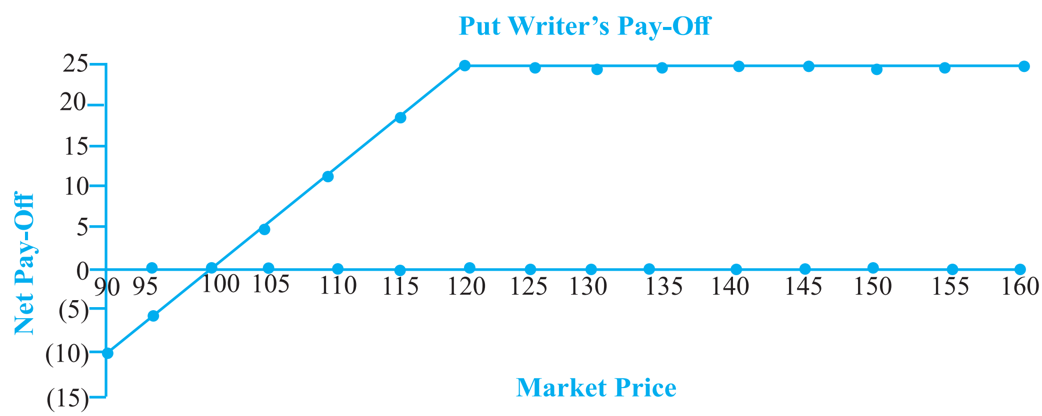


Illustration 50

Fill up the blanks in the following "Break Even Price" table –

Case	Option	Party	Exercise Price (₹)	Premium (₹)	Market Price (₹)
1	Call	Buyer	?	20	160
2	?	Seller	2000	300	1700
3	?	Buyer	50	10	40
4	?	Seller	80	10	90
5	Put	Buyer	?	50	250
6	?	Seller	320	50	370
7	Call	Buyer	680	100	?
8	Call	Seller	?	80	580
9	Put	Buyer	1200	?	1020
10	Put	Seller	?	330	1870

Solution:

Case	Option	Party	Exercise Price (EP) (₹)	Premium (₹)	Market Price (₹)	Reason I Computation (₹)
1	Call	Buyer	140	20	160	Call →MP = EP + Premium, for Pay Off to be "0". → 160 – 20 = 140
2	Put	Seller	2000	300	1700	2000 – 300 = 1700 → MP = EP – Premium. Therefore, it is a Put Option
3	Put	Buyer	50	10	40	50 – 10 = 40 → MP = EP – Premium. Therefore, it is a Put Option
4	Call	Seller	80	10	90	80 + 10 = 90 → MP = EP + Premium. Therefore, it is a Call Option
5	Put	Buyer	300	50	250	Put Option → MP = EP – Premium. → EP = MP + Premium = 250 + 50 = 300
6	Call	Seller	320	50	370	320 + 50 = 370 → MP = EP + Premium. Therefore, it is a Call Option
7	Call	Buyer	680	100	780	Call →MP = EP + Premium, for Pay Off to be "0". 680 + 100 = 780
8	Call	Seller	500	80	580	Call →MP = EP + Premium, for Pay Off to be "0". → EP – Premium → 580 – 80 = 500.
9	Put	Buyer	1200	180	1020	Put →MP = EP – Premium, for Pay Off to be "0". → Premium = EP – MP → 1200 – 1020 = 180
10	Put	Seller	2200	330	1870	Put →MP = EP − Premium, for Pay Off to be "0". → EP = MP + Premium → 1870 + 330 = 2,200.

Illustration 51

Fill up the blanks in the following table ---

Case	Option	Exercise Price (EP) (₹)	Premium (₹)	Holder's Maximum Loss (₹)	Holder's Maximum Gain (₹)	Writer's Maximum Loss (₹)	Writer's Maximum Gain	Break Even Price (₹)
1	Call	520	75	?	?	?	?	?
2	Put	700	140	?	?	?	?	?
3	Put	?	?	4	16	16	4	?
4	Call	?	?	200	?	Unlimited	?	1725
5	?	350	70	70	280	280	70	280
6	?	80	?	12	Unlimited	?	12	?
7	?	?	?	?	?	Unlimited	18	138
8	?	?	?	?	?	592	148	592
9	Call	240	40	40	Unlimited	Unlimited	40	280
10	Put	900	?	180	?	?	?	?

Solution:

Case	Option	Exercise Price (EP) (₹)	Premium (₹)	Holder's Maximum Loss (₹)	Holder's Maximum Gain (₹)	Writer's Maximum Loss (₹)	Writer's Maximum Gain (₹)	Break Even Price (₹)
1	Call	520	75	75	Unlimited	Unlimited	75	595
2	Put	700	140	140	560	560	140	560
3	Put	20	4	4	16	16	4	16
4	Call	1525	200	200	Unlimited	Unlimited	200	1725
5	Put	350	70	70	280	280	70	280
6	Call	80	12	12	Unlimited	Unlimited	12	92
7	Call	120	18	18	Unlimited	Unlimited	18	138
8	Put	740	148	148	592	592	148	592
9	Call	240	40	40	Unlimited	Unlimited	40	280
10	Put	900	180	180	720	720	180	720

General Rules:

1. All Cases, Option Holder's Maximum Loss = Option Writer's Maximum Gain = Amount of Premium
2. If Option Type = Call, then-
   - Holder's Maximum Gain = Writer's Maximum Loss = Unlimited [Conversely, if Holder's Maximum Gain = Writer's Maximum Loss = Unlimited, then the nature of the option is Call]
   - Break Even Price (No Profit No Loss Situation) = Exercise Price Plus Premium
3. If Option Type = Put, then -
   - Holder's Maximum Gain = Writer's Maximum Loss = Exercise Price Less Premium = Break Even Price [Conversely, if Holder's Maximum Gain = Writer's Maximum Loss = Break Even Price, then nature of the option is Put]
   - Break Even Price (No Profit No Loss Situation) = Exercise Price Less Premium

Illustration 52

A put and a call option each have an expiration date 6 months hence and an exercise price ₹9.

The interest rate for the 6 month period is 3 percent.

(a) If the put has a market price of ₹2 and share is worth ₹10 per share, what is the value of the call?

(b) If the put has a market price of ₹2 and the call ₹4. what is the value of the share per share?

(c) If the call has a market value of ₹5 and market price of the share is ₹12 per share what is the value of the put?

Solution:

Under Put Call Parity -

→ Value of Call + Present Value of Exercise Price = Current Spot Price + Value of Put

→ $C + EP \times e^{-rt} = SP_0 + P$

Case (a)	Case (b)	Case (c)
$\rightarrow C + EP \times e^{-rt} = SP_0 + P$	$\rightarrow C + EP \times e^{-rt} = SP_0 + P$	$\rightarrow C + EP \times e^{-rt} = SP_0 + P$
$\rightarrow C = SP_0 + P - EP \times e^{-rt}$	$\rightarrow SP_0 = C + EP \times e^{-rt} - P$	$\rightarrow P = C + EP \times e^{-rt} - SP_0$
$\rightarrow C = 10+2 - (9 \times e^{-0.03\times(6/12)})$	$\rightarrow SP_0 = 4 + (9 \times e^{-0.03\times(6/12)}) - 1$	$\rightarrow P = 5 + 9 \times e^{-0.03\times(6/12)} - 12$
$\rightarrow C = 12 - (9 \div 1.01511)$	$\rightarrow SP_0 = 4 + (9 \div 1.01511) - 1$	$\rightarrow P = 5 + 8.86 - 12$
$\rightarrow C = 12 - 8.86 = 3.14$	$\rightarrow SP_0 = 11.86$	$\rightarrow P = 1.86$
Value of Call = ₹3.14	Value of Share = ₹11.86	Value of Put = ₹1.86

Illustration 53

Shoaib is furnished with the following information about securities of two Companies- Manju Ltd. and Sanju Ltd.

1. **Manju Ltd:** Call option is traded at ₹85 for an exercise price of ₹700. Presently stock of Manju Ltd is traded for ₹650. Put option is available for ₹110.
2. **Sanju Ltd:** Put option is traded at ₹40 at an exercise price of ₹200. Presently stock of Sanju are traded at ₹180. Call options are available for ₹20.

If Shoaib has sufficient money and also holds stock in both these companies, wants to make only ascertained profit and no loss, advise him on the course of action and resultant gain/loss.

Risk Free Interest rate may be assumed at 10% and expiry date for option is 3 Months away.

Solution:

1. Manju Ltd

(a) Computation of Theoretical Value of Put Option:

C+ PV of EP of Call = CMP+P

$\rightarrow$ ₹85 + ₹700 × $e^{-0.10\times0.25}$ = ₹650 + P

$\rightarrow$ P = ₹85 + ₹700 ÷ 1.025 – ₹650

$\rightarrow$ P = ₹85 + ₹682.73- ₹650

= ₹117.73

(b) Evaluation: Theoretical Price of ₹117.73 > Actual Price of ₹110. Therefore, Put Option is undervalued.

(c) Action:

Now	3-Months Later
• Sell Call Option (Write Call) at ₹ 85. • Borrow ₹675 at 10% p.a. for 3 months (Cost of Buying put at ₹110 + Cost of Stock in Spot Market ₹650- Inflow for writing Call ₹85) • Buy Put option at ₹110 • Buy Stock at ₹650	**Spot Price on Expiry is more than ₹700** • **Inflow:** Call Option will be exercised by the Option Holder. Therefore, sell stock and receive for ₹700. • **Outflow:** Repay borrowal of ₹692 including interest i.e. ₹675 × $e^{0.10\times0.25}$ = ₹675 × 1.0253 • **Net Gain 3-Months Later:** ₹700 – ₹ 692 =₹8 **Spot Price on Expiry is less than ₹700** • **Inflow:** Exercise put Option. Sell stock and receive ₹700 • **Outflow:** Repay borrowal of ₹692 including interest i.e ₹675 × $e^{0.10\times0.25}$ = ₹675 × 1.0253 • **Net Gain 3-Months Later:** ₹700 – ₹692 = ₹8

2. Sanju Ltd.

(a) Computation of Theoretical Value of Call Option:

C+ PV of EP of Call= CMP + P

→ C+ ₹200 × $e^{-0.10\times0.25}$= ₹180 + 40

→ C = ₹220 – ₹200 ÷ 1.0253

→ C= ₹220 – ₹195= ₹25

(b) Evaluation: Theoretical Price of ₹25 > Actual Price of ₹20. Therefore, Call Option is undervalued.

(c) Action:

Now	3-Months later
⅄ Sell Put Option (Write Put) at ₹40. (Inflow) ⅄ Sell Stock at ₹180 ⅄ Buy Call Option at ₹20 ⅄ Invest ₹200 in Risk free Investments at 10% p.a. for 3 Months(Receipt on sale of stock ₹180 + Receipt on sale of put Option ₹40 – Cost of Call Option ₹20)	**Spot Price on Expiry is more than ₹200** ⅄ **Inflow:** Realize ₹205 from Investment including interest (₹200 × $e^{0.10\times0.25}$ = ₹200 ×1.0253) ⅄ **Outflow:** Call option will be exercised. Pay ₹200 and buy stock. ⅄ **Net Gain 3-Months later:** ₹205 – ₹200 = ₹5 ⅄ **Spot price on Expiry is less than ₹200** ⅄ **Inflow:** Realize ₹205 from Investment including interest (₹200 × $e^{0.10\times0.25}$ = ₹200 × 1.0253) ⅄ **Outflow:** Put Option holder will exercise option. Pay ₹200 and buy stock. ⅄ **Net Gain 3-Months Later:** ₹ 205 – ₹200 = ₹5

Illustration 54

On 19th July Following are the spot rates – Spot USD/ EUR 1.20000 and INR/ USD 44.8000

Following are the quotes of European Options:

Currency Pair	Call/Put	Strike Price	Premium	Expiry Date
USD/EUR	Call	1.2000	$0.035	Oct. 19
USD/EUR	Put	1.2000	$0.04	Oct. 19
INR/USD	Call	44.8000	Rs. 0.12	Dec. 19
INR/USD	Put	44.8000	Rs. 0.04	Dec. 19

(a) A Trader sells an At- The-Money Spot Straddle expiring at three Months (Oct. 19). Calculate the gain or loss if three months later the spot rate is USD/EUR 1.2900.

(b) Which strategy gives a profit to the dealer if five months later (Dec.19) expected spot rate is INR/USD 45.00. Also calculate profit for a transaction of USD 1.40 Millions.

Solution:

1. Straddle Strategy- At the Money – Profit or Loss Calculation

Straddle is an Option Strategy which involves buying/ writing a call and put with the same strike price and same expiry date. A trader sells a Straddle, will be selling a call option & a put option with strike price of USD 1.2000 per EUR.

2. Computation of Net Pay - Off

Particulars	Amount
Exercise Price	\$1.2000
Spot Price as on Exercise Date	\$1.2900
Action of the Buyer of the Option	Call – Exercise Put - Lapse
Loss on Call Option to the Writer = Strike Price – Exercise Price	\$ 0.0900
Total Options Premium inflow to the Writer = \$0.035 + \$0.040	\$0.0750
Net Loss	\$0.0150

3. Increase in Prices- Strategy

As Expected Future Price is higher, purchase of call option is beneficial. (Otherwise, put option may be sold).

Course of Action-

1. Contract Date: 19th July: Pay Premium for USD 14,00,000 @ Rs. 0.12 per USD = INR 1,68,000.
2. Exercise Date: 19th December: Exercise Call – Gain = 14,00,000 × Rs. (45.00 – 44.80) = INR 2,80,000.
3. Net Gain or Profit = (1) – (2) = INR 1,12,000.

Illustration 55

Fund Managers anticipate a big move in the stock of Bikram Ltd. Anup of ABC Fund believes such change to be upwards, while Shyam of Premier Fund holds the opposite view.

From the following information made available of Bikram Ltd, explain what action will Anup and Shyam take and why?

Exercise Price	Premium for Call Option	Premium for Put Option
₹100	₹15	₹10

Solution:

A. Anup, ABC Fund

1. Choice of Strategy:

(a) Outlook: Extreme Volatility and uncertain future. Stock of Bikram Ltd expected to appreciate i.e. Bullish on Bikram.

(b) Strategy: Creation of Strap i.e. Buying Two Calls, Buying One Put

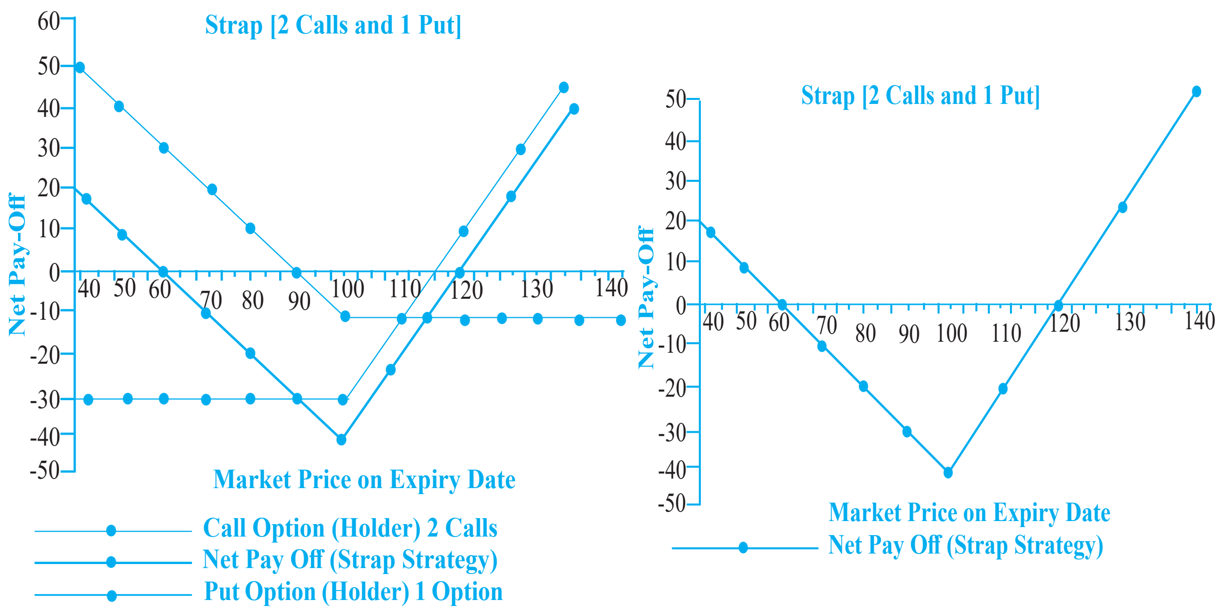
(c) Why? Increase in price is more likely than decrease, therefore two calls would yield better results. Put option is bought to cash in if stock of Bikram spirals downwards.

2. Pay off Table:

Price on Expiry Date	Call Option [2 Options]				Put Option (1 Option]				Net Pay off ₹
	Ex. Price ₹	Premium ₹	Action	Payoff	Ex. Price ₹	Premium ₹	Action	Payoff ₹	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10) = (5) + (9)
40	100	15	Lapse	(30)	100	10	Exercise	50	20
50	100	15	Lapse	(30)	100	10	Exercise	40	10
60	100	15	Lapse	(30)	100	10	Exercise	30	0
70	100	15	Lapse	(30)	100	10	Exercise	20	(10)
80	100	15	Lapse	(30)	100	10	Exercise	10	(20)

90	100	15	Lapse	(30)	100	10	Exercise	0	(30)
100	100	15	Lapse	(30)	100	10	Lapse	(10)	(40)
110	100	15	Exercise	(10)	100	10	Lapse	(10)	(20)
120	100	15	Exercise	10	100	10	Lapse	(10)	0
130	100	15	Exercise	30	100	10	Lapse	(10)	20
140	100	15	Exercise	50	100	10	Lapse	(10)	40

3. Pay off Graphs:



B. Shyam, Premier Fund

1. Choice of Strategy:

(a) **Outlook:** Extreme Volatility and uncertain future. Stock of Shyam Premier Fund expected to depreciate i.e. Bearish on Shyam.

(b) **Strategy:** Creation of Strip i.e. Buying Two Puts, Buying One Call.

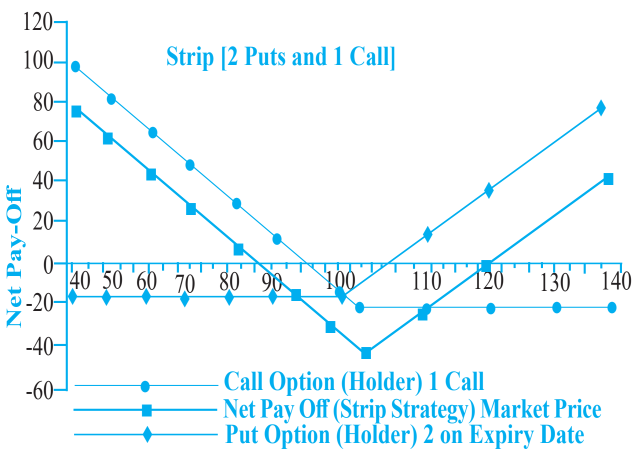
(c) **Why?** Decrease in price is more likely than increase; therefore two puts would yield better results as prices go down. One Call option is bought to cash in if stock of Shyam spirals upwards.

2. Pay off Table:

Price on Expiry Date	Call Option [1 Option]				Put Option [2 Options]				Net Payoff (₹)
	Ex. Price (₹)	Premium (₹)	Action	Payoff	Ex. Price (₹)	Premium (₹)	Action	Payoff (₹)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10) = (5) + (9)
40	100	15	Lapse	(15)	100	10	Exercise	100	85
50	100	15	Lapse	(15)	100	10	Exercise	80	65
60	100	15	Lapse	(15)	100	10	Exercise	60	45
70	100	15	Lapse	(15)	100	10	Exercise	40	25

80	100	15	Lapse	(15)	100	10	Exercise	20	5
90	100	15	Lapse	(15)	100	10	Exercise	0	(15)
100	100	15	Lapse	(15)	100	10	Lapse	(20)	(35)
110	100	15	Exercise	(5)	100	10	Lapse	(20)	(25)
120	100	15	Exercise	5	100	10	Lapse	(20)	(15)
130	100	15	Exercise	15	100	10	Lapse	(20)	(5)
140	100	15	Exercise	25	100	10	Lapse	(20)	5

3. Pay off Graphs:



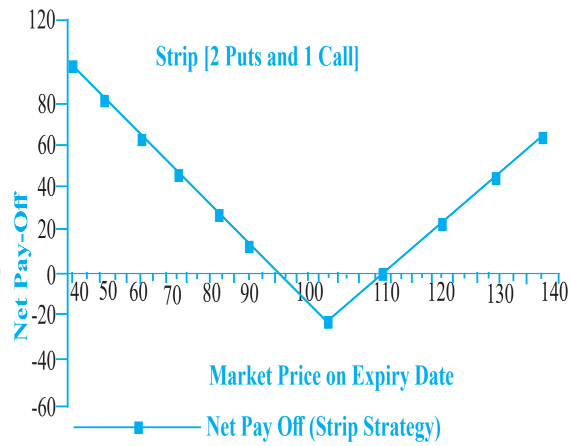


Illustration 56

Ascertain the value of Call Options expiring one year later, of four securities from the following information –

Stock	Current Spot Price (₹)	Exercise Price (₹)	Expected Price One Year Later (₹)
X Ltd	1,020	1,050	1,100
Y Ltd	200	180	220
Z Ltd	500	510	535
D Ltd	80	80	90

Risk Free Rate may be assumed at 10% for continuous discounting. Also show in case of Security Z, how choosing the Stock Route and Option Route with Risk Free Investment will have the same wealth for an investor at the end of the year for the same cash outgo.

Solution :

1. Computation of Value of Call

Stock	Current Spot Price [SP_0] (₹)	Exercise Price [EP] (₹)	PV of EP [EP × $e^{-1\times0.10}$] (₹)	Value of Call Option [SP_0 – PV of EP] (₹)
(1)	(2)	(3)	(4)	(5) = (2) – (4)
X	1,020	1050	1050÷1.1052 = 950.05	1,020 – 950.05 = 69.95
Y	200	180	180÷1.1052 = 162.87	200 – 162.87 = 37.13
Z	500	510	510÷1.1052 = 461.45	500 – 461 .45 = 38.55
D	80	80	80÷1.1052 = 72.39	80 – 72.39 = 7.61

2. Case of Stock of Z Ltd.

Action on Stock Route	Action on Option Plus Risk Free Return Route
Now: Buy Stock of Z at ₹500	Now: • Invest Present Value (i.e. ₹461.45) of Exercise Price at Risk Free Rate of 10% (continuous compounding) • Buy Call Option at ₹38.55 (Strike Price of ₹510) • Total Cash Outgo = ₹461.45 + ₹38.55 = ₹500
1 Year Later: net worth = Value per Share at Expected Future Spot Rate = ₹535	1 Year Later: • Net worth = Maturity Value of Risk Free Investment + Value of Call Option • Maturity Value of Risk Free Investment = ₹461.45 × $e^{1\times 0.10}$ = ₹510 • Value of Call Option (on Expiry) = Gain on Exercise of Option = Spot Price on Expiry Date Less Exercise Price = ₹535 – ₹510 = ₹25 • Net Worth = ₹510 + ₹25 = ₹535

Illustration 57

Ascertain the value of Options expiring one year later, for the following securities-

1. ABC Ltd (ABCL) is quoted at ₹110. At the end of 3 Months, the stock price will either be ₹100 or ₹150. Exercise price is ₹120
2. 3-Month Options on MN Ltd (MNL) carry an exercise price of ₹350. Stock Price is expected to be ₹250 or ₹450. Presently the shares are traded for ₹380.

Risk Free Rate may be assumed at 12% for continuous discounting.

Solution:

1. ABC Ltd

(a) Basic Data

Particulars	₹
Stock Price (SP_0)	110
Exercise Price (EP)	120
Expected Future Spot Price on Expiry Date	
• Future Price 1 [FP_1]	100
• Future Price 2 [FP_2]	150

(b) Computation of Option Delta:

Particulars	FP_1	FP_2
Future Spot Price (₹)	100	150
Position on Expiry Date (in comparison with Exercise Price)	Out of Money	In the Money
Action on Expiry Date	Lapse	Exercise
Value of Option on Expiry [Future Spot Price Less Exercise Price](₹)	–	₹30 [150-120]

Option Delta = Change in Value of Option ÷ Change in Future Spot Price

= (₹30 – 0) ÷ (₹150 – ₹100) = ₹30/₹50 = 0.60

(c) Computation of Amount to be Invested at Risk Free Rate:

= Present Value of Lower Bank of Future Spot Price i.e. FP_1

= Present Value of ₹100 discounted at 12% Continuous Compounding for a 3-Month Period

= ₹100 × e^{rt}

= ₹100 ÷ $e^{0.12\times0.25}$ = ₹100 ÷ 1.0305 = ₹97.04

(d) Value of Call [C]

= Option Delta × [Current Stock Price Less Amount to be invested at Risk Free Rate]

= 0.60 × (₹110 – ₹97.04) = 0.60 × ₹12.96 = ₹7.78

(e) Value of Put [P] (Under Put Call Parity)

→ Value of Call + Present Value of Exercise Price = Current Spot Price + Value of Put

→ C + EP × e^{-rt} = SP_0 + P

→ ₹7.78 + (₹120 ÷ 1.0305) = ₹110 + P

→ P = ₹7.78 + ₹116.45 – ₹110 = ₹14.23

2. MN Limited

(a) Basic Data

Particulars	₹
Stock Price (SP_0)	380
Exercise Price (EP)	350
Expected Future Spot Price on Expiry Date	
• Future Price 1 [FP_1]	250
• Future Price 2 [FP_2]	450

(b) Computation of Option Delta

Particulars	FP_1	FP_2
Future Spot Price (₹)	250	450
Position on Expiry Date (in comparison with Exercise Price)	Out of Money	In the Money
Action on Expiry Date	Lapse	Exercise
Value of Option on Expiry [Future Spot Price Less Exercise Price] (₹)	₹0	₹100 [450-350]

Option Delta = Change in value of options ÷ Change in future spot Price

= (₹100-0) ÷ (₹450 – ₹250) = ₹100 / ₹200 = 0.50

(c) Computation of Amount to be Invested of Risk Free Rate:

= Present Value of Lower Band of Future Spot Price i.e. FP_1

= Present Value of ₹250 discounted at 12% Continuous Compounding for a 3-Month Period

= ₹250 × e^{-rt} = ₹250 ÷ e^{rt}

= ₹250 ÷ $e^{0.12\times0.25}$ = ₹250 ÷ 1.0305 = ₹242.60

(d) Value of Call [C]

= Option Delta × [Current Stock Price Less Amount to be invested at Risk Free Rate]

= 0.50 × (₹380 – ₹242.60) = 0.50 × ₹137.40 = ₹68.70

(e) Value of Put [P] (Under Put Call Parity):

→ Value of Call + Present Value of Exercise Price = Current Spot Price + Value of Put

→ $C + EP \times e^{-rt} = SP_0 + P$

→ ₹68.70 + (₹350 ÷ 1.0305) = ₹380 + P

→ P = ₹68.70 + ₹339.64 – ₹380 = ₹28.34.

Illustration 58

Stock of Kamla Woodwork is currently quoted at ₹110. In three month's time it could either be ₹90 or ₹135. Ascertain the value of Call Option with an exercise price of ₹120 if the risk free rate of return is 8%.

Solution:

1. Basic Data

Factor	Notation	Value
Spot Price	SP_0	₹110
Exercise Price	EP	₹120
Expected Future Spot Price – Lower Limit [FP_1]	FP_1	₹90
Expected Future Spot Price – Higher Limit [FP_2]	FP_2	₹135
Value of Call at Lower Limit [Action = Lapse, since FP_1 < EP. Therefore Value is NIL]	C_d	₹ NIL
Value of Call at Upper Limit [Action = Exercise, since FP_2 > EP. Therefore, Value is FP_2 – EP = ₹135 – ₹120]	C_u	₹15
Extent of Lower Limit of Future Spot Price [FP_1] on Current Price [SP_0] [FP_1/SP_0] = ₹90/₹110	d	0.82
Extent of Upper Limit of Future Spot Price [FP_2] on Current Price [SP_0] [FP_2/SP_0] = ₹135/₹110	u	1.227
Risk Free Rate of Return	r	8%
Tenor of Options Contract [in Years] = 3 Months/ 12 Months	t	0.25
Future Value Factor [Continuous Compounding Factor] = $e^{0.08\times0.25}$	f	1.0202

2. Alternate 1 [Formula Method]

$$= \frac{C_u[\frac{f-d}{u-d}] + C_d[\frac{u-f}{u-d}]}{f} = \frac{₹15\times[\frac{1.0202-0.82}{1.227-0.82}] + ₹0\times[\frac{1.227-1.0202}{1.227-0.82}]}{1.0202}$$

= [₹15 × (0.200 / 0.407) + 0] / 1.0202

= (₹15 × 0.4919) ÷ 1.0202 = ₹7.232

3. Alternative 2 [Decision Tree Method] [Requires Probability Value]

(a) Computation of Probability of FP_1 and FP_2

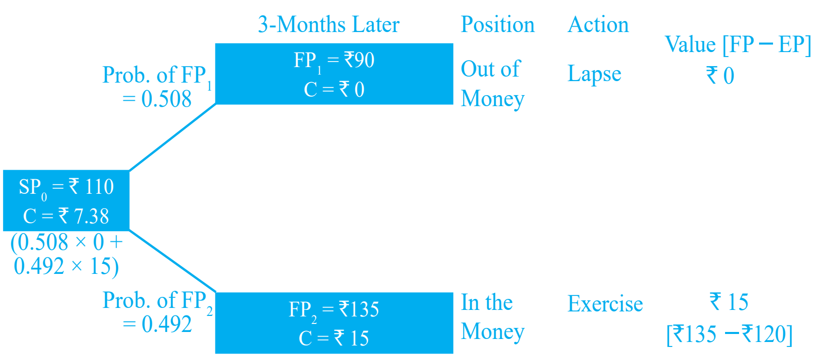
Probability of Lower Limit (FP_1) = (u – f) ÷ (u – d) = (1.227 – 1.0202) / (1.227 – 0.82)

= 0.2068 ÷ 0.407 = 0.508

Probability of Higher Limit (FP_2) = 1 − 0.508

= 0.492

(b) Value of Option [Future Value of Option]



Present Value of Call = Future Value × e^{-rt} or Future Value ÷ e^{rt} = ₹7.38 ÷ 1.0202 = ₹7.23

4. Alternative 3 [Table Method or Delta Route]

Value of Call = No. of Shares per Call Option × [Current Stock Price – Present Value of Lower Limit of Future Spot Price]

= Option Delta × [SP_0 – (FP_1 × e^{-rt})]

= [(15-0)/ (135-90)] × [110 – (90 ÷ 1.0202)]

= [(15/45)] × [110 – 88.22] = 0.3333 × 21.78 = ₹7.26

Illustration 59

Nirmal hydric Ltd. (NHL) is a newly listed Company. Its listing price today is ₹200. Though the industry offers much potential, there are no proven past track records.

Analysts expect the price of NHL to either to rise by 40% every half (on the half yearly opening price), for the next one year, weightage being 40% for every increase and 60% for every fall.

If an One Year option carries a Exercise Price of ₹260, you required to compute the following under Binomial Model –

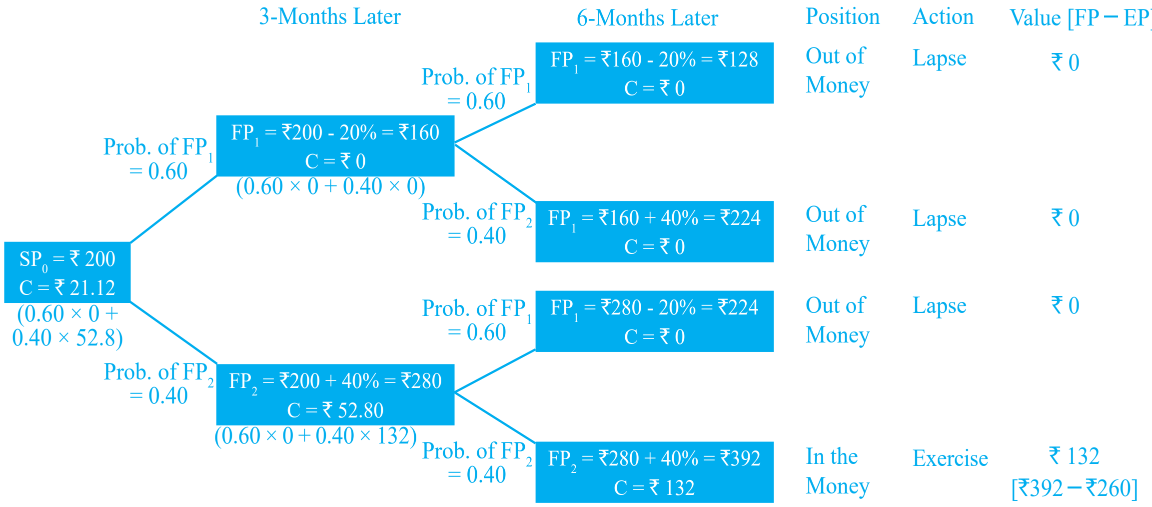
(1) Risk Free Rate of Return,

(2) Value of Call (Future Value and Present Value),

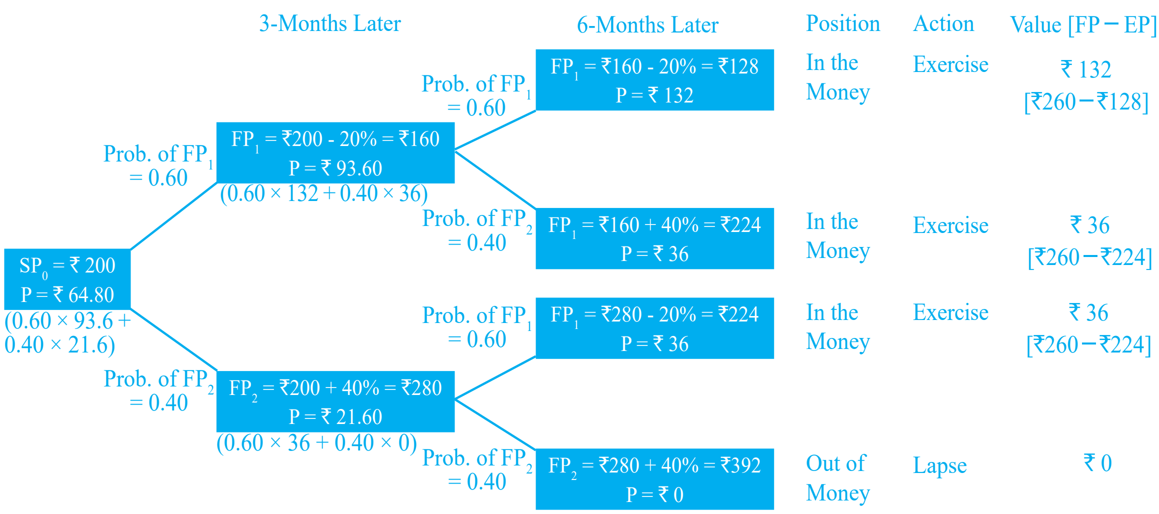
(3) Value of Put (Future Value & Present Value)

Solution:

1. Computation of Future Value of Call



2. Computation of Future Value of Put



3. Computation of Risk Free Rate of Return Basic Data

Factor	Notation	Value
Spot Price	SP_0	₹200
Expected Future Spot Price – Lower Limit [FP_1]	FP_1	₹160
Expected Future Spot Price – Higher Limit [FP_2]	FP_2	₹280
Extent of Lower Limit of Future Spot Price [FP_1] on Current Price [SP_0] [FP_1/ SP_0] = ₹160/₹200	d	0.80
Extent of Upper Limit of Future Spot Price [FP_2] on Current Price [SP_0] [FP_2/ SP_0] = ₹280 /₹200	u	1.40

Risk Free Rate of Return	r	To be ascertained
Tenor of Options Contract [in Years]	t	0.5

(a) Probability of Lower Limit (FP_1) = 0.60

$\rightarrow$ 0.60 = (u − f) ÷ (u − d) = (1.40 – f) / (1.40 – 0.80) = (1.40 – f) / 0.60

$\rightarrow$ 0.60 × 0.60 = 1.40 – f

$\rightarrow$ f = 1.40 – 0.36 = 1.04

$\rightarrow e^{rt} = 1.04$

$\rightarrow e^{r\times 0.50}$ =1.04 (Since per time slot = 6 Months or 0.25 Years)

(b) Computation of Risk Free Rate:

From Natural Log Table, 1.04 is the value for 0.040

$\rightarrow \text{Log } e^{0.5r} = \text{Log } 1.04^{0}$

$\rightarrow$ 0.5r = 0.0392

$\rightarrow$ r = 0.0392 ÷ 0.5 = 0.0784 or 7.84% p.a.

4. Present Value of Options

(a) Call Option: Future Value × e^{-rt}, where r = 7.84% and t = 1 Year

= ₹21.12 × $e^{-0.0784}$

= ₹21.12 ÷ $e^{0.0784}$

= ₹21.12 ÷ 1.0815

= ₹19.53

(b) Put Option: Future Value × e^{-rt}, where r = 7.84% and t = 1 Year

= ₹64.80 × $e^{-0.0784}$ = ₹64.80 ÷ $e^{0.0784}$ = ₹64.80 ÷ 1.0815 = ₹59.92

Under Put Call Parity = P = C + PV of EP – SP_0

= 19.53 + (260 ÷ 1.0815) – 200 = 19.53 + 240.40 – 200 = ₹59.93

Illustration 60

Trie market received rumor about XYZ Corporation's tie – up with a multinational company. This has induced the market price to move up. If the rumor is false , the XYZ Corporation's stock price will probably fall dramatically. To protect from this an investor has bought the call and put options.

He purchased one 3 months call with a strike price of ₹42 for ₹2 premium, and paid ₹1 per share premium for a 3 months put with a strike price of ₹40.

(a) Determine the investor's position if the tie up offer bids the price of XYZ Corporation's stock up to ₹44 in 3 months

(b) Determine the investor's ending position, if the tie up programme fails and the price of the stocks falls to ₹35 in 3 months

Solution:

1. Cost of Call and Put options

Cost of Call and Put Options = (₹2 per share Call)+(₹1 per share put)

= ₹2 + ₹1 = 3

2. Position if Price increases to ₹44

Particulars	Time	₹
(a) Cost of Options	T_0	3
(b) If Price Increases to ₹44, Investor will not exercise the Put Option, Gain on Call [Spot Price on Expiry Date – Exercise Price = ₹44 − ₹42]	T_1	2
(c) Net Loss due to Options [(a) − (b)]	T_1	1

3. Position if Price falls to ₹35

Particulars	Time	₹
(a) Cost of Options	T_0	3
(b) If Price falls to ₹35, Investor will not exercise the call Option. Gain on Put [Exercise Price – Spot price on expiry date = ₹40 − ₹35]	T_1	5
(c) Net Gain due to Options [(b) − (a)]	T_1	2

Illustration 61

Calculate the price of a three –month European put option on a non dividend - paying stock with a strike price of ₹50 when the current stock price is ₹50, the risk –free interest rate is 10% per annum, and the volatility is 30% per annum

Solution:

Black and Scholes also developed formula for determining the price of a put option and the formula is as follows:

$P = Ke^{-rt} N(-d_2) - S_0N(-d_1)$

Where P denotes price of the Put Option.

S_0 is spot price of the underlying stock

K is the strike price of the option

T denotes time to expiration of option expressed in year

r is the risk- free rate of interest

$Ln(d_i)$ denotes the cumulative probability up to d_i (i = 1, 2) following standard normal distribution,

$d_1 = [Ln(S_0/k) + (r + \sigma^2/2)T] / \sigma\sqrt{T}$; σ is the volatility of the price of underlying stock

and $d_2 = d_1 - \sigma\sqrt{T}$

In the above illustration, S_0 = ₹50, K= ₹50, T = 3/12 = ¼ = 0.25. r = 0.10, σ = 0.30

$d_1 = [Ln(50/50) + (0.10 + 0.09 / 2).025] / 0.30\sqrt{0.25} = 0.2417$

$d_2 = d_1 - 0.30\sqrt{0.25} = 0.0917$

The European Put rice is

$50\ e^{-0.10 \times 0.25} N(-0.0917) - 50N(-0.2417)$

$= 50\ e^{-0.10 \times 0.25} \times 0.463 - 50 \times 0.4045$

$= 2.37$

Illustration 62

What difference does it make to your calculation in previous Illustration if a dividend of ₹1.50 is expected in two months?

Solution:

In this case we must subtract the present value of the dividend from the stock price before using Black – Scholes

Hence the appropriate value of S_0 is

$$S_0 = 50 - 1.50\ e^{-0.1667 \times 0.10} = 48.52$$

As before , K= ₹50, $T = 3/12 = 1/4 = 0.25$, $r = 0.10$, $\sigma = 0.30$

$d_1 = [Ln(48.52/50) + (0.10{+}0.09/2)0.25] / 0.30\sqrt{0.25} = 0.0414$

$d_2 = d_1 - 0.30\sqrt{0.25} = -0.1086$

The European put price is

$50\ e^{-0.10 \times 0.25} N(-0.1086) - 48.52\ N(-0.0414)$

$= 50\ e^{-0.10 \times 0.25} \times 0.532 - 48.52 \times 0.4835$

$= 2.48$

Illustration 63

Consider a European call option on a stock when there are ex-dividend dates in two months and five months. The dividend on each ex-dividend date is expected at be ₹0.50. The current share price is ₹40, the exercise price is ₹40, the stock price volatility is 30% per annum, the risk-free rate of interest is 9% per annum, and the time to maturity is six months. Find out the European call price.

Solution:

Black and Scholes developed formula for determining the price of a call option and the formula is as follows:

$C = S_0N(d_1) - K^{e-rt}\ N(d_2)$

where C denotes price of the call option,

S_0 is spot price of the underlying stock,

K is the strike price of the option,

t denotes time to expiration of option expressed in year, ,

r is the risk - free rate of interest,

$N(d_1)$ denotes the cumulative probability up to d_1 ($i = 1, 2$) following standard normal distribution,

$d_1 = [Ln(S_0/K) + (r + \sigma^2/2)t]\ \sigma\sqrt{t}$; σ is the volatility of the price of underlying stock,

and $d_2 = d_1 - \sigma\sqrt{t}$

In this case the present value of the dividend is subtracted from the stock price before using Black - Scholes. The present value of the dividends is

$= 0.5e^{-0.1667 \times 0.09} + 0.5e^{-0.4167 \times 0.09} = 0.9741$

The option price can therefore be calculated form the Balck - Scholes formula with $S_0 = 40 - 0.9741 = 39.0259$, K = 40, r = 0.09, σ = 0.3, and T = 0.5. We have

$$d_1 = \frac{Ln(39.0259/40) + (0.09 + 0.3^2/2) \times 0.5}{0.3\sqrt{0.5}} = 0.2017$$

$$d_1 = \frac{Ln(39.0259/40) + (0.09 - 0.3^2/2) \times 0.5}{0.3\sqrt{0.5}} = -0.0104$$

$N(d_1) = 0.5800$, $N(d_2) = 0.4959$

The call price is:

$39.0259 \times 0.5800 - 40e^{-0.09 \times 0.5} \times 0.4959 = 3.67$

Illustration 64

What is the price of a European put option on a non-dividend-paying stock when the stock price is ₹ 69, the strike price is ₹ 70, the risk-free interest rate is 5% per annum, the volatility is 35% per annum, and the time to maturity is six months?

Solution:

In this case,

$S_0 = 69$, $K = 70$, $r = 0.05$, $\sigma = 0.35$ and $T = 0.5$

$$d_1 = \frac{Ln(69/70) + (0.05 + 0.35^2/2) \times 0.5}{0.35\sqrt{0.5}} = 0.166$$

$d_2 = d_1 - 0.35\sqrt{0.5} = -0.0809$

The price of the European put is

$70e^{-0.05 \times 0.5} N(0.0809) - 69\ N(-0.1666)$

$= 70e^{-0.05 \times 0.5} \times 0.5323 - 69 \times 0.4338$

$= 6.40.$

Swaps

13.4

13.4.1 Meaning, Features, Types, Benefits of Swaps

- **Concept of Swap**

  A swap is an agreement between two parties to exchange sequences of cash flows for a set period of time. Usually, at the time the contract is initiated, at least one of these series of cash flows is determined by a random or uncertain variable, such as an interest rate, foreign exchange rate, equity price or commodity price. Conceptually, one may view a swap as either a portfolio of forward contracts, or as a long position in one bond coupled with a short position in another bond.

  Unlike most standardized options and futures contracts, swaps are not exchange-traded instruments. Instead, swaps are customized contracts that are traded in the over-the-counter (OTC) market between private parties. Firms and financial institutions dominate the swaps market, with few (if any) individuals ever participating. Since swaps occur on the OTC market, there is always the risk of a counterparty defaulting on the swap.

  Swap is a combination of forwards by two counterparties. It is arranged to reap the benefits arising from the fluctuations in the market - either currency market or interest rate market or any other market for that matter.

- **Features of Swap:**

  The following are the important features of a swap:

  a. **Counter parties:** Swaps involve the agreement between two or more parties to exchange cash flows or the parties interested in exchanging the liabilities.

  b. **Facilitators:** The amount of cash flow exchange between parties is huge and also the process is complex. Therefore, to facilitate the transaction, an intermediary comes into picture which brings different parties together for big deal. These may be brokers whose objective is to initiate the counterparties to finalize the swap deal. While swap dealers are themselves counter partied who bear risk and provide portfolio management service.

  c. **Cash flows:** The present values of future cash flows are estimated by the counterparties before entering into a contract. Both the parties want to get assurance of exchanging same financial liabilities before the swap deal.

  d. **Less documentation:** Since these are not exchange traded, the requirement for documentation is comparatively low.

  e. **Transaction costs:** Swap involves a transaction cost in form of commission to the intermediary. However, transaction costs are found to be relatively low in swaps.

  f. **Benefit to both parties:** The swap agreement is undertaken only when there is mutual benefit.

g. Termination: Since it is an agreement between two parties, it cannot be terminated at one's instance. The termination is required to be accepted by the counter party.

h. Default-risk: Since swaps are mostly bilateral not exchange traded like futures or options, default risk is higher in swaps.

Types of Financial Swaps

Major types of financial swaps include the following.

a. Interest Rate Swaps: An interest rate swap, or simply a rate swap, is an agreement between two parties to exchange a sequence of interest payments without exchanging the underlying debt.

b. Currency Swaps: Cross currency swaps are agreements between counter-parties to exchange interest and principal payments in different currencies. In a currency swap, these streams of cash flows consist of a stream of interest and principal payments in one currency exchanged for a stream, of interest and principal payments of the same maturity in another currency. Due to the exchange and re-exchange of notional principal amounts, the currency swap generates a larger credit exposure than the interest rate swap.

c. Equity Swaps: An equity swap is a special type of total return swap, where the underlying asset is a stock, a basket of stocks, or a stock index. In an equity swap, there is an exchange of the potential appreciation of equity's value and dividends for a guaranteed return plus any decrease in the value of the equity.

d. Credit Default Swaps: Credit Default Swap is a financial instrument for swapping the risk of debt default. Credit default swaps may be used for emerging market bonds, mortgage- backed securities, corporate bonds and local government bond. The buyer of a credit default swap pays a premium for effectively insuring against a debt default. He receives a lump sum payment if the debt instrument is defaulted. The seller of a credit default swap receives monthly payments from the buyer. If the debt instrument defaults, they have to pay the agreed amount to the buyer of the credit default swap.

We have discussed, in detail, the Interest Rate Swaps and Credit Default Swaps in this section. For Currency Swaps, please refer to Module 15 of this Study Material.

Benefits of Swap:

The following advantages can be derived by a systematic use of swap:

a. Borrowing at Lower Cost:

Swap facilitates borrowings at lower cost. It works on the principle of the theory of comparative cost as propounded by Ricardo. One borrower exchanges the comparative advantage possessed by him with the comparative advantage possessed by the other borrower. The net result is that both the parties are able to get funds at cheaper rates.

b. Access to New Financial Markets:

Swap is used to have access to new financial markets for funds by exploring the comparative advantage possessed by the other party in that market. Thus, the comparative advantage possessed by parties is fully exploited through swap. Hence, funds can be obtained from the best possible source at cheaper rates.

c. Hedging of Risk:

Swap can also be used to hedge risk. For instance, a company has issued fixed rate bonds. It strongly feels that the interest rate will decline in future due to some changes in the economic scene. So, to get the benefit in future from the fall in interest rate, it has to exchange the fixed rate obligation with floating rate obligation. That is to say, the company has to enter into swap agreement with a counterparty, whereby, it has to receive fixed rate interest and pay floating rate interest. The net result is that the company will have to pay only floating rate of interest. The fixed rate it has to pay is compensated by the fixed rate it receives from the counterparty. Thus, risks due to fluctuations in interest rate can be overcome through swap agreements. Similar, agreements can be entered into for currencies also.

d. Tool to correct Asset-Liability Mismatch:

Swap can be profitably used to manage asset-liability mismatch. For example, a bank has acquired a fixed rate bearing asset on the one hand and a floating rate of interest-bearing liability on the other hand. In case the interest rate goes up, the bank would be much affected because with the increase in interest rate, the bank has to pay more interest. This is so because, the interest payment is based on the floating rate, but the interest receipt will not go up, since, the receipt is based on the fixed rate. Now, the asset- liability mismatch emerges. This can be conveniently managed by swap. If the bank feels that the interest rate would go up, it has to simply swap the fixed rate with the floating rate of interest. It means that the bank should find a counterparty who is willing to receive a fixed rate interest in exchange for a floating rate. Now, the receipt of fixed rate of interest by the bank is exactly matched with the payment of fixed rate interest to swap counterparty. Similarly, the receipt of floating rate of interest from the swap counterparty is exactly matched with the payment of floating interest rate on liabilities. Thus, swap is used as a tool to correct any asset- liability mismatch in interest rates in future.

e. Additional Income:

By arranging swaps, financial intermediaries can earn additional income in the form of brokerage.

13.4.2 Interest Rate Swaps, Credit Default Swaps

13.4.2.1 Interest Rate Swaps

⊙ **Concept of Interest Rate Swaps**

An interest rate swap is a financial contract between the two parties who want to exchange the interest payments or receipts in the same currency on assets or liabilities to a different basis. There is no exchange of principal amount here. In other words, it is an exchange of interest payment for a specific maturity on an agreed upon notional amount. Here, the term 'notional' refers to the theoretical principal underlying the swap. The principal amount applies only for the purpose of calculating the interest to be exchanged under an interest rate swap.

The simplest example of interest rate swap is the exchange of fixed for floating rate interest payments between two parties in the same currency. This is also known as plain vanilla swap, or coupon swap. It involves credit differentials between two borrowers in the fixed and floating debt markets which generate substantial cost savings for both the counter parties.

⊙ **Features of interest rate swaps**

The key features of interest rate swaps are stated as follows:

a. **Notional principal:** In the interest rate swap agreement, the interest amount whether fixed or floating is calculated on a specified amount borrowed or lent. It is notional because the parties do not exchange this amount at any time.

b. **Fixed rate:** This is the rate, which is used to calculate the size of the fixed payment. Banks or the other financial institutions who make market in interest rate swaps quote the fixed rate, they are willing to pay if they are fixed rate payers in a swap (bid swap rates), they are willing to receive if they are floating rate payers in a swap (ask swap rate). For example, a bank might quote a US dollar floating to fixed 5-year swap rate:

(Treasuries + 20 bp)/(Treasuries + 40 bp) as against a six-month LIBOR.

This quote may be interpreted as follows:

(i) The said bank is willing to make fixed payment at a rate equal to the current yield on Five-year treasury notes plus 20 basis points (0.20 percent) in return for receiving floating payments, say at six-month LIBOR.

(ii) The bank has offered to accept at a rate equal to Five-year treasury notes plus 40 basis points in return for payment of six-month LIBOR.

c. **Floating rate:** Floating rate in swaps is determined on the basis of market indexes like LIBOR, MIBOR, Treasury Bill rate, etc.

Interest Rate Swap Mechanism

Suppose, there are two firms X and Y. Firm X is an institution that invests $100 million in fixed rate mortgages yielding 9.5 percent. Assume firm X is not the high rated firm and funding its assets through a floating rate loan from the banks, i.e., charging six-month London Inter Bank Offer Rate (LIBOR) plus 5 basis point (a basis equals 0.01 percent). It means that firm X's profitability depends upon the actual level of the floating interest rate in future that is to be paid over the long run. Therefore, if fluctuation in interest rates will be high then firm X's debt service expenses will increase, consequently the profit will decline. In other words, firm X will lose money whenever LIBOR exceeds 9 percent (9.50 – 0.50).

Suppose, another Firm Y, has also borrowed $ 100 million for five years but at a fixed rate. Assume that firm Y is high graded firm and is funding its loan portfolio at 7.25 percent coupon. Firm Y's portfolio is yielding LIBOR plus 75 basis points. It means Firm Y's profitability depends upon the actual floating interest rate that is received on its portfolio. Whenever, LIBOR is less than 6.50 percent (7.25 – 0.75), Firm Y is losing money. This situation is shown in the following table.

Firm X	Firm Y
Mortgage Portfolio: $100 million portfolio with 5-year average maturity	Loan Portfolio: $100 million portfolio with 5-year average maturity
Yield: 9.5%	Yield: LIBOR + 0.75%
Borrowed at: LIBOR + 0.5%	Borrowed at: 7.25%

In order to eliminate interest rale risk, Firm X may enter into interest rate swap deal with Top Bank. Assume that 7.50 percent will be paid by Firm X to Top Bank for five years with payments calculated by multiplying that rate by $100 million, the notional principal amount. In return, Top Bank agrees to pay Firm X six-month LIBOR over five years.

The result for the same is as follows:

Receipt on Portfolio	9.5%
Pay to Top Bank	7.5%
Receive from Top Bank	LIBOR
Pay on loan	LIBOR + 0.5%
Cost of fund	7.5% + 0.5% = 8%
Locked in spread = Receipt on Portfolio – Cost of Fund	1.5%

Similarly, Firm Y will enter into a swap deal with Top Bank where it agrees to pay six-month LIBOR to Top Bank on a notional principal amount of $100 million for five years in exchange for receiving payments of 7.40%. the net result is shown below.

Receipt on Portfolio	LIBOR + 0.75%
Pay to Top Bank	LIBOR
Receive from Top Bank	7.4%
Pay on Euro Bond	7.25%
Cost of fund	LIBOR +7.25% – 7.40% = LIBOR – 0.15%
Locked in spread = Receipt on Portfolio – Cost of Fund	0.90%

In this swap deal, the interest of Top Bank should also be assessed. For Top Bank the result can be summarized as follows:

Received from X	7.5%
Pay to Y	7.4%
Receive from Y	LIBOR
Pay to X	LIBOR
Net gain	0.10%

Thus, Top Bank receives (100 million × 0.10%) = $1,00,000 as the compensation from the swap deals.

Types of Interest Rate Swaps

a. **Plain vanilla swap:** It is also known as fixed-for-floating swap. In this swap, one party with a floating interest rate liability is exchanged with fixed rate liability.

b. **Zero coupon to floating:** In a zero-coupon bond, the holders get the full amount of loan and interest accrued only at the maturity of the bond. Hence, in this swap, the fixed rate player makes a bullet payment at the end and floating rate player makes the periodic payment throughout the swap period.

c. **Alternative floating rate:** In this type of swap, the floating reference can be switched to other alternatives as per the requirement of the counter party. These alternatives may include three-month LIBOR, one-month commercial paper, T-Bill rate, etc. In other words, alternative floating interest rates are charged in order to meet the exposure of other party.

d. **Floating-to- floating:** In this swap, one counter party pays one floating rate, say, LIBOR while the other counter party pays another, for a specified time period. These swap deals are mainly used by the non-US banks to manage their dollar exposure.

e. **Forward swap:** This swap involves an exchange of interest rate payment that does not begin until a specified future point in time. It is also a kind of swap involving fixed for floating interest rate.

f. **Rate-capped swap:** It is similar to fixed to floating rate swap, whereby the floating rate payments are capped. An upfront fee is paid by floating rate party to fixed rate party for the cap.

g. **Extendable swap:** It contains an extendable feature, which allows the parties to extend the swap period.

Swaptions – An Innovation

Swaptions are combination of the features of two derivative instruments, i.e., option and swap. Option interest rate swaps are referred as swaptions. The buyer of the swaption has the right to enter into an interest rate swap agreement by some specified date in the future. The swaption agreement will specify whether the buyer of the swaption will be a fixed rate receiver or a fixed rate payer. If the buyer exercises the option, then the writer of the option will become the counter party.

Swaption can be of two types: Call swaption or callable swap and put swaption or puttable swap. A callable swap provides the party making the fixed payments with the right to terminate the swap to its maturity. The writer, therefore, becomes the fixed rate receiver and floating rate payer. On the other hand, a puttable swap provides the party making the floating rate payments with a right to terminate the swap. The writer of the put swaption, therefore, becomes the floating rate receiver and fixed rate payer.

Valuation of Interest Rate Swaps

While valuing the plain vanilla interest rate swap, the fixed leg should be considered a fixed coupon bond and the floating rate should be considered a floating rate note.

Considering that at maturity level the fixed and floating parties give each other equal amount of money, the pricing of the swap becomes simply the value of the fixed coupon bond minus the value of the floating rate note. This is denoted by formula given below:

$V = F_B - F_F$

Where,

V = Value of the swap

F_B = Value of fixed coupon bond

F_F = Value of floating rate note.

In the above said formula, the values of both the fixed leg and the floating leg swaps will be different as market rates change after the initial pricing of the swap. On the fixed leg, the cash flows do not change but the discount factor changes and hence the value. While on the floating side, both the cash flows and the discounting factor change and hence the value change. Such kind of swap called an off-market swap. This states that the value of an off-market swap can be either positive or negative but not zero.

Consider the following illustration.

Illustration 65

A bank has agreed to pay six-month LIBOR and receive 8 percent per annum (with semi-annual compounding) on a notional principal of \$100 million. The swap has a remaining life of 1.25 years. The relevant fixed rate of interest with continuous compounding for 3-month, 9-month and 15-month maturities are 10 percent, 10.5 percent and 11.0 percent respectively. The six-month LIBOR rate at the last payment date was 10.2 percent (with semi-annual compounding). The periodic fixed payment and floating payment are \$4.0 million and \$5.1 million respectively. Calculate the value of the swap.

Solution:

$F_B = 4e^{-0.25 \times 0.1} + 4e^{-0.75 \times 0.105} + 4e^{-1.25 \times 0.11} + 100e^{-1.25 \times 0.11} = \$98.24$ million

$F_F = 5.1e^{-0.25 \times 0.1} + 100e^{-0.25 \times 0.1} = \$102.51$ million

Hence, the value of swap = 98.24 − 102.51 = (−) \$4.27 million.

If the bank takes the opposite position of paying fixed and receiving floating, the value of the swap then would be (+) \$4.27 million.

Illustration 66

United Bankers Ltd offer the following interest rates to two of its customers for a loan of ₹100 crores, repayable in 7 years –

Company	Somnath Ltd	Amal IT Services Ltd
Nature of Activity	Supply and Installation of Security Systems for Home, Office, Corporate Surveillance and other Security Services and products	Providing IT support to various Airlines, Shipping Companies and Government Companies
Years in Industry	25	1.5
Market Position	Market Leaders	Market Entrants (Infants)
Rating by UBL	A++	B+
Floating Interest Rate	MIBOR - 0.50%	MIBOR +1%
Fixed Interest Rate	10.00%	12.50%
Share in the net Gain on account of Interest Rate Swap	60%	40%

Assuming, principal amount is repaid at the end of the seven years, what is the effective gain in percentage as well as in value for both the companies, if they enter into a Swap Agreement for reducing interest effect.

Also ascertain the net interest cost (in %) for both the companies.

Solution:

Note: For effecting a swap agreement, choice of interest rates with the respective bankers will be based on the rate of advantage to the stronger company in different interest rate schemes. Expectation on economy or on movement of interest rates are not relevant for structuring a swap agreement.

1. Action and Net Cost

Somnath has an advantage of 2.50% in Fixed Rate (10% vs.12.50%) and 1.50% in floating rate. Therefore, Somnath enjoys a higher advantage in Fixed Rates Loan. Therefore, Somnath Ltd will opt for Fixed Rate Loans with its bankers. Correspondingly Amal Ltd. will opt for Floating RATE Loans with its bankers.

Somnath	Amal
Somnath will borrow at fixed rate	Amal will borrow at floating rate.
Pay interest to bankers at fixed rate (i.e.,10%) [outflow]	Pay interest to its bankers at floating rate (i.e., MIBOR+1%) [outflow].
Will collect from/pay to Amal Interest amount differential i.e., interest computed at Fixed rate (10%) less Interest computed at Floating rate (MIBOR – 0.5%) i.e., (10.50% – MIBOR) [inflow]	Will pay to/collect from Somnath interest amount differential i.e., interest computed at Fixed rate to Somanth (10%) Less Interest Computed at floating rate to Somnath (MIBOR – 0.50%) i.e., (10.50% – MIBOR) [Outflow]
Will collect from Amal share in the gain on account of interest rate swap i.e., 60% of difference in the spread of fixed rate and floating rate [inflow] [see note]	Will pay to Somnath share in the gain on account of interest rate swap i.e., 60% of difference in spread of 1% i.e., 0.60% [outflow].

Gain on account of Interest Rate Swap:

Spread in fixed rate	[12.50 – 10.00%]	2.50%
Less: Difference in floating rate	[1% – (– 0.50%)]	1.50%
Net difference	[Maximum Gain]	1.00%
Share of Somnath in the gain	[60% of 1%]	0.60% p.a.
Share of Amal in the Gain	[40% of 1%]	0.40% p.a.

2. Effective Interest Rate

Particulars	Somnath Ltd	Amal IT Services
Expectation in Interest rate	Contraction	Increase
Interest Rate Scheme (Desired)	Floating Rate	Fixed Rate
Interest rate Less: Share in Gain	MIBOR–0.50% 0.60%	12.50% 0.40%
Effective Interest Gain	MIBOR–1.10%	12.10%

3. Interest Cost Saved

Particulars	Somnath Ltd	Amal IT Services
Share in Gain (p.a.)	0.60%	0.40%
Amount of Loan	₹100 crores	₹100 crores
Interest Savings per annum	₹60 lakhs [₹100 crores × 0.6%]	₹ 40 lakhs [₹100 crores ×0.40%]
Number of years of loan	7 years	7 years
Total Interest Savings	₹4.20 crores [7 × ₹0.60 crores]	₹2.80 crores [7 × ₹0.40 crores]

Illustration 67

Structure of a swap arrangement in the following situations and also ascertain the extent of gain

Case	Company D			Company E		
	Interest rates		Expectation on interest rate			Expectation on interest rate
	Floating	Fixed		Floating	Fixed	
1	PLR + 0.50%	12.00%	Increase	PLR + 0.50%	11.00%	Increase
2	PLR + 1.00%	11.00%	Decrease	PLR + 2.00%	12.00%	Increase
3	PLR + 1.25%	11.25%	Decrease	PLR – 0.50%	10.75%	Decrease
4	PLR – 1.50%	10.00%	Increase	PLR – 0.50%	11.50%	Decrease

PLR refers to Prime Lending Rate of a Bank i.e., Benchmark Lending Rate, which are altered time to time by the banks.

Solution:

Case	Evaluation on Interest Rates	Structure of Swap	Extent of Gain
1	⅄ Fixed rate spread= 12.00% –11.0% =1.00% ⅄ Floating Rate Spread = 0.50% – 0.50% = 0 ⅄ Difference in spread = 1.00% Possibility of Gain on Swap: Yes	E is the stronger Company (due to interest rate advantage). Company E has an advantage of 1% in Fixed Rate and no advantage in Floating Rate. Therefore, E Ltd. Should opt for Fixed Rate and D Ltd. Opt for Floating Rate with their Bankers.	Total Gain=1.00%
2	⅄ Fixed rate spread =12.00% –11.0% =1.00% ⅄ Floating Rate Spread = 2.00% – 1.00%=1% ⅄ Difference in spread = 0% Possibility of Gain on Swap: No	Swap Arrangement will not lead to any interest advantage. Therefore, no viable swap arrangement can be structured.	Total Gain=0
3	⅄ Fixed rate spread= 11.25% – 10.75% = 0.50% ⅄ Floating Rate Spread = 1.25% – (– 0.50%) =1.75% ⅄ Difference in spread =1.25% Possibility of Gain on Swap: Yes	E is the stronger company (due to interest rate advantage). Company E has an advantage of 0.50% in fixed rate and 1.75% advantage in floating rate. Therefore, E Ltd should opt for Floating Rate and D Ltd. opt for Fixed Rate with their Bankers.	Total Gain=1.25%
4	⅄ Fixed rate spread= 11.50% – 10.00% =1.50% ⅄ Floating Rate Spread =1.50% – 0.50% =1.00% ⅄ Difference in spread = 0.50% Possibility of Gain on Swap: Yes	D is the stronger company (due to interest rate advantage). Company D has an advantage of 1.50% in fixed rate and 1.00% advantage in floating rate. Therefore, D Ltd should opt for Fixed Rate and E Ltd. opt for Floating Rate with their Bankers.	Total Gain=0.50%

Illustration 68

Companies X and Y face the following interest rates:

Particulars	X	Y
U.S. Dollars (floating rate)	LIBOR +0.50%	LIBOR+1.0%
Canadian Dollar (fixed rate)	5.0%	6.5%

Particulars	Value (₹)
a. Difference in floating Rates [(LIBOR +1%) – (LIBOR+0.50%)]	0.5%
b. Difference in Fixed Rates [6.5% – 5%]	1.5%
c. Net Difference {[(a) – (b)] in absolute terms}	1.0%
d. Amount paid for arrangement of Swap Option	(0.5%)
e. Net Gain [(c) – (d)]	0.5%
f. Company X’s share of gain [0.5% × 60%]	0.3%
g. Company Y’s share of gain [0.5% × 40%]	0.2%

Company X	Company Y
1. Company X will borrow at Fixed Rate	1. Company Y will borrow at Floating Rate
2. Pay Interest to bankers at fixed rate (5.0%).	2. Pay Interest to bankers at floating rate (LIBOR+1.0%).
3. Will collect from Company Y interest amount differential i.e. Interest computed at Fixed Rate (5.0%) Less Interest Computed at Floating rate of (LIBOR+0.5%) =4.5% – LIBOR	3. Will pay interest amount differential to Company X i.e. Interest computed at Fixed Rate (5.0%) Less Interest Computed at Floating rate of (LIBOR+0.5%) =4.5% – LIBOR
4. Receive its share of gain from company Y = 0.3%	4. Pay to company X its share of Gain = 0.2%
5. Effective Interest Rate:2–3–4 =Fixed Rate paid by Company X – Interest Differential Received from Company Y – Share of Gain = (5.0%) – (4.5% – LIBOR) – 0.3% = LIBOR+0.2%	5. Pay commission Charges to the Financial Institution for arranging Interest Rate Swaps i.e.,0.5%
	6. Effective Interest Rate:2+3+4+5 = Floating Rate to Company Y(LIBOR+1.0%)+ Interest Differential paid to Company X (4.5%–LIBOR)+ Share of Gain paid to Company X (0.25%)+ Commission charges paid (0.5%) = LIBOR+1.0% +4.5% – LIBOR+0.2%+0.5% = 6.2%

Illustration 69

Companies PQR and DEF have been offered the following rate per annum on a $200 million five-year loan:

Company	Fixed Rate	Floating Rate
PQR	12.00%	LIBOR+0.1%
DEF	13.40%	LIBOR +0.6%

Company PQR requires a floating rate loan; Company DEF requires a fixed rate loan.

Design a swap that will net a bank acting as intermediary at 0.5% per annum and be equally attractive to both the companies.

Solution:

Particulars	Value (₹)
a. Difference in floating Rates [(LIBOR +0.1%) – (LIBOR+0.60%)]	0.5%
b. Difference in Fixed Rates [13.4% – 12%]	1.4%
c. Net Difference {[(a) – (b)] in absolute terms}	0.9%
d. Amount paid for arrangement of Swap Option	(0.5%)
e. Net Gain [(c) – (d)]	0.4%
f. Company X's share of gain [0.5% × 60%]	0.2%
g. Company Y's share of gain [0.5% × 40%]	0.2%

PQR is the strongest company (due to comparative interest advantage). PQR has an advantage of 1.40% in fixed rate and 0.5% in floating rate. Therefore, PQR enjoys a higher advantage in Fixed Rate Loans. Therefore, PQR will opt for Fixed Rate Loans with its bankers. Correspondingly DEF Ltd. will opt for Floating Rate Loans with its bankers.

Company PQR	Company DEF
1. Company PQR will borrow at Fixed Rate.	1. Company DEF will borrow at Floating Rate.
2. Pay Interest to bankers at fixed rate (12.0%).	2. Pay Interest to bankers at floating rate (LIBOR+0.6%).
3. Will collect from Company DEF interest amount differential i.e. Interest computed at Fixed Rate (12.0%) Less Interest Computed at Floating rate of (LIBOR+0.1%) =11.9% – LIBOR	3. Will pay to Company PQR interest amount differential i.e. Interest computed at Fixed Rate (12.00%) Less Interest Computed at Floating rate of (LIBOR+0.1%) =11.9% – LIBOR
4. Receive its share of gain from company DEF=0.2%	4. Pay to company PQR its share of Gain=0.2%
5. Effective Interest Rate: 2-3-4 = (12.00%)–(11.9%–LIBOR)–0.2% = LIBOR–0.1%	5. Pay commission Charges to the Financial Institution for arranging Interest Rate Swaps i.e.,0.5%
	6. Effective Interest Rate:2+3+4+5 = Floating Rate to Company DEF (LIBOR+0.6%)+ Interest Differential paid to Company PQR (11.9% – LIBOR) + Share of Gain paid to Company PQR + Commission charges paid for arranging Swaps = LIBOR+0.6% +11.9% – LIBOR+0.5%+0.2% =13.2%

Illustration 70

Company A has outstanding debt on which it currently pays fixed rate of interest at 9.5%. The company intends to refinance the debt with a floating rate interest. The best floating rate it can obtain is LIBOR + 2%. However, it does not want to pay more than LIBOR. Another Company B is looking for a loan at a fixed rate of interest to finance its exports. The best rate it can obtain is 13.5%, but it cannot afford to pay more than 12%. However, one bank has agreed to offer finance at a floating rate of LIBOR + 2%. Citi Bank is in the process of arranging an interest rate swap between these two companies.

a. With a schematic diagram, show how the swap deal can be structured.

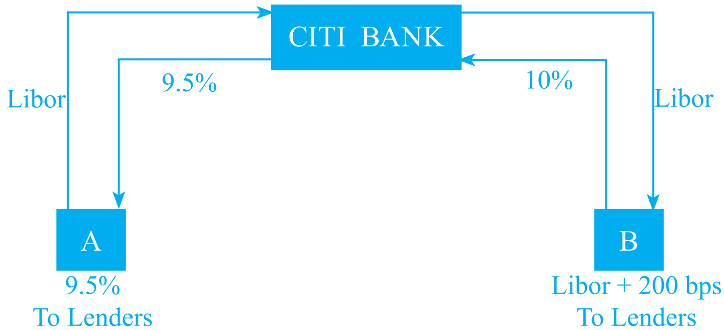
b. What are the interest savings by each company?

c. How much would Citi bank receive?

Solution:

First let us tabulate the details to find the quality of spread differential:

		Cost of Funds to Company A and B	
	Objective	Fixed rate	Floating rate
Company A	Floating	9.50% p.a.	Libor + 200bp
Company B	Fixed	13.50% p.a.	Libor + 200bp
Differential		400 bps	0bps



The differential between the two markets = 400 bps. A total of 400 bps needs to be shared between A, B and Citi bank. Since A cannot afford to pay more than Libor, it needs 200 bps benefits out of the total 400 bps (Libor + 2% - Libor). Similarly B cannot pay more than 12% as against the existing available fixed rate funding of 13.5%, it requires 150 bps benefits out of 400 bps. The balance 50 bps would be shared / Charged by the Citi bank.

The swap can therefore be structured as follows:

Firm	Paid to Bank	Received from Bank	Paid to market	Net Cost	Savings
A	Libor	9.5%	9.5%	Libor	(Libor +2%) – (Libor) = 200bps
B	10%	Libor	Libor +200bps	12%	(13.5 − 12.0) = 150bps

Company A gets floating rate funds at Libor as against Libor + 2%, thereby getting an advantage of 200 bps, Company B gets fixed rate funds at 12% as against 13.5%, thereby getting an advantage of 150 bps and finally Citi bank gets 50 bps commission.

13.4.2.2 Credit Default Swaps

- **Concept of Credit Default Swap**

  A credit default swap (CDS) is a financial instrument for swapping the risk of debt default. In other words, a CDS is a credit derivative contract between two counterparties under which the buyer makes periodic payments to the seller and in return receives a payoff if the underlying financial instrument defaults or experiences a similar credit event. Here the underlying financial instrument may be emerging market bonds, mortgage-backed securities, assets backed securities, corporate bonds or local government bonds.

  Forms of credit default swaps had been in existence from at least the early 1990s, with early trades carried out by Bankers Trust in 1991. J.P. Morgan & Co. is widely credited with creating the modern credit default swap in 1994. In 2000, credit default swaps became largely exempt from regulation by both the U.S. Securities and Exchange Commission (SEC) and the Commodity Futures Trading Commission (CFTC). By 2007, the outstanding credit default swaps value stood at $62.2 trillion. During the financial crisis of 2008, the value of CDS was hit hard, and it dropped to $26.3 trillion by 2010 and $25.5 trillion in 2012. In mid-2010, the value of outstanding CDS was $26.3 trillion.

- **Uses of Credit Default Swaps**

  Credit default swaps can be used by investors for speculation, hedging as well as arbitrage.

  a. Hedging

  Credit default swaps are often used to manage the risk of default which arises from holding debt. A bank, for example, may hedge its risk that a borrower may default on a loan by entering into a CDS contract as the buyer of protection. If the loan goes into default, the proceeds from the CDS contract will cancel out the losses on the underlying debt.

Another kind of hedge is against concentration risk. A bank's risk management team may advise that the bank is overly concentrated with a particular borrower or industry. The bank can lay off some of this risk by buying a CDS, because the borrower—the reference entity—is not a party to a credit default swap, entering into a CDS allows the bank to achieve its diversity objectives without impacting its loan portfolio or customer relations. Similarly, a bank selling a CDS can diversify its portfolio by gaining exposure to an industry in which the selling bank has no customer base.

Example : A pension fund owns 5-year bonds issued by C Corp. with par value of ₹10 million. To protect itself from the loss arising on the possible default of C Corp. the pension fund buys a CDS from Derivative bank in a notional amount of ₹10 million. The CDS trades at 200 basis point (2% p.a.). There may arise the following two situations. (₹ millions)

No default at all		Default after three years	
Premium paid (10×2%×5) Bond proceeds received from C Corp. on maturity	1 10	Premium paid (10×2%×3) Proceeds received from bank on default of C Corp. (assuming zero recovery)	0.6 10
Net proceeds (default risk avoided)	9	Net Proceeds *(default risk avoided)	9.4

*Without CDS, loss would have been ₹10 million (subject to recovery)

b. Arbitrage

Capital Structure Arbitrage is an example of an arbitrage strategy that utilizes CDS transactions. This technique relies on the fact that a company's stock price and its CDS spread should exhibit negative correlation; i.e., if the outlook for a company improves then its share price should go up and its CDS spread should tighten and vice-versa. Techniques reliant on this are known as capital structure arbitrage because they exploit market inefficiencies between different parts of the same company's capital structure; i.e., mis-pricings between a company's debt and equity. An arbitrageur will attempt to exploit the spread between a company's CDS and its equity in certain situations. For example, if a company has announced some bad news and its share price has dropped by 25%, but its CDS spread has remained unchanged, then an investor might expect the CDS spread to increase relative to the share price. Therefore, a basic strategy would be to go long on the CDS spread (by buying CDS protection). This technique would benefit in the event of the CDS spread widening relative to the equity price.

Interest Rate Derivatives – Forward Rate Agreement, Interest Rate Futures and Options, Caps, Floors and Collars

13.5

Concept of Interest Rate Derivatives

Interest Rate Derivative (IRD) is a financial derivative contract whose value is derived from one or more interest rates, prices of interest rate instruments, or interest rate indices. Interest rate derivatives are often used as hedges by institutional investors, banks, companies, and individuals to protect themselves against changes in market interest rates, but they can also be used to increase or refine the holder's risk profile or to speculate on rate moves. In practice, Interest Rate Derivatives are used to limit interest rate risks. By means of Interest Rate Derivatives, one can get protection against rising or falling interest rates.

Types of Interest Rate Derivatives

Following are various types of interest rate derivatives:

a. **Forward Rate Agreement (FRA):** An FRA is an agreement between participants (normally the Bank and a Customer) to pay or receive the difference (called settlement money) between an agreed fixed rate (FRA rate) and the interest rate prevailing on stipulated future date (the fixing date) based on a notional amount for an agreed period (the contract period). Thus, FRA allows participants to make a known interest payment at a later date and receive in return an unknown interest payment. In that way, a participant whose business will involve borrowing at a future date can lock in a fixed payment and receive a random payment that offsets the unknown interest payment it will make on its loan.

b. **Interest Rate Futures:** An Interest Rate Futures contract is "an agreement to buy or sell a debt instrument at a specified future date at a price that is fixed today." At NSE the underlying security for Interest Rate Futures is either Government Bond or T-Bill. Exchange traded Interest Rate Futures on NSE are standardized contracts based on 6-year, 10 year and 13-year Government of India Security (NBF II) and 91-day Government of India Treasury Bill (91DTB). All futures contracts available for trading on NSE are cash settled.

c. **Interest Rate Options:** Interest Rate Option (IRO) is an option contract whose value is based on interest rates or interest rate instruments. At NSE, currently, IRO contracts are available on Government of India securities.

d. **Interest Rate Swaps:** An interest rate swap is a financial contract between the two parties who want to exchange the interest payments or receipts in the same currency on assets or liabilities to a different basis. There is no exchange of principal amount here. In other words, it is an exchange of interest payment for a specific maturity on an agreed upon notional amount.

e. **Interest Rate Caps:** An interest rate cap is a type of interest rate derivative in which the buyer receives payments at the end of each period in which the interest rate exceeds the agreed strike price (the maximum interest rate). An example of a cap would be an agreement to receive a payment for each month the LIBOR rate exceeds 2.5%. An Interest Rate Cap (Cap) is an interest rate risk management tool that provides the borrower with protection against adverse rate movements above an agreed "Strike" or maximum interest rate.

f. **Interest Rate Floor:** An interest rate floor is a derivative contract in which the buyer receives payments at the end of each period in which the interest rate is below the agreed strike price. An example of a cap would be an agreement to receive a payment for each month the LIBOR rate falls below 1.5%. An Interest Rate Floor (Floor) is an interest rate risk management tool that provides the borrower with protection against adverse rate movements below an agreed "Strike" or minimum interest rate.

g. **Interest Rate Collars:** An interest rate collar is an instrument that combines both a cap and a floor. The cap component of the instrument gives the investor protection against rising rates by guaranteeing that the investor will never pay above a pre-agreed rate. The floor component of the collar allows the investor to take advantage of the falling interest rates until the interest rate hits a predetermined rate known as floor rate. Thus, an Interest Rate Collar (Collar) is an interest rate risk management tool that effectively creates a band within which the borrower's variable interest rate will fluctuate, by combining an Interest Rate Cap with an Interest Rate Floor.

Some of the above derivatives are discussed in detail in the following section. For Interest Rate Swaps, please refer to Section 13.4 of this Module.

13.5.1 Forward Rate Agreement

a. Concept and Mechanism

A Forward Rate Agreement (FRA) is a contract between the two parties, (normally between a banker and its customer or independent party), in which one party (the banker) gives the other (customer) a guaranteed future rate of interest to cover a specified sum of money over a specified period of time in the future. For example, two parties agree that a 6 percent per annum rate of interest will apply to one year deposit in six months' time. If the actual rate of interest proves to be different from 6 percent, then one party will pay and other receives the difference between the two sets of interest cash flows.

In an FRA, no actual lending or borrowing is done. It only fixes the rate of interest for a futures transaction. At the time of maturity, when the customer actually needs funds, then he has to borrow the funds at the prevailing rate of interest from the market. If the market rate of interest is higher than the FRA interest then the banker will have to pay to the other party (customer) the difference in the interest rate. However, if market interest is lesser than the FRA rate then the customer will have to pay the difference to the banker. This transaction is known as purchase of FRA from the bank.

Sometimes, a customer (depositor) may also make a FRA contract with the bank for his deposits for seeking a guaranteed rate of interest on his deposits. If the market rate on his deposit turns out to be lower than that guaranteed interest rate in the FRA, the bank will compensate him for the difference, i.e., FRA rate minus market interest.

In this way, purchase of FRA protects the customer against a rise in interest in case of borrowing from the bank. Similarly, sale of FRA will protect the customer from deposits point of view. The bank charges different rates of interest for borrowing and lending, and the spread between these two constitutes bank's profit margin. As a result, no other fee is chargeable for FRA contracts.

b. Determination of Settlement amount

Final settlement amounts owed by the parties to an FRA are determined by the formula:

$$\text{Payment} = \text{Notional Amount} \times \frac{\text{Reference Rate} - \text{Fixed}}{\text{Rate } 1 + \text{Reference Rate} \times \alpha} \times \alpha$$

Where, α is the day count function

c. Settlement

Situation	Course of action
Forward Rate > LIBOR	Buyer has to pay the decrease in interest cost i.e., FR - LIBOR
Forward Rate < LIBOR	Seller has to pay the increased interest cost i.e., LIBOR - FR

Note: The principal amount is "notional" since though it determines the amount of differential payment to be settled between the parties, actual exchange of principal never takes place.

Consider the following Example on settlement process.

d. Example on FRA

Let two banks A and B enter into a Forward Rate Agreement containing the following clauses: (a) A forward rate of 10% on a Eurodollar deposit with 6 months maturity. (b) A $5 Million notional principal and (c) Settlement in 2 months. Show the settlement process.

Solution:

(a) The above agreement is termed as 2×8 FRA - Since it fixes the interest rate for a deposit to be placed after 2 months and maturing 8 months after the date the contract is negotiated.

(b) Settlement:

(i) If the 6-month LIBOR is 12% on the settlement date, the seller would owe the buyer - 2% (difference between 12% and 10%) interest on $5 million for 6 months amounting to $50,000.

(ii) But the interest on a Eurodollar deposit is paid on maturity (at the end of the term of deposit) whereas FRAs are settled on the contract maturity date (which would correspond to the date the underlying hypothetical deposit would be placed). Therefore, to make the cash payment on the FRA equivalent to the extra interest that would have been earned on a Eurodollar deposit paying 12%, the difference of $50,000 in interest costs calculated above is discounted back 6 months using the actual 6-month LIBOR of 6%.

(iii) Hence, on contract maturity date the buyer would receive $50000 ÷ [1+0.06(180/360)] = $48,543.69

Consider the following illustrations.

Illustration 71

Consider that a bank sells a 3 × 6 FRA worth $3,00,00,000. The agreed rate with the buyer is 5.5 %. There are actually 92 days in the three-month FRA period. Assume that three months from today the settlement rate is 4.875%. Determine how much the FRA is worth and whom pays who i.e. whether the buyer pays the seller or seller pays the buyer. Had the settlement rate been 6.125%, what is the answer?

Solution:

A seller of a FRA would benefit if the settlement rate is lower than the agreed rate. Since the settlement rate is less than the agreement rate, the buyer pays the seller the absolute value of the FRA. The payoff of the FRA is:

$$\text{Payoff} = \text{Notional Amount} \times \frac{\text{Reference Rate} - \text{Fixed Rate}}{1 + \text{Reference Rate} \times \alpha} \times \alpha \text{ (}\alpha\text{ is the day count function)}$$

$$= 3{,}00{,}00{,}000 \times \frac{(0.04875 - 0.055) \times 92/360}{1+(0.04875 \times 92/360)}$$

$$= 47{,}326.39$$

Hence, Payoff is \$ 47,326.39

Had the settlement rate been 6.125%, since the settlement rate is greater than the agreement rate, the seller pays the buyer the absolute value of the FRA. The absolute value of the FRA is:

$$= 3{,}00{,}00{,}000 \times \frac{(0.06125 - 0.055) \times 92/360}{1+(0.06125 \times 92/360)}$$

= 47,178.20

Hence, Payoff \$ 47,178.20

Illustration 72

MNC rolls over a \$25 million loan priced at LIBOR on a three-month basis. The company feels that interest rates are rising and that rates will be higher at the next roll-over date in three months. Suppose the current LIBOR is 5.4375%. Explain how MNC can use FRA at 6% offered by a bank to reduce its interest rate risk on this loan. In three months, if interest rates have risen to 6.25%, how much will MNC receive/pay on its FRA? Assume the three month period as 90 days.

Solution:

MNC can use 3×6 FRA, if it expects that the rates would be higher at the next roll-over of three months, starling three months from today. In other words MNC would buy 3×6 FRA @ 6%, clearly with a view that higher rate would prevail on the settlement date i.e. 3 months from now.

Now if on the settlement date, the rate is 6.25%, then MNC's decision to buy 3×6 FRA has been proved right and it would receive the present value of the interest differentials on the loan amount i.e. it would receive:

$$\text{Payoff} = \text{National Amount} \times \frac{\text{Reference Rate} - \text{Fixed Rate}}{1 + \text{Reference Rate} \times \alpha} \times \alpha \text{ (}\alpha\text{ is the day count function)}$$

$$= \$2{,}50{,}00{,}000 \times \frac{(0.0625 - 0.0600) \times 92/360}{1+ (0.06125 \times 90/360)}$$

= \$15,385

13.5.2 Interest Rate Futures

a. Concept and features of Interest Rate Futures

As mentioned earlier, Interest rate futures is standardized interest rate derivative contract traded on a stock exchange to buy or sell an interest-bearing instrument at a specified future date, at a price determined at the time of the contract. The contracts are exchange traded.

Following are the features of Interest Rate Futures:

(i) These are exchange traded cash settled contracts.

(ii) The contract size is kept at the minimum for wider participation.

(iii) Transparency is the key to these contracts. Settlement is done at clean price.

(iv) Contracts available across yields/benchmarks/maturities.

(v) There is centralized clearing supported by guaranteed settlement.

(vi) They provide easier and cheaper access to rates trading.

b. Uses of Interest Rate Futures

Following are the purposes form which Interest Rate Futures are used:

(i) Hedging

(ii) Managing the Duration of a Portfolio

(iii) Yield Locking

(iv) Using Calendar Spread for Speculation

(v) Arbitrage

(vi) Directional Trading

Some of these uses are described below with appropriate examples.

- **Hedging:** All types of investors are exposed to interest rate risk. Interest rate exposure can be hedged by taking an opposite position in IRF to offset a loss (gain) in underlying exposure with potential gain (loss) in the IRF.

  Consider the following example.

  Suppose, an investor holds debt-oriented mutual fund. He expects that yield will rise and NAV will decrease. However, Investor does not wish to redeem MF units. Here, the investor will short IRF to hedge, as illustrated below:

On Trade Date (say on 22th April, 2021):	
Investment Holding	Debt Oriented Mutual Fund 10,000 units @ NAV ₹13.30
Strategy Sell	610GS2031 lot of 2,000 bonds i.e., 6.1% Govt. Securities maturing in 2031 with lot size 2,000 bonds
Future price of 6.10% GS 2031 (May contract)	₹ 104.20
On Expiry Date (26th May, 2021):	
NAV of MF	₹13.15
Final Settlement Price of 6.10% GS 2031 (May contract)	₹ 103.50
Loss on underlying MF	10,000 × (13.30 − 13.15) = (₹ 1500)
Profit In IRF	2,000 × (104.20 − 103.50) = ₹ 1400
Net Profit / (Loss)	(₹ 100)

  Thus, he successfully avoids the loss on mutual funds.

- **Calendar Spread:** A Calendar Spread, also known as an Inter-delivery Spread, is the simultaneous purchase of one delivery month of a given futures contract and the sale of another delivery month of the same underlying on the same exchange.

  The mechanism of a calendar spread is explained in an example below:

	First leg – 3rd March 2021	Second Leg – 31st March 2021
Security	6.10 % GS 2031	6.10 % GS 2031
Strategy	Sell Spread i.e., Buy near month and Sell mid-month Buy April contract @105.00 Sell May Contract @105.10	Square off the position Sell April contract @104.20 Buy May contract @104.25
Profit / Loss (INR)	0.10	-0.05
Total Profit / Loss (INR)	0.05 per bond. ₹100 per lot	

- **Directional Trading:** As there is an inverse relationship between interest rate movement and underlying bond prices, the futures price also likely to move vis-a-vis the underlying bond prices. If an investor has a strong view that interest rates will increase in the near future and wants to reap benefit from the rise in interest rates, he can take a short position in IRF contracts and benefit from the falling futures prices.

  Consider the following example:

  Suppose, an investor expects yields to rise or that bond prices to fall. In order to reap the benefits, he will IRFs on the expectation of fall in prices. Suppose the investor sells the futures contract when the yield is 9.01% & buys it back when yield increases by 9 bps, i.e.,9.10%. During the period, the future price changes from 104.45 to 103.90. Lot size of 8.57% GOI Securities maturing in 2031 is 2,000. The investor sells 10 lots with applicable margin at 2.5%. The investor, in this case, will earn a profit of ₹11,000 as illustrated below:

Underlying Bond	8.57% GOI 2031
Futures Contract	30.06.2021
Trade Date	04.06.2021
Future Price (INR)	104.45
Yield	9.01%
Position	Short Position i.e., Sell Futures
Lot Size	2,000
No. of Lot	10
Total Value (INR)	(2,000 × 10 × 104.45) = 20,89,000
Margin (2.5% approx.) (INR)	52,225
Trade Date	12.06.2021
Future Price (INR)	103.9
Yield	9.10%
Position Square of positions	Long Position (to Square Off): Buy Futures
Total Value (INR)	(2,000 × 10 × 103.90) = 20,78,000
Profit/Loss (INR)	11,000

13.5.3 Interest Rate Options

Interest Rate Options are a derivative financial instrument that allows an investor to gain from the changes in the interest rates. These are connected to interest-bearing financial products, such as treasury notes. Moreover, these options trade on exchanges, such as CME Group, and are also available OTC (over the counter). An interest rate option works similarly to stock options, allowing buyers to speculate on the direction of the interest rate movement. However, unlike stock options, interest rate options depend on the actual rates. Moreover, Federal Reserve or any other authority can influence the interest rates. Thus, it is very important that investors in interest rate options have a good knowledge of the macroeconomic factors that can impact the interest rates.

There are two types of interest rate options – call and put. A call option gives the investor the right (not obligation) to gain from a rise in the interest rate. The holder of a call option will profit if the interest rate is above the strike rate at the time of the expiry. However, the holder will only make a profit if the interest rate at expiry is high enough to cover the premium cost as well.

In contrast, a put interest rate option gives the buyer the right (not obligation) to gain from the drop in the interest rates. The holder makes a profit if the interest rate drops below the strike rate and is enough to cover the premium cost as well. Such options are profitable when they are in the money.

The mechanism of Interest Rate Options can be explained with the help of the following example.

Suppose, in USA, an investor wants to speculate on rising interest rates, they could buy a call option on the 30-year Treasury with a strike price \$60 and an expiration date of August 31st. The premium for the call option is \$1.50 per contract. In the options market, the \$1.50 is multiplied by 100 (lot size) so that the cost for one contract would be \$150, and two call option contracts would cost \$300.

If yields rise by August 31st, and the option is worth \$68 at expiry, the investor would earn the difference of \$8, or \$800 based on the multiplier of 100. If the investor had originally bought one contract, the net profit would be \$650 or \$800 minus the \$150 premium paid to enter into the call option.

Conversely, if yields were lower on August 31st, and the call option was now worth \$55, the option would expire worthless, and the investor would lose the \$150 premium paid for the one contract.

In India, Interest Rate Options are traded at NSE and BSE. At NSE, currently, Interest rate Options are based on underlying G-Sec bonds 5.77% 2030 Bond, 5.79% 2030 Bond, 5.85 % 2030 Bond, 6.10 % 2031 Bond & 6.67 % 2035 Bond. The unit of trading is ₹ 2 lakh face value of G-Sec, corresponding to 2,000 units. The order quotation is the premium quoted as the price of G-Sec and the tick size is ₹ 0.0025.

13.5.4 Interest Rate Caps

a. Concept of Interest Rate Cap

An interest rate cap is an agreement between two parties in which one party, for an up-front premium, agrees to compensate the other party if a designated interest rate, called the reference rate, is different from a predetermined level. In other words, an interest rate cap is an option to fix a ceiling or maximum short term interest rate payment. The contract is written such that the buyer of the cap will receive a cash payment equal to the difference between the actual market interest rate and the cap strike rate on the notional principal, if the market rate rises above the strike rate. Usually, caps are designed to provide insurance against the rate of interest on a floating-rate loan going above a certain level. This level is known as the cap rate.

b. Features of Interest Rate Caps

(a) The buyer of an Interest Rate Cap pays premium to the seller for the right to receive the difference in interest cost (on notional principal) when a specified index of market interest rates rises above a stipulated "cap rate".

(b) The buyer has no obligation or liability if interest rates fall below the specified cap rate.

(c) Thus, a cap resembles an option which represents a right rather than an obligation to the buyer.

(d) Interest rate caps cover periods ranging from 1-10 years with interest rate reset and payments dates most commonly set either 3 or 6 months apart.

c. Constituents

(a) Notional Principal amount

(b) Interest Rate Index (say, LIBOR)

(c) A Cap rate which is equivalent to strike or, exercise price on an option and

(d) Period of agreement, including payment dates and interest rate reset dates.

d. Valuation of Interest Rate Cap

Amount of payment on settlement: $[(N) \times \text{Max}(0, r - rc) \times (dt/360)]$

Where, N = Notional principal amount; r = Index rate; rc = cap rate; dt = time gap between interest rate reset date and payment date (in days)

e. Settlement

If the specified market index is above the cap rate, the seller pays the buyer the difference in interest cost on the next payment date.

13.5.5 Interest Rate Floors

a. Concept of Interest Rate Floor

An interest rate floor guarantees the buyer of the floor option a minimum interest rate to be received on a specified notional amount for a specified period or series of periods. In other words, the floor writer pays the floor buyer when the reference rate falls below the contract rate, called floor rate. So, a floor places a lower limit on the interest rate that will be charged.

If a lending firm fears that interest rates may fall in future, it may wish to purchase a floor so that it can receive a minimum return on invested funds. If the actual market rate of interest falls even below the floor ace, the holder of the floor will receive from the writer of the floor a cash payment equal to the difference between the actual reference rate (say, LIBOR) and the floor rate.

b. Features of Interest Rate Floors

(a) The buyer of an Interest Rate Floor pays premium to the seller for the right to receive the difference in interest cost (on notional principal) when a specified index of market interest rates falls below a stipulated “floor rate”.

(b) The buyer has no obligation or liability if interest rates rise above the specified floor rate.

(c) Thus, a floor resembles an option which represents a right rather than an obligation to the buyer.

(d) Interest rate floors cover periods ranging from 1-10 years with interest rate reset and payments dates most commonly set either 3 or 6 months apart.

c. Constituents

(a) Notional Principal amount

(b) Interest Rate Index (say, LIBOR)

(c) A Floor rate which is equivalent to strike or, exercise price on an option and

(d) Period of agreement, including payment dates and interest rate reset dates.

d. Valuation of Interest Rate Floors

Amount of payment on settlement: [(N) × Max (0, rf - r) × (dt/360)]

Where, N = Notional principal amount; r = Index rate; rf = floor rate; dt = time gap between interest rate reset date and payment date (in days)

e. Settlement

If the specified market index is below the floor rate, the seller pays the buyer the difference in interest cost on the next payment date.

13.5.6 Interest Rate Collars

An interest rate collar is a combination of an interest rate cap and an interest rate floor in which the buyer buys a cap and simultaneously sells a floor. So, collars specify both the upper and lower limits for the rate that will be charged. Collar can be constructed from two separate transaction (one for cap another for floor) or they can be combined into a single transaction. Since the collar has the effect of locking both the high side and the lower side interest rate, it is also called locking into a band. Further, if the collar is created by two separate contracts, so as a purchaser one will pay the premium, and as a seller the premium will be received. When the two premiums are equal, the position is often referred to as a zero-premium collar.

The basic objective of constructing a collar is to retain some of the benefits of declining rates while paying if the interest rate falls below a particular limit. Let us consider an example. Suppose that a firm holds a fixed rate assets which are yielding 11 percent. These assets are financed through floating rate liabilities tied to the LIBOR, assuming current rate at 9 percent. Suppose that the firm wants to cap the-cost at 10.5 percent (buying a cap at 10.5 percent) then it has to pay upfront premium, assuming 0.5 percent p.a. If the firm feels that this premium is too high to pay, but, as it happens, the firm finds that it can sell a prime (a prime rate or prime lending rate is an interest rate used by banks, usually the interest rate at which banks lend to customers with good credit) floor with a floor rate at 7 percent for a premium at 0.5 percent p.a. From the firm's perspective, its annual costs are now bounded between 7 percent to 9.5 percent. It means that when the prime rate rises above 9.5 percent, the dealer pays the firm the difference. If prime rate falls below 7 percent, the firm pays the difference to the dealer.

Consider the following illustrations on interest rate caps, floors and collars.

Illustration 73

Amit Company has borrowed $200 million on floating basis for 3 years. The interest rates reset every year. The spread over LIBOR is 25 bps. The company buys a 3 year cap on a 1-year LIBOR with a strike rate of 9% and having a face value of $200 million. The cap carries a premium of 2% of face value or $4 million. Current 1 Year LIBOR is 9%. If the LIBOR at the end of 1, 2 and 3 years are 9.5%, 8.5% and 10%, what is the cash flow from cap each year? Amortize premium equally over three years.

Solution:

The strike rate of the cap is Libor which is currently 9%. Since the spread over Libor is 25 bps, the interest rate applicable on the borrowing would be 9.75%, 8.75% & 10.25% respectively for the three years. Thus the interest payable in amount terms over three years would be: $1,95,00,000, $1,75,00,000 and $2,05,00,000 respectively. Now, the premium paid for buying this cap is $ 4 million. As given in the problem equal amortization would involve $13,33,333 each year. The seller of the cap would part with the difference whenever Libor is above the strike price. Therefore we can construct the cash flow table as follows:

(Amount in $)

Time	Cash Flow : Loan	Amortization of premium	Cash Flow from Cap	Total
0	+20,00,00,000	-	-	+20,00,00,000
1	−1,95,00,000	−13,33,333	+10,00,000	−1,98,33,333
2	−1,75,00,000	−13,33,333	-	−1,88,33,333
3	−2,05,00,000	−13,33,333	+20,00,000	−1,98,33,333
3	−20,00,00,000	-	-	−20,00,00,000

Illustration 74

A fund manager Mr. Adittya deposited $200 million on floating basis for 3 years, which pay LIBOR + 50 bps. The interest rates are reset every year. The company buys a 3 year floor on a 1-year LIBOR with a strike rate of 8% and having a face value of $200 million. The floor carries a premium of 1.5% of face value or $3 million. Current 1 year LIBOR is 8.60%. If the LIBOR at the end of 1, 2 and 3 years are 7.5%, 9% and 7%, what is the cash flow from floor each year? Amortize premium Equally over three years.

Solution:

The strike rate of the floor is Libor which is currently 8.6% The interest rate applicable on the deposit would be Libor + 50 bps i.e. 50 bps over 7.5%, 9% & 7% respectively for the three years. Thus the interest payable in amount terms over three years would be: $1,60,00,000, $1,90,00,000 and $1,50,00,000 respectively. Now, the premium paid for buying this floor is $ 3 million. As given in the problem equal amortization would amortization would involve $10,00,000 each year. The seller of the floor would part with the difference whenever the Libor is below the strike price of 8%. Therefore we can construct the cash flow table as follows:

Time	Cash Flow : Deposit	Amortization of Premium	Cash Flow from Floor	Total
0	−20,00,00,000	-	-	−20,00,00,000
1	+1,60,00,000	−10,00,000	+10,00,000	+1,60,00,000
2	+1,90,00,000	−10,00,000	-	+1,80,00,000
3	+1,50,00,000	−10,00,000	+20,00,000	+1,60,00,000
3	+20,00,00,000	-	-	+20,00,00,000

Illustration 75

DY has purchased ₹400 million cap (i.e., call options on interest rates) of 9% at a premium of 0.65% of face value. ₹400 million floor (i.e., put options on interest rates) of 4% is also available at premium of 0.69% of face value.

(a) If interest rates rise to 10%, what is the amount received by DY? What are the net savings after deducting the premium?

(b) If DY also purchases a floor, what are the net savings if interest rates rise to 11%? What are the net savings if interest rates fall to 3%?

(c) If, instead, DY sells (writes) the floor, what are the net savings if interest rates rise to 11%? What if they fall to 3%?

(d) What amount of floors should it sell in order to compensate for its purchases of caps, given the above premium?

Solution:

(a) Premium for purchasing the cap = 0.65% × ₹400 million = ₹26,00,000. If interest rates rise to 10 percent, cap purchasers receive ₹400 million × 0.01 = ₹40,00,000. The net savings is ₹14,00,000.

(b) If DY also purchases the floor: Premium = 0.0069 × ₹400 million = ₹27,60,000, and the total premium = ₹27,60,000 + ₹26,00,000 = ₹53,60,000.

If interest rates rise to 11 percent, cap purchasers receive 0.02 × ₹400 million = ₹80,00,000 and the net savings = ₹80,00,000 – ₹53,60,000 = ₹26,40,000.

If interest rates fall to 3 percent, floor purchaser receive 0.01 × ₹400 million = ₹40,00,000 and the net savings = ₹40,00,000 – ₹53,60,000 = − ₹13,60,000.

(c) If DY sells the floor, it receives net ₹27,60,000 (-) the cost of the cap of ₹26,00,000 = + ₹1,60,000.

If interest rates rise to 11 percent, cap purchasers receive 0.02 × ₹400 million = ₹80,00,000. The net the savings = ₹80,00,000 + ₹1,60,000 = ₹81,60,000.

If interest rates fall to 3 percent, floor purchasers receive 0.01 × ₹400 million = ₹40,00,000. The net savings to DY = − ₹40,00,000 + 1,60,000 = − ₹38,40,000

(d) DY. Needs to sell: X × 0.0069 = ₹26,00,000, or X = ₹37,68,11,594 worth of 4 percent floors.

Solved Case Studies

Heading of Risks - Futures Rate Available Vs. Future rate not Available

1. Fashion Ltd. manufactures cruiser bikes for export to Americana and Europe. It requires a special type alloy called "Fecal" made up of Iron, Aluminum and Cope. Fecal is sold at ₹230 per kg in the spot market. If Fashion Ltd. has a requirement of 6 tonnes in 6 months time, and the 6-Months Future Contract rate is ₹2.42 Lakhs per tonne. Carrying cost is 5% p.a. if the interest rate is 10%, should the Company opt for Futures Contract?

Case A: If the Company does opt for Futures Contract for buying 6 Tonnes of Fecal, what will be the effect if –

(a) Spot Rate at the end of 6 months is ₹2,55,000 per tonne?

(b) Spot Rate at the end of 6 months is ₹2,35,000 per tonne?

Has the Company gained or lost? If the Company has lost, is it proper to conclude that Futures Contract has failed to save the company from loss, and therefore need not be resorted to?

Case B: what will be the course of action and effect of such action in the above two cases, if -

(a) There is no Futures Market for Fecal;

(b) Hedge ratio for Fecal with the Metal Index is 0.9 i.e. Beta of Fecal with Metal Index is 0.90 (i.e. beta for change in values)

(c) Each Metal index contract is equivalent to 5000 kgs of Fecal.

(d) 6-Months' Metal Index Future is 4800 points [Assume futures contract are divisible]

If in Case A, Fashion Ltd. wants to cash in on an arbitrage opportunity, what should it do?

Solution:

1. Computation of Theoretical Forward Price [TFP_x]

$FP_x = S_x \times e^{(r+c)\times t}$

Where,

S_x = Current Spot Price = ₹230 per kg or ₹2,30,000 per tonne

r = Rate of Interest per annum = 10% p.a. or 0.10

c = Carrying Cost (rate per annum) = 5% p.a. or 0.05

t = Period of Futures contract in Years = 6 Months or 0.50 Years

TFP_x = ₹2,30,000 × $e^{(0.10+0.05)\times 0.50}$

=₹2,30,000 × $e^{0.15 \times 0.50}$

=₹2,30,000 × $e^{0.075}$

=₹2,30,000 × 1.0779

= ₹2,47,917

2. Evaluation of Futures Contract Proposal

- Theoretical Futures price ₹2,47,917 is greater than Actual Futures Price ₹2,42,000
- Therefore, the Company should go in for futures for buying 6 Tonnes of Fecal
- Theoretically the Company stands to gain ₹5,917 per tonne based on theoretical futures Price
- Company can freeze its loss (based on current spot price of ₹2.30 Lakhs per tonne) to ₹10,000 per tonne.

3. Effect of Futures Contract Proposal – Based on Actual Spot rate 6-Months Later

Particulars	Case A	Case B
Spot Rate (6-Months later) is (per tonne)	₹2.55 Lakhs	₹2.35 Lakhs
Actual Futures price is (per tonne)	₹2.42 Lakhs	₹2.42 Lakhs
6-Month's Future price vs. Spot Rate [s_1]	AFP is lower	AFP is higher
Based on Actual Spot Rate on the date of exercise		
(i.e. 6 Months later), buying 6 tonnes at ₹2.42 Lakhs per tonne	Gain of ₹13,000 per tonne.	Loss of ₹7,000 per tonne.

Conclusion:

- Futures contract does not eliminate loss. It only eliminates uncertainty associated with price. It is only a guarantee that the contractee will not gain or lose beyond a particular level (level determined by the Future price) with reference to the current spot price.
- As a hedging tool, it freezes (fixes) the price and thereby mitigates the risk associated with price. The maximum gain or loss is known the day on which futures contract is entered into. One need not wait for the actual delivery or exercise day to know the rate.
- Therefore, it is inappropriate to conclude that Futures Contract should not be resorted to since it has failed to save the company from loss.

4. No future Rate Available

(a) Basis and suggested course of Action

- Since Fecal is not traded in the Futures Market, Fashion Ltd. can resort to Cross Hedge i.e. entering into a Futures Contract in a related index/commodity (whose prices move in tandem with Fecal)
- Since the Metal Index moves in tandem with the price of Fecal, Fashion Ltd. should enter into a Futures Contract in Metal index opposite to its position in Fecal's Cash Market i.e. it required 6 tonnes of Fecal six months hence (Going Long), therefore, it should sell 6 Months future Contract for Metal Index (Going Short)
- Course of Action: Sell Metal Index Futures. Buy Fecal Stock in Cash Market (to be executed six Months hence)

(b) Activity Flow

Activity	Time	Description
Contract	Now	Enter into 6 Month's Futures Contract for Selling 10.80 Metal Index futures
Settle Futures Contract	6-Months Later	Settle 6-Month's Future Metal Index liability by pocketing (gain) or paying (loss) the price difference. Gain (₹) = No. of Contracts × No. of Fecal Units per Contract × Gain in Metal Index Points Loss (₹) = No. of Contracts × No. of Fecal Units per Contract × Loss in Metal Index Points
Buy	6-Months Later	Buy Six Tonnes at prevailing spot price [Prevailing Spot Price = Spot Price at the beginning of Futures contract ± Gain/Loss in settlement of Metal Index Futures]

Working note: Contract Determination

Number of Metal Index futures to be sold

$$= \text{Hedge Ratio} \times \frac{\text{Units of Spot Position requiring hedging}}{\text{No. of Units Underlying one Futures Contract}}$$

$$= \text{Hedge Ratio [Beta of changes in Price of Fecal w.r.t. metal Index]} \times \frac{\text{Quality of Fecal required by Fashion}}{\text{Quantity of fecal equivalent of one Futures Contract of Metal Index}}$$

= 0.90 × (6 Tonnes ÷ 0.50 Tonne) = 0.90 × 12 = 10.80 Futures Contracts

(c) Cash Flow

Price in Spot Market 6-Months later is ₹2.55 Lakhs

Particulars	Value
Value per Kg six months later [₹2,55,000÷1,000 Kgs]	₹255
Less: Value per Kg at the beginning	₹230
Appreciation / (Depreciation) in price per Kg of Fecal	₹25
Hedge Ratio (i.e.Beta Value of movement in Fecal w.r.t to Metal Index Futures)	0.90

Appreciation in Metal Index [per metal index futures [Appreciation in Fecal price ÷ Hedge Ratio] = 25÷0.90 = 27.778 points i.e. Metal Index would have appreciated by 27.778 points to 4,827.778 points (4,800 + 27.778)	27.778 Points
Gain on Settlement of Metal Index Futures [No. of Contract × No. of Fecal Units per Contract × Gain in Metal Index points] = 10.80 × 500 kgs × 27.778	
[This is the Cash Inflow for Fashion Ltd]	₹1,50,000
Cash Outflow	
=> For purchase of 6 Tonnes of Fecal ₹2.55 Lakhs per tonne × 6 tonnes = ₹15,30,000 = Spot Price at the Beginning + Gain on Settlement of Metal Index Futures = ₹2,30,000 × 6 Tonnes + ₹1,50,000 = ₹13,80,000 + ₹1,50,000	₹15,30,000
Net Outflow for Fashion Ltd. = ₹15,30,000 – ₹1,50,000	₹13,80,000

Price in Spot Market 6-Months later is ₹2.35 Lakhs

Particulars	Value
Value per Kg six months later [₹2,35,000 ÷ 1,000 Kgs]	₹235
Less: Value per Kg at the beginning	₹230
Appreciation / (Depreciation) in price per kg of Fecal	₹5
Hedge Ratio (i.e. Beta Value of movement in Fecal w.r.t to Metal Index Futures)	0.90
Appreciation in Metal Index [per metal index futures] = Appreciation in Fecal Price ÷ Hedge Ratio = 5 ÷ 0.90 = 5.556 points i.e. Metal Index would have appreciated by 5.556 points to 4805.556 points (4800 + 5.556)	5.556 points
Gain on Settlement of Metal Index Futures [No. of Contracts × No. of Fecal Units per Contract × Gain in Metal Index Points] = 10.80 × 500 kgs. × ₹5.556 [This is the Cash Inflow for Fashion Ltd.]	₹30,000
Cash Outflow	
=>For purchase of 6 Tonnes of Fecal ₹2.35 Lakhs per tonne × 6 Tonnes = ₹14,10,000 = Spot Price at the Beginning + Gain on Settlement of Metal Index Futures = ₹2,30,000 × 6 Tonnes + ₹30,000 = ₹13,80,000 + ₹30,000	₹14,10,000
Net Outflow for Fashion Ltd. = ₹14,10,000 – ₹30,000	₹13,80,000

5. **Arbitrage Opportunity**

- **Position:** Theoretical Futures Price (₹2,47,917)≠Actual Futures Price (₹2,42,000)
- **AFP vs. TFP:** To benefit from the opportunity, Fashion Ltd. should buy Future and Sell Spot.
- Profit: = Sale Value (Spot Price) – Purchase Cost (Present Value of Future Price)

= [₹2,30,000 × 6 Tonnes] – [₹2,42,000 per Tonnes÷e^{rt}]

= ₹13,80,000 – [₹14,52,000 ÷ $e^{(0.10+0.05)\times 0.5}$]

=₹13,80,00 – [₹14,52,000 ÷ $e^{0.15\times 0.5}$]

=₹13,80,000 – [₹14,52,000 ÷ $e^{0.075}$]

=₹13,80,000 – [₹14,52,000 ÷ 1.07788]

= ₹13,80,000 – ₹13,47,089

= ₹32,911.

2. Soumo has ₹3,00,000 to invest in the Capital Market. He Considers stock of Kraft Components Ltd, an auto mobile industry ancillary unit, to be a safe bet, KCL is currently traded at ₹200. Industry analyst say opine that KCL will either remain at ₹190 or go upto ₹250 in 6- months time, considering the performance of the industry. Soumo views this as an opportunity and has decided to invest ₹3,00,000 to buy shares of KCL and earn a maximum of upto 25% which is more than the risk free rate.

His actuarial friend, Rakesh, also has ₹3,00,000 to invest. However, he considers Soumo's proposition to be bit risky, having some knowledge on options, Rakesh intends to buy calls and invest at Risk Free Rate of 12%. 6-Months option carries an Exercise Price of ₹220.

What should be the price of the call, for Rakesh's proposition to yield the same result 6- months later (i.e. a minimum net wealth of ₹3,00,000)? How many calls should Rakesh buy?

Who would be better off at the end of 6-months, if the actual spot price is ₹180, ₹250 and ₹300?

Solution:

1. Basic Data

Particulars	₹
Current Stock Price (SP_0)	200
Exercise Price (EP)	220
Expected Future Spot Price on Expiry Date	
⅄ Future Price 1 [FP_1]	190
⅄ Future Price 2 [FP_2]	250

2. Computation of Option Delta:

Particulars	FP_1	FP_2
Future Spot Price	190	250
Position on Expiry Date(in comparison with Exercise Price of ₹ 220)	Out of Money	In the Money
Action on expiry date	Lapse	Exercise
Value of Option on Expiry [Future Spot Price Less Exercise Price]	₹ 0	₹ 30 [250-220]

Option Delta = Change in Value of Option ÷ Change in Future Spot Price

= (₹30 – ₹0) ÷ (₹250 – ₹190) = ₹30 ÷ ₹60 = 0.50

3. Computation of Amount to be invested at Risk Free Rate:

= Present Value of Lower Band of Future Spot Price i.e. FP_1

= Present Value of ₹190 discounted at 12% Continuous Compounding for a 6-Month Period

= ₹190 × e^{-rt} = ₹190 ÷ e^{rt}

= ₹190 ÷ $e^{0.12\times0.5}$

= ₹190 ÷ $e^{0.06}$

= ₹190 ÷ 1.0618 = ₹178.94

4. Value of Call [C]

= Option Delta×[Current Stock Price Less Amount to be invested at Risk Free Rate]= 0.50×(₹200–178.94)

= 0.50 × ₹21.06 = ₹10.53

5. Value of Put [P] (Under Put Call Parity):

→ Value of Call + Present Value of Exercise Price = Current Spot Price + Value of Put

→ $C + EP \times e^{-rt} = SP_0 + P$

→ ₹10.53 + (₹220 ÷ 1.0618) = ₹200 + P

→ P = ₹10.53 + ₹207.20 – ₹200 = ₹17.73

6. No. of Calls to be Bought by Rakesh

= (1 ÷ Options Delta) per share of KCL

= 1 / 0.50 = 2 per share of KCL or 5 Calls for every 3 Shares of KCL

7. No. of Shares that can be bought = ₹3,00,000 ÷ ₹200 per share (CMP) = 1,500 shares

8. Position 6 - Months Later

(a) Soumo

Particulars	Case A	Case B	Case C
Closing Net Worth = Actual Stock Price after 6 Months	₹180 × 1500 Shares = ₹2,70,000	₹250 × 1500 Shares = ₹3,75,000	₹300 × 1500 Shares = ₹4,50,000
Opening Net Worth= Purchase Price of Stock/ Initial Investment	₹200 × 1500 Shares = ₹3,00,000	₹200 × 1500 Shares = ₹3,00,000	₹200 × 1500 Shares = ₹3,00,000
Change	(₹30,000)	₹75,000	₹1,50,000
% Change	(10%) [(30)÷300]	25% [75÷300]	50% [150÷300]
Inference	Erosion in Wealth	Increase in Wealth	Increase in Wealth

(b) Rakesh

Outflow per set of 5 Calls on KCL and Investment of ₹178.94 in Risk Free per Share for 3 shares.

Particulars		Value
Outflow towards Purchase of Calls Outflow	5 Call's × ₹10.53 per Call	₹52.65
Towards Investment	3 Shares of KCL × ₹178.94	₹536.82
Total Investment per set of 5 Calls and Risk Free Investment		₹589.47
Total Number of Portfolio Sets invested	₹3,00,000 ÷ ₹589.47	509 Sets
Total No. of Calls	509 Sets × 5 Calls per Set	2545 Calls
Total amount invested in Risk Free Rate	509 Sets × ₹536.82	₹2,73,241

Particulars	Case A	Case B	Case B
Actual Closing Price per Share	₹180	₹250	₹300
Exercise Price	₹220	₹220	₹220
Position	Out of Money	In the Money	In the Money
Action	Lapse	Exercise	Exercise

Value of Call before Expiry	₹0	₹30 [₹250 – ₹220]	₹80 [₹300 – ₹220]
No. of Calls	2545	2545	2545
Total Value of Calls on Expiry [6–Months later] [A]	₹ NIL [2545 × ₹0]	₹76,350 [2545 × ₹30]	₹2,03,600 [2545 × ₹80]
Maturity Value of Investment [Investment ₹2,73,241 × $e^{0.12\times0.5}$] [B]	₹2,90,127 [2,73,241 × 1.0618]	₹2,90,127 [2,73,241 × 1.0618]	₹2,90,127 [2,73,241 × 1.0618]
Closing Net Worth [A+B]	₹2,90,127	₹3,66,477	₹4,93,727
Opening Investment	₹3,00,000	₹3,00,000	₹3,00,000
Change	₹(9,873)	₹66,477	₹1,93,727
%Change	(3.291)% (9,873 ÷ 3,00,000)	22.16% [66,477 ÷ 3,00,000]	64.58% [1,93,727 ÷ 3,00,000]
Inference[Ignoring Time Value of Money]	Decrease in wealth	Increase in Wealth	Increase in Wealth

Conclusion:

- Rakesh will be better off when actual market price is either ₹250 or ₹300.
- Risk is neutralized in case of Rakesh by going in for the Options.

Exercise

Theoretical Questions

Multiple Choice Questions

1. A buyer of forward contract will make profit if
   A. Future price is lower than the forward price
   B. Future price is higher than the forward price
   C. Future price is equal to the forward price
   D. Both (A) and (C) of the above
2. Which of the following is/are underlying instrument(s) in a Forward Rate Agreement?
   A. Interest rate
   B. Exchange rate
   C. Inflation rate
   D. Both (a) and (c) of the above
3. The market in which the futures price is greater than the spot price is referred to as
   A. Basis
   B. Contango
   C. Backwardation
   D. Reverse Cash and carry arbitrage market
4. Buying and selling call or put option with the same strike price but different expiration dates is called
   A. Long hedge
   B. Short hedge
   C. Horizontal option spread
   D. None of the above.
5. Maintenance margins deposited by an investor in a futures contract is
   A. Greater than or equal to the initial margin
   B. Less than or equal to the initial margin
   C. Greater than the initial margin
   D. Less than the initial margin
6. Backwardation occurs when
   A. Current spot price = futures price
   B. Current spot price < futures
   C. Futures price < current spot price
   D. Futures price > current spot price
7. American options are those
   A. Options which are traded on New York Stock Exchange
   B. That can be exercised at any time during a specified period
   C. That can be exercised only at the specified period
   D. That can be exercised even after the specified period

8. The writer of the option is also known as a
   A. Buyer of the option
   B. Holder of the option
   C. Seller of the option
   D. Mediator of the option
9. Covered Call Writing means
   A. Buying a stock and a put option and writing a call option on the asset already owned
   B. Buying a call option and stock and writing a put option
   C. Buying a call option and writing a put option
   D. Selling a call option and purchasing a stock
10. Plain vanilla interest rate swaps involved
   A. Fixed to fixed rate swap
   B. Fixed to floating rate swap
   C. Floating to floating rate swap
   D. Currency swap

Answer:

1	2	3	4	5	6	7	8	9	10
B	A	B	C	D	C	B	C	D	B

State True or False

1. The derivatives market helps to transfer risks.
2. A forward contract is a standardized contract.
3. A credit derivative is a contract whose value depends on the creditworthiness or a credit event experienced by the entity referenced in the contract.
4. Basis is defined as the Spot price minus the futures price.
5. Intrinsic value is the amount by which the price of an option exceeds its intrinsic value.
6. Option which gives the holder the right to sell an asset, but not an obligation to sell is called a call option.
7. A diagonal spread can be created by using similar options with different strike prices and also different time to expire.
8. Delta of a Stock Option is the ratio of the change in the price of the stock option to the change in the price of the underlying stock.
9. An interest rate cap is a type of interest rate derivative in which the buyer receives payments at the end of each period in which the interest rate exceeds the agreed strike price (the maximum interest rate).
10. A CDS in which the buyer does not own the underlying debt is referred to as a naked credit default swap.

Answer:

1	2	3	4	5	6	7	8	9	10
True	False	True	False	False	False	True	True	True	True

Fill in the Blanks

1. Derivatives are mostly ____________ market instruments.
2. In a___________, the holders get the full amount of loan and interest accrued only at the maturity of the bond.
3. ____________ is an option contract whose value is based on interest rates or interest rate instruments.
4. Longer the time to maturity, higher the period of uncertainty, and hence _________ the option premium.
5. An interest rate ________is an instrument that combines both a cap and a floor.
6. A _________ spread is a non-directional options strategy that limits both gains and losses while seeking to profit from either low or high volatility.
7. Option premium is paid by the _______to the _________ of the option.
8. Hedge Ratio = ___________ ÷ Underlying asset position.
9. __________ essentially means that at the end of the trading session (day), all outstanding contracts are repriced at the settlement price of that session (daily closing price).
10. The financial forward and futures contracts are priced using the ___________ Model.

Answer:

1	secondary	2	zero-coupon bond
3	Interest Rate Option	4	higher
5	collar	6	condor
7	buyer, seller	8	Futures Position
9	Marking to market	10	Cost of Carry

Short Essay Type Questions

1. Discuss the benefits of financial derivatives.
2. Discuss, in brief, the four basic financial derivatives.
3. What do you mean by Forward Contract? Discuss its features.
4. In the context of Futures Contract, discuss the feature ‘Standardization’.
5. Write a Short Note on: Types of Option Contracts.
6. Write a Short Note on: Interest Rate Collars.
7. Explain ‘in-the-money’, at-the-money’ and ‘out-of-the-money’ options.
8. What is the difference between Intrinsic Value and Time Value of an option contract?
9. Write a Short Note on: Types of Credit Default Swap.
10. How can Credit Default Swaps be used for hedging? Explain with the help of one example.

Practical Problems

Multiple Choice Questions

1. An investor writes a three-month put on the stock of an oil company at an exercise price of ₹275 per share at a premium of ₹34. If the expiration date price is ₹280, calculate the gain/loss of put writer.

   A. ₹5

   B. (–) ₹5

   C. ₹34

   D. None of the above

2. An investor buys 100 shares of a sugar mill at ₹210 per share and at the same time writes a September 250 call at a premium of ₹20 per share. If the expiration date price is ₹280, calculate the net gain/loss.

   A. ₹20

   B. ₹40

   C. ₹60

   D. None of the above

3. If the share of BA Ltd. (F. V. ₹10) quotes ₹920 on NSE, and the 3 months futures price quotes at ₹950, and the borrowing rate is given as 8% and the expected annual dividend yield is 15% p.a. payable before expiry, then the price of 3-month BA Ltd. futures would be

   A. ₹948.40

   B. ₹939.90

   C. ₹938.50

   D. ₹936.90

4. The stock of ABC Ltd. sells for ₹210. The present value of exercise price and the value of call option are ₹217.40 and ₹9.60 respectively. What is the value of put option?

   A. ₹16.50

   B. ₹22.00

   C. ₹17.00

   D. ₹18.00

5. In June 2005, a six month Call on Ritz Ltd.'s stock with an exercise price of ₹25 sold for ₹5. The stock price was ₹20. The risk- free interest rate was 5% per annum. How much would you be willing to pay for a Put Option on Ritz Ltd.'s stock with same maturity and exercise price? [Given: PVIF (5%, 1/2 year) = 0.9756]

   A. ₹6.39

   B. ₹9.39

   C. ₹12.39

   D. None of (A), (B), (C).

6. A call option at a strike price of ₹ 200 is selling at a premium of ₹ 24. At what share price on maturity will it break-even for the buyer of the option?

   A. ₹ 200

   B. ₹ 176

   C. ₹ 224

   D. ₹ 248

7. An investor is bullish about X Ltd. which trades in the spot market at ₹ 1,150. He buys two call option contracts with three months (one contract is 100 shares) with a strike price of ₹ 1,195 at a premium of ₹ 35 per share. Three months later, the share is selling at ₹ 1,240. Net profit/loss of the investor on the position will be

   A. ₹ 1,000

   B. ₹ 16,000

   C. ₹ 11,000

   D. ₹ 2,000

8. M buys a call option contract for a premium of ₹ 200. The exercise price is ₹ 25 and the current market price of the share is ₹ 22. If the share price after three months reaches ₹ 30, what is the profit made by M on exercising the option? A contract is for 100 shares. Ignore transaction charges.

   A. ₹ 200

   B. ₹ 300

   C. ₹ 100

   D. ₹ 600

9. Presently, a company's share price is ₹ 120. After 6 months, the price will be either ₹ 150 with a probability of 0.8 or ₹ 110 with a probability of 0.2. A call option exists with an exercise price of ₹ 130. What will be the expected value of call option at maturity date?

   A. ₹ 20

   B. ₹ 16

   C. ₹ 12

   D. ₹ 10

10. A stock is currently selling at ₹ 270. The call option to buy the stock at ₹ 265 costs ₹ 12. What is the Time Value of the option ?

    A. ₹ 5

    B. ₹ 17

    C. ₹ 7

    D. None of (A), (B) or (C)

11. The spot Value of Nifty is 4430. An investor bought a one month Nifty 4410 call option for a premium of ₹ 12. The option is:

    A. In the money

    B. At the money

    C. Out of the money

    D. Insufficient data

12. You are given the following information of a stock:

    Strike Price ₹ 400

    Current stock price ₹ 370

    Risk free rate of interest 5%

    Theoretical minimum price of a European 6 months' put option after six months is

    A. ₹ 9.37

    B. ₹ 20.12

    C. ₹ 30.76

    D. ₹ 20.63

13. A wants to hedge its portfolio of shares worth ₹ 150 million using the Index futures. The contract size is 100 times the index. The index is currently quoted at 7500. The beta of the portfolio is 0.9. Consider the beta of the index as 1. The number of contracts to be traded is

    A. 18000

    B. 180

    C. 22

    D. 200

14. A company's share is currently trading at ₹ 240. After 6 months, the price will be either ₹ 250 with probability of 0.80 or ₹ 220 with probability 0.20. A European call option exists with an exercise price of ₹ 230. The expected value of call option at maturity date will be

    A. ₹ 10

    B. ₹ 16

    C. ₹ 4

    D. ₹ 14

15 An option's theoretical value increases by 1.75 if the interest rate is decreased by 1%.Then, 1.75 is

    A. The rho of a put option

    B. The rho of a call option

    C. The theta of call option

    D. The theta of a put option

16. Which of the following is not an assumption of Black-Scholes Model?

    A. The risk-free rate of interest is known

    B. Options can be exercised only at expiration

    C. Dividend is paid on the shares

    D. No imperfection exists in writing an option

17. When the spot price decreases, the value of a call option

    A. is equal to its premium

    B. decreases

    C. increases

    D. does not change

18 Buying a call and put with the same expiry date, on the same stock with a different strike price is a

A. Strangle

B. Strap

C. Straddle

D. Strip

19. A stock is currently sells at ₹ 350. The put option to sell the stock sells at ₹ 380 with a premium of ₹ 20. The time value of option will be

A. ₹ 10

B. ₹ -10

C. ₹ 20

D. ₹ 0

20. An investor bought 2,000 shares of X Ltd. for ₹ 90 per share. The initial margin is 50%. The maintenance margin is 40%. If the stock price decreases to ₹ 70 per share. The additional funds put by the investors to his margin account is –

A. ₹ 20,000

B. ₹ 20,500

C. ₹ 21,000

D. ₹ 22,000

21. What should be the price of call, if value of a put ₹ 5, strike price ₹ 100, rate of interest 6% p.a. , time period -2 months?

A. ₹ 4

B. ₹ 5

C. ₹ 6

D. ₹ 7

22. An investor purchases a July Call Option of X Ltd. with a strike price of ₹ 100 for a premium of ₹ 7. Till what level the investor will not realize his profit.

A. ₹ 105

B. ₹ 107

C. ₹ 110

D. ₹ 115

23. In a put-call parity, the pay-offs of buying stock can be replicated by:

A. Buying a call and buying a put option

B. Buying a call and writing a put option

C. Writing a call and buying a put option

D. Writing a call and writing a put option

24. A stock is currently sells at ₹ 350. The put option to sell the stock sells at ₹ 380 with a premium of ₹ 20. The time value of option will be

    A. ₹ 10

    B. ₹ 10

    C. ₹ 20

    D. 0

25. The spot value of NIFTY is 6430. An investor bought a two month NIFTY for 6410 call option for a premium of ₹ 24. The option is

    A. In-the Money

    B. At-the Money

    C. Out-of the Money

    D. Insufficient Data

26. Shares of C Ltd. is traded at ₹ 1,150. An investor is bullish about the market. He buys two one month call option contracts (one contract is 100 shares) on C Ltd. with a strike price of ₹ 1,195 at a premium of ₹ 35 per share. Three months later, if the share is selling at ₹ 1240 what will be net profit/loss of the investor on the position?

    A. ₹ 1000

    B. ₹ 1200

    C. ₹ 1500

    D. ₹ 2000

27. A stock index currently stands at 7000. The risk free interest rate is 8% p.a. continuously compounded and the dividend yield on the index is 4% p.a. What should be the futures price for a four month contract? [Given e(.08-.04)4/12 = 1.013423]

    A. 7093.96

    B. 7097.34

    C. 7098.68

    D. 7099.25

28. A 6-month forward contract on a non-dividend paying stock when the stock price is ₹ 60 and the riskfree interest rate (with continuous compounding) is 12% p.a. What is the forward price? [Given e0.06 = 1.0618]

    A. ₹ 61.86

    B. ₹ 62.23

    C. ₹ 64.23

    D. ₹ 65.27

29. If you sell a call option on a share with a strike price of ₹ 375, market price of ₹ 360, and a premium of ₹ 21.What is the maximum loss on expiry of this position?

    A. ₹ 354

    B. Unlimited

    C. ₹ 396

    D. None of these

Answer:

1	2	3	4	5	6	7	8	9	10
C	C	D	C	B	C	D	B	B	C
11	12	13	14	15	16	17	18	19	20
A	B	B	B	A	C	B	A	D	A
21	22	23	24	25	26	27	28	29	
C	B	B	D	A	D	A	A	B	

Comprehensive Numerical Problems

1. On Aug. 2, Mr. Tandon buys 5 contracts of December Reliance features at 840. Each contract covers 50 shares. Initial margin was set at ₹2,400 per contract while maintenance margin was fixed at ₹2,000 per contract.

   Daily settlement prices are as follows:

   Aug. 2 818

   Aug. 3 866

   Aug. 4 830

   Aug. 5 846

   Mr. Tandon meet all margin calls. Whenever he is allowed to withdraw money from the Margin Account, he withdraws half the maximum amount allowed.

   Compute for each day: (i) Margin call; (ii) Profit & (Loss) on the contracts; (iii) The balance in the Account at the end of the day.

   [Answer: (i) 5,500, Nil, 3,000, Nil; (ii) (-) 5,500, 12,000, (-) 9,000, 4,000; (iii) 12,000, 18,000, 12,000, 14,000]

2. The settlement price of JUNE NIFTY Futures contract on a particular day was 4585. The minimum trading lot on Nifty futures is 100. The initial margin is 8% and the maintenance margin is 6%. The index closed at the following levels on the next five days:

Day	Settlement Price (₹)
1	4,690
2	4,760
3	4,550
4	4,480
5	4,570

   Required:

   (i) Calculate the Mark to Market Cash Flows and daily closing balances in the account of (A) an investor who has gone long at 4585; (B) an investor who has gone short at 4585.

   (ii) Calculate the net profit/(loss) on each of the contracts.

   [Answer: (i) (A) Cash flows: + 10,500, + 7000. - 27,000. - 7,000, + 9000 Closing Balance: 47180, 54180, 33180, 366680, 0 (B) Cash Flows: - 10,500, 7,000, + 21,000, + 7,000, - 9,000 Closing Balance: 36680, 29680, 50680, 57680, 48680 (ii) Long: Loss of ₹ 1500, Short: Profit of ₹1500]

3. MUMBAI LTD. is an Indian company, they are in the process of raising a US dollar loan and are negotiating the rates with City Bank. The company has been offered a fixed rate of 7% p.a. with a provision that should they opt for a floating rate, the interest rate is likely to be linked to the Bench mark rate of 60 basis points over the 10-year US T - Bill Rate, with interest re fixation on a three monthly basis. The expectations of Mumbai Ltd are that the dollar interest rates with fall, and are inclined to have a flexible-mechanisms built into their interest rates. On enquiry they find that they could go for a swap arrangement with CHENNA1 INDIA LTD. who have been offered a floating rate of 120 basis points over 10-year US T - Bill Rale, as against a fixed rate of 8.20%. Describe the swap on the assumption that the swap differential is shared between Mumbai Ltd. and Chennai India Ltd. in the proportion of 2: 1.

4. Shares of M Ltd. are currently trading at ₹190. At the end of three months, the stock price is expected to be ₹125 or ₹225 with respective probabilities 1/3 and 2/3. The 3-months' European call option on M Ltd. is available with an exercise price of ₹175. The risk-free rate of interest is 6% per annum continuously compounded.

   (i) Find out the value of a 3-month European Call under the Binomial Model (Delta Method).

   (ii) Calculate the value of the put option under Put-Call Parity.

   (iii) If an investor wants to buy 100 shares, how many call options should be transacted in for a complete hedge? Present workings to prove that the risk is covered.

   (iv) What is the expected value of the option and also of the stock price at the end of three months?

[Answer: (i) ₹33.43; (ii) ₹15.82; (iii) 200; (iv) ₹33.33 and ₹191.67]

5. The following information is given:

Current Stock Price	₹ 190
Strike Price	₹ 210
Price of 6 months' European Put Option	₹ 10
Risk free interest rate p.a.	5%

   (i) Calculate the theoretical minimum price of the put option at the end of 6 months.

   (ii) Show the arbitrage process step by step and find out the gain if

   (a) the price on the expiration day is ₹ 200

   (b) the price on the expiration day is ₹ 220.

[Answer: (i) ₹14.813]

6. The following quotes are available for 3-months options in respect of a share of P Ltd. which is currently traded at ₹ 310.

Strike Price	₹ 300
Call option	₹ 30
Put option	₹ 20

   An investor devises a strategy of buying a call and selling the share and a put option.

   Risk free interest rate is 10% per annum.

   Using Put-call parity theory

   (i) Find out profit/loss of the investor.

   (ii) What would be the position if the strategy adopted is selling a call and buying the put and the share? ($e^{0.025}$ = 1. 0253; $e^{0.25}$ = 1. 2840)

[Answer: (i) ₹7.40]

7. Y, a British firm with a US subsidiary, seeks to refinance some of its existing British pound debt to include floating rate obligations. The best floating rate it can obtain in London is LIBOR + 2.0%. Its current debts are as follows:

   US$ 10 million owed to CT Bank at 9.5% (fixed annually); and

   £ 5 million owed to MD Bank at 9.5% (fixed) annually.

   HRS Company wishes to finance exports to Britain with £3 million of pound denominated fixed rate debt for six months. HRS is unable to obtain a fixed interest rate in London for less than 13.5% interest because of its lack of credit history in the UK. However, Lloyds Bank is willing to extend a floating rate British pound loan at LIBOR + 2%. HRS, however, cannot afford to pay more than 12%.

   Assume that Y is in a strong bargaining position and can negotiate the best deal possible, but HRS will not pay over 12%. Assume further that transaction costs are 0.5% and exchange rates are stable.

   Can Y and HRS help each another by an interest rate swap? If so, how? Compute the amount of gains for Y, HRS and the Swap Dealer.

   Illustrate the effective post-swap interest rates of each party with a diagram. What are the effective interest rates for each party over the six months period of the swap?

8. A share is currently priced at ₹600. It is known that at the end of one month, it will be either ₹570 or ₹630. The risk-free interest rate is 8% per annum with continuous compounding. Find the value of a one-month European call option with a strike price of ₹592 with the help of a Binomial Model. (Given that $e^{0.007} = 1.00702$)

   [Answer: ₹21.522]

9. Companies X and Y want to raise US$ 50 million each. They have been offered the following rates per annum:

Company	Fixed	Floating
X	7.5%	LIBOR + 25 bps
Y	8.45%	LIBOR + 37 bps

   Bank B, on a commission of 0.2% (fully borne by Y) is arranging an interest rate swap between X and Y. X wants a floating rate and Y wants a fixed rate. Work out the payables and receivables on the swap (in %), given that the benefits (after commission) are shared between X and Y in the ratio 60: 40. What will be the effective rate of interest payable by X and Y their respective gains (in %) due to the swap? How many dollars does each save per annum due to the swap?

10. Name the most appropriate combined trading strategy on the stock of PQ Ltd. in the following independent cases. (You may present only columns I and II in your answer books.)

Sl. No.	Strategy	Action		Expiry Date	Strike Price
		Buy	Sell		
I.		One Call One Put		30th June 30th June	215 215
II.			Two Calls One Put	20th June 20th June	220 220

III.			One Call Two Puts	20th June 20th June	230 230
IV.		One Call One Put		20th June 20th June	215 220

[Answer: I. Long Straddle; II. Strap; III. Strip; IV. Strangle]

Unsolved Case Study

Three companies, Alpha, Beta and Gamma required $100 million each for next five years. The following are the requirement and the costs of borrowings faced by them in different markets:

Company	Requirement	PLR	LIBOR	Fixed $
Alpha	PLR based $ funds	PLR + 0.30%	LIBOR + 0.50%	3.35%
Beta	LIBOR based $ funds	PLR + 0.05%	LIBOR + 0.30%	3.25%
Gamma	Fixed $ funds	PLR + 0.05%	LIBOR + 0.15%	3.10%

Alpha, Beta and Gamma, not being satisfied with the costs of borrowing at the markets of their choice, have come together to reduce their interest burden. They have approach you as an expert in this field.

Arrange a swap between these three parties in such a way that the benefit of swap is equally divided among the three parties. What is the effective cost of borrowing to each party, after the swap?

[Answer: Effective Cost: Alpha PLR + 0.25%; Beta LIBOR +0.25% and Gamma 3.05%]

References:

1. Jorion; Financial Risk Management Handbook Plus Test Bank; Wiley
2. Hopkin; Fundamentals of Risk Management; IRM
3. Allen; Financial Risk Management a Practitioners Guide to Managing Market and Credit Risk; John Wiley
4. Hull; Risk Management and financial Institutions; Wiley

SECTION - D

INTERNATIONAL FINANCIAL MANAGEMENT

The International Financial Environment 14

This Module Includes:

14.1 International Financial Institutions and Markets

14.2 Sources of Foreign Currency

The International Financial Environment

SLOB Mapped against the Module

To develop a detail understanding of the sources and impact of risks to which an organisation is exposed to in a dynamic business environment at national and international level and the techniques for managing the same to sustain competitive advantages. (CMLO 3b, 3c)

Module Learning Objectives:

After studying this module, the students will be able to -

- Understand the role of International Financial Institutions
- Develop an understanding of different sectors of International Financial Market
- Acquire adequate knowledge about various sources of foreign currency

International Financial Institutions and Markets

14.1

Around the world, financial markets are getting integrated. People and firms are entering into more and more cross-border financial deals. In order to make these transactions feasible, a system for determination of the amount and method of payment of the underlying financial flows is needed. Since each country has a currency different from the other, the flows should take place in some mutually acceptable currency. The parties involved will then need to convert the amount involved into their domestic currencies. However, there must be well defined rules, regulations and procedures to enable such conversion. The set of rules, regulations, institutions and mechanisms which determine the rate at which this conversion takes place (called the exchange rate) and the movements in the exchange rate over a period is called the international monetary system. In addition, the system also includes intermediary and facilitating institutions and well-integrated markets to support international trade and finance. All these elements together form the international financial environment.

14.1.1 International Financial Institutions

As mentioned earlier, international financial institutions play the role of a facilitator and intermediary. An international financial institution (IFI) is basically a financial institution that has been established by more than one country, and hence is subject to the international law. Its owners or shareholders are generally the national governments, although other international institutions and other organisations also occasionally figure as shareholders. Generally, IFIs are the creations of multiple nations, although some bilateral financial institutions (created by two countries) do exist and should also technically be termed as IFIs.

The idea of IFIs was first conceived of under the Bretton Woods System post the World War II. The Second World War effectively stopped all international economic activities. Global economic growth was severely affected. On one hand, the warring nations suffered huge damages on account of the war, and on the other hand, most of the countries were suffering from hyper-inflation. The continuing war also made any co-operation on the economic front absolutely impossible. In this scenario, the need was felt for an economic system which would restore international trade and investments. For this, however, a system of stable exchange rates was required, which would also ensure that the countries do not get any incentive by following inflationary policies. In addition, there was a need for some arrangement which would help countries to tide over their short-term balance of payments problems and help them remain within the system without causing undue turmoil in their economies.

In 1944, representatives of 44 countries assembled in Bretton Woods, New Hampshire, USA, and signed an agreement to establish a new monetary system which would address all these issues. This system came to be known as the Bretton Woods System.

Accordingly, two new institutions were established, namely, the International Monetary Fund (IMF) and the World Bank. International Monetary Fund was established to promote international monetary cooperation, exchange rate stability, and orderly exchange arrangements; to accelerate economic growth and facilitate high levels of employment; and to provide temporary financial assistance to countries to help balance of payments adjustment.

On the other hand, World Bank was established to help countries in reconstructing their economies in the post-World War-II scenario and to help the developing countries improve their economic growth rate. Though the Bretton Wood System failed subsequently, these two IFIs are still playing significant role in the international monetary system. Also, a number of other IFIs have been established over the time. The IFIs are discussed below.

A. International Monetary Fund (IMF)

The IMF was conceived in July 1944 at the United Nations Bretton Woods Conference in New Hampshire, United States. The 44 countries in attendance sought to build a framework for international economic cooperation and avoid repeating the competitive currency devaluations that contributed to the Great Depression of the 1930s.

The IMF's primary mission is to ensure the stability of the international monetary system—the system of exchange rates and international payments that enables countries and their citizens to transact with each other. Accordingly, IMF promotes international financial stability and monetary cooperation. It also facilitates international trade, promotes employment and sustainable economic growth, and helps to reduce global poverty. The IMF is governed by and accountable to its 190 member countries.

At the top of IMF's organizational structure is the Board of Governors. The daily operation of the IMF is overseen by its 24-member Executive Board, representing the entire membership and supported by IMF staff. The Managing Director is the head of the IMF staff and Chair of the Executive Board. He/she is assisted by four Deputy Managing Directors.

Resources for IMF loans to its members on non-concessional terms are provided by member countries, primarily through their payment of quotas. Each member of the IMF is assigned a quota, based broadly on its relative position in the world economy. The IMF regularly conducts general reviews of quotas to assess the adequacy of overall quotas and their distribution among members. Multilateral and bilateral borrowing (New Arrangement to Borrow or NAB and Bilateral Borrowing Agreements or BBA) serve as a second and third line of defense, respectively, by providing a temporary supplement to quota resources. These borrowed resources played a critical role in enabling the IMF to support its member countries during the global economic crisis.

The IMF has three main functions: overseeing economic development, lending, and capacity development.

IMF oversees economic development by encouraging international trade, fostering global monetary cooperation and securing financial stability.

All IMF members are eligible to access the Fund's resources in the General Resources Account (GRA) on non-concessional terms, but the IMF also provides concessional financial support (currently at zero interest rates through June 2021) through the Poverty Reduction and Growth Trust, which is better tailored to the diversity and needs of low-income countries. IMF lends to its member countries under various schemes.

B. World Bank Group

In addition to IMF, the Bretton Wood System also proposed the establishment of the World Bank. World Bank is structured like a cooperative that is owned and operated for the benefits of its member countries. It was established in July, 1944.

The World Bank is made up of two unique development institutions owned by the member countries. These two institutions are –

(a) The International Bank for Reconstruction and Development (IBRD): It lends to governments of middle-income and creditworthy low-income countries. It has 189 member countries.

(b) The International Development Association (IDA): It provides interest-free loans (called credits) and grants to governments of the poorest countries. It has 174 members.

The World Bank Group, however, includes three more institutions –

(a) The International Finance Corporation (IFC): It is the largest global development institution focused exclusively on the private sector. We help developing countries achieve sustainable growth by financing investment, mobilizing capital in international financial markets, and providing advisory services to businesses and governments.

(b) The Multilateral Investment Guarantee Agency (MIGA): It was created in 1988 to promote foreign direct investment into developing countries to support economic growth, reduce poverty, and improve people's lives. MIGA fulfills this mandate by offering political risk insurance (guarantees) to investors and lenders.

(c) The International Centre for Settlement of Investment Disputes (ICSID): It provides international facilities for conciliation and arbitration of investment disputes.

The World Bank generally makes medium- and long-term loans for infrastructure projects. It is also lending to countries having BoP problems, if they are willing to adopt growth-oriented economic policies. It requires a government guarantee for making these loans. For these activities, it raises funds through subscriptions from member countries and by issuing bonds which are generally meant for private subscription.

C. Regional Development Banks (RDBs)

Regional development banks provide funds for the financing of manufacturing, mining, agricultural, and infrastructure projects essential for development. They tend to support projects that promote regional cooperation and economic integration. In most of the cases, repayment terms for the loans are over a 5 to 15 year period at favorable interest rates. The leading regional development banks include the following:

- **European Investment Bank (EIB):** The EIB offers financial assistance for certain public and private projects in European and other nations associated with the Common Market. It emphasizes loans to the lesser-developed regions in Europe and to the associated members in Africa.
- **Inter-American Development Bank (IADB):** The IADB is an important source of long-term capital in Latin America. It provides loans to joint ventures, both minority and majority foreign-owned, and also provides small amounts of equity capital. One initiative was to act as a catalyst for further private sector funding for Latin American infrastructure projects. By partially guaranteeing commercial bank loans and directly lending to infrastructure projects, the IADB aims to bring funding to many projects for which commercial bank loans might not otherwise be available.
- **Atlantic Development Group for Latin America (ADELA):** ADELA is an international private investment company working towards the socio-economic development of Latin America. Its objective is to strengthen private enterprises by providing capital and entrepreneurial and technical support.
- **Asian Development Bank (ADB):** The ADB guarantees or makes direct loans to member states and private ventures in Asian/Pacific nations and helps develop local capital markets by underwriting securities issued by private enterprises.
- **African Development Bank (AFDB):** The AFDB makes or guarantees loans and provides technical assistance to member states for various development projects. Beneficiaries of AFDB loans and activities are normally governments or government-related agencies.
- **Arab Fund for Economic and Social Development (AFESD):** The AFESD is a multilateral Arab fund that actively searches for projects (restricted to Arab League countries) and then assumes responsibility for project implementation by conducting feasibility studies, contracting, controlling quality, and supervising the work schedule.
- **European Bank for Reconstruction and Development (EBRD):** The EBRD was founded in 1990 with an initial capital of about $13 billion. It is supposed to finance the privatization drive in Eastern Europe.

Among the other regional development banks are Islamic Development Bank Group (IsDB), West African Development Bank, Development Bank for Central African States etc.

The Regional Rural banks are generally the multilateral development banks. In addition to this, there may be

Bilateral Development banks as well. A bilateral development bank is a financial institution set up by one individual country to finance development projects in a developing country and its emerging market. Examples include:

- the Netherlands Development Finance Company FMO, headquarters in The Hague is one of the largest bilateral development banks worldwide.
- the DEG German Investment Corporation headquartered in Cologne, Germany.
- the French Development Agency and Caisse des dépôts, founded 1816, both headquartered in Paris, France.
- the CDC Group, a development finance institution owned by the UK Government headquartered in London.

D. National Development Banks (NDBs)

Some national development banks concentrate on a particular industry or region; others are multipurpose. These are mostly public institutions. However, there are several privately controlled development banks as well. The characteristics for success, however, are the same: they must attract capable, investment-oriented management; and they must have a large enough supply of economically viable projects to enable management to select a reasonable portfolio of investments.

E. Other Regional Financial Institutions

These are financial institutions of neighbouring countries established themselves internationally to pursue and finance activities in areas of mutual interest; most of them are central banks. Example include –

- **The Bank of International Settlement (BIS):** Established in 1930, the BIS is owned by 63 central banks, representing countries from around the world that together account for about 95% of world GDP. Its head office is in Basel, Switzerland. Its medium-term strategy, Innovation BIS 2025, leverages technology and new collaboration channels to serve the central banking community in this fast-changing world.
- **The European Investment Bank (EIB):** It is the European Union's investment bank and is owned by the EU Member States. It is one of the largest supranational lenders in the world. The EIB is a not-for-profit organisation which funds projects that achieve the policy aims of the European Union through loans, guarantees and technical assistance.
- **International Investment Bank (IIB):** It is a multilateral development institution with headquarters in Budapest, Hungary. It was established in 1970 and operates as an international organisation. IIB specializes in medium- and long-term financing of projects aimed at supporting the economies of its members that would have a significant positive social, economic and environmental impact. IIB offers direct financing and provides loans in partnership with other financial institutions as well as through partner banks.
- **The European Central Bank (ECB):** It is the prime component of the Eurosystem and the European System of Central Banks (ESCB) as well as one of seven institutions of the European Union. It is one of the world's most important central banks.

14.1.2 International Financial Markets

International financial markets may be defined as the markets that operate worldwide and facilitate international trade and finance. Due to growth in international business over the last 50 years, various international financial markets have been developed which cater to specific needs of the participants. These markets can broadly be categorized into the following –

- Foreign Exchange Market
- International Money Market
- International Credit Market
- International Bond Market
- International Stock Market

Sources of Foreign Currency 14.2

An organisation may obtain foreign currency financing either by Debt Route or by Equity Route. Various instruments under each of them are discussed below:

14.2.1 Debt Route

The avenues available under Debt route are as follows:

A. Eurobonds

Eurobonds are bonds denominated in a currency other than that of the country in which they are issued. A bond denominated in Japanese Yen and issued in the UK, or a bond denominated in US dollars and issued in France or the UK are examples of Eurobonds. London is the preeminent market for Eurobonds along with other types of bonds.

Many companies borrow in the international capital markets via Eurobonds. Investors purchase such bonds from foreign issuers, in addition to buying bonds from domestic issuers to gain exposure to international markets. Eurobonds should not be confused with bonds that are issued in a foreign country but in the same currency as the investor. For example, a yen-denominated bond sold by a non-Japanese issuer (such as a French company) in Japan, or a US dollar-denominated bond sold by a German company in the US.

Eurobond issue structures can be classified into two broad categories; Fixed rate bonds (also known as straights) and Floating Rate Notes (FRN).

Straight Debt Bonds are fixed interest-bearing securities which are redeemable at face value. These unsecured bonds which are floated in domestic markets or international markets, are denominated in the respective currency with interest rates fixed on the basis of a certain formula applicable in a given market. The bonds issued in the Euro-market referred to as Euro-bonds, have interest rates fixed with reference to the creditworthiness of the issuer. The yields on these instruments depend on short-term interest rates. LIBOR is the most commonly used benchmark for measuring the yields on these bonds. The interest rate on dollar denominated bonds is set at a margin over the US treasury yields. On the other hand, FRNs can be described as a bond issue with a maturity period varying from 5-7 years having varying coupon rates - either pegged to another security or re-fixed at periodic intervals. Conventionally, the paper is referred to as notes and not as bonds. The spreads or margin on these notes will be above 6 months LIBOR for Eurodollar deposits. FRNs are restructured into the different types, such as, Flip-Flop FRNs (where the investors have the option to convert the paper into flat interest paying instrument at the end of a particular period), Mismatch FRNs (these notes have semi-annual interest payments though the actual rate is fixed monthly) and Mini-Max FRNs (These notes include both minimum and maximum coupons).

Eurobonds account for approximately 30% of the global bond market. Often very large companies (multinational companies and supranational organisations) and countries prefer to issue Eurobonds denominated in that currency (for example, the US dollar) that can offer the most attractive interest rate.

An advantage of Eurobonds is that they are relatively easy to sell, have relatively low risk and are a fairly safe investment alternative. Another advantage is that Eurobonds remain outside the purview of official regulation of the country of the currency in which they are denominated.

B. Foreign Bonds

These are relatively lesser-known bonds issued by foreign entities for raising medium-to long-term financing from domestic money centers in their domestic currencies. Different types of foreign bonds are as follows:

a. **Yankee Bonds:** These are US dollar denominated issues by foreign borrowers (usually foreign governments or entities, supranational and highly rated corporate borrowers) in the US bond markets. Reliance Industries Ltd. has been the most successful corporate to tap this instrument with a 50-year, $50 million Yankee Bond issue in 2013.

b. **Samurai Bonds:** These are bonds issued by non-Japanese borrowers in the domestic Japanese markets. Borrowers are supranational and have at least a minimum investment grade rating (A rated). The maturities range between 3-20 years.

c. **Bulldog Bonds:** These are sterling denominated foreign bonds which are raised in the UK domestic securities market. The maturity of these bonds will be either for very short periods (5 years) or for very long maturities (25 years and above). Bonds with intermediate maturity periods are rare. These bulldog bonds are generally subscribed by long-term institutional investors like pension funds and life insurance companies.

d. **Shibosai Bonds:** These are the privately placed bonds issued in the Japanese markets. The qualifying criteria is less stringent as compared to Samurai or EuroYen bonds. Shibosai bonds are offered to a different market segment that consists of institutional investors, including banks.

C. Foreign Currency Convertible Bonds

Foreign currency convertible bonds, as the name suggests, are bonds that are issued in a currency foreign to the investor. The name also suggests that the bonds are convertible in nature, indicating that investors not only receive principal and coupon payments but also offer the option of converting their bonds into stocks. Foreign currency convertible bonds are classified as quasi-debt instruments and tradable on the stock exchange. Investors are hedge-fund arbitrators or foreign nationals.

Benefits of FCCBs:

a) The coupon rates on FCCB's are generally lower than traditional bank interest rates, reducing the cost of debt financing for the issuer.

b) When converted, the issuer is able to reduce its debt gains additional, much-needed equity capital.

c) If there is a favorable move in the exchange rate, the issuer may benefit from a reduction in the cost of debt.

d) Investors have an assured minimum fixed rate of return.

e) Investors can participate in any price appreciation in the issuer's stock upon conversion.

f) Investors enjoy the flexibility in choosing to enter the capital market or receiving a stable stream of income through bond payments (coupons).

Limitations of FCCBs

a) If the stock market is down, the demand for foreign currency convertible bonds decreases.

b) If converted, ownership will be diluted, and earnings per share will decrease for existing shareholders.

c) If there is an unfavorable move in the exchange rate, the principal and coupon payments will become more costly.

d) These are subject to credit risk.

e) Bondholders have no control over the established conversion rates and prices.

D. Syndicated Credits

These are bank loans, usually at floating rate of interest with fixed maturity, arranged by one or more lead managers (banks) with a number of other banks participating in the loan. Generally, one, two or even three banks may act as the lead managers and distribute the loan among themselves and other participating banks. A typical Eurocredit we have maturity between five and 10 years, amortization in semiannual instalments, and interest rate every three or six months with reference to LIBOR.

Syndicates are classified into two types - club loans and syndicated loans.

The club loan is a private arrangement between lending banks and a borrower. Conventionally, the entry into Euromarkets for a funding deal is well-publicized. When the loan amounts are small and parties familiar with each other, lending banks form a club and advance a loan. Therefore, in view of this private arrangement, an information memorandum is not complied and neither is the deal publicized in the financial press.

Syndicated credits can be structured to incorporate various options. As in the case of FRNs, a drop-lock feature converts the floating rate loan into a fixed rate loan if the benchmark index hits a specified floor. A multicurrency option allows the borrower to switch the currency of denomination on a rollover date.

E. Euro Notes

Euronotes as a concept is different from syndicated bank credit and is different from Eurobonds in terms of its structure and maturity period. Euronotes command the price of a short-term instrument usually a few basis points over LIBOR and in many instances at sub-LIBOR levels. The documentation formalities are minimal (unlike in the case of syndicated credits or bond issues) and cost savings can be achieved on that score too. There are numerous-applications of basic concepts of Euronotes. These may be categorized under the following heads:

a. **Commercial Paper:** These are short-term unsecured promissory notes which repay a fixed amount on a certain future date. Euronotes, underlying CP, are unsecured and stand on the general creditworthiness of the issuers. Referred as Euro Commercial Paper, these papers are not underwritten and have maturities up to one year, mostly by way of three-month or six-month paper.

b. **Note Issuance Facilities (NIFs):** A NIF is a medium-term legally binding commitment under which a borrower can issue short-term paper, of up to one year. The underlying currency is mostly US dollar. In a typical NIF program, the issuer instructs the lead manager to issue Euro notes at desired intervals. Maximum and minimum amounts of each issue are also specified.

c. **Medium Term Notes:** MTNs are defined as sequentially issued fixed interest securities which have a maturity of over one year. A typical MTN program enables an issuer to issue Euronotes for different maturities, from over one year up to the desired level of maturity. These are essentially fixed rate funding arrangements.

F. Euro-bonds with Equity Warrants: These bonds carry a coupon rate determined by the market rates. The warrants are detachable. Pure bonds are traded at a discount. Fixed income funds' managers may like to invest for the purpose of regular income.

G. Euro Convertible Bonds: Euro Convertible Bonds are quasi debt securities (unsecured) which can be converted into Depository Receipts or local shares at a fixed price after the minimum lock-in period. Price of Equity Shares at the time of conversion will have a premium element. Bonds carry a fixed rate of interest, and the payment of interest is made in US Dollars.

Issue of these Bonds carry options —

Call Option: Right to the Company to convert the ECB into Equity before maturity. Pre-Mature conversion is generally done, when the market price of the shares exceeds a particular percentage of the conversion price.

Put Option: Put Option allows the investors to get his money back before maturity.

Company desirous of issuing ECB, should obtain the prior permission of Ministry' of Economic Affairs. Certain restrictions are imposed on the eligibility norms such as good financial track record, nature of industry etc.

Proceeds of ECBs can be applied only for the following —

(a) Import of Capital Goods,

(b) Retiring Foreign Currency Debts,

(c) Capitalizing Indian Joint Venture Abroad,

(d) Application for Working Capital and Others is restricted to 25% of total proceeds.

H. Euro-Convertible Zero Bonds: These bonds are structured as convertible bonds. No interest is payable on the bonds, but the conversion of bonds takes place on maturity at a pre-determined price. Usually there is a 5 years maturity period and they are treated as a deferred equity issue.

14.2.2 Equity Route

The avenues available under Equity route are as follows:

A. Depository Receipts

A depositary receipt (DR) is a type of negotiable (transferable) financial security that is traded on a local stock exchange but represents a security, usually in the form of equity, that is issued by a foreign publicly listed company. The DR, which is a physical certificate, allows investors to hold shares in equity of other countries. One of the most common types of DRs is the American Depositary Receipt (ADR), which has been offering companies, investors and traders global investment opportunities since the 1920s.

Since then, DRs have spread to other parts of the globe in the form of global depositary receipts (GDRs) (the other most common type of DR), European DRs and international DRs. ADRs are typically traded on a U.S. national stock exchange, such as the New York Stock Exchange (NYSE) or the American Stock Exchange, while GDRs are commonly listed on European stock exchanges such as the London Stock Exchange. Both ADRs and GDRs are usually denominated in U.S. dollars, but can also be denominated in euros.

Working of DR

The DR is created when a foreign company wishes to list its already publicly traded shares or debt securities on a foreign stock exchange. Before it can be listed to a particular stock exchange, the company in question will first have to meet certain requirements put forth by the exchange. Initial public offerings, however, can also issue a DR. DRs can be traded publicly or over-the-counter.

Pricing and Cross-Trading

When any DR is traded, the broker will aim to find the best price of the share in question. He or she will therefore compare the U.S. dollar price of the ADR with the U.S. dollar equivalent price of the local share on the domestic market. For example, if the ADR of the Russian gas company is trading at US$12 per share and the share trading on the Russian market is trading at $11 per share (converted from Russian rubles to dollars), a broker would aim to buy more local shares from Russia and issue ADRs on the U.S. market. This action then causes the local Russian price and the price of the ADR to reach parity. The continual buying and selling in both markets, however, usually keeps the prices of the ADR and the security on the home market in close range of one another. Due to this minimal price differential, most ADRs are traded by means of intra-market trading.

A U.S. broker may also sell ADRs back into the local Russian market. This is known as cross-border trading. When this happens, an amount of ADRs is canceled by the depository and the local shares are released from the custodian bank and delivered back to the Russian broker who bought them. The Russian broker pays for them in Rubles, which are converted into dollars by the U.S. broker.

The Benefits of Depository Receipts

The DR functions as a means to increase global trade, which in turn can help increase not only volumes on local and foreign markets but also the exchange of information, technology, regulatory procedures as well as market transparency. Thus, instead of being faced with impediments to foreign investment, as is often the case in many emerging markets, the DR investor and company can both benefit from investment abroad.

Benefits for the Company:

A company may opt to issue a DR to obtain greater exposure and raise capital in the world market. Issuing DRs has the added benefit of increasing the share's liquidity while boosting the company's prestige on its local market ("the company is traded internationally"). Depositary receipts encourage an international shareholder base, and provide expatriates living abroad with an easier opportunity to invest in their home countries. Moreover, in many countries, especially those with emerging markets, obstacles often prevent foreign investors from entering the local market. By issuing a DR, a company can still encourage investment from abroad without having to worry about barriers to entry that a foreign investor might face.

Benefits for the Investor:

Buying into a DR immediately turns an investors' portfolio into a global one. Investors gain the benefits of diversification while trading in their own market under familiar settlement and clearance conditions. More importantly, DR investors will be able to reap the benefits of these usually higher risk, higher return equities, without having to endure the added risks of going directly into foreign markets, which may pose lack of transparency or instability resulting from changing regulatory procedures. It is important to remember that an investor will still bear some foreign-exchange risk, stemming from uncertainties in emerging economies and societies. On the other hand, the investor can also benefit from competitive rates the U.S. dollar and euro have to most foreign currencies.

Giving you the opportunity to add the benefits of foreign investment while bypassing the unnecessary risks of investing outside your own borders, you may want to consider adding these securities to your portfolio. As with any security, however, investing in ADRs requires an understanding of why they are used, and how they are issued and traded.

Sponsored and Unsponsored DRs

Companies have a choice of four types of Depository Receipt facilities - unsponsored and three levels of sponsored Depository Receipts.

Unsponsored Depository Receipts are issued by one or more depositories in response to market demand, but without a formal agreement with the company. Today, unsponsored Depository Receipts are considered obsolete and, under most circumstances, are no longer established due to lack of control over the facility and its hidden costs. Sponsored Depository Receipts are issued by one depository appointed by the company under a Deposit Agreement or service contract. Sponsored Depository Receipts offer control over the facility, the flexibility to list on a national exchange in the U.S. and the ability to raise capital.

Sponsored Level I Depository Receipts

A sponsored Level I Depository Receipt program is the simplest method for companies to access the U.S. and non-U.S. capital markets. Level I Depository Receipts are traded in the U.S over-the-counter ("OTC") market and on some exchanges outside the United States. The company does not have to comply with U.S Generally Accepted Accounting Principles ("GAAP") or full Securities and Exchange Commission ("SEC") disclosure. Essentially, a Sponsored Level I Depository Receipt program allows companies to enjoy the benefits of a publicly traded security without changing its current reporting process.

The Sponsored Level I Depository Receipt market is the fastest growing segment of the Depository Receipt business. Among the Depository Receipt programs currently in opertaion, the vast majority of the sponsored programs are Level I facilities. In addition, because of the benefits investors receive by investing in Depository Receipts, it is not unusual for a company with a Level I program to obtain 5% to 15% of its shareholder base in Depository Receipt form. Many well-known multinational companies have established such programs including: Roche Holding, ANZ Bank, South African Brewery, Guinness, Cemex, Jardine Matheson Holding, Dresdner Bank, Mannesmann, RWE, CS Holding, Shiseido, Nestle, Rolls Royce, and Volkswagen to name a few. In addition, numerous companies such as RTZ, Elf Aquitaine, Glaxo Wellcome, Western Mining, Hanson, Medeva, Bank of Ireland, Astra, Telebrás and Ashanti Gold Fields Company Ltd. started with a Level I program and have upgraded to a Level II (Listing) or Level III (Offering) program.

Sponsored Level II and III Depository Receipts

Companies that wish to either list their securities on an exchange in the U.S. or raise capital use sponsored Level II or III Depository Receipts respectively. These types of Depository Receipts can also be listed on some exchanges outside the United States. Each level requires different SEC registration and reporting, plus adherence to U.S. GAAP. The companies must also meet the listing requirements of the national exchange (New York Stock Exchange, American Stock Exchange) or NASDAQ, whichever it chooses.

Each higher level of Depository Receipt program generally increases the visibility and attractiveness of the Depository Receipt.

Private Placement (144A) Depository Receipt

In addition to the three levels of sponsored Depository Receipt programs that trade publicly, a company can also access the U.S and other markets outside the U.S through a private placement of sponsored Depository Receipts. Through the private placement of Depository Receipts, a company can raise capital by placing Depository Receipts with large institutional investors in the United States, avoiding SEC registration and to non-U.S. investors in reliance on Regulations. A Level I program can be established alongside a 144A program.

a. American Depositary Receipts (ADR)

An American Depositary Receipt (ADR) is a certificate that represent shares of a foreign stock owned and issued by a U.S. bank. The foreign shares are usually held in custody overseas, but the certificates trade in the U.S. Through this system, a large number of foreign-based companies are actively traded on one of the three major U.S. equity markets (the NYSE, AMEX or Nasdaq).

Investors can purchase ADRs from broker/dealers. These broker/dealers in turn can obtain ADRs for their clients in one of two ways: they can purchase already-issued ADRs on a U.S. exchange, or they can create new ADRs.

To create an ADR, a U.S.-based broker/dealer purchases shares of the issuer in question in the issuer's home market. The U.S. broker/dealer then deposits those shares in a bank in that market. The bank then issues ADRs representing those shares to the broker/dealer's custodian or the broker-dealer itself, which can then apply them to the client's account.

A broker/dealer's decision to create new ADRs is largely based on its opinion of the availability of the shares, the pricing and market for the ADRs, and market conditions.

Broker/dealers don't always start the ADR creation process, but when they do, it is referred to as an unsponsored ADR program (meaning the foreign company itself has no active role in the creation of the ADRs). By contrast, foreign companies that wish to make their shares available to U.S. investors can initiate what are called sponsored ADR programs. Most ADR programs are sponsored, as foreign firms often choose to actively create ADRs in an effort to gain access to American markets.

ADRs are issued and pay dividends in U.S. dollars, making them a good way for domestic investors to own shares of a foreign company without the complications of currency conversion. However, this does not mean ADRs are without currency risk. Rather, the company pays dividends in its native currency and the issuing bank distributes those dividends in dollars-net of conversion costs and foreign taxes – to ADR shareholders. When the exchange rate changes, the value of the dividend changes.

Advantages of ADRs: ADRs provide the following advantages -

(i) Access to Large Capital.

(ii) Access to Foreign Exchange.

(iii) No Change in the Shareholding / voting pattern.

(iv) Increased recognition for the Company internationally by bankers, customers, etc.

(v) No Exchange Rate risk since the Company pays interest and dividends in Indian Rupees.

Limitations of ADRs:

(i) High cost of Issue.

(ii) Requirement as to large size of issue.

(iii) Stringent compliance requirements.

b. Global Depository Receipt

These are a class of investment which allows international investors to own shares in foreign companies where the foreign market is hard to access for the retail investor, and without having to worry about foreign currencies and tax treatments. Global Depository Receipts are issued by international investments banks as certificates (the GDR) which represents the foreign shares but which can be traded on the local stock exchange. For example, a UK investor may be able to buy shares in a Vietnamese company via a GDR issued by a UK investment bank. The GDR will be denominated in GB Pounds and will be tradable on the London Stock Exchange. The investment bank takes care of currency exchange, foreign taxes etc. and pays dividends on the GDR in GB Pounds.

The concept originally started in the USA with the creation of American Depository Receipts which were created so that US retail investors could buy shares in a foreign company without having to worry about foreign exchange, or foreign taxes.

It should be noted that although the risks of owning the foreign shares directly have been removed, there is now a risk of third-party default, because the investment bank owns the underlying assets, and may not be able to pass on the benefits to ADR holders if they get into financial difficulty.

Global Depository Receipts (GDRs) are negotiable certificates issued by depository banks which represent ownership of a given number of a company's shares which can be listed and traded independently from the underlying shares. These instruments are typically used by companies from emerging markets and marketed to professional investors only.

GDRs can be listed on either the Main Market via a Standard Listing or on the Professional Securities Market. A GDR will be used to access two or more markets, usually London and the US. They are often launched for capital raising purposes, so the US element is generally either a Rule 144(a) ADR or a Level III ADR, depending on whether the issuer aims to tap the private placement or public US markets.

These securities are generally traded in US dollars on the Exchange's Electronic Trading Service the International Order Book (IOB). Associated dividends are paid to investors in US dollars. GDRs are settled in either DTC or Euroclear Bank enhancing their cross-border liquidity. The more liquid IOB securities have central counterparty clearing ensuring pre and post trade anonymity as well as mitigation of counterparty risk.

Features of GDRs

(a) Underlying Shares: Each GDR may represent one or more underlying share, which are physically held by the Custodian appointed by the Depository Bank.

(b) Entry in Company's Books: In the Company's books, the Depository Bank's name appears as the holder of the shares.

(c) Returns: Depository gets the dividends from the Company (in local currency) and distributes them to the holders of the Depository Receipts after converting into dollars at the going rate of exchange.

(d) Negotiable: GDRs are exchangeable with the underlying share either at any time, or after the lapse of a particular period of time, generally 45 Days.

(e) Globally Marketed: GDRs are marketed globally without being confined to borders of any market or country as it can be traded in more than one country.

(f) Settlement: GDRs are settled through CEDEL & Euro-Clear International Book Entry Systems.

Impact of GDRs on Indian Capital Market

(a) Track of Worldwide Events: Arbitrage possibility in GDR Issues has created additional responsibility on the investors. Investors are now required to keep track of world-wide economic events, and how the Company's GDRs are being traded.

(b) Free Pricing: GDR can be issued for any price, and therefore retail investors can longer expect discounted rights or public issues.

(c) Flow of Foreign Investment into India: Since GDRs are sold primarily to institutional investors abroad, it serves as an easy way for flow of huge volume of foreign funds into Indian Capital Market.

Illustration 1: GDR Issue

A Ltd. is considering an expansion project in USA. For the proposed project, it requires an investment of $20 million (net of issue expenses/floatation cost). The floatation cost is estimated at 2%. The company has proposed to issue GDR to finance the project.

You have been appointed as the principal financial consultant for the project. Compute the number of GDRs to be issued and cost of the GDR with the help of following additional information.

(i) Expected market price of share at the time of issue of GDR is ₹500 (Face Value ₹100)

(ii) 2 Shares shall underly each GDR and shall be priced at 10% discount to market price.

(iii) Expected exchange rate ₹72/$.

(iv) Dividend expected to be paid is 20% with growth rate 10%.

Solution:

Net issue size = \$20 million

Gross Issue = \$20 million ÷ (1 – 0.02) = \$20.408 million

Issue price per GDR in ₹ = ₹ (500 × 2 × 90%) = ₹900

Issue price per GDR in \$ = ₹900 ÷ ₹72 = \$12.50

Dividend per GDR (D_1) = ₹20 × 2 = ₹40

Net proceeds per GDR P_0 = ₹900 × (1 – 0.02) = ₹882

No. of GDRs to be issued = \$20.408 ÷ \$12.50 = 1.63264 million

Cost of GDR (K_e) = (D_1/P_0) + g = (40/882) + 0.10 = 14.54%

B. Warrants

A warrant is a security that entitles the holder to buy the underlying stock of the issuing company at a fixed exercise price until the expiration date. Some important characteristics to consider include the following:

- A warrant is exercised when the holder informs the issuer of their intention to purchase the shares underlying the warrant.
- A warrant's "premium" represents how much extra you have to pay for your shares when buying them through the warrant as compared to buying them in the regular way.
- A warrant's "gearing" is the way to ascertain how much more exposure you have to the underlying shares using the warrant as compared to the exposure you would have if you buy the shares through the market.
- If you plan on exercising the warrant, you must do so before the expiration date. The more time remaining until expiration, the more time for the underlying security to appreciate, which, in turn, will increase the price of the warrant (unless it depreciates). The expiration date is the date on which the right to exercise ceases to exist.
- Like options, there are different exercise types associated with warrants such as American style (holder can exercise any time before expiration) or European style (holder can only exercise on expiration date).

Sometimes, the issuer will try to establish a market for the warrant and to register it with a listed exchange. In this case, the price can be obtained from a stockbroker. Often, though, warrants are privately held or not registered, which makes their prices less obvious.

Exercise

Theoretical Questions

Multiple Choice Questions

1. Which of the following bonds are denominated in Yen?
   A. Yankee.
   B. Samurai.
   C. Shibosai.
   D. Both (a) and (c) above.
2. ____________ are underwritten and have a maturity of up to one year.
   A. Note issuance facilities
   B. Medium-term notes
   C. Commercial paper
   D. ADRs
3. ___________ is a private arrangement between lending banks and a borrower.
   A. Club loan
   B. Multiple component facility
   C. Syndicated Euro credit
   D. All of the above
   4. A Yankee bond is
4. A dollar dominated bond issued for global market by a non-US entity
   B. A dollar denominated bond issued in the US by a non-US entity
   C. A dollar denominated bond issued by a US resident to a non-US investor
   D. A dollar denominated bond issued in US by a US resident
5. Shibosai bond is a bond
   A. Denominated in ¥ and issued outside Japan
   B. Denominated in a currency other than ¥ and issued in Japan
   C. Denominated in Japanese ¥ and issued under private placement in Japan
   D. Denominated in ¥ and issued by a overseas corporate to the public in Japan

Answer:

1	2	3	4	5
B	A	A	B	C

State True or False

1. A Bull-dog bond is issued in UK in Sterling by non-UK borrower and listed.
2. Eurobonds are bonds denominated in the currency of the country in which they are issued.

3. The World Bank was established in July, 1944.
4. IDA provides interest-free loans (called credits) and grants to governments of the poorest countries.
5. A foreign bond is issued by a borrower foreign to the country where the bond is placed.

Answer:

1	2	3	4	5
True	False	True	True	True

Fill in the Blanks

1. Syndicates are classified into two types - _________and syndicated loans.
2. Straight Debt Bonds are ___ interest-bearing securities which are redeemable at face value.
3. ________are short-term unsecured promissory notes which repay a fixed amount on a certain future date.
4. ________are bonds issued by non-Japanese borrowers in the domestic Japanese markets.
5. An__________ is a certificate that represent shares of a foreign stock owned and issued by a U.S. bank.

Answer:

1	club loans	2	fixed
3	Commercial papers	4	Samurai bonds
5	American Depositary Receipt		

Short Essay Type Questions

1. Discuss the various lending schemes of IMF.
2. Discuss the major initiatives of the World Bank.
3. What are the different types of foreign bonds? Discuss.
4. Write a short note on: Foreign Currency Convertible Bonds.
5. Write a short note on: Syndicated Credits.

Essay Type Questions

1. Discuss the different types of Euro Notes.
2. Discuss the benefits of Depository Receipts.
3. What do you mean by ADR? Discuss its advantages and limitations.
4. What is GDR? Discuss its features.
5. Discuss about international stock market.
6. Discuss about international bond market.

References:

1. Kim. & Kim. (2006); Global Corporate Finance (6e); Blackwell Publishing
2. Shapiro & Moles (2014); International Financial Management; Wiley
3. Jacque (2014); International Corporate Finance; Wiley
4. RBI Circulars on External Commercial Borrowings in India

Foreign Exchange Market 15

This Module Includes:

15.1 Introduction – Structure of Foreign Exchange Market

15.2 Foreign Exchange Rate – Meaning, Determinants, Equilibrium Exchange Rate, Exchange Rate Quotations – Meaning, Direct vs. Indirect Quote, American vs. European Quote, Bid-Ask Rate and Spread, Cross Rates

15.3 Segments of Foreign Exchange Market – Spot Market (including two and three-point Arbitrage), Forward Market

15.4 Foreign Currency Derivatives

15.5 Parity Relationships

Foreign Exchange Market

SLOB Mapped against the Module

To develop a detail understanding of the sources and impact of risks to which an organisation is exposed to in a dynamic business environment at national and international level and the techniques for managing the same to sustain competitive advantages. (CMLO 3b, 3c)

Module Learning Objectives:

After studying this module, the students will be able to -

- Appreciate the meaning of foreign exchange and foreign exchange market.
- Develop in-depth understanding of foreign exchange rate and associated issues.
- Understand various segments of foreign exchange market and their interrelation.
- Appreciate different types of foreign currency derivatives and their use in risk management.
- Understand various parity relationships and their impact on exchange rate.

Introduction – Structure of Foreign Exchange Market

15.1

15.1.1 Introduction to Foreign Exchange Market

Over the past years, the volume of international transactions has grown enormously. The export value worldwide grew from US$2.0 trillion in 1980 to US$19.0 trillion in 2019 at current prices registering a compounded annual growth rate of 7.2%. Similarly, annual capital flows involving hundreds of billions of U.S. dollars occur between nations. International trade and investment of this magnitude would not be possible without the ability to buy and sell foreign currencies.

Currencies must be bought and sold, because buyers expect to pay in their local currency, while sellers expect to receive their currency in exchange. Unless the two parties share a common currency, as is the case within the Eurozone, in most other countries foreign currency is not the normally acceptable means of payment. Investors, tourists, exporters, and importers must exchange their domestic currencies for foreign currencies, and vice versa.

The trading of currencies takes place in foreign exchange markets whose primary function is to facilitate international trade and investment. Knowledge of the operation and mechanics of these markets, therefore, is important for any fundamental understanding of international financial management.

15.1.2 Definition of Foreign Exchange Market

The Foreign Exchange Market (Forex, FX, or currency market) is a form of exchange for the global decentralized trading of international currencies. Financial centers around the world function as anchors of trading between a wide range of buyers and sellers around the clock. The purpose of the foreign exchange market is to permit transfers of purchasing power denominated in one currency to another - that is, to trade one currency for another currency and thereby to assist international trade and investment.

15.1.3 Characteristics of Foreign Exchange Market

a. **Not a Physical Place:** The foreign exchange market is not a physical place; rather, it is an electronically linked network of banks, foreign exchange brokers, and dealers whose function is to bring together buyers and sellers of foreign exchange.

b. **Not Confined to a Single Country:** The foreign exchange market is not confined to any one country but is dispersed throughout the leading financial centers of the world: London, New York, Paris, Zurich, Amsterdam, Tokyo, Hong Kong, Toronto, Frankfurt, Milan, and other cities.

c. **Round the Clock operation:** In foreign exchange market, currency trading takes place 24 hours a day, but the volume varies depending on the number of potential counterparties available.

d. **Predominantly an Interbank Market:** Most currency transactions are channelled through the worldwide interbank market, the wholesale market in which major banks trade with one another. This market accounts for about 95% of foreign exchange transactions.

e. Role of Brokers: A large fraction of the interbank transactions is conducted through foreign exchange brokers, specialists in matching net supplier and demander banks. These brokers receive a small commission on all trades.

f. International Capital Flows Dominate the Trades: In foreign exchange market, trade in goods and services accounts for less than 5% of foreign exchange trading. More than 95% of foreign exchange trading relates to cross-border purchases and sales of assets, that is, to international capital flows.

g. Largest Financial Market worldwide: The foreign exchange market is by far the largest financial market in the world. A survey of the world's central banks by the Bank for International Settlements placed the average foreign exchange trading volume in 2013 at US$5.3 trillion daily, or $1,272 trillion a year[1]. This figure compares with an average daily trading volume in 2013 of about $1,200 billion on the New York Stock Exchange and is 16 times the average daily turnover of global equity markets[2].

h. Spot Market and Forward Market: Foreign exchange market has two segments namely, spot market and forward market. In the spot market, currencies are traded for immediate delivery, which is actually paid or received two business days after the transaction has been entered into. In the forward market, contracts are made to buy or sell currencies for future delivery; namely dates beyond the spot settlement date.

15.1.4 Functions of Foreign Exchange Market

The foreign exchange market performs the following important functions:

(i) to effect transfer of purchasing power between countries- transfer function;

(ii) to provide credit for foreign trade - credit function; and

(iii) to furnish facilities for hedging foreign exchange risks - hedging function.

(i) Transfer Function:

The basic function of the foreign exchange market is to facilitate the conversion of one currency into another, i.e., to accomplish transfers of purchasing power between two countries. This transfer of purchasing power is effected through a variety of credit instruments, such as telegraphic transfers, bank drafts and foreign bills.

In performing the transfer function, the foreign exchange market carries out payments internationally for trades or for internal capital flows by clearing debts in both directions simultaneously, analogous to domestic clearings.

(ii) Credit Function:

Foreign exchange market provides short-term credit to the importers to promote foreign trade. An importer can use credit to finance the foreign purchases. For example, an Indian company wants to purchase the machinery from the USA, can pay for the purchase by issuing a bill of exchange in the foreign exchange market, essentially with a three-month maturity.

(iii) Hedging Function:

The third function of a foreign exchange market is to help hedging foreign exchange risks. The parties to the foreign exchange are often afraid of the fluctuations in the exchange rates, i.e., the price of one currency in terms of another. The change in the exchange rate may result in a gain or loss to the parties concerned. Foreign exchange market provides the services for hedging the anticipated or actual claims/liabilities in exchange for the forward contracts.

In addition to the above primary functions, foreign exchange also facilitates arbitrage as well as speculation.

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1 Survey results appear in Bank for International Settlements, "Triennial Central Bank Survey: Report on Global Foreign Exchange Market Activity in 2013" (September 2013): 4. Annual data are based on an estimated 20 trading days per month.

2 Data are from http://www.world-exchanges.org/statistics.

15.1.5 Structure of Foreign Exchange Market: The Market Participants

The foreign exchange market has a multi-layer structure comprising of various participants. These participants in foreign exchange market can be categorized into five major groups, viz.; commercial banks, foreign exchange brokers, central banks and general buyers and sellers including MNCs, individuals and small businesses.

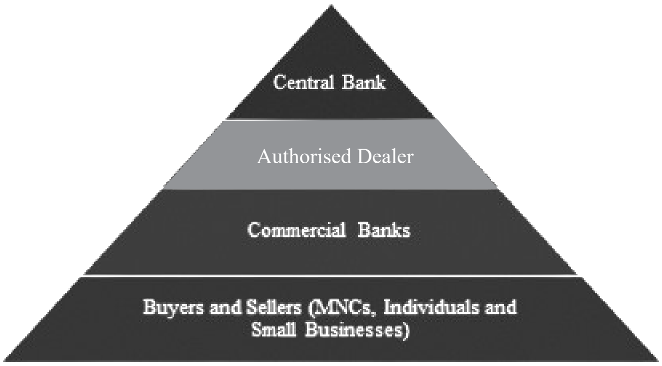


Figure 15.1: Structure of Foreign Exchange Market

a. Central Bank

Central bank is the apex body in foreign exchange market which has power to regulate operations related to trading of foreign currency. It directly intervenes in the functioning of forex market to avoid aggressive fluctuations. For controlling fluctuations, currency is sold off when it is overvalued and purchased in case it is undervalued. Central bank ensure that an exchange rate is at optimum that fulfils the needs of national economy. The level of the bank's intervention will depend upon the exchange rate regime followed by the given country's central bank.

b. Commercial Banks

The major participants in the foreign exchange market are the large commercial banks who provide the core of market. These banks across the globe acts as the market makers. They serve their retail clients, the bank customers, in conducting foreign commerce or making international investment in financial assets that require foreign exchange.

These banks operate in the foreign exchange market at two levels. At the retail level, they deal with their customers-corporations, exporters and so forth. At the wholesale level, banks maintain an inert bank market in foreign exchange either directly or through specialized foreign exchange brokers.

The bulk of activity in the foreign exchange market is conducted in an inter-bank wholesale market-a network of large international banks and brokers.

c. Foreign Exchange Brokers

Foreign exchange brokers also operate in the international currency market. Brokers in foreign exchange market work as an intermediary between the commercial bank and central bank and also between the commercial banks and buyers. Unlike the banks, brokers serve merely as matchmakers and do not put their own money at risk. They work on a commission basis while performing the task of striking the deal between the seller and buyer.

Brokers actively and constantly monitor exchange rates offered by the major international banks through computerized systems such as Reuters and are able to find quickly an opposite party for a client without revealing the identity of either party until a transaction has been agreed upon. This is why inter-bank traders use a broker primarily to disseminate as quickly as possible a currency quote to many other dealers.

d. General Buyers and Sellers

These are the real buyers and sellers of foreign currencies who trade in foreign exchange market with the help of brokers. They approach commercial banks for purchasing and selling off currencies. They may further be classified into:

- **MNCs**

  MNCs are the major non-bank participants in the forward market as they exchange cash flows associated with their multinational operations. MNCs often contract to either pay or receive fixed amounts in foreign currencies at future dates, so they are exposed to foreign currency risk. This is why they often hedge these future cash flows through the inter-bank forward exchange market.

- **Individuals and Small Businesses**

  Individuals and small businesses also use foreign exchange market to facilitate execution of commercial or investment transactions. The foreign needs of these players are usually small and account for only a fraction of all foreign exchange transactions. For example, foreign tourists may need to exchange their local currency just to fund their foreign purchases. Even then they are very important participants in the market. Some of the business participants use the market to hedge foreign exchange risk.

Foreign Exchange Rate – Meaning, Determinants, Equilibrium Exchange Rate, Exchange Rate Quotations – Meaning, Direct vs. Indirect Quote, American vs. European Quote, Bid-Ask Rate and Spread, Cross Rates

15.2

15.2.1 Foreign Exchange Market

The Foreign Exchange Market (Forex, FX, or currency market) is a form of exchange for the global decentralized trading of international currencies. Financial centers around the world function as anchors of trading between a wide range of buyers and sellers around the clock, with the exception of weekends. The foreign exchange market determines the relative values of different currencies. The foreign exchange market assists international trade and investment by enabling currency conversion. For example, it permits a business in the United States to import goods from the European Union member states, especially Euro zone members, and pay Euros, even though its income is in United States dollars. It also supports direct speculation in the value of currencies, and the carry trade, speculation based on the interest rate differential between two currencies.

The foreign exchange market is unique because of the following characteristics:

- its huge trading volume representing the largest asset class in the world leading to high liquidity;
- its geographical dispersion;
- its continuous operation: 24 hours a day except weekends, i.e., trading from 20:15 GMT on Sunday until 22:00 GMT Friday;
- the variety of factors that affect exchange rates;
- the low margins of relative profit compared with other markets of fixed income; and
- the use of leverage to enhance profit and loss margins and with respect to account size.

Sectors: The Foreign Exchange Market has the following major sectors:

(a) Spot Market,

(b) Forward and Futures Market, and

(c) Currency Options Market.

Functions of the Foreign Exchange Market

The foreign exchange market merely a part of the money market in the financial centers is a place where foreign currencies are bought and sold. The buyers and sellers of claims on foreign money and the intermediaries together constitute a foreign exchange market. It is not restricted to any given country or a geographical area.

Thus, the foreign exchange market is the market for a national currency (foreign money) anywhere in the world, as the financial centers of the world are united in a single market.

The foreign exchange market performs the following important functions:

(i) to effect transfer of purchasing power between countries- transfer function;

(ii) to provide credit for foreign trade - credit function; and

(iii) to furnish facilities for hedging foreign exchange risks - hedging function.

(i) Transfer Function:

The basic function of the foreign exchange market is to facilitate the conversion of one currency into another, i.e., to accomplish transfers of purchasing power between two countries. This transfer of purchasing power is effected through a variety of credit instruments, such as telegraphic transfers, bank drafts and foreign bills.

In performing the transfer function, the foreign exchange market carries out payments internationally by clearing debts in both directions simultaneously, analogous to domestic clearings.

(ii) Credit Function:

Another function of the foreign exchange market is to provide credit, both national and international so as to promote foreign trade. Obviously, when foreign bills of exchange are used in international payments, a credit for about 3 months, till their maturity, is required.

(iii) Hedging Function:

A third function of the foreign exchange market is to hedge foreign exchange risks. In a free exchange market when exchange rates, i.e., the price of one currency in terms of another currency change, there may be a gain or loss to the party concerned. Under this condition, a person or a firm undertakes exchange risk to a large extent if there are huge amounts of net claims or net liabilities which are to be met in foreign money.

Participants in Foreign Exchange Market

The following are the financial market participants :

1. Commercial companies

An important part of this market comes from the financial activities of companies seeking foreign exchange to pay for goods or services. Commercial companies often trade fairly small amounts compared to those of banks or speculators, and their trades often have little short term impact on market rates. Nevertheless, trade flows are an important factor in the long-term direction of a currency's exchange rate. Some multinational companies can have an unpredictable impact when very large positions are covered due to exposures that are not widely known by other market participants.

2. Central banks

National central banks play an important role in the foreign exchange markets. They try to control the money supply, inflation, and/or interest rates and often have official or unofficial target rates for their currencies. They can use their often substantial foreign exchange reserves to stabilize the market. Nevertheless, the effectiveness of central bank "stabilizing speculation" is doubtful because central banks do not go bankrupt if they make large losses, like other traders would, and there is no convincing evidence that they do make a profit trading.

3. Hedge funds as speculators

About 70% to 90%of the foreign exchange transactions are speculative. In other words, the person or institution that buys or sells the currency has no plan to actually take delivery of the currency in the end; rather, they are solely speculating on the movement of that particular currency. Hedge funds have gained a reputation for aggressive currency speculation since 1996. They control billions of dollars of equity and may borrow billions more, and thus may overwhelm intervention by central banks to support almost any currency, if the economic fundamentals are in the hedge funds' favour.

4. Investment management firms

Investment management firms (who typically manage large accounts on behalf of customers such as pension funds and endowments) use the foreign exchange market to facilitate transactions in foreign securities. For example, an investment manager holding an international equity portfolio needs to purchase and sell several pairs of foreign currencies to pay for foreign securities purchases.

Some investment management firms also have more speculative specialist currency overlay operations, which manage clients' currency exposures with the aim of generating profits as well as limiting risk. While the number of this type of specialist firms is quite small, many have a large value of assets under management and, hence, can generate large trades.

5. Retail foreign exchange traders

Individual Retail speculative traders constitute a growing segment of this market with the advent of retail foreign exchange platforms, both in size and importance. Currently, they participate indirectly through brokers or banks. There are two main types of retail FX brokers offering the opportunity for speculative currency trading: brokers and dealers or market makers. Brokers serve as an agent of the customer in the broader FX market, by seeking the best price in the market for a retail order and dealing on behalf of the retail customer. They charge a commission or mark-up in addition to the price obtained in the market. Dealers or market makers, by contrast, typically act as principal in the transaction versus the retail customer, and quote a price they are willing to deal at.

6. Non-bank Foreign Exchange Companies

Non-bank foreign exchange companies offer currency exchange and international payments to private individuals and companies. These are also known as foreign exchange brokers but are distinct in that they do not offer speculative trading but rather currency exchange with payments (i.e., there is usually a physical delivery of currency to a bank account).

These companies' selling point is usually that they will offer better exchange rates or cheaper payments than the customer's bank. These companies differ from Money Transfer/Remittance Companies in that they generally offer higher-value services.

7. Money transfer/remittance companies and bureaux de change

Money transfer companies/remittance companies perform high-volume low-value transfers generally by economic migrants back to their home country. The four largest markets receiving foreign remittances are India, China, Mexico and the Philippines. The largest and best known provider is Western Union with 345,000 agents globally followed by UAE Exchange.

Bureaux de change or currency transfer companies provide low value foreign exchange services for travelers. These are typically located at airports and stations or at tourist locations and allow physical notes to be exchanged from one currency to another. They access the foreign exchange markets via banks or non bank foreign exchange companies.

Different Terms Used in a Foreign Exchange Market

1. Exchange Rate	It is the price of one currency quoted in terms of another currency.
2. Spot Rate	It is the exchange rate applicable for an immediate settlement, i.e. the exchange rate prevailing now.
3. Forward Rate	It is the exchange rate contracted today for exchange of currencies at a future date.

4. Direct Quote	It refers to the expression of exchange rate where one unit of foreign currency is expressed in terms of number of units of local / domestic currency. Example $1 = ₹40.00 [in India]
5. Indirect Quote	It refers to quoting per unit of Local / Domestic Currency in terms of number of units of Foreign Currency. Example: ₹1 = $0.025.
6. Two Way Quote	Two Way Quote refers to quoting Exchange Rates by an Exchange Dealer in terms of Buying (Bid) Rate and Selling (Ask) Rate.
7. Bid Rate	Bid Rate is the price at which the Exchange Dealer will buy currency. It is also called as Buy Rate. [It is the rate at which a Customer can sell a Foreign Currency]
8. Offer Rate	Offer Rate is the rate at which the Exchange Dealer will sell currency. It is also called as Sell Rate or Ask Rate. [It is the rate at which a Customer can Buy a Foreign Currency]
9. American Quote	It refers to quoting per unit of any currency in terms of American Dollars.
10. European Quote	It refers to quoting per unit of American Dollars in terms of any other currency an indirect quotation whereby the value of foreign currency is stated as per unit measure of the U.S Dollar.

15.2.1 Foreign Exchange Rate Management

A foreign exchange rate, which is also called a forex rate or currency rate, represents the value of a specific currency compared to that of another country. For example, an interbank exchange rate of 91 Japanese yen (JPY, ¥) to the United States dollar (US$) means that ¥91 will be exchanged for each US$1 or that US$1 will be exchanged for each ¥91. Exchange rates are determined in the foreign exchange market, which is open to a wide range of different types of buyers and sellers where currency trading is continuous: 24 hours a day except weekends.

Currency rates are applicable only on currency pairs. The currency listed on the left is called the reference (or base) currency while the one listed to the right is the quote (or term) currency.

Exchange rates are always written in the form of quotations. A quotation reflects the number of quote currencies that can be bought by using a single unit of reference currency.

Foreign Exchange Rates – Determinants

1. **Interest Rate Differentials:** Higher rate of interest for an investment in a particular currency can push up the demand for that currency, which will increase the exchange rate in favour of that currency.
2. **Inflation Rate Differentials:** Different countries' have differing inflation rates, and as a result, purchasing power of one currency may depreciate faster than currency of some other country. This contributes to movement in exchange rate.
3. **Government Policies:** Government may impose restriction on currency transactions. Through RBI, the Government, may also buy or sell currencies in huge quantity to adjust the prevailing exchange rates.
4. **Market Expectations:** Expectations on changes in Government, changes in taxation policies, foreign trade, inflation, etc. contribute to demand for foreign currencies, thereby affecting the exchange rates.
5. **Investment Opportunities:** Increase in investment opportunities in one country leads to influx of foreign currency funds to that country. Such huge inflow will amount to huge supply of that currency, thereby bringing down the exchange rate.
6. **Speculations:** Speculators and Treasury Managers influence movement in exchange rates by buying and selling foreign currencies with expectations of gains by exploiting market inefficiencies. The quantum of their operations affects the exchange rates.

Equilibrium Exchange Rate

Equilibrium Exchange Rate is the one that balances the value of nation's imports and exports. It is based on the flow of goods and services. Equilibrium Exchange Rate is also called as Trade Approach or Elasticity's Approach to determination of exchange rate.

If the value of the nation's imports exceeds the value of the nation's exports, then domestic currency will depreciate against the importing currency. Import requires payment in Forex and therefore importers will sell home currency to buy foreign currency, pushing up the demand and price of the foreign currency. Since Foreign Currency appreciates, the nation's exports become cheaper to Foreign Countries. Imports become more expensive to domestic residents. This results in increase in exports and fall in imports, until trade is balanced. For above purposes, exchange rate should be market determined and not Government fixed.

The speed of adjustment depends on how responsive or elastic imports and exports are to Exchange Rate changes. Hence, this approach to exchange rate determination is called Elasticity Approach. If the nation is at or near full employment, a larger depreciation of home currency is essential, to shift domestic resources to the production of more exports. If the nation has huge amount of unemployed resources, then the production should look out for import substitutes, to bring about an realignment in the exchange rates. Government policies may be required to reduce domestic expenditure, and to release domestic resources to produce more exports and import substitutes, and thus allow the elasticities approach to operate.

Elasticities Approach stresses on trade and flow of goods and services to determine exchange rate. This theory explains the determination of exchange rate in the long run.

Bid-Ask Rate

The bid price is the highest price that someone is willing to pay for buying an asset at that moment. The foreign exchange market is nothing more than an ongoing auction to buy and sell. Just as with any auction, buyers place bids.

The asking price is the lowest price at which someone is willing to sell at that moment. Think of it as when you sell a house or other item, you are "asking" a certain price for it. Sellers place asking prices.

Therefore, if you are interested in buying dollars, you should look at the asking price of a seller. You would have a buyer matched with a seller and the trade could be executed.

Likewise, if you are interested in selling dollars, you should look at the bid price since of a buyer. Again, you'd have a buyer matched with a seller and the trade could get executed.

The bids and offers come from "limit" orders placed by buyers and sellers. For instance, assume that a rupee has a bid of $50 and an asking price of $50.30. If you place a limit order to buy 100 rupees at $50.10 that means your order could only get executed if you pay $50.10 or less. The bid would be raised to $50.10. The new quote would be bidding $50.10 and asking $50.30. You are now the highest bidder and get posted to the board.

Likewise, if someone placed a limit order to sell at $50.20 that means they will only sell their rupees if they can get that price or higher. The new quote would be bid $50.10 and asking $50.20. They are now the lowest offer so get posted to the board.

Spread

Spread is the difference between the dealer's Ask Rate and Bid Rate.

If the exchange rate is expected to be stable, the spread will be narrow. If the exchange rate is volatile, the spread will be wider.

Where volume of transactions is very high, the Bid-Offer Spread will be very low. In case of a thinly-traded currency, the spread will be wider.

Example: USD = Rs. 40.00 - Rs. 40.25. Spread is Rs. 0.25 (Ask Rate Less Bid Rate]

Computation of forward Rates of a Currency based on rate of appreciation or depreciation or from swap points

Nature of Appreciation	Forward Rate is Ascertained By
Foreign Currency is appreciating	Multiply the value of home currency by (1+ Appreciation Percentage)
Foreign Currency is depreciating	Multiply the value of home currency by (1 - Depreciation Percentage)
Home Currency is appreciating	Divide the value of home currency by (1 + Appreciation Percentage)
Home Currency is depreciating	Divide the value of home currency by (1 - Depreciation Percentage)

1. Premium / Depreciation in Percentage

Example: In the spot market USD 1 = Rs. 40, if in the forward market (1 Year) —

If Dollar is appreciating by 10%, then USD 1 = Rs. 40 × (1 + 10%) = Rs. 40 × 1.1 = Rs.44.00

If Dollar is depreciating by 10%, then USD 1 = Rs. 40 × (1 - 10%) = Rs. 40 × 0.9 = Rs. 36.00

If Rupee is appreciating by 10%, thenUSD 1 = Rs. 40 ÷ (1 + 10%) = Rs. 40 ÷ 1.1 = Rs. 36.36

If Rupee is depreciating by 10%, then USD 1 = Rs. 40 ÷(1 - 10%) = Rs. 40 ÷ 0.9 = Rs. 44.44

Note: Home Currency Depreciation Rate ≠ Foreign Currency Appreciation Rate. Home Currency Appreciation Rate ≠ Foreign Currency Appreciation Rate.

From Swap Points: Forward Rates are ascertained based on the nature of spread of Swap Points (in case of a Two Way Quote) –

Nature of Spread	Forward Rate is Ascertained By
Spread is Positive (i.e. Swap Points are increasing)	Add the Swap Points to the Spot Rate.
Spread is Negative (i.e. Swap Points are decreasing)	Reduce the Swap Points from the Spot Rate.

Swap Points are movement in Exchange Rate expressed in absolute terms, i.e. in value terms.

Note: Spread = Ask Swap Less Bid Swap

Example:

Spot Rate	Swap Points	Forward Bid Rate	Forward Ask Rate
USD 1 = Rs.40/41	0.50 - 0.60	Rs.40 + 0.50 = Rs.40.50	Rs.41 + 0.60 = Rs.41.60
USD 1= Rs.40/41	0.80 - 0.70	Rs.40 - 0.80 = Rs.39.20	Rs.41 - 0.70 = Rs.40.30

Ascertaining the Appreciation and Depreciation in the case of a Currency Appreciation:

Currency is said to have appreciated if its value has increased, i.e. an investor is required to pay more for purchasing that currency.

Example: USD 1 = Rs. 40 becomes USD 1 = Rs. 42. Here the value of USD has increased. An investor is required to pay more Rupees to acquire one USD.

Premium Quote: A currency is said to be at Premium, if it is appreciating relative to another currency. In the above example, USD is quoted at Premium.

Depreciation: Currency is said to have depreciated if its value has decreased, i.e. an investor is required to pay less for purchasing that currency.

Example: USD 1 = Rs. 41 becomes USD 1 = Rs. 39. Here the value of USD has decreased. An investor is required to pay lesser amount in Rupees in acquire one USD.

Discount Quote: A Currency is said to be quoted at Discount, if it is depreciating relative to another currency. In the above example, USD is quoted at Discount.

Currency at premium or at discount?

Rule for ascertaining whether quoted at Premium / Discount [Based on Forward Rates]:

Foreign Currency is Expressed	Premium	Discount
Under Direct Quote	Forward Rate > Spot Rate	Forward Rate <Spot Rate
Under Indirect Quote	Forward Rate <Spot Rate	Forward Rate > Spot Rate

Forward Rates are Quoted in Terms of Swap Points:

Foreign Currency is Expressed	Premium	Discount
Under Direct Quote	Swap Points are increasing	Swap Points are decreasing
Under Indirect Quote	Swap Points are decreasing	Swap Points are increasing

Computation of Annualized Appreciation / Depreciation:

(a) For Direct Quotes: $\frac{\text{(Forward Rate - Spot Rate)}}{\text{Spot Rate}} \times 100 \times \frac{\text{12 Months or 365 Days}}{\text{Period of Quote}}$

Positive Result = Appreciation in %; Negative Result = Depreciation in %

(b) For Indirect Quotes: $\frac{\text{(Spot Rate - Forward Rate)}}{\text{Forward Rate}} \times 100 \times \frac{\text{12 Months or 365 Days}}{\text{Period of Quote}}$

Positive Result = Appreciation in %; Negative Result = Depreciation in %

Cross Rate

Cross Rate denotes an exchange rate that does not involve the home currency. It is an exchange rate between the currencies of two countries that are not quoted against each other, but are quoted against one common currency.

Example: From an Indian perspective, USD per GBP, FFr. Per Euro are cross rates.

Benefits: When a Foreign Currency (A) is not traded locally, or no exchange rates are available in terms of the local currency, but only in terms of some other Foreign Currency (B) and Currency B is traded locally, then Exchange Rate for Currency A can be obtained in terms of Local Currency.

Example: Exchange Rate for Peso is not available in terms of Rupee. However, quote for Peso is available per Euro (Euro 1 = Peso 17.50). Euro is traded in India at ₹ 57.50. Therefore, Rupee per Unit of Peso can be ascertained as follows —

Rupees/Peso = Rupee/Euro x Euro/Peso

= Rupee/Euro x [1 / (Peso/Euro)]

= Rs.57.50 × (1 ÷ Peso 17.50 per Euro) = Rs.57.50 x 0.0571 = Rs.3.2833 per Peso.

Cross Currency using Two Way Quotes: In case of Two Way Quotes, Exchange Rate between two currencies A and B, using C should be determined as follows-

(a) Bid Rate (A per unit of B) = Bid Rate of A per unit of C × Bid Rate of C per unit B

= Bid A/C + Bid C/B

(b) Ask Rate (A per unit of B) = Ask Rate of A per unit of C × Ask Rate of C per unit B

=Ask A/C + Ask C/B

Rule for Ascertaining Bid from Ask Rates (Where Currencies are expressed in Direct Quote and Indirect Quote):

(a) Bid Rate (A per Unit of B) = 1 ÷ Ask Rate (B per Unit of A)

= 1 ÷ Ask B/A

(b) Ask Rate (A per Unit of B) = 1÷ Bid Rate (B per Unit of A)

= 1 ÷ Bid B/A

Segments of Foreign Exchange Market – Spot Market (including two and three-point Arbitrage), Forward Market

15.3

There are two segments of Foreign Exchange Market

a) Spot Market

b) Forward Market

Spot Rate

Spot rate is the most commonly used term in the context of exchange rates. "The spot rate is the rate applicable for immediate settlement." However, both in India and internationally, by convention spot rate means the exchange rate at which the transaction will be settled on the second working day.

For example, if a spot transaction is concluded on a Friday, the settlement will be on the following Tuesday with Saturday and Sundays being holidays (Monday being the first working day and the second working day happens to be Tuesday). In some countries, e.g., Bahrain, the weekly closing day is a Friday and, Sunday a working day. The two-day time differential is a reasonable cushion for actual movement of funds through approved banking channels, necessitated by differed time zones.

Forward Rate

The Forward Rate (a k a Forward rate) is "the rate contracted today for exchange of currencies at a specified future date." In other words, the price is decided today, the delivery and settlement is made on the specified future date.

Once the rate is contracted, both parties, namely the customer and the dealer-banker, are obliged to perform on the specified future date irrespective of the exchange rate prevailing on that date.

Since a bank can buy a currency in forward market there is a forward bid price for the currency. Similarly since a bank can sell a currency in forward market, there is a forward ask price for the currency.

Currency Arbitrage

A forex strategy in which a currency trader takes advantage of different spreads offered by brokers for a particular currency pair by making trades. Different spreads for a currency pair imply disparities between the bid and ask prices. Currency arbitrage involves buying and selling currency pairs from different brokers to take advantage of this disparity.

Currency arbitrage involves the exploitation of the differences in quotes rather than movements in the exchange rates of the currencies in the currency pair. Forex traders typically practice two-currency arbitrage, in which the differences between the spreads of two currencies are exploited. Traders can also practice three-currency arbitrage, also known as triangular arbitrage, which is a more complex strategy. Due to the use of computers and high-speed trading systems, large traders often catch differences in currency pair quotes and close the gap quickly.

In today's global economy, a multinational company must deal with currencies of the countries in which it operates. Currency arbitrage , or simultaneous purchase and sale of currencies in different markets, offers opportunities for advantageous movement of money from one currency to another.

For example, converting £1,000 to U.S. Dollars with an exchange rate of $ 1.60 to £1 will yield $ 1,600. Another way of making the conversion is to first change the British Pound to Japanese Yen and then convert the Yen to U.S. Dollars using the current exchange rates of £1 = ¥175 and $1 = ¥ 105. The dollar amount is

$$(\pounds 1{,}000 \times ¥\ 175)/¥105 = \$1{,}666.67$$

This example demonstrates the advantage of converting British money first to Japanese Yen and then to dollars.

Two Point and Three Point Arbitrage

Exchange rate arbitrage is the practice of taking advantage of inconsistent exchange rates in different markets by selling in one market and simultaneously buying in another. Arbitrageurs do not take risks or, at least, it is not their intention to do so. In other words, they endeavour to maintain closed positions at all times. Rates of profit on arbitrage operations are necessarily low in competitive, well-informed markets, but since transactions are usually very large, absolute profits may also be large from successful arbitrage. Arbitrage performs the function for a market system of bringing prices in one market into line with those in other markets.

There are two types of arbitrage of relevance to forex markets: exchange rate arbitrage and interest rate arbitrage. In exchange rate arbitrage, advantage is taken of differentials in the price of a currency in different markets. Exchange rate arbitrage transactions may be classified in terms of the number of markets involved. Thus, we may have two-point and three-point arbitrage depending on whether it involves two or more exchange centres (two-point arbitrage or multiple- point arbitrage).

Two-point arbitrage

Two-point arbitrage concerns two currencies in two geographically separated markets. For example, let the spot exchange rate be £1 = $1.55 in London and £1 = $1.60 in New York. Here we are quoting both exchange rates against sterling. That is, we are quoting GBP/USD. This is the indirect quotation of sterling and the direct quotation of the dollar. Remember that the expression Currency A/Currency B gives you the amount of Currency B that exchanges for one unit of Currency A. In practice, most exchange rates are quoted against the US dollar. If we were to do this, we would quote:

In London: USD/GBP £0.645

In New York: USD/GBP £0.625.

Thus, in relative terms, sterling is undervalued in London and overvalued in New York. Provided that capital was free to flow between the two centres, arbitrageurs would attempt to exploit, and hence profit from the differential by selling dollars for pounds in London and reselling the pounds in New York. Assume the arbitrageur sold $1 million in London. For this, he would have received £645,161.29. Selling this in New York would have returned him £1,032,258.06 - a profit of 5 cents per £1. The sale of dollars in London would have strengthened sterling and pushed the value of the pound above $1.55. At the same time, the sale of sterling in New York would have caused sterling to weaken there, pushing its value below $1.60. The action of arbitrageurs would bring the rates of exchange in the two centres together.

In practice, the rates wouldn't come exactly into line because of the existence of transactions costs, but the rates should move to being 'transactions costs close'. There is another simplification in the above example since no regard is paid to the existence of bid and offer rates of exchange. In the real world, the rates may have been something like:

London: GBP/USD Bid 1.5495 Offer 1.5505

New York: GBP/USD Bid 1.5995 Offer 1.6005

Selling dollars in London, the arbitrageur would have been quoted the offer rate of 1.5505 and, thus, would have received £644,953.24. Buying dollars in New York, the arbitrageur would have been quoted the bid rate of 1.5995 and would have received £1,031,602.71. That is, the profits would have been lower because of the bid-offer spread.

Three-point (triangular) arbitrage

Exchange rates may be externally consistent but internally inconsistent. That is, exchange rates among different currencies may be mutually inconsistent. Arbitrageurs will then attempt to profit from these inconsistencies and in the process will eliminate discrepancies and establish mutually consistent cross- exchange rates. A cross-exchange rate is simply the price of a second currency expressed in terms of a third or an exchange rate calculated from two other rates. For example, the rate of the Euro against the Swedish krona derived as the cross rate from US$ - Krona and US$ against the Euro.

Example : Imagine you are a British arbitrageur, holding sterling, in the following example:

Actual exchange rates

GBP/USD £1 = $ 1.5715-721 USD/JPY $1 = ¥ 106.090-120 GBP/JPY £1 = ¥ 176.720-831

Start with £1,000,000.

(a) List the steps you need to take to make a profit.

(b) Calculate the rate of profit you will make.

Solution : Implied cross rates are £1 = ¥ 176.720-831. Thus, in the actual market, sterling is overpriced in relation to yen and we must sell sterling for yen.

Thus:

(a) The steps to make riskless profit from arbitrage are:

Step A: Use £ to buy yen;

Step B: Use yen to buy $;

Step C: Use $ to buy £

(b) Calculation of profit from arbitrage

(i) Sell £ for yen; market-maker buys the foreign currency (¥) at the bid rate of ¥176.720. This gives ¥176,720,000.

(ii) Sell ¥ for $; market-maker sells dollars at the offer rate of ¥106.120. This gives $1,665,284.58

(iii) Sell $ for £. The market-maker buys dollars at the higher rate of $1.5721, which gives £1,059,273.95 or a profit of 5.9%.

This is, of course, a ridiculously high rate of profit, since it could be made in a matter of moments. In practice, rates only have to get slightly out of line before the arbitrageurs step in.

Foreign Currency Derivatives

15.4

A derivative is an instrument that derives its value from another underlying asset or rate. Without the underlying asset, a derivative would have no independent existence or value.

Accordingly, foreign currency derivatives are certain contracts which have a foreign currency as its underlying. These are certain contracts to buy or sell foreign currencies at an expected future date or just to exchange two streams of payments.

Foreign currency derivatives are very important risk-management tools. However, they are widely used for speculative purposes as well.

The common foreign currency derivatives are Currency Forwards, Currency Futures, Currency Options and Swaps. In addition, there may be Exotics which are more complex than the commonly traded 'vanilla' products like Currency Futures, Currency Options and Swaps.

15.4.1 Currency Forwards

A currency forward is a customized, written contract between parties to buy or sell a specified amount of foreign currency at a fixed foreign currency exchange rate to be settled on a specified future date. The future date for which the currency exchange rate is fixed is usually the date on which the two parties plan to conclude a buy/sell transaction of goods.

For example, suppose, A needs € 1000 on a date sometime in near future. So, instead of buying this amount now and keeping it idle, A will enter into a currency forward contract with, say B. The contract will mature around the date when he needs € 1000. Suppose the agreed upon rate is ₹86 per euro today. Once A enters into a contract to buy €1000 at ₹86 per euro, he will have to pay neither more nor less than ₹86 per euro irrespective of the actual spot rate on the date of delivery of the €1000.

Currency forward contracts are private agreements between the parties involved. Hence, they can be tailored to precisely fit the parties' respective needs regarding a monetary amount, the agreed-upon exchange rate, and the time frame that the contract covers. The currency exchange rate specified in a currency forward contract is usually determined in relation to prevailing interest rates in the home countries of the two currencies involved in a transaction.

As these contracts are highly customized, they are transacted as Over-the-Counter (OTC) products. Unlike Currency Futures which are extremely standardized, these are not traded at organised exchanges.

Currency forwards are used to hedge foreign currency exchange risk. Hence, often these are used by importers and exporters to hedge the risk arising out of foreign exchange rate fluctuations which may negatively impact their foreign currency payables or receivables.

Currency forward contracts create obligation for both the parties. However, being an OTC product, they suffer from high counter-party risk or default risk.

15.4.2 Currency Futures

15.4.2.1 Meaning of Currency Futures

A Currency Futures Contract is a commitment to either to buy or to sell a specified amount of a foreign currency on a future date at a specified exchange rate. Currency futures are conceptually similar to currency forward contracts. However, they are extremely standardized in terms of available currencies, delivery dates, contract size. The leverage is high, margin requirement is less and being an exchange traded product, counterparty risk is negligible.

In a futures market, only the members of the exchange are allowed to transact. They are known as the brokers. The non-members need to transact through the brokers for which the brokers charge commission.

The participants on currency futures market may be traders including large business enterprises as well as speculators. Business enterprises, operating through their brokers, buy or sell currency futures in order to cover or hedge their currency exposures. They are called hedgers for this reason. On the other hand, speculators take positions in futures market to make profits.

15.4.2.2 Characteristics of Currency Futures

As mentioned above, currency futures are conceptually similar to currency forwards. Yet, they are different in terms of their dealing. Following are the characteristic features of the currency futures that distinguish them from forward contracts:

(a) Exchange Traded: Unlike currency forward contracts which are traded in an over-the-counter (OTC) market, currency futures are traded on organised exchanges. This provides a ready liquid market in which currency futures can be bought and sold. Some of these exchanges are Chicago Mercantile Exchange, Philadelphia Board of Trade, London International Financial Futures Exchange (LIFFE), Tokyo International Financial Futures Exchange (TIFFE), Sydney Futures Exchange, and Singapore International Monetary Exchange (SIMEX). In India, currency futures are sold at BSE and NSE.

(b) Selective Currencies: Currency futures are not available on all foreign currencies. Only a limited number of widely traded currencies have currency futures in various exchanges. For example, Currency Derivatives are available on four currency pairs viz. US Dollars (USD), Euro (EUR), Great Britain Pound (GBP) and Japanese Yen (JPY).

(c) Standardization: Currency futures are standardised in terms of contract size, maturity date and minimum variation in their value.

- **Standardized Size:** Standardization of contract size means that a certain minimum amount would constitute one futures contract in a particular currency. For example, a pound sterling future has a size of £62,500 on Chicago Mercantile Exchange (CME). This means that one can buy or sell pound sterling futures only as multiples of £62,500.

- **Standardized Maturity Dates:** Another feature of standardization is maturity dates. On Chicago Mercantile Exchange (CME), most of the currency futures contracts mature on third Wednesdays of March, June, September and December. Normally, futures contracts carry a prefix by name of the month of their maturity. Hence, a March yen future simply means that the futures contract on the currency, yen, will mature in the month of March.

- **Minimum Variation:** Standardization also relates to minimum variation, called "tick". Variations in dollar prices of future contracts cannot be random; they are multiples of a certain minimum value. For example, this minimum variation for pound sterling is US$0.0002/£. Hence, the value of a pound sterling futures can vary only in terms of $12.50 (0.0002 × 62,500). So, the value of one tick is $12.50. Therefore, if a sterling futures price changes from US$1.7970 to US$1.7868, the variation in the value of futures contract can be worked out as follows:

Price variation	= US$(1.7970 – 1.7868)	= US$0.0102	
Hence, number of ticks	= US$0.0102/ US$0.0002	= 51	
Value of one tick	= £62500 × $0.0002/£	= $12.50	
Thus, the variation in the price of the sterling contract			
	= Number of ticks × Value of one tick	= 51× $12.50	= $637.50

(d) Clearing House: In case of futures contracts, buyers and sellers do not come face-to-face. They operate through the clearing house. Clearing house is an entity that acts as counterparty to each transaction on futures market. Clearing house has the responsibility of maintaining accounts, margin payments and settlement of deliveries. A clearing house serves as the third party to all transactions. That is, the buyer of a futures contract effectively buys from the clearing house and the seller of a futures contract sells to the clearing house. This reduces the counterparty risk. As a result, an active and liquid secondary market develops. The liability of the clearing house is limited because futures position is marked-to market daily and parties are to maintain a margin account for this purpose.

(e) Marking to Market: Marking to market essentially means that at the end of the trading session (day), all outstanding contracts are repriced at the settlement price of that session (daily closing price). Margin account of those who made losses at debited and of those who gained are credited. This daily settlement feature can be best illustrated with an example.

Suppose, an investor takes a long position (i.e., agreed to buy) in a Swiss Franc (CHF) futures contract that matures on Thursday afternoon. The agreed upon price is. $0.75 for CHF 1,25,000. At the close of trading on Tuesday, the futures price has increased to $0.755. Due to the daily settlement feature, three things will occur. First, the investor will receive his cash profit of $625. Second, the existing futures contract with price of $0.75 will be cancelled and third the investor will receive a new futures contract with the prevailing price of $0.755.

The daily settlement reduces the default risk of futures contract relative to forward contracts.

(f) Initial and Maintenance Margin: Only members of an exchange can trade in futures contract on the exchange. He is known as broker. A non-member uses the broker's services. The broker must deposit with the clearing house a certain percentage of the contract value. This amount is known as the margin. A member acting on behalf of the client, in turn, requires the client to post a margin with the member.

In a futures market, there are two types of margin requirements – Initial (Minimum) Margin and Maintenance Margin. If the actual margin falls below the maintenance level, that is, the cumulative loss exceeds the difference between initial margin and the maintenance margin, the trader is required to make good any shortfall in margin account below the minimum margin. In other words, trader will have to bring an amount switch to make the margin equal to the minimum margin or initial margin level.

15.4.2.3 Comparison Between Currency Forward and Currency Futures Contracts

Following are the major differences between Currency Forward and Currency Futures Contracts:

S. No.	Feature	Currency Forward	Currency Futures
1.	Size of Contract	Negotiated	Standardized
2.	Available currencies	Majority of currencies	Selected currencies
3.	Maturity	Negotiated	Standardized
4.	Location of trading	Linkage by telephone/fax	Futures Exchange
5.	Rates	Normally with bid-ask spread	Unified rates quoted on the exchange
6.	Settlement	Generally with delivery of currencies	Mainly cash settled
7.	Counterparties	Generally in contact with each other	Do not know each other. Clearing house is the counterparty to each side
8.	Negotiation hours	Round the clock	During market sessions
9.	Guarantee/Margin deposit	None	Initial and maintenance margins
10.	Marking-to-market	No	Gains/losses settled everyday

15.4.3 Currency Options

15.4.3.1 Meaning of Currency Options

A currency option, as the name suggests, gives its holder a right and not an obligation to buy or sell a currency at a predetermined rate on or before a specified maturity date. Options are traded on the Over-the-Counter (OTC) market as well as on organised exchanges. Currency options are used by different participants for different purposes. For example, enterprisers (known as hedgers) use options to cover their exposures while banks profit by speculating.

Standardised currency option contracts started being traded for the first time in 1982 on Philadelphia Stock Exchange (PHLX). Following table shows the standard size of selected currency option contracts at PHLX.

Table 15.5 Standard Size of Selected Currency Options

Sr. No.	Currency	Standard Contract Size
1.	Australian dollar	Aus$50,000
2.	British pound	£31,250
3.	Canadian dollar	C$50,000
4.	Euro	€62,500
5.	Japanese yen	¥62,50,000
6.	Swiss franc	CHF62,500

15.4.3.2 Important Concepts Relating to Currency Options

A. Call Option vs. Put Option

- Call Option: A call option is the type of option that gives its holder a right, but not the obligation, to buy a currency at a pre-specified rate.
- Put Option: A put option is the type of option that gives its holder a right, but not the obligation, to sell a currency at a pre-specified rate.

B. European vs. American Option

- European Option: An option which can be exercised only on the maturity date is called a European Option.
- American Option: An option which can be exercised at any date up to maturity is called a European Option.

C. Parties to an Option

There are two parties to every option contract – the buyer or holder of the option and the seller or writer of the option.

D. Strike Price or Exercise Price

It is the exchange rate at which the holder of a call option can buy and the holder of a put option can sell the currency under the deal, irrespective of the actual spot rate at the time of exercise of option. It is normally denoted by the symbol 'X'.

E. Spot Price

It is the exchange rate available at the spot market for the concerned deal. It is normally denoted by 'S_T'.

F. Premium

It is the price that the option holder needs to pay to the option writer 'up-front'. By paying this premium, the holder acquires a right for himself and by receiving it, the writer takes an obligation upon himself to fulfil the right of the holder. Call premium is denoted by 'C' while put premium is denoted by 'P'. For exchange traded options, premium is also known as the price of option. These factors and how they impact the price of a currency option are shown.

S. No.	Increase in	Impact on call premium	Impact on put premium
1.	Time to maturity	Increase	Increase
2.	Volatility	Increase	Increase
3.	Forward Premium on foreign currency	Increase	Decrease
4.	Forward Discount on foreign currency	Decrease	Increase
5.	Domestic interest rate	Increase	Decrease
6.	Foreign interest rate	Decrease	Increase
7.	Exercise price	Decrease	Increase
8.	Spot rate	Increase	Decrease

G. Out-of-the-Money, At-the-Money and In-the-Money Option

As mentioned earlier, a currency option gives its holder the right but not the obligation to buy or sell a currency at a predetermined rate. Now, whether the option will be exercised or not depends on the spot price relative to the exercise price. Accordingly, there can be the following three alternatives:

(a) Out-of-the-Money Option: As option is said to be out-of-the-money when the spot price (S_T) is less than the strike price (X) in case of call option and higher than the strike price in case of a put option. In this situation the option will have no positive value and hence will not be exercised at all. The holder will lose the premium paid.

Suppose, the strike price of a 3-month European call option on US$ is ₹74/US$ and premium paid is ₹0.40/US$. If on the date of expiry of the call option, the spot price (S_T) is ₹73.50/US$, it will be beneficial for the option holder to buy the currency from the spot market rather than to exercise the call option to get the same. Hence, the option will be out-of-the money and will not be exercised.

(b) At-the-Money Option: As option is said to be at-the-money when the spot price (S_T) is exactly equal to the strike price (X) in case of both a call option and a put option. In this situation also, there will be no positive value and the option holder stands to lose the option premium.

Suppose, in our previous example, the spot price on expiry is ₹74/US$. Hence, the option holder may buy the currency at the same rate as in case of option. Thus, he will remain indifferent as in both cases he won't make any further gain and his loss will be equal to the premium paid.

(c) In-the-Money Option: As option is said to be in-the-money when the spot price (S_T) is higher than the strike price (X) in case of call option and lower than the strike price in case of a put option. In this situation the option will have positive value and hence will be exercised. However, there may be three possibilities as follows:

If the difference between the strike price and spot price is higher than the premium, there will be net gain, but if difference between the strike price and spot price is lower than the premium, there will be net loss, though the same will be lower than the previous two situations and will actually mean partial recovery of premium paid. Finally, if difference between the strike price and spot price is equal to the premium, the option holder will achieve a break-even as the premium will be recovered in full.

Thus, in our previous example on call option, if the spot price is ₹74.40, the option will be in-the-money by ₹(74.40-74.00) = ₹0.40 which will be sufficient enough to recover only the premium paid. Hence the option holder will be able to break-even at this price.

The following summarizes the above situations.

Situation	Call Option		Put Option	
	Status	Net Profit/Loss	Status	Net Profit/Loss
$S_T > X$	In-the-money	$(S_T - X) - C$	Out-of-the-money	- P
$S_T = X$	At-the-money	-C	At-the-money	- P
$S_T < X$	Out-of-the-money	-C	In-the-money	$(X - S_T) - P$

Thus, the break-even price for a call option is $S_T = X + C$. Similarly, BEP for a put option is $S_T = X - P$

Illustration 1

The strike price of a put option on US$ is ₹73.50/US$. Put premium is ₹0.30/US$ and contract size is US$1000 (one contract). What will be your course of action and resultant profit/loss, if on expiration the spot price is ₹74.00/US$, ₹73.50/US$ and ₹72.50/US$?

Solution:

When spot price is ₹74.00/US$

Here the put option is out-of-the money as Spot Price (S_T) > Strike Price.

Hence, loss = premium paid (P) = ₹0.30 × 1000 = ₹300.

When spot price is ₹73.50/US$

Here the put option is at-the money as Spot Price (S_T) = Strike Price.

Hence, loss = premium paid (P) = ₹0.30 × 1000 = ₹300.

When spot price is ₹72.50/US$

Here the put option is in-the money as Spot Price (S_T) < Strike Price. Hence, the option will be exercised and profit = $(X – S_T) – P = [(73.50 – 72.50) \times 1000] – 300 = ₹700$.

H. Value of Option – Intrinsic Value and Time Value

From a theoretical standpoint, the value of an option is comprised of two components: Intrinsic Value and Time Value. The intrinsic value of an option is the gain to the holder on immediate exercise of the option. It is therefore the amount by which the option is in the money. Thus, the further into the money an option is, the more valuable it is. An out of the money option has no intrinsic value at all.

In other words, Intrinsic Value of a call option is -

IV $= (S_T – X)$ when $S_T > X$; and

$= 0$

Similarly, for a put option, the intrinsic value is given by -

IV $= (X – S_T)$ when $S_T < X$; and

$= 0$

Any excess of the option value over its intrinsic value is called time value of the option. The time value of an option arises out of the possibility that at some point of time in future. The option may have a value higher than its current intrinsic value.

I. Put-Call Parity

Put-call parity shows the relationship that has to exist between European put and call options that have the same underlying asset, expiration, and strike prices. The concept says that the price of a call option implies a certain fair price for the corresponding put option with the same strike price and expiration and vice versa.

In other words, $C + PV(X) = P + S_T$.

Where, C is the call price (or premium), P is the put price (or premium), S_T is the spot price and PV(X) = the present value of the strike price (X), discounted from the value on the expiration date at the risk-free rate.

The concept is not applicable in case of American option.

Consider the following illustration.

Illustration 2

With the data as given below, find the price of the call option:

P = US$0.039/£, X = US$1.74/£

S_T = US$1.7252/£

Risk free rate of return = 8 per cent p.a., Time to expiration = 3 months.

Solution:

We use the parity equation to find the value of C. That is,

$PV(X) = 1.74 \times e^{-0.08 \times 3/12} = 1.74 \times 0.9802 = \$1.705548$

So, $C + PV(X) = P + S_T$

or, $C + 1.705548 = 0.039 + 1.7252$

or, $C = 0.058652$ or 0.059 (app.)

So, the call premium is US$0.059/£.

15.4.4 Currency Swaps

15.4.4.1 Meaning of Currency Swaps

Currency Swaps refer to the arrangement where principal and interest payments in one currency are exchanged for such payments in another currency. Technically, a currency swap (sometimes also called a cross-currency swap) is an exchange of debt-service obligations denominated in one currency for the service on an agreed-upon principal amount of debt denominated in another currency. By swapping their future cash-flow obligations, the counterparties are able to replace cash flows denominated in one currency with cash flows in a more desired currency. In this way, company A, which has borrowed, say, Japanese yen at a fixed interest rate, can transform its yen debt into a fully hedged U.S. dollar liability by exchanging cash flows with counterparty B.

Financial institutions play very important role in swap deals. Through swaps, they enable their customers who are generally enterprises to get loans and make deposits in the currency of their (i.e., customers') choice.

15.4.4.2 Types of Currency Swaps

Currency swaps can be of the following two types –

I. Fixed-to-Fixed Rate Currency Swaps

In a fixed-to-fixed swap, the two parties borrow at a fixed rate of interest. The swap deal enables them to get the desired currency at a favourable rate.

Consider the following illustration.

Illustration 3

D Ltd., an U.S. company, is looking to hedge some of its euro exposure by borrowing in euros. At the same time, a French manufacturer M Ltd. is seeking U.S. dollars to finance additional investment in the American market. Both want the equivalent of $200 million in fixed-rate financing for 10 years.

The market rates available for the two companies are as follows:

	D Ltd.	M Ltd.
Dollar rate	7.5 per cent	7.7 per cent
Euro rate	8.25 per cent	8.1 per cent

Comment on the possibility of a currency swap.

Solution:

Given that both companies have similar credit ratings, it is clear that the best way for them to borrow in the other's currency is to issue debt in their own currencies and then swap the proceeds and future debt-service payments. Assuming a current spot rate of €1.1/$, M would issue €220 million in 8.1% debt and D would float a bond issue of $200 million at 7.5%. The coupon payments on these bond issues are €17,820,000 (0.081 × €220 million) and $15,000,000 (0.075 × $200 million), respectively, giving rise to the following debt-service payments:

Year	M Ltd.	D Ltd.
1-10	€17,820,000	$15,000,000
10	€220,000,000	$200,000,000

After swapping the proceeds at time 0 (now), D winds up with €220 million in euro debt and M has $200 million in U.S. dollar debt to service. In subsequent years, they would exchange coupon payments and the principal amounts at repayment. The net result is that the swap enables D to borrow fixed-rate euros indirectly at 8.1%, saving 15 basis points relative to its 8.25% cost of borrowing euros directly, and M Ltd. can borrow U.S. dollars at 7.5%, saving 20 basis points relative to its direct cost of 7.7%.

Note: The given illustration shows that the companies are dealing directly with one another. In practice, they would use a financial intermediary, such as a commercial bank or an investment bank, as either a broker or a dealer to arrange the swap. As a broker, the intermediary simply brings the counterparties together for a fee. In contrast, if the intermediary acts as a dealer, it not only arranges the swap, but it also guarantees the swap payments that each party is supposed to receive, because the dealer guarantees the parties to the swap arrangement against default risk, both parties will be concerned with the dealer's credit rating. Financial intermediaries in the swap market must have high credit ratings because most intermediaries these days act as dealers.

II. Fixed to Floating Currency Swaps

The steps to be followed in the fixed-to-floating rate swap are the same as in fixed-to- fixed swap. Here the only difference is that one currency has fixed rate while the other has floating rate.

Consider the following illustration.

Illustration 4

D Ltd. decides that it prefers to borrow floating-rate euros instead of fixed-rate euros, whereas M maintains its preference for fixed-rate U.S. dollars. Assume that D can borrow floating-rate euros directly at LIBOR + 0.35%, versus a cost to M of borrowing floating-rate euros of LIBOR + 0.125%. D's cost of borrowing U.S. dollars is 7.5% versus M's cost of 7.7%.

Comment on the possibility of a currency swap.

Solution:

The best way for them to achieve their currency and interest rate objectives is to issue debt in their own currencies and then swap the proceeds and future debt-service payments.

Assuming a current spot rate of €1.1/$, M would issue €220 million in LIBOR + 0.125% debt and D would float a bond issue of $200 million at 7.5%. The proceeds will be swapped at time 0 (now). For the next 10 years, M will continue to pay interest at 7.5% on $200 million to D which it will pay to its lender of $ debt. Similarly, D will continue to pay interest at LIBOR + 0.125% on €220 million to M which it will pay to its lender of € debt. At the end of 10 years, they will again exchange their repayment proceeds and finally repay their respective lenders.

The net result of the swap is that D can borrow euros indirectly at a floating rate of LIBOR + 0.125%, saving 22.5 basis points relative to its cost of borrowing floating-rate euros directly (i.e., LIBOR + 0.35%). M's cost of borrowing fixed-rate U.S. dollars remains at 7.5%, a savings of 20 basis points.

Illustration 5

	F Ltd.	B Ltd.	Difference
Floating rate on dollar	LIBOR + 0.8 per cent	LIBOR + 0.1 per cent	0.7 per cent
Fixed rate on euros	8.5 per cent	9 per cent	(0.5) per cent

A German company, F, can raise loan at fixed rate in European market but prefers to obtain dollar funding at floating rate. On the other hand, an American company, B, which is better placed on floating rate market, prefers a fixed rate euro loan. The rates available to the two companies are:

Comment on the possibility of currency swap. Assume that they have approached an intermediary.

Solution:

From the rates, it is obvious that company F has relative advantage of 0.5 per cent on fixed rate market whereas company B has a relative advantage of 0.7 per cent on floating rate market. The net difference of 1.2 [0.7 - (-0.5)] per cent is available to be shared between the two companies and intermediary bank.

Company F which actually needs floating dollar rate financing, borrows euros at a fixed rate of 8.5 per cent. Company B which actually needs fixed rate euro financing borrows dollars at LIBOR + 0.1 per cent. Then, the two companies enter into swap deal with an intermediary bank. Suppose, the swap contract stipulates that company F will pay floating rate of LIBOR + 0.1 to the bank and receive from it 8.3 per cent fixed rate whereas company B will pay a fixed rate of 8.4 per cent to the bank and receive LIBOR from it. The net rate paid by each company and profit received by the bank can be worked out as given below.

Net rate to be paid by F = 8.5 per cent paid to market - 8.3 received from intermediary bank + (LIBOR + 0.1) per cent paid to intermediary bank = (LIBOR + 0.3)

Net rate to be paid by B = (LIBOR + 0.1) per cent paid to market - LIBOR per cent received from intermediary bank + 8.4 per cent paid to intermediary bank = 8.5 per cent

Net gain of the bank = 8.4 per cent received from B - 8.3 per cent paid to F + (LIBOR + 0.1) per cent received from F - LIBOR per cent paid to B = 0.2 per cent

Thus, the savings of 1.2 per cent have been shared by the three entities: 0.5 per cent each by company F and company B respectively, and 0.2 per cent by the intermediary. F is paying floating rate of LIBOR + 0.3 instead of LIBOR + 0.8 which it would have had to pay without swap deal. Likewise, B is paying a fixed rate of 8.5 per cent rather than 9 per cent that it would have been required to pay if it were to borrow euros at fixed rate on its own. The bank has earned 0.2 per cent for its services in the deal.

15.4.4.3 Benefits of Currency Swap

Currency swaps provide a real economic benefit to both parties only if a barrier exists to prevent arbitrage from functioning fully. Legal restrictions on spot and forward foreign exchange transactions, different perceptions by investors of risk and creditworthiness of the two parties, appeal or acceptability of one borrower to a certain class of investor, tax differentials are some of those barriers.

Swaps also allow firms that are parties to the contracts to lower their cost of foreign exchange risk management by arbitraging their relative access to different currency markets.

Currency swaps are often used to provide long-term financing in foreign currencies. This function is important because in many foreign countries long-term capital and forward foreign exchange markets are notably absent or not well developed. Currency swaps are one vehicle that provides liquidity to these markets.

Parity Relationships

15.5

Managers of multinational firms, international investors, importers and exporters, and government officials often deal with the following fundamental issues:

- Are changes in exchange rates predictable?
- How are exchange rates related to interest rates?
- What, at least theoretically, is the 'proper' exchange rate?

To answer these questions, one needs to first understand the economic fundamentals of international finance, known as parity conditions.

Parity conditions provide an intuitive explanation of the movement of prices and interest rates in different markets in relation to exchange rates.

The derivation of these conditions requires the assumption of Perfect Capital Markets (PCM).

- no transaction costs
- no taxes
- complete certainty

The parity conditions are expected to hold in the long-run, but not always in the short term.

These Parity conditions should apply to product prices, interest rates, and spot and forward exchange rates if the markets are not impeded. Thus, they provide the foundation for much of the theory and practice of international finance.

The concept of arbitrage is of particular importance in international finance because so many of the relationships between domestic and international financial markets, exchange rates, interest rates, and inflation rates depend on arbitrage for their existence. Indeed, by linking markets together, arbitrage underlies the globalization of markets.

One of the central ideas of international finance stems from arbitrage: in competitive markets, characterized by numerous buyers and sellers having low-cost access to information, exchange-adjusted prices of identical tradable goods and financial assets must be within transaction costs of equality worldwide. This idea, referred to as the law of one price, is enforced by international arbitrageurs who follow the profit-guaranteeing dictum of "buy low, sell high" and prevent all but trivial deviations from equality. Similarly, in the absence of market imperfections, risk-adjusted expected returns on financial assets in different markets should be equal.

Five key theoretical economic relationships, which are depicted in the following figure, result from these arbitrage activities.

- Purchasing Power Parity (PPP)
- Fisher effect (FE)
- International Fisher effect (IFE)
- Interest rate parity (IRP)
- Forward rates as unbiased predictors of future spot rates (UFR)

This framework (Figure 15.2) emphasizes the links among prices, spot exchange rates, interest rates, and forward exchange rates.

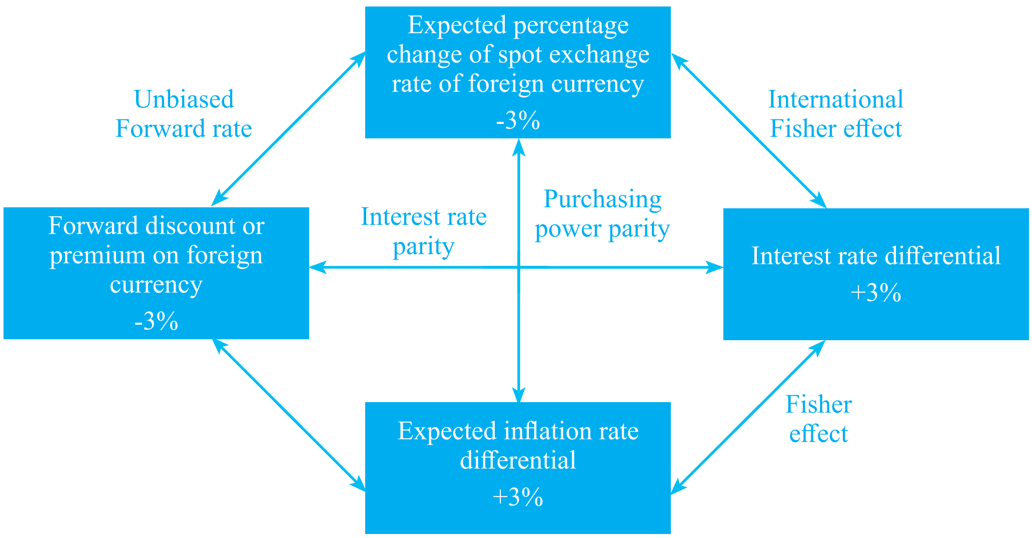


Figure 15.2 International Parity Conditions

According to the diagram, if inflation in, say, Switzerland is expected to exceed inflation in the United States by 3 percent for the coming year, then CHF should decline in value by about 3 percent relative to the dollar. By the same token, the one-year forward CHF should sell at a 3 percent discount relative to the U.S. dollar. Similarly, one-year interest rates in Switzerland should be about 3 percent higher than one-year interest rates on securities of comparable risk in the United States.

A. Purchasing Power Parity

Purchasing Power Parity (PPP) was first stated in a rigorous manner by the Swedish economist Gustav Cassel in 1918. He used the concept as the basis for recommending a new set of official exchange rates at the end of World War I that would allow for the resumption of normal trade relations. Subsequently, PPP has been widely used by regulators as a guide to establishing new par values for their currencies when the old ones were clearly in disequilibrium. From a management standpoint, the concept is often used to determine the expected spot exchange rates or currency denomination of long-term debt issues to determining in which countries to build projects.

In its absolute version, purchasing power parity states that price levels should be equal worldwide when expressed in a common currency. In other words, a unit of home currency should have the same purchasing power around the world. This theory is just an application of the ‘law of one price’ (LOOP) to national price levels rather than to individual prices. However, absolute PPP ignores the effects on free trade of transportation costs, tariffs, quotas and other restrictions, and product differentiation.

The relative version of purchasing power parity, which is used more commonly now, states that the exchange rate between the home currency and any foreign currency will adjust to reflect changes in the price levels of the two countries.

Consider the following example.

Suppose, at the period zero, a basket of goods and services is costing £100 in the UK and $180 in USA. There is no restriction of buying this basket of goods and services either from the UK or from the USA.

Then, £100 = $180

or £I = $1.80 will be the exchange rate.

Say after one year (period 1), the same basket of goods and services costs £103 in the UK market while it costs $186 in the USA market.

Then, £103=$186

or £1 =$1.8058 will be the new exchange rate.

Here, it is clear that pound sterling has slightly appreciated vis-a-vis US dollar over the period of past one year.

Now, the inflation rate in UK = (103 – 100)/100 = 3%; and the inflation rate in USA = (186 – 180)/180 = 3.33%.

This shows that the rate of inflation is higher in the USA than in the UK.

Hence, it is inferred that the currency of the country where inflation rate is higher is likely to depreciate vis-a-vis the currency of the country with lower rate of inflation.

Formally, if i_h and i_f are the periodic price-level increases (rates of inflation) for the home country and the foreign country, respectively; e_0 is the euro (home currency or HC) value of one unit of foreign currency at the beginning of the period; and e_t is the spot exchange rate in period t, then = $\frac{e_t}{e_0} = \frac{(1+i_h)^t}{(1+i_f)^t}$

Therefore, the expected spot rate, $e_t = e_0 \times \frac{(1+i_h)^t}{(1+i_f)^t}$

Thus, the expected spot rate after one year = $e_t = e_0 \times \frac{1+i_h}{1+i_f}$

The value of e_t appearing in the above equation is known as the PPP rate.

Purchasing power parity is often represented by the following approximation: = $\frac{e_1 - e_0}{e_0} = \frac{i_h - i_f}{1+i_f}$

That is, the exchange rate change during a period should equal the inflation differential for that same time period. In effect, PPP says that currencies with high rates of inflation should depreciate relative to currencies with lower rates of inflation.

Illustration 6

Inflation rates in the UK and India are respectively 3 per cent and 6 per cent per annum. What is the expected exchange rate after one year, if it was ₹78/£ at the beginning? What will be the exchange rate after 2 years?

Solution:

Given, e_0 = ₹78/£

Inflation rate in home country = i_h = 6%

Inflation rate in foreign country = i_f = 3%

Therefore, expected exchange rate after one year,

$$e_1 = e_0 \times \frac{1+i_h}{1+i_f}$$

$$= 78 \times \frac{1+0.06}{1+0.03} = 80.27$$

The exchange rate after one year is ₹ 80.27/£.

Expected exchange rate after two years,

$$e_2 = e_0 \times \frac{(1+i_h)^2}{(1+i_f)^2} = 78 \times \frac{(1+0.06)^2}{(1+0.03)^2} = 78 \times \frac{1.1236}{1.0609} = 82.61$$

The exchange rate after one year is ₹82.61/£.

Note: The country from whose viewpoint the given spot rate is a direct quote, should be the home country.

Illustration 7

The inflation rates in India and the UK are 2.5 per cent and 5.5 per cent respectively. If the exchange rate at time zero is ₹79/£, calculate expected exchange rate a year later and expected change in spot rate. Also calculate the inflation rate differential and verify if PPP holds good.

Solution:

Given, e_0 = ₹79/£

Inflation rate in home country = i_h = 5.5%

Inflation rate in foreign country = i_f = 2.5%

Therefore, expected exchange rate after one year,

$$e_1 = e_0 \times \frac{1+i_h}{1+i_f}$$

$$= 79 \times \frac{1+0.055}{1+0.025} = 81.3122$$

The exchange rate after one year is ₹ 81.3122/£.

Expected change in spot rate = $\frac{e_1 - e_0}{e_0} = \frac{81.3122 - 79}{79} \times 100 = 2.93\%$

Inflation rate differential = $\frac{i_h - i_f}{1 + i_f} = \frac{0.055 - 0.025}{1+0.025} = 2.93\%$

Since, expected change in spot rate = inflation rate differential, PPP holds good.

Illustration 8

The inflation rates in India and the USA are 5 per cent and 4 per cent respectively. If the existing spot exchange rate is ₹69/£, calculate expected exchange rate after 3 months and expected change in spot rate. Also calculate the inflation rate differential and show that PPP holds good.

Solution:

Given, e_0 = ₹69/$

Inflation rate in home country (India) = i_h = 5% p.a. (for 3 months)

Inflation rate in foreign country (USA) = i_f = 4% p.a. (for 3 months)

Therefore, expected exchange rate after three,

$$e_1 = e_0 \times \frac{1+i_h}{1+i_f}$$

$$= 69 \times \frac{1 + 0.05 \times \frac{3}{12}}{1 + 0.04 \times \frac{3}{12}} = 69 \times \frac{1 + 0.0125}{1 + 0.01} = 69.1708$$

The exchange rate after one year is ₹69.1708/$.

Expected change in spot rate = $\frac{e_1 - e_0}{e_0} = \frac{69.1708 - 69}{69} \times 100 = 0.25\%$

Inflation rate differential = $\frac{i_h - i_f}{1 + i_f} = \frac{0.05 \times \frac{3}{12} - 0.04 \times \frac{3}{12}}{1 + 0.04 \times \frac{3}{12}} \times 100 = 0.25\%$

Since, expected change in spot rate = inflation rate differential, PPP holds good.

Note: the inflation rate differential and expected change in spot rate may be annualised by multiplying '12/3'.

B. Interest Rate Parity

Spot and forward rates are closely linked to each other and to interest rates in different currencies through the medium of arbitrage. In other words, the movement of funds between two currencies to take advantage of interest rate differentials through the process of arbitrage is a major determinant of the forward premium or discount.

As per the interest rate parity (IRP) theory, the currency of the country with a lower interest rate should be at a forward premium in terms of the currency of the country with the higher rate. Thus, in an efficient market with no transaction costs, the interest differential should be (approximately) equal to the forward differential (premium or discount). When this condition is met, the forward rate is said to be at interest rate parity, and equilibrium prevails in the money markets.

Interest parity ensures that the return on a hedged (or "covered") foreign investment will just equal the domestic interest rate on investments of identical risk, thereby eliminating the possibility of having a money machine. This is why interest rate parity is also known as covered interest rate parity theory.

However, interest rate parity holds only when there is no restrictions on mobility of capital, taxes are absent and no government restriction on foreign currency borrowings.

Consider the following example.

Suppose an investor with US$1,000,000 to invest for 90 days is trying to decide between investing in U.S. dollars at 8% per year or in euros at 6% per year.

The current spot rate is €0.75000/$, and the 90-day forward rate is €0.74632/$. His $1,000,000 investment in U.S. dollars for 90 days will yield $1,000,000 × (1 + 0.08 × 90/360) = $1,020,000. Alternatively, if the investor chooses to invest in euros on a hedged basis, he will

1. Convert the $1,000,000 to euros at the spot rate of €0.75000/$. This yields €750,000 available for investment.
2. Invest the principal of €750,000 at 6% p.a. for 90 days. At the end of 90 days, the investor will have €750,000 × (1 + 0.06 × 90/360) = €761,250.
3. Simultaneously with the other transactions, sell the €7,61,250 in principal plus interest forward at a rate of €0.74632⁄$ for delivery in 90 days. This transaction will yield 761,250/0.74632 = $1,020,000 in 90 days.

Thus, regardless of the investor's currency choice, their hedged return will be identical. This is a situation where interest rate parity holds good.

However, if in the above example, the 90-day forward rate is €0.74/\$, he will receive 761250/0.74 = \$1,028,716. Hence, investing in euros will fetch a gain of (1,028,716 – 1,020,000) = \$8,716.

Therefore, there is an arbitrage incentive to move money from USA to the other. This movement of money to take advantage of a covered interest differential is known as covered interest arbitrage. The process of covered interest arbitrage will continue until interest parity is achieved, unless there is government interference.

Interest rate parity holds when there are no covered interest arbitrage opportunities. On the basis of the previous discussion, this no-arbitrage condition can be stated as follows:

$$\frac{f_1}{e_0} = \frac{1+r_h}{1+r_f}$$

The above equation can also be expressed as –

$$\frac{f_1 - e_0}{e_0} = \frac{r_h - r_f}{1+r_f}$$

That is, forward premium or discount should be equal to interest rate differential.

Illustration 9

Interest rates on Indian rupee and pound sterling are 8% p.a. and 5% p.a. respectively. The current exchange rate is ₹79/£. Estimate the 6-month forward rate.

Solution:

Given, e_0= ₹79/\$

Interest rate in home country (India) = r_h = 8% p.a. (for 6 months)

Interest rate in foreign country (USA) = r_f = 5% p.a. (for 6 months)

Therefore, 6-month forward rate,

$$f_1 = e_0 \times \frac{1+r_h}{1+r_f}$$

$$\text{or, } f_1 = 79 \times \frac{1+0.08 \times \frac{6}{12}}{1+0.05 \times \frac{6}{12}} = 80.1561$$

So, 6-month forward rate is likely to be ₹80.1561/£.

Illustration 10

The interest rate in the United States is 10%; in Japan, the comparable rate is 7%. The spot rate for the yen is \$0.003800 (¥263.16/\$). If interest rate parity holds, what is the 90-day forward rate?

Solution:

According to IRP, the 90-day forward rate on the Japanese yen should be:

$$f_1 = e_0 \times \frac{1+r_h}{1+r_f} = 0.0038 \times \frac{1+0.10 \times \frac{90}{360}}{1+0.07 \times \frac{90}{360}} = 0.003828$$

In other words, the 90-day forward Japanese yen should be \$0.003828.

Illustration 11

Exchange rate between Rupee and Swiss franc is ₹33/SFr at the reference period and the forward rate is found to be ₹33.40/SFr after 9 months. Nine-month interest rate on Rupee is 8% p.a. What should have been corresponding interest rate on Swiss franc? Show that interest rate differential is equal to forward premium or discount.

Solution:

Given, e_0 = ₹33/SFr

f_1 = ₹33.40/SFr

Interest rate in home country (India) = r_h = 8% p.a. (for 9 months)

Interest rate in foreign country (USA) = r_f = x% p.a. (for 9 months)

Since, as per IPR, $= f_1 = e_0 \times \frac{1+r_h}{1+r_f}$

Conditionally, $33.40 = 33 \times \dfrac{1+0.08 \times \frac{9}{12}}{1+X \times \frac{9}{12}}$

or, x = 0.063 or 6.3%

So, the interest rate on Swiss franc is 6.3% p.a.

Interest rate differential $= \dfrac{r_h + r_f}{1+r_f} = \dfrac{0.08 \times \frac{9}{12} - 0.063 \times \frac{9}{12}}{1+0.063 \times \frac{9}{12}} = 1.21\%$

Forward premium or discount $= \dfrac{f_1 - e_0}{e_0}$ = (33.40 – 33.00)/33.00 = 1.21%

So, interest rate differential is equal to forward premium or discount.

Illustration 12

Suppose, the interest rate on pound sterling is 12% p.a. in London and interest rate on a comparable dollar investment in New York is 7% p.a. The pound sterling spot rate is \$1.95/£ and one year forward rate is \$1.87/£. Is there any arbitrage opportunity? If so, explain the steps to earn arbitrage profit.

Solution:

Given, e_0 = \$1.95/£

f_1 = \$1.87/£

Interest rate in home country (USA) = r_h = 7% p.a.

Interest rate in foreign country (UK) = r_f = 12% p.a.

Here, $1 + r_h = 1 + 0.07 = 1.07$

and, $\frac{f_1}{e_0}(1 + r_f)$ = 1.87/1.95(1+0.12) = 1.074

Since, $(1 + r_h) \neq \frac{f_1}{e_0}(1 + r_f)$, arbitrage opportunity exists.

Now, as $(1 + r_h) < \frac{f_1}{e_0}(1 + r_f)$, funds will move from home country to foreign country.

The steps to be followed by the arbitrager are as follows:

1. Borrow \$1,000,000 in New York at an interest rate of 7%. This means that at the end of one year, the arbitrageur must repay principal plus interest of \$1,070,000.

2. Immediately convert the \$1,000,000 to British pounds at the spot rate of £1 = \$1.95. This yields £512,820.51 available for investment.

3. Invest the principal of £512,820.51 in London at 12% for one year. At the end of the year, the arbitrageur will have £574,358.97.

4. Simultaneously with the other transactions, sell the £574,358.97 in principal plus interest forward at a rate of £1 = \$1.87 for delivery in one year. This transaction will yield \$1,074,051.28 next year.

5. At the end of the year, collect the £574,358.97, deliver it to the bank's foreign exchange department in return for \$1,074,051.28, and use \$1,070,000 to repay the loan. The arbitrageur will gain \$4,051.28 on this set of transactions.

Implications of Interest Rate Parity Theory

The implications of interest rate parity theory are as follows:

a) If IRP theory holds then arbitrage is not possible. No matter whether an investor invests in domestic country or foreign country, the rate of return will be the same.

b) If domestic interest rates are less than foreign interest rates, foreign currency must trade at a forward discount to offset any benefit of higher interest rates in foreign country to prevent arbitrage.

c) If foreign currency does not trade at a forward discount or if the forward discount is not large enough to offset the interest rate advantage of foreign country, arbitrage opportunity exists for domestic investors. So domestic investors can benefit by investing in the foreign market.

d) If domestic interest rates are more than foreign interest rates, foreign currency must trade at a forward premium to offset any benefit of higher interest rates in domestic country to prevent arbitrage.

e) If foreign currency does not trade at a forward premium or if the forward premium is not large enough to offset the interest rate advantage of domestic country, arbitrage opportunity exists for foreign investors. So foreign investors can benefit by investing in the domestic market.

C. Fisher Effect

Interest rates and inflation are objects of financial fascination around the world. The Fisher effect is a theory about the relationship between the two, basically stating that when one rises, so does the other. The Fisher Effect is an economic hypothesis stating that the real interest rate is equal to the nominal rate minus the expected rate of inflation. It states that, in response to a change in the money supply, the nominal interest rate changes in tandem with changes in the inflation rate in the long run. For example, if monetary policy were to cause inflation to increase by 5 percentage points, the nominal interest rate in the economy would eventually also increase by 5 percentage points.

In order to understand the Fisher effect, it's crucial to understand the concepts of nominal and real interest rates. In the late 1930s, U.S. economist Irving Fisher wrote a paper which posited that a country's interest rate level rises and falls in direct relation to its inflation rates. Fisher mathematically expressed this theory in the following way:

1 + Nominal rate = (1 + Real rate) × (1 + Expected inflation rate)

or, $1 + r = (1 + a) \times (1 + i)$

or, $r = a + i + ai$

The above equation may be approximated by the equation $r = a + i$.

i.e., Nominal interest rate = Real interest rate + Expected inflation rate

The equation states that a country's current (nominal) interest rate is equal to a real interest rate adjusted for the rate of inflation. In this sense, Fisher conceived of interest rates, as the prices of lending, being adjusted for inflation in the same manner that prices of goods and services are adjusted for inflation.

The Fisher equation says, for example, that if the required real return is 3% and expected inflation is 10%, then the nominal interest rate will be about 13% (13.3%, to be exact using).

The logic behind this result is that €1 next year will have the purchasing power of €0.90 in terms of today's money. Thus, the borrower must pay the lender €0.103 to compensate for the erosion in the purchasing power of the €1.03 in principal and interest payments, in addition to the €0.03 necessary to provide a 3% real return.

In equilibrium, then, with no government interference, it should follow that the nominal interest rate differential will approximately equal the anticipated inflation differential between the two currencies, or

$$r_h - r_f = i_h - r_f$$

where and are the nominal home and foreign currency interest rates, respectively. The exact form of this relationship is expressed by the following equation,

$$\frac{1 + r_h}{1 + r_f} = \frac{1 + i_h}{1 + i_f}$$

In effect, the generalized version of the Fisher effect says that currencies with high rates of inflation should bear higher interest rates than currencies with lower rates of inflation.

Consider the following illustration.

Illustration 13

Assume that the real interest rate is 5.5% and the rate of inflation changes from 2.5% to 3.5%. How will the nominal interest rate change?

Solution:

As per Fisher Effect, the nominal interest rate is calculated as follows:

(1 + Nominal Interest Rate) = (1+Real Interest Rate) (1+Inflation Rate)

When inflation rate was 2.5%

Nominal Interest Rate = (1+0.055) (1+0.025) – 1

= (1.055) (1.025) – 1

= 0.081 or 8.1%

When inflation rate was 3.5%

Nominal Interest Rate = (1.055) (1.035) – 1

= 0.092 or 9.2%

Hence, the nominal interest rate will change from 8.1% to 9.2%.

D. The International Fisher Effect

In foreign exchange terminology, the International Fisher Effect is based on the idea that a country with a higher interest rate will have a higher rate of inflation which, in turn, could cause its currency to depreciate. In theoretical terms, this relationship is expressed as an equality between the expected percentage exchange rate change and the interest rate differential.

In other words,

$$\frac{e_1 - e_0}{e_0} = \frac{r_h - r_f}{1 + r_f}$$

Since the divisor approximates 1, the expected percent exchange rate change roughly equals the interest rate differential.

It is based on present and future risk-free nominal interest rates rather than pure inflation, and is used to predict and understand present and future spot currency price movements. In order for this model to work in its purest form, it is assumed that the risk-free aspects of capital must be allowed to free flow between nations that comprise a particular currency pair.

The USD/CAD spot exchange rate is 1.30, and the interest rate of the United States is 5.0%, while that of Canada is 6.0%.

Based on the IFE assumption, the country with a higher interest rate, Canada in this case, will see a higher inflation rate and will experience a depreciation of its currency. The future spot rate is calculated by taking the spot rate and multiplying it by the ratio of the foreign interest rate to the domestic interest rate, as shown below:

1.3 × (1.06/1.05) = 1.312

Given the future spot rate, the International Fisher Effect assumes that the CAD currency will depreciate against the USD. 1 USD will be exchanged into 1.312 CAD, up from the original rate of 1.30. On one hand, investors will receive a lower interest rate on the USD currency, but on the other hand, they will gain from an increase in the value of the US currency.

The Relevance of the International Fisher Effect

In the short term, the International Fisher Effect is seen as an unreliable variable of estimating the price movements of a currency due to the existence of other factors that affect exchange rates. The factors also exert an effect on the prediction of nominal interest rates and inflation.

However, in the long run, the IFE is viewed as a more reliable variable to determine the effect of changes in nominal interest rates on shifts in exchange rates.

Fisher Effect vs. International Fisher Effect

The Fisher effect describes the relationship between interest rates and the rate of inflation. It proposes that the nominal interest rate in a country is equal to the real interest rate plus the inflation rate, which means that the real interest rate is equal to the nominal rate of interest minus the rate of inflation.

Therefore, any increase in the rate of inflation will result in a proportional increase in the nominal interest rate, where the real interest rate is constant.

The International Fisher Effect expands on the Fisher Effect theory by suggesting that the estimated appreciation or depreciation of two countries' currencies is proportional to the difference in their nominal interest rates. For example, if the nominal interest rate in the United States is greater than that of the United Kingdom, the former's currency value should fall by the interest rate differential.

E. Unbiased Forward Rate Theorem

In the absence of government intervention in the foreign exchange market, the spot rate as well as the forward rate are heavily influenced by current expectations of future events. The two rates move in tandem, both reacting to the interest differentials. New information, such as a change in interest rate differentials, is reflected almost immediately in both spot and forward rates.

Suppose a depreciation of the British pound is anticipated. Recipients of British pounds will begin selling the pound forward, and British pound-area U.S. dollar earners will slow their sales of dollars in the forward market. These actions will tend to depress the price of forward British pounds. At the same time, banks will probably try to close out their long (net purchaser) positions in forward British pounds by selling pounds spot. In addition, British pound-area recipients of U.S. dollars will tend to delay converting dollars into British pounds, and earners of British pounds will speed up their collection and conversion of pounds. In this way, pressure from the forward market is transmitted to the spot market, and vice versa.

Ignoring risk, equilibrium will be achieved only when the forward differential equals the expected change in the exchange rate. At this point, there will be no longer any incentive to buy or sell the currency forward. In other words,

$$\frac{f_1 - e_0}{e_0} = \frac{e_1 - e_0}{e_0}$$

This is known as unbiased forward rate theory.

A formal statement of the unbiased forward rate (UFR) condition is that the forward rate should reflect the expected future spot rate on the date of settlement of the forward contract:

$$f_t = e_t$$

where e_t is the expected future exchange rate at time t (units of home currency per unit of foreign currency) and f_t is the forward rate for settlement at time t.

Under the condition of market efficiency, it is possible that risk-averse investors will demand a risk premium on forward contracts, much the same as they demand compensation for bearing the risk of investing in stocks. Hence, in such a case, the forward rate will not reflect exclusively the expectation of the future spot rate.

Exercise

Theoretical Problems

Multiple Choice Questions

1. Arbitrageur in a foreign exchange market
   A. buys when the currency is low and sells when it is high
   B. buys and sells simultaneously the currency with a view to making riskless profit
   C. sells the currency when he has a receivable in future
   D. buys or sells to take advantage of market imperfections.
2. Indirect rate in foreign exchange market means
   A. The rate quoted with the units of home currency kept fixed.
   B. The rate quoted with the units of foreign currency kept fixed.
   C. The rate quoted in terms of a third currency.
   D. None of the above.
3. In foreign exchange markets, 'American Quotation' refers to
   A. Quotation by a US based bank
   B. Quotation in New York foreign exchange market
   C. Quotation in which value of foreign currency is expressed for U.S. dollar
   D. Quotation in which the value of U.S. dollar is expressed per unit of foreign currency
4. The transaction where the exchange of currencies takes place 2 days after the date of the contract is known as
   A. Ready transaction
   B. Value today
   C. Spot transaction
   D. Value tomorrow
5. The buying rate is also known as
   A. Bid rate
   B. Offer rate
   C. Spread
   D. Swap
6. Which of the following is not an assumption of perfect capital market?
   A. No transaction cost.
   B. No taxes.
   C. Complete certainty.
   D. None of the above.
7. Which of the following is a function of foreign exchange market?
   A. Transfer function.
   B. Credit function.

C. Hedging function.

D. All of the above.

8. Which of the following is a currency derivative?

   A. Currency forward.

   B. Currency futures.

   C. Currency swaps.

   D. All of the above.

   Answer:

1	2	3	4	5	6	7	8
B	A	D	C	A	D	D	D

State True or False

1. The difference between buying rate and selling rate is the gross profit for the bank and is known as spread.
2. While calculating the outright forward quote, swap points given in high/low order should be added to the spot rate.
3. Three-point arbitrage occurs when the exchange rates are internally inconsistent.
4. Purchasing Power Parity explains the relationship between inflation rate differential and the expected spot rate.
5. Interest rate parity explains the relationship between interest rate differential and expected spot rate.
6. Uncovered interest rate theory states that expected appreciation or depreciation of a currency is offset by lower or higher interest rate.
7. If domestic interest rates are less than foreign interest rates foreign currency must trade at a forward discount to offset any benefit of higher interest rates in foreign country to prevent arbitrage.
8. According to Fisher Effect nominal interest rate should be equal to real interest rate as reduced by the rate of inflation.

Answer:

1	2	3	4	5	6	7	8
True	False	True	True	False	True	True	False

Fill in the Blanks

1. Spread on forward exchange rate is _________than that on spot exchange rate.
2. _________is the rate at which the Exchange Dealer will sell currency.
3. __________provide the right but not the obligation to buy or sell the underlying.
4. __________ are exchange traded contracts.
5. Currency forwards involves high degree of___________.
6. There are two types of margins – Initial margin and ___________.
7. The price payable to buy an option is called__________.
8. _________refer to the arrangement where principal and interest payments in one currency are exchanged for such payments in another currency.

Answer:

1	higher	2	Offer Rate
3	Currency options	4	Currency futures
5	counterparty risk	6	maintenance margin
7	premium	8	Currency Swaps

Short Essay Type Questions

1. What do you mean by ‘foreign exchange market’? Who are the participants in such market?
2. What are the functions of foreign exchange market?
3. Explain the following terms:
   a) Bid Rate and Ask/Offer Rate,
   b) Direct Quote and Indirect Quote,
   c) Spot Rate and Forward Rate
   d) Cross Rate
4. What do you understand by ‘currency arbitrage’? Differentiate two-point arbitrage from three-point currency arbitrage.
5. What is ‘covered interest arbitrage’? Explain the steps to be taken in covered interest arbitrage.

Essay Type Questions

1. Critically examine ‘purchasing power parity’ theory.
2. Critically examine the ‘interest rate parity’ theory.
3. What do you mean by ‘Fisher effect’ and ‘International Fisher effect’? Is there any relationship between the two? Explain.

Practical Problems

Multiple Choice Questions

1. The 6-month forward rate for US dollar against Rupee is quoted as ₹49.50 as opposed to a spot price of ₹48.85. The forward premium on US dollar is
   A. 1.50 %
   B. 3.08 %
   C. 3.05 %
   D. None of the above.
2. An Indian company is planning to invest in US. The US inflation rate is expected to be 3% and that of India is expected to be 8% annually. If the spot rate currently is ₹45/US $, what spot rate can you expect after 5 years?
   A. ₹56.09/US $
   B. ₹57.00/US $
   C. ₹57.04/US $
   D. ₹57.13/US$

3. The spot and 6 months forward rates of £ in relation to the rupee (₹/£): are ₹77.9542/ 78.1255 and ₹78.8550/9650 respectively. What will be the annualised forward margin (Premium with respect to Ask Price)?

   A. 2.31%

   B. 2.15%

   C. 1.80%

   D. 1.59%

4. The United States Dollar is selling in India at ₹45.20. If the interest rate for a 6-months borrowing in India is 10% and the corresponding rate in USA is 4%, what would be the rate of forward premium/(discount)?

   A. 5.93 %

   B. 5.88 %

   C. (5.17%)

   D. (5.52%)

5. The following various currency quotes are available from a leading Indian Bank:

   ₹/£: ₹75.31/75.33

   £/$: £0.6391/0.6398

   $/¥: $0.01048/0.01052

   The rate at which yen (¥) can be purchased with rupees will be

   A. ₹0.5070

   B. ₹1.5030

   C. ₹1.7230

   D. None of the above

6. The sterling is trading at $1.6400 today. Inflation U.K. is 3.8% and that in U.S.A. is 2.9%. What would be the spot rate ($/£) after 2 years?

   A. $1.6117

   B. $1.615

   C. $1.625

   D. None of the above

7. Given, ₹/£ 81.31/81.33

   £/$: £0.6491/0.6498

   $/¥: $0.01098/0.01102

   The rate at which yen (¥) can be purchased with rupees will be:

   A. ₹1.5270

   B. ₹1.5890

   C. ₹0.5824

   D. ₹0.7824

8. The dollar is currently trading at ₹40. If Rupee depreciates by 10%, what will be the spot rate?

   A. ₹0525

   B. ₹0552

   C. ₹0.0225

   D. ₹0.0522

9. If the following rates are prevailing: Euro/$: 1.1916/1.1925 and $/£: 1.42/1.47 what will be the cross rate between Euro/Pound?

   A. £1.6921/1.730

   B. £1.7530/1.6921

   C. £1.6921/1.1925

   D. £1.7530/1.1916

10. Spot (Euro/Pound) = 1.6543/1.6557 Spot (Pound/NZ $) = 0.2786/0.2800 What is the % Spread on the Euro/Pound rate?

    A. 0.085%

    B. 0.805%

    C. 0.508%

    D. 0.058%

11. The 90 day interest rate is 1.85% in USA and 1.35% in the UK and the current spot exchange rate is $ 1.6/£. The 90-day forward rate is

    A. $ 1.607893

    B. $ 1.901221

    C. $ 1.342132

    D. $ 1.652312

12. BLC Ltd. a valued customer engaged in import business, is in need to remit EURO 1 million to his European exporter. The spot rate of ₹ /US$ is ₹ 65.47/65.57 and that of US$/EURO is $ 0.8053/0.8057. What rate will a banker quote to BLC Ltd. if the bank's margin is 0.50%?

    A. ₹ 53.09

    B. ₹ 53.067

    C. ₹ 53.01

    D. ₹ 52.99

13. An Indian Company is planning to invest in the US. The annual rates of inflation are 8% in India and 3% in USA. If the spot rate is currently ₹ 60.50/$, what spot rate can you expect after 5 years, assuming the inflation rates will remain the same over 5 years?

    A. ₹ 88.89

    B. ₹ 54.95

    C. ₹ 76.68

    (D) ₹ 76.10

14. You are a forex dealer in India. Rates of rupee and pound in the international market are US \$0.01386952 and US \$1.3181401 respectively. What will be your direct quote of £ (pound) to your customer.

    A. ₹54.6987

    B. ₹71.1408

    C. ₹95.0386

    D. ₹0.0105

15. A Ltd., an export customer requested his banker B to purchase a bill for USD 80,000. Calculate the rate to be quoted to A Ltd. if B wants a margin of 0.08%, given that the inter bank rate is ₹/\$ 71.50/10.

    A. ₹ 71.1569

    B. ₹ 71.0431

    C. ₹71.5572

    D. ₹71.4428

16. From the following quotes of a bank, determine the rate at which Yen can be purchased with Rupees.

₹/£ Sterling	75.31 - 33
£ Sterling / Dollar (\$)	1.563 - 65
Dollar (\$) / Yen (¥)	1.048 / 52 [per 100 Yen]

    A. ₹ 124.02

    B. ₹ 142.02

    C. ₹ 412.02

    D. ₹ 214.02

17. The spot and 6 months forward rates of US dollar in relation to the rupee (₹ /\$) are ₹ 74.532/75.4143 and ₹ 75.1278/76.2538 respectively. What will be the annualized forward margin (with respect to Ask price)?

    A. 2.42%

    B. 1.60%

    C. 2.23%

    D. 2.31%

18. MS Ltd. is planning to invest in USA. The annual rates of inflation are 8% in India and 3% in USA. If spot rate is currently ₹ 75-50/\$, what spot rate can the company expect after 3 years?

    A. ₹ 65.49

    B. ₹ 79.16

    C. ₹ 87.04

    D. ₹ 72.00

19. The following various currency quotes are available: ₹ / 1£ 103.0213/ 103.5404 £ /1 \$ 0.7354 / 0.7385 \$ /100 ¥ 0. 8720 / 0. 8810 The rate at which 100 Yen (¥) can be purchased with rupees will be

    A. ₹ 66.40

    B. ₹ 67.03

    C. ₹ 66.06

    D. ₹ 67.37

20. The spot rate is USD 1 = ₹ 75.4035/75.9848. 3 months' swap points are 0.80-0.70. Theforward rates are

    A 74.7035/75.1848

    B. 75.80/75.70

    C. 74.6035/75.2848

    D. 76.2035/76.6848

21. The spot and 3 months' forward rates of US \$ in relation to Rupee (₹ /1 US \$) are ₹ 75.00 / 75.35 and ₹ 74.60/75.05 respectively. What will be the annualized forwarddiscount (with respect to ask price)?

    A. 1.59%

    B. 0.53%

    C. 0.40%

    D. 2.13%

22. An Indian invested USD 1,00,000 in USA when the US\$ was ₹ 72. The investment hasappreciated by 10%, while the US\$ has become stronger by 4%. The investment return in Rupees is

    A. 6%

    B. 5.58%

    C. 14.40%

    D. 9.60%

23. An Indian Company is planning to invest in USA. The annual rates of inflation are 8%in India and 3% in USA. If the spot rate is currently ₹ 73.50/1\$, what spot rate can you expect after 2 years, assuming the inflation rates will remain the same over 2 years?

    A.₹ 66.85

    B. ₹ 80.81

    C. ₹ 70.09

    D. ₹ 77.07

24. X imports goods from USA. X will not do the following as a hedging measure:

    A. Buy call options

    B. Buy currency forward

    C. Buy put options

    D. Buy currency futures

25. The spot rate of the US dollar is ₹ 65.00/USD and the four month forward rate is 65.90/USD. The annualized premium is

    A. 4.2%

    B. 5.1%

    C. 6.0%

    D. 6.4%

26. The following statement is true in the context of rupee-dollar exchange rate with ri denoting interest rate in India and ru denoting interest rate in the US.

    A. Rupee will be at forward discount if ri > ru

    B. Rupee will be at forward premium if ru > ri

    C. Rupee will be forward premium if ri > ru

    D. Rupee will be at par with dollar if ri = ru.

27. The price of a bond just before a year of maturity is \$10,000. Its redemption value is \$10500 at the end of the that period. Interest is \$700 p.a. The Dollar appreciates by 2% during the that period. The rate of return would be----

    A. 12%

    B. 12.5%

    C. 13.25%

    D. 14%

28. Arbitrage pricing theory model helps to

    A. Reduce risk

    B. Eliminate arbitrage

    C. Identify the equilibrium asset price

    D. None of the above

29. In July, the one year interest rate is 4% on Swiss Francs and 13% on US dollars. If the current exchange rate SFr 1=\$0.63, what is the expected future exchange rate in one year?

    A. \$ 0.5561

    B. \$ 0.6845

    C. \$ 0.8542

    D. \$ 0.8283

30. Between 2000 and 2015, the ¥/\$ exchange rate moved from ¥226.63 to ¥93.96. During this same 15 year period, the consumer price index (CPI) in Japan rose from 91.0 to 119.2 and the US CPI rose from 82.4 to 152.4. If PPP held over this period, what would the ¥/\$ exchange rate have been in 2015?

    A. ¥ 140.13

    B. ¥ 152.15

    C. ¥160.51

    D. ¥ 180.18

31. The 90-day interest rate is 1.85% in USA and 1.35% in the UK and the current spot exchange rate is \$1.6/£. The 90-day forward rate is-

    A. \$1.607893

    B. \$ 1.901221

    C. \$ 1.342132

    D. \$ 1.652312

32. The current spot rate for the U.S. dollar is ₹ 66. The expected inflation rate is 6.5% in India and 3% in USA. The expected rate of dollar a year hence is –

    A. ₹ 72.33

    B. ₹ 72.12

    C. ₹ 69.33

    D. ₹ 66.89

33. The following rates are prevailing: Euro/\$:1.1916/1.1925 and \$/£:1.42/1.47 what will be the cross rate?

    A. 1.6921/1.7530

    B. 1.7530/1.6921

    C. 1.6921/1.1925

    D. 1.7530/1.1916

34. The following rates appear in the foreign exchange market:

    How many dollars should a firm sell to get ₹ 5 crore after 2 months?

    A. \$105500

    B. \$106500

    C. \$107500

    D. \$108500

Answer:

1	2	3	4	5	6	7	8	9	10
D	C	B	B	A	A	C	C	A	A
11	12	13	14	15	16	17	18	19	20
A	A	C	C	B	A	C	C	D	C
21	22	23	24	25	26	27	28	29	30
A	C	B	C	A	B	A	C	B	C
31	32	33	34						
A	D	A	C						

Comprehensive Numerical Problems

1. The following quotes are available.

    Spot (AUD/CAD) : 0.7940/0.8007

    Three-month swap points : 25/20

    Six-month swap points : 30/25

    Calculate the three-month and six-month outright forward rates.

    [Answer: 0.7915/0.7987; 0.7910/0.7982]

2. You are given the following information.

   Spot AUD/CAD : 0.7940/0.8007

   Three-month swap : 25/35

   Spot GBP/CAD : 1.8215/1.8240

   Three-month swap : 35/25

   Calculate the three-month GBP/AUD rate.

   [Answer: 2.2606/2.2755]

3. As a dealer in the bank, you observed the following quotes in the market:

   $/₹ 45.30/45.45

   GBP/₹ 82.70/82.96

   Euro/₹ 57.00/57.05

   Compute the cross rates for £/$ and Euro/$.

   [Answer: £/$:1.8196/1.8313; Euro/$: 1.2541/1.2594]

4. Fill the blanks in the following table.

Country	USD	AUD	GBP	CAD	CHF	Euro
US$	-	? (a)	1.8313	0.7623	0.8026	1,2594
Australia (AUD)	1.2895	-	2.3615	0.9829	? (b)	1.6240
Britain (GBP)	0.6877	0.4235	-	? (c)	0.4383	0.6877
Canada (CAD)	? (d)	1.0174	2.4025	-	1.0533	1.6522
Switzerland (CHF)	1.2459	0.9622	2.2816	0.9497	-	-
Germany (EUR)	0.7940	? (e)	? (f)	1.6522	0.6373	-

   [Answer: (a) 0.7755; (b) 1.0350; (c) 0.4162; (d) 1.3119; (e) 0.6158; (f) 1.4541]

5. You are told that the spot rate is £/$ 1.8313.

   The expected inflation rates in the UK and the US for the next three years are given below.

Year	UK Inflation (%)	US Inflation (%)
1	2.10	1.60
2	2.15	1.65
3	2.25	1.70

   Calculate the expected £/$ spot rate after three years.

   [Answer: $1.8037/£]

6. You are given the following information.

   Spot rate : $ 0.7940 per Euro

   3-month forward rate : $ 0.7945 per Euro

   The inflation rate in Germany is 1.3%.

   Calculate the inflation rate in the USA assuming that Purchasing Power Parity holds good even in the short run.

   [Answer: 1.057%]

7. The spot rate is ₹45.00 per \$. inflation rate in India and USA are expected to be 5.4% and 1.6% respectively. What is the expected rate of depreciation of the Rupee?

   [Answer: 3.51%]

8. A trader buys a put option in euros at an exercise price of \$1.2480 per euro. The contract size is €62,500 and the option premium is \$0.02 per euro. Calculate the profit/ loss for various prices at expiration clearly showing out-of-money, at-money, in-the-money positions. Determine the break-even spot rate.

9. The spot quotation placed by a bank in New York is \$0.6650 - 0.6662/C\$. On the same day a bank in Toronto made the spot quotation C\$1.5030-1.5040/\$. Is there any arbitrage opportunity?

10. Suppose the current inflation rate in USA is 7%, while it is 5% in France. The initial value of euro quoted from New York is \$1.2400. What would you expect the spot rate to be one year after? Show that the inflation rate differential is equal to expected change in the spot rate.

    [Answer: \$1.2636]

11. Suppose the interest rate on pound sterling is 9% in the UK, while that of a compatible dollar investment is 5% in the USA, the spot rate is \$1.8860 per pound, and the one year forward rate is. \$1.8280 per pound. Calculate the forward premium or discount. State which currency is at forward premium and which one is at a forward discount. Also explain to which country the funds will move.

    [Answer: Pound is in forward discount at 3.08%; USA to UK]

References:

1. Kim. & Kim. (2006); Global Corporate Finance (6e); Blackwell Publishing

2. Shapiro & Moles (2014); International Financial Management; Wiley

3. Jacque (2014); International corporate Finance; Wiley

Foreign Exchange Risk Management 16

This Module Includes:

16.1 Transaction Exposure

16.2 Translation Exposure

16.3 Operating Exposure

Foreign Exchange Risk Management

SLOB Mapped against the Module

To develop a detail understanding of the sources and impact of risks to which an organisation is exposed to in a dynamic business environment at national and international level and the techniques for managing the same to sustain competitive advantages. (CMLO 3b, 3c)

Module Learning Objectives:

After studying this module, the students will be able to -

- Learn the techniques for measurement and management of transaction exposure
- Learn the techniques for measurement and management of translation exposure
- Learn the techniques for measurement and management of operating exposure

Transaction Exposure

16.1

Introduction

Exchange rate risk or exchange rate exposure emanates from fluctuations in the foreign exchange rate. A firm that is engaged in any transactions with foreign entities is subject to this exposure. These transactions include exports, imports, borrowing, lending, portfolio investment and direct investment. Currency rate fluctuations affect the value of assets and liabilities arising out of these transactions and consequently revenues and costs are also subject to this risk.

Exchange rate fluctuations can affect not only firms which are directly engaged in international trade. Purely domestic firms may also subject to this risk. An Indian leather goods manufacturer who sources only domestic materials and sells exclusively in the Indian market with no foreign currency receivables or payables, will certainly be exposed to foreign exchange risk if it competes against imports, say, from Chinese leather goods manufacturer.

This is because as Chinese yuan will depreciate against Indian Rupee, the Rupee price of Chinese goods will come down increasing their sales in India, thus harming the Indian manufacturer.

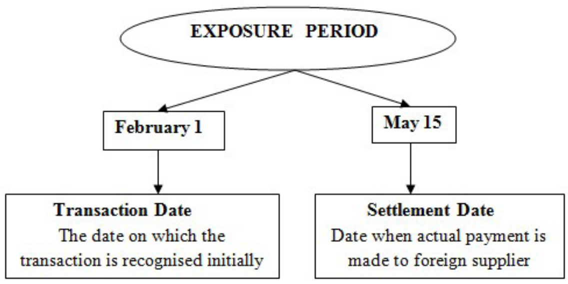
Thus, management of foreign exchange risk must be given utmost priority by firms operating internationally or facing foreign competitors.

In this context, the following sections of the Module discuss about measurement and management of three different types of exchange rate exposure namely Transaction Exposure, Translation Exposure and Economic Exposure.

16.1.1 Transaction Exposure

Meaning: Transaction risk refers to the effect of exchange rate movement associated with the time-gap between the date of the transaction and the date on which the consideration is settled. These generally occur at operational level.

Explanation: When a business entity concludes a purchase or sale of an asset with a customer outside India, a transaction take place. Transaction risk occurs when there is a time gap between date of the sale (or purchase) of goods and the date of receipt (or payment) of proceeds.



For example, a transaction takes place on Feb. 1 but the settlement (payment of consideration) takes place on 15th May. While the transaction (and hence the receivable or payable) is recorded on Feb. 1 at the prevailing exchange rate, the actual receipt or payment leading to settlement takes place on and is recorded on May 15, at the exchange rate prevailing on May 15. Since these two rates may not be the same, risk arises. In the above example, the difference in exchange rates between 1st Feb. And 15th May represents transaction risk.

16.1.2 Management of Transaction Exposure

The techniques used for management of transaction exposure can be categorized into two classes: (A) Internal techniques and (B) External techniques. These are explained below:

A. Internal Techniques for Management of Transaction Exposure

The major techniques for Management of Transaction Exposure are:

a) Choice of a particular currency for invoicing receivables and payables

b) Leading and lagging

c) Exposure Netting

d) Back-to-back credit swap

e) Sharing risk

The above techniques are called internal as the firm does not have to take recourse to any external agency or market to apply these techniques. These techniques are some internal arrangements either between different subsidiaries of the a single MNC or between two transacting but unrelated companies.

a) Choice of a particular currency for invoicing

A very simple way of eliminating the transaction exposure is to invoice all receivables and payables in the domestic currency. Invoice in home currency or foreign currency in respect of an export and whether, to receive invoices home currency or foreign currency in respect of an import would depend on which way the currency is expected to move. The Rule is simple. "In the case of export, you should select that currency (home or foreign) which would lead to higher Rupee realisation. In the case of import you should select the currency (home or foreign) which would lead to a lower Rupee outflow." The following snapshot should help:

Foreign Currency	Export Invoicing	Import Invoicing
Appreciates	Foreign currency	Home currency
Depreciates	Home currency	Foreign currency

b) Leading and Lagging

A firm will accelerate or delay receipt from or payment to foreign counter parties, depending upon what is beneficial to it in the context of the movement in exchange rate. In case, home currency is expected to depreciate, an importer would like to expedite or lead payments of the payables due. On the other hand, in the same situation, an exporter will be better off by delaying or lagging the receipts in foreign currency.

For example, suppose a firm has payables of US$1,00,000 due in one month. Anticipating appreciation of rupee against dollar it delays payment to 3 months. If the rates after one month and three months turn out to be ₹ 66 per dollar and ₹ 65.50 per dollar respectively, the firm will save ₹ 50,000 [1,00,000 (66.00 - 65.50)] bydelaying payments. Of course, it will have to negotiate with its counter party and as a result, the savings will beless than ₹ 50,000. Let us suppose that the counter party agrees to delay the settlement if it as paid US $1,00,500 instead of US $1,00,000. Therefore, the Indian firm will effectively be paying ₹ 6,582,750. Still the firm saves ₹ 17,250 (100000 × 66 - 100500 × 65.50).

c) Exposure Netting

Netting: Netting is a process under which debit balances are netted off against credit balances, so that only the net amounts remain due to be paid in actual currency flows. Very clearly, this is not a tool for managing exchanging risks. The objective here is to save on transaction costs, by netting off inter company balances, before payment is arranged.

i) **Bilateral Netting:** In this arrangement, only two entities are involved. The lower balances are netted off against higher balances, and the remainder is paid or received.

ii) **Multi-lateral Netting:** This process is adopted mostly among three or more subsidiaries (or outfits) in the same group (under one control). The procedure is slightly more complex than bilateral netting, but the essential idea is the same. The arrangement is generally coordinated by the Group's treasury operations department, at its Group Headquarters.

d) Back-to-Back Credit Swap

Under this method, two companies, located in two different countries, agree to exchange loans in their respective currencies. Loans are given for a pre-specified fixed period at a pre-specified exchange rate. On maturity, the sums are again re-exchanged. This arrangement can work effectively between MNCs of two different countries, each having subsidiaries in the country of the other. For example, Hitachi (an MNC of Japan) has a subsidiary in USA while Procter & Gamble (an MNC of USA) has a subsidiary in Japan. The subsidiary of Mitsubishi located in USA needs to raise a dollar loan whereas the subsidiary of Microsoft located in Japan needs yen loan. Each parent company can advance loans to the subsidiary of the other in the former's home currency. The loan amount is equivalent in the two currencies. (US dollar and Japanese yen). After the period of loans is over, the sum will again be re-exchanged. Thus, the two companies have been able to manage their exchange risk internally.

e) Sharing Risk

Any two companies from two different countries can practice this technique. The basic principle underlying this technique is that both the parties will share the loss arising out of unfavorable movement of foreign exchange rate. This may be achieved by denominating the transaction partly in each of the domestic currencies of the parties involved. This way, the exposure for both the parties gets reduced.

For example, suppose, a French aircraft manufacturing company has sold aircrafts to a UK company. One way is to invoice the whole sales price of €10 million in euros. In this case the French company will shift the entire exchange risk to the UK Company. Alternatively, the sales can be invoiced as £7 million. This means that the exchange risk is now totally shifted to the French company. The third possibility is that the sales be invoiced as €5 million plus £3.5 million. This arrangement enables both the parties to share the exchange risk.

B. External Techniques for Management of Transaction Exposure

The major external risk management techniques include:

a) Hedging through Currency Forward Market

b) Hedging through Money Market

c) Hedging through Currency Options Market

d) Hedging through Currency Futures Market

These techniques are called External Techniques simply because the various instruments that are used are external to a business organisation. In order to avail these techniques, the company needs to enter into a contractual agreement with an external agency.

The techniques are discussed below:

a) Hedging through Currency Forward Market

In order to hedge its transaction exposure, a company having a long position in a currency (having a receivable) will sell the currency forward, i.e., go short in the forward market, and a company having a short position in a currency (having a payable) will buy the currency forward, i.e., go long in the forward market.

The idea behind buying or selling a currency in the forward market is to lock the rate at which the foreign currency transaction takes place, and hence, the costs or profits.

For example, if an Indian firm is importing computers from the USA and needs to pay $1,00,000 after 3 months to the exporter, it can book a 3-month forward contract to buy $1,00,000. If the 3-month forward rate is ₹ 62.50per $, the cost to the Indian firm will be locked at ₹ 62,50,000. Whatever be the actual spot price at the end of three months, the firm needs to pay only the forward rate. Thus, a forward contract eliminates transaction exposure completely.

The cost of a forward hedge can be measured by the opportunity cost, which depends on the expected spot rate at which the currency needs to be bought or sold in the absence of the forward contract. Hence, the cost of a forward hedge is measured as the difference between the forward rate and the expected spot rate for the relevant maturity. In an efficient market, as mentioned earlier, the forward rate is an unbiased predictor of the future spot rate. The process equating these two requires the speculators to be risk-neutral. Hence, when the markets are efficient and the speculators are risk-averse, the cost of hedging through the forward market will be nil.

Consider the following example.

An Indian importer has bought goods worth $6,00,000 from an American company. The payables are due in three months. The US dollar has a tendency to appreciate. The rates available are as follows:

Spot rate: ₹ 64.00/$

3-m forward rate: ₹ 65.50/$

The value of payables on the date of transaction between the Indian and the American company is ₹ 32 million($5,00,000 × ₹ 64/$), but the importer will have to pay more than this amount, if US dollar appreciates during the three months that remain before settlement. To avoid this uncertainty, the importer covers his payables by buying US dollars in forward market. Once he does so, the value of his payable becomes ₹ 32.75 million($5,00,000 × ₹ 65.50/$).

After the import transaction, he waits for 3 months and then he pays ₹ 32.75 million to the foreign exchange dealer to receive $500,000 which he pays to the American company. By covering in the forward market, he has ensured that he has to pay neither more nor less than ₹ 32.75 million.

Suppose the spot rate on the date of settlement turns out to be ₹ 66.00/$. It is easy to see that by buying forward, the importer has made a notional gain of ₹ 0.50 per dollar. In other words, his total notional gain is ₹ 2,50,000 (500,000 × 0.50).

Instead of appreciation, if dollar actually depreciates to ₹ 63.80/$ on the date of settlement. In that case, the importer made a notional loss of ₹ 0.20/$ (₹ 64 - ₹ 63.80) if compared with the spot exchange rate as it was on the date of transaction and a much bigger loss of ₹ 1.70/$ (₹ 65.50 - ₹ 63.80) if compared with the forward rate.

However, as explained in the previous example, notional gains or losses are only post-event exercises. The main purpose of hedging was to reduce uncertainty about the amount in rupees to be paid out for the imports.

That amount is ₹ 32.75 million, neither more nor less, with no uncertainty whatsoever.

b) Hedging through Money Market

Money markets can also be used for hedging foreign currency receivables or payables. Let us say, a firm has a dollar payable after three months. It can borrow in the domestic currency now, convert it at the spot rate into dollars, invest those dollars in the money markets, and use the proceeds to pay the payable after three months. This process locks the exchange rate at which the firm needs to buy dollars. At the same time, it knows its total cost in advance in the form of the principal and interest it needs to repay in the domestic markets.

Consider the following example.

A French exporter has an exposure of £1 million in the form of receivables. The following money market data are given:

3-m interest rate:

Euro: 5.5% p.a.

Pound Sterling: 8% p.a.

Spot exchange rate: €1.4120/£

The process of money market hedge will be as follows:

Step 1: Borrow a sum of pound sterling at 8% p.a. interest for three months such that this sum become £1million along with the interest after 3 months. Say, the borrowed amount is B. Thus,

B (1 + 0.08 × 3/12) ÷ £1 million

B = £1/1.02 = £0.98039 million

Step 2: Sell this borrowed sum of pound sterling in the spot currency market at the rate of €1.4120/£ to get euros. The amount in euros is going to be £0.98039 × €1.4120/£ million = €1.3843 million

Step 3: Place €1.3843 million for 3 months in the money market at the rate of 5.5% p.a. Thus, at the end of 3 months, the amount that the French exporter will have is:

€1.3843 × (1 + 0.055 × 3/12) million

= €1.4033 million

Step 4: Refund the loan and interest combined that works out to be £l million as soon as this amount is received from the British company. It is clear that irrespective of the movement of the exchange rate, the exporter will have a definite amount of €1.4033 million. There is no uncertainty about this amount. This has been possible due to hedging in money market.

c) Hedging Through Options

Options can prove to be a useful and flexible tool for hedging transaction and translation exposure. A firm having a foreign currency receivable can buy a put option on the currency, having the same maturity as the receivable. Conversely, a firm having a foreign currency payable can buy a call option on the currency with the same maturity.

Hedging through options has an advantage over hedging through forwards or futures. While the latter fixes the price at which the currency will be bought or sold, options limit the downside loss without limiting the upside potential. That is, since the firm has the right to buy or sell the foreign currency but not the obligation, it can let the option expire by not exercising its right in case the exchange rates move in its favour, thereby making the profits it would not have made had it hedged through forwards or futures, but this advantage does not come free, because of this feature, options generally cost more than the other tools of hedging.

Consider the following example.

A German company has payables of \$10 million due to be paid in one month. The company wants to hedgethis exposure by using a call option. The data are as follows:

Spot exchange rate: \$1.20/€

Option strike price: \$1.19/€

Maturity: One month

Option premium: 2.5%

The German company knows that the dollar has tendency to appreciate in near future. So, it buys call option for the underlying dollar amount of \$10 million. For this, it pays the premium upfront, which works out to be:

€0.025 × 10/1.20 million

= €0.2083 million

On the maturity date, different scenarios can be as follows:

Situation 1: Dollar does appreciate against euro and the spot rate on the settlement date is \$1.175/€

The company exercises its call option and buys required amount of dollars at the rate of \$1.19/€. Thus, the total sum paid by the company is

€10/1.19 + Premium already paid

= €8.4034 + €0.2083 million

= €08.6117 million

Situation 2: Dollar does appreciate against euro and the spot rate on the settlement date is \$1.19/€

The company is said to be indifferent between exercising and abandoning its call option. In either situation, it will pay €10/1.19 + Premium already paid

= €8.4034 + €0.2083 million

= €8.6167 million

Situation 3: Dollar depreciates against euro and the spot rate on the settlement date is \$1.21/€

The company abandons its call option and buys required amount of dollars directly from the exchange market.

The total outgo in euro works out to be

€10/1.21 + Premium paid on call option

= €8.2645+ €0.2083 million

= €8.4728 million

Thus, the company does not have to pay more than 08.6167 irrespective of the degree of appreciation of dollar, but it benefits from the favorable movement (depreciation) of dollar.

d) Hedging Through Currency Futures

Another way to hedge exposure is through futures. The rule is the same as in the forward market, i.e., go short in futures if you are long in the currency and vice versa. Hence, if an importer needs to pay \$5,50,000 after four months, he can buy dollar futures for the required sum and maturity. Futures can be similarly used for hedging translation exposure. Hedging through futures has an effect similar to hedging through forward contracts, As the gain/loss on the futures contract gets cancelled by the loss/gain on the underlying transaction, the exposure gets-almost eliminated. Here it is assumed that basis remains constant. Only a small part of the exposure is left due to the mark-to-market risk on the futures contract. The main difference between hedging through forwards and through futures is that while under a forward contract the whole receipt/payment takes place at the time of maturity of the contract, in case of futures, there has to be an initial payment of margin money, and further payments/receipts during the tenure of the contract on the basis of market movements.

Consider the following example.

An American company expects to receive €6 million in December from its European client. Euro is likely to depreciate against dollar between now and settlement date. The exchange data available now are as follows:

Spot rate: \$1.200/€

December euro futures: \$1.196/€

The American company decides to hedge its exposure in futures market. The standard size of euro futures is€125000. The number of euro futures needed for hedging the exposure is:

€6000000/€l25000 = 48

The number of euro futures required being an exact number, it is clear that the hedge ratio is 1 and the full amount of €6 million can be hedged.

The American company sells 48 December euro futures by depositing guarantee margin and follows daily movement of futures. It honours margin call whenever required or withdraws excess amount from its margin account.

On 20 December, it decides to close the futures contract by a reverse operation. The rates on 20 December are:

Spot rate: \$1.1925/€

December futures: \$1.1890/€

It is clear that the American company suffered a loss on spot market as the rate has come down from \$1.20/€to \$1.1925/€. But on the future market, it makes a gain as the futures which was sold at \$1.196 is trading at a lower rate of \$1.1890/€.

The loss on spot market = \$6 million × (1.200 - 1.1925) =\$0.045 million

The gain on Futures = \$6 million × (1.196 - 1.189) = \$0.042 million

Thus, a part of the loss suffered on spot market has been compensated by the gain on futures market. The hedge efficiency is 93 per cent (0.042/0.045).

Translation Exposure

16.2

16.2.1 Meaning of Translation Exposure

While transaction exposure arises out of day-to-day activities of the firm, translation exposure arises due to the need to translate the foreign currency values of assets and liabilities into the domestic currency. Translation of the balance sheet items from their value in foreign currency to that in domestic currency is done in order to consolidate the accounts of various subsidiaries. Therefore, translation exposure is also called Consolidation Exposure or Balance Sheet Exposure.

Suppose, an Indian parent company has a subsidiary in the UK. In the beginning of the year, the UK subsidiary has plant and machinery, inventory and cash valued at £400,000, £200,000 and £40,000 respectively. The exchange rate is ₹65 per pound. Therefore, the translated value of these assets is ₹41,600,000. At the end of the year, the assets are $420,000 (plant and machinery), $210,000 (inventory) and $20000 (cash) respectively. At the exchange rate of ₹66 per pound, the translated value becomes ₹42,900,000. Thus, there is a translation "gain" of ₹1,300,000 on asset side of the balance sheet. Similarly, there must have been a translation "loss" on liabilities of the subsidiaries such as, debts-denominated in pounds.

It may be noted in this context that the above gain and loss is only notional and there is no real inflow or outflow of cash as the assets and liabilities are not liquidated in practice.

16.2.2 Translation Rules

There are four methods of foreign currency translation**.** These are as follows:

a) **Current/Non-current Method:** The basic principle behind the current/non-current method is that assets and liabilities are translated on the basis of their maturity. Under the current/non-current method, all current assets and current liabilities of foreign affiliates are translated into the parent currency at current exchange rates. All noncurrent assets, non-current liabilities, and owners' equity are translated at historical exchange rates. Hence, under this method, there will be a translation gain (loss) if the foreign currency (the currency in which the subsidiary keeps its books) appreciates (depreciates) in case the subsidiary has net positive working capital.

b) **Monetary/Non-monetary Method:** As per this method, all monetary items of balance sheet of a foreign subsidiary are translated at the current exchange rate while all the non-monetary items in the balance sheet, including equity, are translated at the historical exchange rate. The income statement items, under this method, are translated at the average exchange rate for the accounting period.

c) **Temporal Method:** Under generally accepted accounting principles of historical accounting in the United States, the temporal method produces essentially the same results as the monetary/non-monetary method. The only difference is that under the monetary/non-monetary method, inventory is always translated at the historical rate. Under the temporal method, inventory is usually translated at the historical rate, but it could be translated at the current rate if inventory is carried at market prices or at replacement costs.

d) **Current Rate Method:** The current-rate method is the simplest; all assets and liabilities are translated at the current rate. Existing equity accounts such as common stock and paid-in capital are translated at the historical rate.

16.2.3 Management of Translation Exposure

The risk of translation exposure can be effectively managed by the following strategies:

(a) Balance Sheet Hedge

A balance sheet hedge involves the selection of the currency in which exposed assets and liabilities are denominated so that an exchange rate change would make exposed assets equal to exposed liabilities. In order to do so, a company must maintain the same amount of exposed assets and exposed liabilities in a particular currency. Thus, a devaluation would affect both types of balance sheet accounts equally leading to a situation where gain in one will get offset by loss on the other. When an MNC has several subsidiaries, a variety of funds-adjustment techniques can be used to reduce its translation loss. These techniques require the company to adopt the following two basic strategies:

i) The company must decrease soft-currency assets and increase soft-currency liabilities.

ii) The company must increase hard-currency assets and decrease hard-currency liabilities.

Hard currencies are those currencies that are likely to appreciate; soft currencies are those currencies that are likely to depreciate. Thus, if the company thinks that the local currency is likely to depreciate, it should reduce local-currency assets and/or increase local-currency liabilities to generate local-currency cash. In order to reduce translation exposure, these local-currency funds must be converted into hard-currency assets. This conversion can be accomplished, either directly or indirectly, by a variety of funds-adjustment techniques. Direct funds-adjustment techniques include pricing exports in hard currencies and imports in the local currency, investing in hard-currency securities, and replacing hard-currency loans with local-currency loans.

(b) Indirect Funds Adjustment Methods

A variety of indirect funds-adjustment methods can be used to reduce foreign-currency exposure. These are as follows:

- **Exposure Netting** (Refer to discussion in Module 16.1.2)
- **Leading and Lagging** (Refer to discussion in Module 16.1.2)
- **Transfer Pricing:** Transfer prices are prices of goods and services sold between related parties, such as a parent and its subsidiary. Transfer prices are frequently different from arm's length prices (fair market prices) so that they can be used to avoid foreign-currency exposure. For example, an MNC can remove funds from soft-currency countries by charging higher transfer prices on goods sold to its subsidiaries in those countries. For the same reason, an MNC can keep funds at those subsidiaries in hard-currency countries by charging lower prices on goods sold to its subsidiaries in those countries. Governments usually assume that MNCs manipulate their transfer prices to avoid financial problems or to improve financial conditions. Thus, most governments set up policing mechanisms to review the transfer pricing policies of MNCs.

Operating Exposure

16.3

16.3.1 Meaning of Operating Exposure

Operating exposure emanates from those items which have an impact on cash flows but whose values are not contractually defined, as is the case of transaction exposure. Some examples of operating exposure are as follows:

a) A deal for buying or selling of goods is under negotiation. The price of goods being negotiated may be affected by fluctuations in the exchange rate.

b) If a part of raw material is imported, the cost of production will increase following a depreciation of the home currency.

c) Domestic inflation will increase input costs of the firm even if there is no change in the exchange rate. This will adversely affect its competitiveness vis-a-vis the firms of other countries.

d) Tender submitted for a contract remains an item of operating exposure until the award of contract. Once the contract is awarded, it becomes transaction exposure.

e) Interest cost on working capital requirements may increase if money supply is tightened following a depreciation of the home currency.

Unfavourable movement in exchange rate will affect future revenues as well as costs and hence operating profits of the firms. Consequently, these effects the long-term prospect and competitiveness of firms. This is why operating exposure is also called **Strategic Exposure**. It influences the long-term business decisions such as production, marketing, sources of supply and location of production facilities etc.

The two cash-flow exposures—operating exposure and transaction exposure—combine to equal a company's economic exposure. In technical terms, economic exposure is the extent to which the value of the firm, as measured by the present value of its expected cash flows, will change when exchange rates change.

16.3.2 Management of Operating Exposure

The risk of economic exposure can be hedged either by operational strategies or currency risk mitigation strategies.

a) Diversifying Production Facilities and Markets for Products

Diversifying the production facilities and sales to a number of markets rather than concentrating on one or two markets would mitigate the risk inherent. However, in such cases, the companies have to forego the advantage earned by economies of scale.

b) Choosing Currency Zones

Avoidance of inflexible currency zones and locating production and sales in many currency zones with high currency diversification benefit may help to minimize economic exposure.

c) Sourcing Flexibility

Companies may have alternative sources for acquiring key inputs. The substitute sources can be utilized in case the exchange rate fluctuations make the inputs expensive from one region.

d) Flexible Manufacturing

Creation of flexible manufacturing systems that allow rapid product differentiation for acquiring greater control over foreign currency prices and faster introduction of new products in overseas markets may also help firms to manage economic exposure. In addition, development of production systems that can promptly respond to product changes and can be used to tailor products to unique niches in the market place and also reduce the sensitivity of products to foreign currency price changes as well as provide the means to exploit exchange rate changes.

e) Diversifying Financing

A company can have access to capital markets in a number of major regions. This enables the company to gain flexibility in raising capital in the market with the cheapest cost of funds.

f) Making R&D effort for product differentiation

R&D activity aims at strengthening competitive position of a firm against the adverse effect of exchange rate changes. R&D can bring about gains in productivity, reduction in costs and, most importantly, differentiation in products that the firm offers. New or differentiated products have inelastic demand. That is, their demand is not or less sensitive to price variations. Price inelasticity would make the firm immune to economic exposure.

g) Hedging through financial products

Though various ways outlined above will be necessary for effective management of economic exposure, financial products should be used as supplements as far as possible. The firm can use forward, futures or option contracts. These contracts can be rolled over several times, if the situation so demands. Also, the firm can borrow and/or lend foreign currencies on long-term basis.

Additional Illustrations

1. On 25th March 2023, a customer requested his bank to remit DG 12,50,000 to Netherlands in payment of import of diamonds under an irrevocable LC. However due to bank strikes, the bank could affect the remittance only on 2nd April 2023. The inter-bank market rates were as follows:

Date	25.03.2023	02.04.2023
Bombay [$ / ₹100]	2.2873 - 2.2962	2.3063 - 2.3159
London [US$/Pound]	1.9120 -1.9135	1.9050 - 1.9070
DG /Pound	4.1125 - 4.1140	4.0120 - 4.0130

The bank wishes to retain an exchange margin of 0.25%. How much does the customer stand to gain or lose due to the delay?

Solution:

1. **Determination of Rupee Value of DG 1 on 25.03.**2023

Process: Buy US $ at Ask Rate at Bombay ⇒ Buy Pound (using US $) at Ask Rate at London ⇒ Sell Pound at Bid Rate for DG

Therefore, ₹ / DG = Ask Rate at Bombay (for Purchase of Dollar) × Ask Rate for Pound at London (for Purchase of Pound) × Bid Rate for DG (for conversion of Pound into DG)

= 100/2.2873 × 1.9135 × (1/4.1125)

= ₹20.34 per DG

2. Determination of Rupee Value of DG 1 on 02.04.2023

Process: Buy US $ at Ask Rate at Bombay ⇒ Buy Pound (using US $) at Ask Rate at London

⇒ Sell Pound at Bid Rate for DG

Therefore, ₹/DG = Ask Rate at Bombay (for Purchase of Dollar) × Ask Rate for Pound at London (for Purchase of Pound) × Bid Rate for DG (for conversion of Pound into DG)

= 100/2.3063 × 1.9070 × (1/ 4.0120)

= ₹20.61 per DG

3. Loss because of Delay

(a) Loss without considering Banker's Margin (Extra Money payable by the Company)

= Amount Payable × (Exchange Rate on the date of a ctual payment - Exchange Rate on the date on which payable)

= DG 12,50,000 × (₹20.61 – ₹20.34) = ₹3,37,500

(b) Banker's Margin on Loss

= ₹3,37,500 × 0.25% = ₹ 844

(c) Total Loss to the Company

= ₹3,37,500 + ₹844 = ₹3,38,344

2. Evaluation of Forward Premium – Encashing Foreign Currency Deposits – The following 2 – way quotes appear in the foreign exchange market –

	Spot Rate	2-Months Forward
₹/ US $	₹46.00/ ₹46.25	₹47.00/ ₹47.50

Required –

(a) How many US Dollars should a firm sell to get ₹25 Lakhs after two months?

(b) How many Rupees is the firm required to pay to obtain US $2,00,000 in the spot market?

(c) Assume the firm has US $ 69,000 current account's earning interest. ROI on Rupee Investment is 10% p.a. should the firm encash the US $ now, 2 months later?

Solution:

1. **(a) US dollars for ₹25 Lakhs in the forward Market**

Action	Sell Foreign Currency in Forward Market
Relevant Rate	Forward Bid Rate = ₹47.00
US $ Required to get ₹25,00,000	₹25,00,000 ÷ ₹47.00 = US $ 53,191.49

(b) Rs. Required to obtain US dollars 2,00,000 in the Spot Market

Action	Buy Foreign Currency in Spot Market
Relevant Rate	Spot Ask Rate = ₹46.25
Rupees Required to obtain US$2,00,000	US $ 2,00,000 × ₹46.25 = ₹92,50,000

(c) Evaluation of Investment in Rupees

Forward Premium (For Bid Rates)

= (Forward Rate ₹47 – Spot Rate ₹46)/ Spot Rate ₹46 × 12/2 × 100 = 13.04%

Observation and conclusion: Annualized Forward Premium for Bid Rates (13.04%) is greater than the Annual Return on Investment in Rupees (10%). Therefore, the firm should not encash its US $ balance now. It should sell the US $ in the forward market and enc ash them two months later.

Alternatively,

Particulars	**Encash Now**	**Encash 2 Months Later**
Relevant Rate	Spot Bid Rate = ₹46.00	Forward Bid Rate = ₹47.00
₹ available for US $ 69,000	₹31,74,000	₹32,43,000
Add: Interest for 2 Months (if converted now)	₹52,900 (31,74,000 × 10% × 2/12)	Not Applicable
Amount Available after Two Months	**₹32,26,900**	**₹32,43,000**

Conclusion: Encashing two months later yields higher Rupee Return than encashing now and investing in Rupee Deposits. Therefore, the firm should wait for two months to encash under forward market.

3. Ankita Papers Ltd (APL), on 1st July 2023 entered into a 3 Month forward contract for buying GBP 1,00,000 for meeting an import obligation. The relevant rates on various dates are-

Date	Nature of Quote	Quote
01.07.2023	Spot	₹ 81.50 - 81.85
	3-Month Forward	₹ 81.90 - 82.30
01.08.2023	Spot	₹ 82.10- 82.40
	2-Month Forward	₹ 82.25 - 82.60
01.09.2023	Spot	₹ 81.70 - 82.05
	1-Month Forward	₹ 82.00 - 82.30
	2-Month Forward	₹ 82.40 - 82.70
01.10.2023	Spot	₹ 82.50 - 82.75

	1-Month Forward	₹ 82.60 - 82.90

Explain the further course of action if APL—

(A) Honours the contract on

- 01.10.2023
- 01.09.2023; and meets the import obligation on the same date.

(B) Cancels the contract on —

- 01.08.2023
- 01.09.2023
- 01.10.2023; as the import obligation does not materialize.

(C) Rolls over the contract for --

- 2 Months on 01.09.2023
- 1 Month on 01.10.2023; as the import obligation gets postponed to 01.11.2023. Also determine the cost/ gain of that action. Ignore transaction costs.

Solution:

A. APL Honours the Contract

On (Date)	Action	Cost/ Gain
01.10.2023	No Further Action	NIL
01.09.2023	• Original deal (Buy Contract) should be cancelled. • **Sell Forward:** Therefore, APL should enter into a 1-Month Forward Contract for sale of GBP 1,00,000 at ₹82.00 (Forward Bid Rate) for reversal of original contract. • **Settlement of Difference:** Net difference between the original contract and the new contract should be settled i.e., GBP 1,00,000 × (3-Month Buy Rate (Ask Rate) as on 01.07.2023 ₹82.30 Less 1-Month Sell Rate (Bid Rate) as on 01.09.2023 ₹82.00) = ₹30,000 to be paid to the Banker. • **Buy Spot:** Buy GBP 1,00,000 at Spot Ask Rate of ₹82.05 and settle the import obligation.	Cost of Settlement ₹30,000.

B. APL Cancels the Contract

On (Date)	Action	Cost/ Gain
01.08.2023	• Original deal (Buy Contract) should be cancelled. • **Sell Forward:** Therefore, APL should enter into a 2-Month Forward Contract for sale of GBP 1,00,000 at ₹82.25 (Forward Bid Rate) for reversal of original contract. • **Settlement of Difference:** Net difference between the original contract and the new contract should be settled i.e., GBP 1,00,000 × (3-Month Buy Rate (Ask Rate) as on 01.07.2023 ₹82.30 Less 2-Month Sell Rate (Bid Rate) as on 01.08.2023 ₹82.25)	Cost of Cancellation ₹5,000.

	= ₹5,000 to be paid to the Banker.	
01.09.2023	⅄ Original deal (Buy Contract) should be cancelled. ⅄ **Sell Forward:** Therefore, APL should enter into a 1- Month Forward Contract for sale of GBP 1,00,000 at ₹82.00 for reversal of original contract. ⅄ **Settlement of Difference:** Net difference between the original contract and the new contract should be settled i.e. GBP 1,00,000 × (3-Month Buy Rate (Ask Rate) as on 01.07.2023 ₹82.30 Less 1-Month Sell Rate (Buy Rate) as on 01.09.2023 ₹82.00) = ₹30,000 to be paid to the Banker.	Cost of Cancellation ₹30,000.
01.10.2023	⅄ Original deal (Buy Contract) should be cancelled. ⅄ **Sell Spot:** Therefore, APL should sell GBP 1,00,000 at the Spot Bid Rate of ₹82.50 for reversal of original contract. ⅄ **Settlement of Difference:** Net difference between the original contract and the spot sale contract should be settled i.e., GBP 1,00,000 × (3-Month Buy Rate-(Ask Rate) as on 01.07.2023 ₹82.30 Less Spot Bid Rate as on 01.10.2023 ₹82.50) = (₹20,000) i.e., ₹20,000 to be received from the Banker.	Gain on Cancellation ₹ 20,000.

C. APL Rolls Over the Contract for a further period of Two Months

On (Date)	Action	Cost / Gain
01.09.2023	⅄ Original deal (Buy Contract) should be cancelled. ⅄ **Sell Forward:** Therefore, APL should sell GBP 1,00,000 at the 1-Month Forward Bid Rate of ₹82.00 for reversal of original contract. ⅄ **Settlement of Difference:** Net difference between the original 3-Month Forward Buy Contract and 1-Month Forward Sell Contract should be settled i.e., GBP 1,00,000 × (3-Month Buy Rate (Ask Rate) as on 01.07.2023 ₹82.30 **Less** 1-Month Sell Rate (Bid Rate) as on 01.09.2023 ₹82.00) = ₹30,000 i.e., **₹30,000 to be paid to the Banker.** ⅄ **Buy Forward:** APL should buy GBP 1,00,000 at 2-Month Forward Ask Rate of ₹82.70.	Cost of Roll Over ₹30,000.
01.10.2023	• Original deal (Buy Contract) should be cancelled. • **Sell Spot:** Therefore. APL should sell GBP 1,00,000 at the Spot Bid Rate of ₹82.50 for reversal of original contract. • **Settlement of Difference:** Net difference between the original 3-Month Forward Buy Contract and the Spot Bid Rate of ₹82.50 should be settled i.e. GBP 1,00,000 × (3-Month Buy Rate (Ask Rate) as on 01.07.2023 ₹82.30 **Less** Spot Bid Rate as on 01.10.2023 ₹82.50) = (₹20,000) i.e., **₹20,000 to be received from the Banker.**	Gain on Roll Over ₹20,000.

	• **Buy Forward:** APL should buy GBP 1,00,000 at 1-Month Forward Ask Rate of ₹82.90.	

4. Sunny Ltd. (SL), have exported goods to UAE for Arab Emirates Dirham (AED) 5,00,000 at a credit period of 90 days. Rupee is appreciating against the AED and SL is exploring alternatives to mitigate loss due to AED Depreciation. From the following information, analyze the possibility of Money Market Hedge —

Foreign Exchange Rates		
	Bid	Ask
Spot	₹11.50	₹ 11.80
3-Month Forward	₹11.20	₹ 11.40

Money Market Rates		
	Deposit	Borrowings
AED	9%	12%
Rupees	8%	10%

Solution:

Facts: SL will sell AED 5,00,000 in 3 Months

Evaluation: Money Market Hedge is possible only if the 3-Month Forward Rate is lower than value of Spot Bid in the next 3 Months (computed by applying AED Borrowing Rate and Rupee Deposit Rate).

Value of Spot Bid

In 3 Month's Time $= \text{Spot Bid Rate} \times \dfrac{(1+\text{Rupee Deposit Rate for 3 Months})}{(1+\text{AED Borrowing Rate for 3 Months})}$

$$= 11.50 \times \frac{(1+8\%\text{ p.a. for 3 Months})}{(1+12\%\text{ p.a. for 3 Months})}$$

$= ₹11.50 \times (1+0.02) \div (1+0.03)$

$= ₹11.388$

$= ₹11.39$

Value of Spot Bid ₹11.39 in 3 Month's time > Forward Bid Rate of ₹11.20

⇒ Therefore, there is a possibility for Money Market Hedge

Inference: ⇒ AED 5,00,000 Receivable is an Asset

⇒ Under Money Market Hedge, liability in AED should be created

⇒ SL should borrow AED for 3 Months, which along with interest would amount to AED 5,00,000 in 3 Months.

Action	Date	Activity
Borrow	Now	Borrow an amount of AED at 12% p.a. for 3 Months so that, the total liability including interest for 3 months, is AED 5,00,000. ⇒ AED 5,00,000 ÷ (1 + Interest Rate for 3 Months) ⇒ AED 5,00,000 ÷ (1 + 12% × 3 Months/12 Months) ⇒ AED 5,00,000 ÷ 1.03 = AED 4,85,436.8932 should be borrowed.
Convert	Now	Convert AED 485436.8932 into Rupees at Spot Rate (Bid Rate since AED is sold) ⇒ AED 4,85,436.8932 × ₹11.50 = ₹55,82,524

Invest	Now	Invest ₹55,82,524 in Rupee Deposit for 3 Months at 8% p.a.
Realize	3 Months hence	Realize the maturity value of rupee deposit. Amount received will be - ⇒ ₹55,82,524 × (1 + Interest Rate for 3 Months) ⇒ ₹55,82,524 × (1 + 8% × 3 Months/ 12 Months) ⇒ ₹55,82,524 × (1 + 0.02) = ₹55,82,524 × 1.02 = ₹56,94,175
Receive	3 Months hence	Receive the AED 5,00,000 from the customer abroad.
Repay	3 Months hence	Repay the AED Loan using the money received from the customer abroad. Amount Payable = Amount Borrowed AED 4,85,436.8932 × (1 + 12% p.a. for 3 Months) = AED 4,85,436.8932 × 1.03 = AED 5,00,000.

Amount Saved by Utilizing Money Market Hedge

Action: Enter into a 3-Months Forward Sale Contract for sale of AED 5,00,000 at ₹ 11.20. Sell AED 5,00,000 3 Months from now at ₹11.20

Effect: Amount in ₹ in hand in 3 Months = AED 5,00,000 × ₹ 1 1.20 = ₹56,00,000

Amount Saved under Money Market Hedge

Under Money Market Hedge is	₹ 56,94,175
Less: Under Forward Contract is	₹ 56,00,000
Amount Saved	₹ 94,175

Conclusion: Hedging risks using Money Market Operations will be advantageous to SL.

5. Good Morning Ltd., London will have to make a payment of US $ 3,64,897 in six month's time. It is currently 1st October. The company is considering the various choices it has in order to hedge its transaction exposure.

Exchange rates:

Spot rate	$1.5617 – 1.5773
Six-month forward rate	$1.5455 – 1.5609

	Borrow(%)	Deposit(%)
US	6	4.5
UK	7	5.5

Foreign currency option prices (1 unit is £ 12,500):

Exercise Price	Call option (March)	Put option (March)
$1.70	$ 0.037	$ 0.096

By making the appropriate calculations and ignoring time value of money (in case of Premia) decide which of the following alternative is preferable by the company?

(a) Forward market;

(b) Cash (Money) market;

(c) Currency options.

Solution:

Relevant Rule for Conversion: Based on nature of Quote (Direct or indirect)

Nature of Quote	Buying-Foreign Currency (Converting - Home Currency into Foreign Currency)	Selling Foreign Currency (Converting Foreign Currency into Home Currency)
Direct Quote, relevant rate is	Ask Rate	Bid Rate
Indirect Quote, relevant rate is	1 ÷ Bid Rate	1 ÷ Ask Rate

(a) Forward Market:

Particulars	Computation	Amount ($)
Amount Payable	Given	$ 3,64,897
Amount under Forward Contract	$ 3,64,897 ÷1.5455 (Forward Bid Rate)	£2,36,103

(b) Cash Money Market

1. **Requisite:** Money Market Hedge is possible only in case of difference in rates of interest for borrowing and investing.
2. **Activity Flow:**

   Borrow: Borrow Sterling equivalent of money at 7% p.a. for 6 Months for investing.

   Convert: Convert the money borrowed in Sterling to US $ at Spot Rate (**Bid)**

   Invest: Invest US $ so converted in Dollar Deposits at 4.5% p.a. for 6 Months

   Realize: Realize the Deposit including Interest and use the proceeds to settle the liability.
3. **Cash Flow:**

Particulars	Amount
Amount Payable After 6 Months	US $ 3,64,897
Amount to be Invested at 4.5% p.a. for realizing US $ 3,64,897 = US $ 3,64,897 ÷ (1 + Interest Rate of 4.5% p.a. × 6/12) = $ 3,64,897 ÷ 1.0225	US $ 3,56,867
Amount be borrowed = Amount to be invested in US $ 3,56,867 ÷ 1.5617(Spot Bid Rate)	£2,28,512
Interest payable on money borrowed @ 7% p.a. for 6 Months = 2,28,512 × 7% × 6 Months / 12 Months	£ 7,998
Total Amount Payable (Amount Borrowed £ 2,28,512 + Interest £ 7,998)	£2,36,510

(c) Currency Options

Payment is to be made in Pounds after 6 months, hence Put option to sell Pounds is relevant.

Number of Options Contract

- Value of one Options Contract = Value per unit × Exercise price
  = £ 12,500 × 1.70
  = £21,250
- Number of Contracts to be purchased = Amount payable in 6 month's time ÷ Value per contract
  = 3,64,897 ÷ 21,250

= 17.17 Contracts

Alternative 1:

17 Options Contracts are undertaken and the balance through Forward Contract.

- Value covered under Options = 17 Contracts × $ 21,250 per Contract
  = $ 3,61,250
- Value under Forward Contract = Amount payable after 6 months - Value under Options
  = $ 3,64,897 - $ 3,61,250
  = $3,647

Cash Flows under Options

Particulars	Amount
Value of Forward Contract in £ = ($ 3,647 ÷ 1.5455)	£ 2360
Premium Payable [$0.096 × 17 × 12,500 = $ 20,400 = $ 20,400 ÷1.5617 (Spot Bid Rate)	£ 13,063
Value of the 17 Options Contract [17 × 12,500]	£2,12,500
Total Outflow under Options	£ 2,27,923

Alternative 2:

18 Option Contracts are undertaken and the excess Dollars are sold in the Forward Market

- Value covered under Options = 18 Contracts × $ 21,250 per Contract
  = $ 3,82,500
- Value sold under Forward Contract = Amount payable after 6 months - Value under Options
  = $3,64,897 - $ 3,82,500
  = $17,603

Cash Flows under Options

Particulars	**Amount**
Value of Forward Contract in £ = ($ 17,603 ÷ 1.5609)	£ 11,277
Premium Payable [$0.096 × 18 × 12,500 = $ 21,600 = $21,600 ÷ 1.5617 (Spot Bid Rate)	£ 1,3831
Value of the 18 Options Contract [18 × 12,500]	£ 2,25,000
Total Outflow under Options	£ 2,27,554

Conclusion: The Cash outflow under Options is the lowest and hence it may be undertaken.

6. Following are the details of cash inflows and outflows in foreign currency denominations of M Co., an Indian export firm, which have no foreign subsidiaries —

Currency	Inflow	Outflow	Spot rate	Forward rate
US $	4,00,00,000	2,00,00,000	48.01	48.82
French Franc (F Fr)	2,00,00,000	80,00,000	7.45	8.12
UK £	3,00,00,000	2,00,00,000	75.57	75.98
Japanese Yen	1,50,00,000	2,50,00,000	3.20	2.40

(a) Determine the net exposure of each foreign currency in terms of Rupees.

(b) Are any of the exposure positions off-setting to some extent?

Solution:

1. Computation of Net Exposure

Particulars	US $	F Fr	UK £	Japan Yen
Inflow (in Lakhs)	400.00	200.00	300.00	150.00
Less: Outflow	(200.00)	(80.00)	(200.00)	(250.00)
Net Exposure (Foreign Currency Terms)	200.00	120.00	100.00	(100.00)
Spot Exchange Rate	48.01	7.45	75.57	3.20
Net Exposure (in Rupee Terms based on Spot Exchange Rate)	9602 [200 × 48.01]	894 [120 × 7.45]	7557 [100 × 75.57]	(32) [100 × 3.20/10]

Particulars	US $	F Fr	UK£	Japan Yen
Forward Rate [₹/ FC]	48.82	8.12	75.98	2.40
Less: Spot Exchange Rate [₹/ FC]	48.01	7.45	75.57	3.20
Forward Premium / (Discount)	0.81	0.67	0.41	(0.80)
Net Exposure in Rupee Terms based on extent of uncertainty represented by Premium/ (Discount)	162.0 [200 × 0.81]	80.4 [120 × 0.67]	41.0 [100 × 0.41]	(8.0) [(100) × (0.8)/10]

2. Off Setting Position:

(a) Net Exposure in all the currencies is offset by better forward rates. In the case of USD. F Fr and UK Pound, the net exposure is receivable, and the forward rates are quoted at a premium for these currencies.

(b) In case of Japanese Yen, the net exposure is payable, and the forward rate is quoted at a discount. Therefore, a better forward rate is also offsetting the net payable in Japanese Yen.

7. Proactive Ltd. imports some specialty instruments from Japan and exports the finished product to US. The company has a payable of ¥ 500 million and a receivable of $10 million three months hence. The following exchange rates are available in the market:

	$/₹	¥/₹
Spot Rate	46.65/85	0.4065/0.4 11 5
3m forward	46.90/15	0.4218/0.4268

The current interest rate scenario is as follows:

Maturity	Rupee (%)	Dollar (%)	Yen (%)
3-m	8.0/9.0	6.00/6.50	0.4/0.5

The company is considering to cover the exposures either through the forward market or through the money market.

You are required to advise the company which alternative should be better for covering both the payables and receivables.

Solution:

Payable of ¥500 million after 3 months:

Covering through forward market:

Rupee outflow	= ¥ 500 million × 0.4268 ¥ per ₹	= ₹213.40 million

Covering through money market:

Borrow rupee, convert into yen spot and invest for 3 months.

Yen to be invested	= 500/ (1 + 0.004/4)	= ¥499.500 million
Rupee amount to be borrowed	= ¥499.500 million × 0.4115¥ per ₹	= ₹205.5443 million
Rupee amount repayable	= ₹205.5443 × (1 + 0.09/4)	= ₹210.1690 million

So, we see outflow through money market is lower than the forward market cover. So, money market cover is preferable.

Receivable of $10 million after 3 months:

Covering through forward market:

Rupee inflow	= $10 million × ₹46.90 per $	= ₹469 million

Covering through money market:

Borrow $, convert into rupee spot and invest for 3 months.

$ amount to be borrowed	= 10/ (1 + 0.08/4)	= $9.80 million
Rupee inflow at spot	= $9.80 million × ₹46.65 per $	= ₹457.353 million
Rupee inflow after 3 months	= 457.353 (1 + 0.08/4)	= ₹466.300 million

So, forward cover is preferable.

8. A customer with whom the bank had entered into 3 month's forward purchase contract for Swiss Francs 10,000 at the rate of ₹ 27.25 comes to the bank after 2 months and requests cancellation of the contract. On this date, the rates, prevailing, are:

   Spot: CHF 1 = ₹ 27.30/27.35

   One month forward: ₹ 27.45/27.52

   What is the loss/gain to the customer on cancellation?

   Solution:

Forward contract cancelled at the one month forward sale rate of	₹ 27.52
Francs bought from customer under original forward contract	₹ 27.25
Francs sold to customer on cancellation of forward contract	₹ 27.52
Net amount payable by customer per Franc (27.52 - 27.25)	₹ 0.27

At ₹0.27 per Franc, exchange difference for CHF 10,000 is ₹2,700 is payable by the customer for cancellation of forward contract.

Solved Case Study

In January 1985, Lufthansa purchased twenty 737 jets from Boeing for a total cost of USD 500,000,000 to be paid on delivery of the jets in January 1986. The US dollar had been continuously rising since about mid-1981 and had reached approximately DEM 3.2 by January 1985. This represented a substantial exposure with a potential for a huge cash loss if the dollar continued to rise. Herr Heinz Ruhnau, the Chairman of the airline believed (with many others) that the dollar had peaked and would shortly turn down. One-year forward dollar could be purchased at approximately DEM 3.2. Put options on DEM (call options on USD) at a strike price of DEM 3.2 could be bought for a total premium amounting to about 6% of the contract value or DEM 96 million. What should he have done? Among the choices available to him were:

1. Be very conservative. Cover the whole payable forward.
2. Trust his instincts. Leave it completely unhedged, buy 500 million dollars spot in January 1986.
3. Take a limited risk. Cover partially e.g., buy half forward, leave half open.
4. Buy put options on DEM or call options on USD, go with your instinct but protect yourself on the downside, of course at a cost, viz. the up-front option premium.
5. Buy US dollars now and hold them in a deposit for a year to settle the payable, that is, money market cover.

The case is analyzed as follows:

1. Full forward cover is the most conservative no-risk approach. It would involve a payment of DEM 1.6 billion on delivery of the aircraft.
2. Remaining completely unhedged is the maximum risk alternative. The DEM outlay would be 500 S_T million where S_T is the spot USD/DEM rate at the time of settling the payment.
3. Cover 50%, leave the rest open. The DEM outflow on settlement would have been (800 + 250 S_T) million.
4. The put option is a little complicated. If the dollar remains at or above 3.2 DEM, the DEM cost would be 1696 million—1600 million to buy the 500 million dollars at DEM 3.2 per dollar, plus the premium payment of DEM 96 million. (We are ignoring the financing cost of the premium which would have to be paid up-front in January 1995.) If the dollar falls below 3.2, the cost would be ($500S_T + 96$) million for $S_T < 3.2$. It would have been better than full forward cover if dollar had fallen to 3.008 or lower, and better than 50% forward cover if it had fallen below 2.816.
5. The money market cover would have required that Lufthansa borrow the spot equivalent of USD 500 million in January 1995. Due to some strict covenants in its existing debt, the amount and currency of additional debt it could take on were severely restricted. Also, this option would probably have worked out to be almost equivalent to a forward purchase.

   Lufthansa's management ultimately opted for strategy (3), viz. 50% forward cover and rest left open. As it turned out, the dollar had fallen to DEM 2.3 by January 1986. The DEM outflow was thus 1.375 billion. With alternative (2), that is, no hedge at all, it would have been 1.150 billion and with a put option, 1.246 billion. With hindsight, Mr. Ruhnau's handling of the situation could be criticized as to why he did not go with his instinct that the dollar had peaked. But given the magnitude of the exposure and the high degree of uncertainty, such criticism would not be justified.

Exercise

Theoretical Problems

Multiple Choice Questions

1. The firm producing and selling in domestic market may face following risk when the economy is opened
   A. Transaction risk
   B. Translation risk
   C. Operating risk
   D. Both (a) and (b) above
2. Hedging through 'currency of invoicing' results in
   A. The exporter covering forex exposure
   B. The importer covering forex exposure
   C. Both exporter and importer covering forex exposure
   D. Either exporter or importer covering forex exposure
3. Which of the following is an internal hedging technique?
   A. Leading
   B. Netting
   C. Swap
   D. Both (a) and (b) above
4. Hedge ratio is the
   A. Ratio of futures to a spot position that achieves an objective such as minimizing risk
   B. Ratio of spot position to futures position that achieves an objective such as minimizing risk
   C. Ratio of spot position to option position that achieves an objective such as minimizing risk
   D. Ratio of basis to a spot position that achieves an objective such as minimizing risk
5. Which of the following is not an appropriate hedging strategy for a likely devaluation of a currency?
   A. Reduce the level of cash.
   B. Tighten credit term to decrease account receivables.
   C. Reduce borrowing in the currency.
   D. Delay account payables.

Answer:

1	2	3	4	5
C	B	D	A	C

State True or False

1. Exposure netting is an external technique of managing transaction exposure.
2. Under Current Non-current method of transaction, all non-current assets are translated under historical exchange rate.
3. Under Monetary/Nonmonetary method, inventory is always translated at the current rate.
4. A balance-sheet hedge involves the selection of the currency in which exposed assets and liabilities are denominated.
5. Under Multilateral Netting more than two members of the MNC group are involved.

Answer:

1	2	3	4	5
False	True	False	True	True

Fill in the Blanks

1. Hedging through forward contracts is an ______ technique of managing transaction exposure.
2. Leading and lagging is an ________ technique of managing transaction exposure.
3. Transfer pricing is an important tool for managing __________ exposure.
4. Economic exposure is the combination of transaction and ________ exposure.
5. Ensuring flexible manufacturing is an example of managing _______ exposure.

Answer:

1	external	2	internal
3	operating	4	operating
5	operating		

Short Essay Type Questions

1. What do you mean by Transaction Exposure?
2. What do you mean by Translation Exposure?
3. What do you mean by Operating Exposure?
4. Name the internal techniques of managing transaction exposures.
5. What is Balance Sheet Hedge?

Essay Type Questions

1. Discuss the internal techniques of management of transaction exposure.
2. Discuss the external techniques of management of transaction exposure.
3. Discuss the various rules of translation.
4. Explain different methods of management of translation exposure.
5. Discuss the methods of managing operating exposure.

Practical Problems

Multiple Choice Questions

1. An Indian company's cost of production is ₹20/unit while its export price is $ 1/ unit. If the $ appreciates by 10% and the spot rate today is ₹40 per $, what is the impact of transaction exposure?

   A. Increase in profit by ₹4 per unit.

   B. Decrease in profit by ₹4 per unit.

   C. No change in profit.

   D. Insufficient data.

2. The foreign exchange market prices for US dollar ($) against Indian rupees (₹) are quoted as under:

	Buying	Selling
Spot	₹65.30	₹65.50
Three months' forward	₹66.35	₹67.20

   Calculate the cost of the forward cover.

   A. 8.15%

   B. 8.17%

   C. 8.20%

   D. 8.22%

3. In September, 2021, X Ltd. assessed the March, 2022 spot rate for pound sterling at the following rates:

$/Pound	1.30	1.35	1.40	1.45	1.50
Probability	0.15	0.20	0.25	0.20	0.20

   What is the expected spot rate for March, 2022?

   A. $1.385

   B. $1.395

   C. $1.405

   D. $1.415

Answer:

1	2	3
A	D	C

Comprehensive Numerical Problems

1. RB Alliance sold Omani Rial 3,22,500 value spot to your customer at ₹167.43 per OMR & covered yourself in UK stock exchange on the same day, when the exchange rates were

   GBP 1 = OMR 0.4901 - 0.4941

   Local inter-bank market rates for GBP were

   Spot GBP 1 = ₹80.71 - 80.86

   Calculate cover rate and ascertain the profit or loss in the transaction. Ignore brokerage.

   [Answer: Cover rate ₹164.9867 per OMR; Profit to bank ₹7,87,964]

2. HDIL Ltd. is a listed real estate development company in India, with significant operations in the Mumbai Metropolitan Region has an export exposure of HKD 12,00,000 payable August 31, 2021. Hong Kong Dollar (HKD) is not directly quoted against Indian Rupee.

   The current spot rates are:

   GBP/INR ₹82.05

   GBP/HKD: HKD 9.93

   It is estimated that Hong Kong Dollar will depreciate to 10.89 level and Indian Rupee to depreciate against GBP to ₹84.83.

   Forward rates for August 2021 are

   GBP/INR: ₹86.33

   GBP/HKD: HKD 10.77

   Required:

   i. Calculate the expected loss, if the hedging is not done. How the position will change, if the firm takes forward cover?

   ii. If the spot rates on August 31, 2021 are:

      GBP/INR = ₹82.09

      GBP/HKD = HKD 9.99

      Is the decision to take forward cover justified?

   [Answer: (i) Loss without hedging ₹5,67,720; (ii) Loss under Forward cover ₹2,96,400; Forward cover is justifiable; Expected loss on August 31, 2021 ₹54,720]

3. A company is considering hedging its foreign exchange risk. It has made a purchase on 1st. January, 2021 for which it has to make a payment of British Pound GBP 73,500 on September 30, 2021. The present exchange rate is 1 GBP £ = ₹82.3953. It can purchase forward 1 GBP at ₹81.5375. The company will have to make a upfront premium of 2% of the forward amount purchased. The cost of funds to the company is 11% per annum and the rate of corporate tax is 45%. Ignore taxation. Consider the following situations and compute the Profit/ Loss the company will make if it hedges its foreign exchange risk:

   i. If the exchange rate on September 30, 2021 is ₹84.5000 per £.

   ii. If the exchange rate on September 30, 2021 is ₹83.0000 per £.

   [Answer: (i) Net gain ₹87,996; (ii) Total loss ₹2,37,424]

4. An Indian importer has a payable of £100,000. The seller has given the Indian importer the following two options:

   i. Pay immediately with a cash discount of 1% on the payable,

   ii. Pay after 3 months with interest at 4% p.a.

   The borrowing rate for the importer in Rupees is 12% p.a. The following are the exchange rates as on December 02, 2021.

£/₹ Spot	₹74.76/80
3-month forward	38/40

   Which of the above two options is advisable for the importer?

   [Answer: Option 1: Outflow ₹76,27,356; Option 2: Outflow ₹75,95,200]

5. An exporter in UK is expecting to receive Euro 1 million after 3 months. He has collected the following information from his banker.

Euro/£Spot	1.5778/80
3 months forward	1.5770/72

   3-months interest rates (p.a.)

Euro	4.5% - 5%
£	6% - 6.5%

   Which of the following would you recommend for covering the exposure?

   i. Forward market

   ii. Money market.

   [Answer: Forward market inflow £ 634035; Money market inflow £ 635278.29]

References:

1. Apte., P.G., International financial Management (Third Edition); Tata McGraw Hill
2. Shapiro & Moles; International Financial Management (Nineth Edition); Wiley
3. Kim & Kim; Global Corporate Finance (Sixth Edition); Blackwell

SECTION - E

DIGITAL FINANCE

Digital Finance 17

This Module Includes:

17.1 Meaning, Traditional Finance vs. Digital Finance

17.2 Digital Finance Ecosystem

17.3 Regulation and Governance in a Digital Finance Environment

Digital Finance

SLOB Mapped against the Module

To obtain an overview of various components of digital finance to better understand the interrelationship among them. (CMLO 1a, b, c)

Module Learning Objectives:

After studying this module, the students will be able to -

- Understand the meaning of digital finance.
- Understand the difference between traditional and digital finance.
- Appreciate, in detail, various components of digital finance.
- Appreciate the regulatory framework and governance issues in a digital finance environment.

Meaning, Traditional Finance vs. Digital Finance

17.1

Introduction

Financial services are the lifeblood of an economy, enabling households and businesses alike to buy, save, invest, and protect themselves against risk. Yet in many emerging economies today, larger section of individuals and small businesses lack the access to basic financial services. Around two billion people in the developing world lack access to a bank, and 200 million small businesses cannot get the credit they need to grow, a gap estimated at $2.2 trillion.

The solution for the above problem can be summed up in two words **Digital Finance**.

17.1.1 Meaning of Digital Finance

Digital finance is the delivery of traditional financial services digitally, through devices such as computers, tablets and smartphones. In other words, digital finance is the term used to describe the impact of new technologies on the financial services industry.

According to Gomber, Koch, and Siering (2017), digital finance encompasses a magnitude of new financial products, financial businesses, finance-related software, and novel forms of customer communication and interaction - delivered by FinTech companies and innovative financial service providers.

While there is no standard definition of digital finance, there is some consensus that digital finance encompasses all products, services, technology and/or infrastructure that enable individuals and companies to have access to payments, savings, and credit facilities via the internet (online) without the need to visit a bank branch or without dealing directly with the financial service provider.

While technological innovation in finance is not new, investment in new technologies has substantially increased in recent years with the pace of innovation in technologies being exponential. Artificial intelligence, social networks, machine learning, mobile applications, distributed ledger technology, cloud computing and big data analytics have given rise to new services and business models to be used by established financial institutions and new market entrants. Accordingly, digital finance is increasingly becoming a new idea to be analyzed and experimented separately.

17.1.2 Traditional Finance vs. Digital Finance

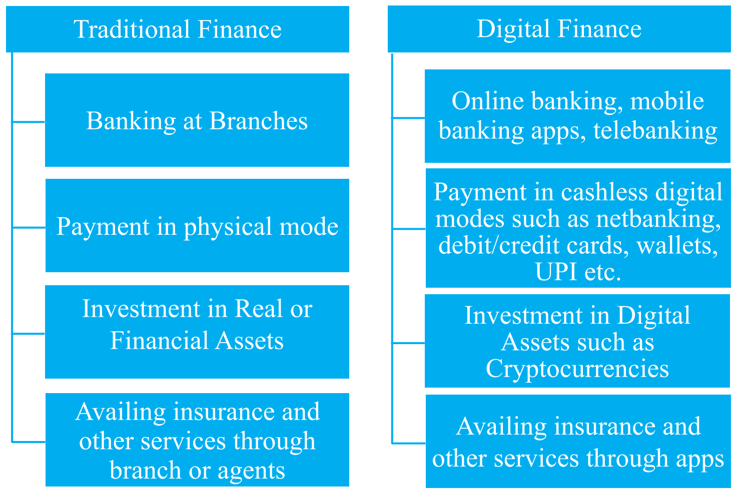


Figure 17.1: From Traditional Finance towards Digital Finance

Though digital finance aims to provide the same services as were offered by traditional finance through a brick-and-mortar bank and insurance company or other financial service provider, it surely overpowers the latter in terms of reach, ease of access and affordability.

Through digital intervention, financial services have expanded even to the most remote areas of a country where setting up a physical facility may not be profitable for the financial service providers. High rate of internet and mobile penetration have made it possible. This has truly contributed to the financial inclusion drives of the nations.

Financial services supported by digital technology offers improved user experience and ease of access. In most of the cases, a minimum internet quality and a smartphone are sufficient to access the services. User interface is extremely simple and easy to use. These have facilitated faster adoption of digital platforms.

Quite understandably, shifting to digital modes in providing the traditional financial services has significantly reduced the cost. The savings in cost of operations has been passed on to the customers which has increased the affordability of the services.

In addition to the above, digital finance has led to the advent of a new breed of assets, known as Digital Assets in form of Non-Fungible Tokens and Cryptocurrencies which are attracting significant investment and may prove to be a source of diversification benefits in the long run.

In yet another dimension, digital finance is showing great potential in form of central bank digital currency which may eventually replace physical currency and thereby lead to a digital economy at large. This has the potential of doing away with many limitations of physical currency including the problems of counterfeit currency, black money and terror financing etc.

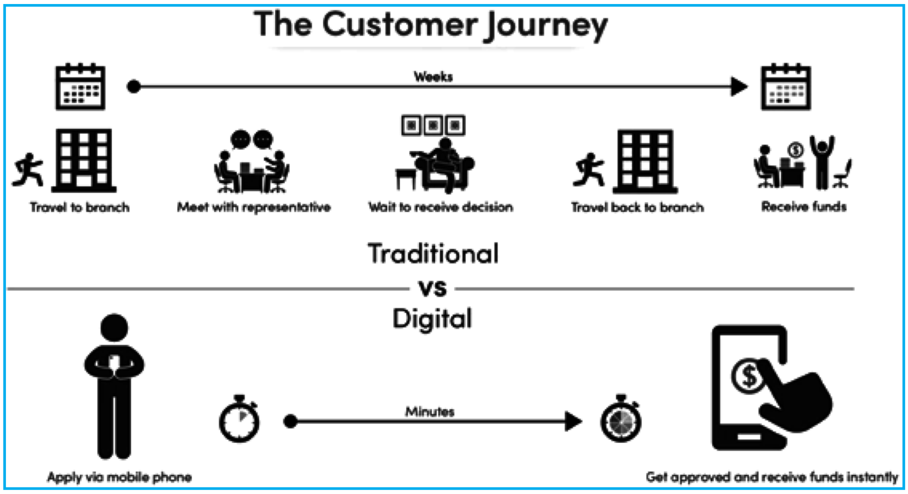


Figure 17.2: The Customer Journey (Availing Credit) – Traditional vs. Digital Finance

17.1.3 Benefits of Digital Finance

Digital finance offers a whole host of benefits.

a. Digital finance promises to boost the gross domestic product (GDP) of digitalized economies by providing convenient access to diverse range of financial products and services including credit facilities for individuals as well as small, medium and large businesses. This significantly increases aggregate expenditure thereby improving GDP figures. Digital finance can also lead to greater economic stability and increased financial intermediation, both for customers and for the economy.

b. Innovation in digital finance can have long-term positive effects for banking performance. In a study, Scott et al. (2017) have showed that adoption of SWIFT, a network-based technological infrastructure and set of standards for worldwide interbank telecommunication, has significant positive impact on bank's profitability in the long run in 29 countries across USA and Europe. They also have found that these profitability effects are greater for small banks than for large banks.

c. Digital finance also benefits governments by providing a platform to facilitate increase in aggregate expenditure which subsequently generates higher tax revenue arising from increase in the volume of financial transactions.

d. Digital finance also benefits the money market regulators. This is because full-scale digital finance adoption can significantly reduce the circulation of counterfeit currency and instances of money laundering etc.

e. Through adoption of digital finance users enjoys benefits like greater control of personal finance, quick financial decision making, and the ability to make and receive payments within seconds.

f. Digital finance has the potential to provide affordable, convenient and secure banking services to poor individuals in developing countries. Recent improvement in the accessibility and affordability of digital financial services around the world has helped millions of poor customers move from cash-based transactions to formal digital financial transactions on secured digital platforms.

g. Digital finance can also lead to greater financial inclusion, expansion of financial services to non-financial sectors, and the expansion of basic services to individuals since nearly most of the people in the developing world already own a mobile phone.

Digital Finance Ecosystem

17.2

The term 'ecosystem' is generally used in biological sciences. However, now-a-days it is being increasingly adopted in business literature as well. As per Collin's English Dictionary, 'ecosystem' is defined as 'all the plants and animals that live in a particular area together with the complex relationship that exists between them and their environment.' When used in the context of digital finance, the term 'Digital Finance Ecosystem' may be defined as all the users or participants together their complex transactional relationship in a given digital environment.

The users or participants are the consumers of products or services or buyers of digital assets as well as the suppliers and sellers of the same while the environment, at large, comprises the infrastructure, the assets, the products or the services as well as money being the medium of exchange.

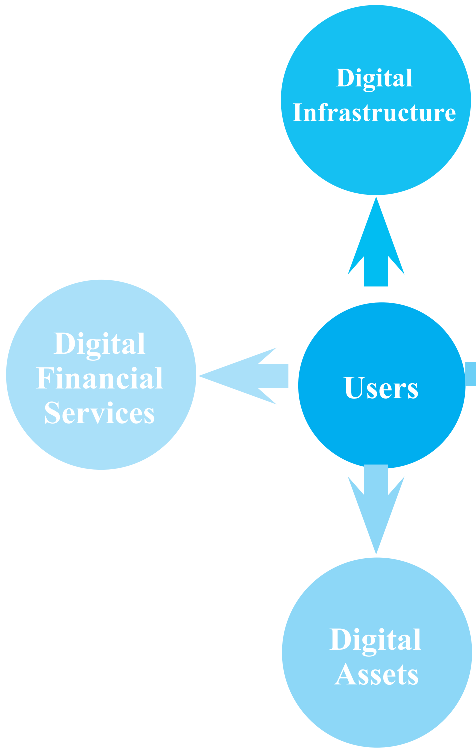


Figure 17.3: Components of Digital Finance Ecosystem

The above components are discussed in detail as follows:

17.2.1 Digital Infrastructure

Digital infrastructure refers to the digital technologies that bring together and interconnect physical and virtual technologies such as computer, storage, network, applications etc. to provide the foundation for an organisation's digital operations. Businesses use this foundation to re-architect their services for global digital delivery and to access the ecosystems and capabilities they need to rapidly build products and services and deliver them at scale.

Components of digital infrastructure include:

a. **Internet:** The Internet is the global system of interconnected computer networks that uses the Internet protocol suite (TCP/IP) to communicate between networks and devices. It is a network of networks that consists of private, public, academic, business, and government networks of local to global scope, linked by a broad array of electronic, wireless, and optical networking technologies. The Internet carries a vast range of information resources and services, such as the inter-linked hypertext documents and applications of the World Wide Web (WWW), electronic mail, telephony, and file sharing. Internet acts as the prime enabler or connecting force that integrates the digital world including digital finance.

b. **Mobile telecom and digital communication suites, including applications:** These components connect various organisations to a common network and enables communication for digital transactions.

c. **Data centers and networks:** A data center is a physical facility that organisations use to house their critical applications and data. A data center's design is based on a network of computing and storage resources that enable the delivery of shared applications and data. The key components of a data center design include routers, switches, firewalls, storage systems, servers, and application-delivery controllers.

d. **Enterprise portals, platforms, systems, and software:** An enterprise portal, also known as an enterprise information portal (EIP), is a framework for integrating information, people and processes across organizational boundaries in a manner similar to the more general web portals. Enterprise portals provide a secure unified access point, often in the form of a web-based user interface, and are designed to aggregate and personalize information through application-specific portlets. The portal integrated with required systems and applications delivers the required service.

e. **Cloud services:** The term "cloud services" refers to a wide range of services delivered on demand to companies and customers over the internet. These services are designed to provide easy, affordable access to applications and resources, without the need for internal infrastructure or hardware. These are infrastructure, platforms, or software that are hosted by third-party providers and made available to users through the internet. Cloud services can be of three types – (i) Infrastructure-as-a-service (IaaS) where the cloud service provider manages the infrastructure for the firm through an internet connection; (ii) Platforms-as-a-Service (PaaS) where the hardware and an application-software platform are provided and managed by an outside cloud service provider, but the user handles the apps running on top of the platform and the data the app relies on and (iii) Software-as-a-Solution (SaaS) where the service provider delivers a software application—which the cloud service provider manages—to its users.

f. **Operational security, user identity and data encryption:** Operational security is a security and risk management process that prevents sensitive information from getting into the wrong hands. It applies specific authentication process to verify user identity and also systems and software to ensure data encryption apart form advanced data security through antivirus and antimalware.

g. **APIs and integrations:** An application programming interface (API) is a messenger that processes request and ensures seamless functioning of enterprise systems. An API integration is the connection between two or more applications, via their APIs, that lets those systems exchange data. API integrations power processes throughout many high-performing businesses that keep data in sync, enhance productivity, and drive revenue.

17.2.2 Digital Money - Cards, Central Bank Digital Currency

Money has been the medium of exchange in commercial transactions since the primitive ages. Over the years, however, it took various forms such as metal coins, paper notes and the latest being digital money. Digital money or e-money is the digital or electronic representation of value. In a broader sense, it includes plastic money or debit and credit cards or stored value cards also which basically represent the amount stored in account or the credit granted by the banks. However, digital money is largely interpreted as digital currency issued by the central bank of a country and is essentially a digital version of cash that can be stored and transferred using an internet or mobile application. It may also include cryptocurrencies and stablecoins if they are accepted as the medium of exchange (though largely these are seen as digital assets as they are not everywhere accepted as the medium of exchange).

Central Bank Digital Currencies (CBDC) are digital tokens, similar to cryptocurrency, issued by a central bank. It is the virtual money backed and issued by a central bank. They are pegged to the value of that country's fiat currency.

A CBDC is a high-security digital instrument; like paper banknotes, it is a means of payment, a unit of account, and a store of value. Like paper currency, each unit is uniquely identifiable to prevent counterfeiting.

The potential advantages of a CBDC include:

a. Technological efficiency in storing and transacting with reduced cost;

b. Keeping track of transactions, exact location of money;

c. Preventing illegal activities like money laundering, tax evasion, terror financing;

d. Providing a digital record of every transaction;

e. More secure payment system;

f. Introducing competition and resilience in the domestic payments market;

g. Promoting financial inclusion.

The present concept of "central bank digital currency" may have been partially inspired by Bitcoin and similar blockchain-based cryptocurrencies. However, a central bank digital currency would likely be implemented using a database run by the central bank, government, or approved private-sector entities. The database would keep a record (with appropriate privacy and cryptographic protections) of the amount of money held by every entity, such as people and corporations. In contrast to cryptocurrencies, a central bank digital currency would be centrally controlled (even if it was on a distributed database), and so a blockchain or other distributed ledger would likely not be required. This will make CBDCs more secure.

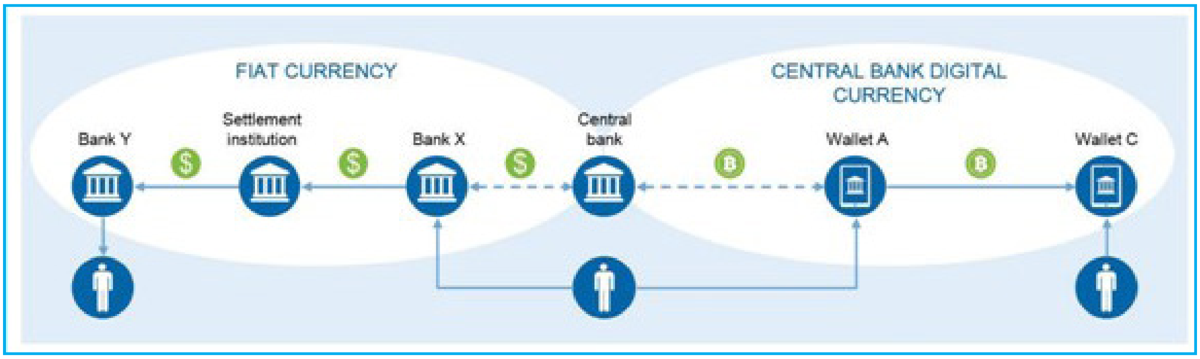


Figure 17.4: CBDC will remove the need for a settlement institution

17.2.3 Digital Assets - Non-Fungible Tokens, Private Cryptocurrency, Stablecoins

A digital asset is anything that is stored digitally and is uniquely identifiable that the owner can use to realize value. In other words, a digital asset is anything that exists only in digital form and comes with a distinct usage right. Data that do not possess that right are not considered.

Types of digital assets include, but are not exclusive to: photography, logos, illustrations, animations, audio-visual media, presentations, spreadsheets, digital paintings, word documents, electronic mails, websites, and a multitude of other digital formats and their respective metadata.

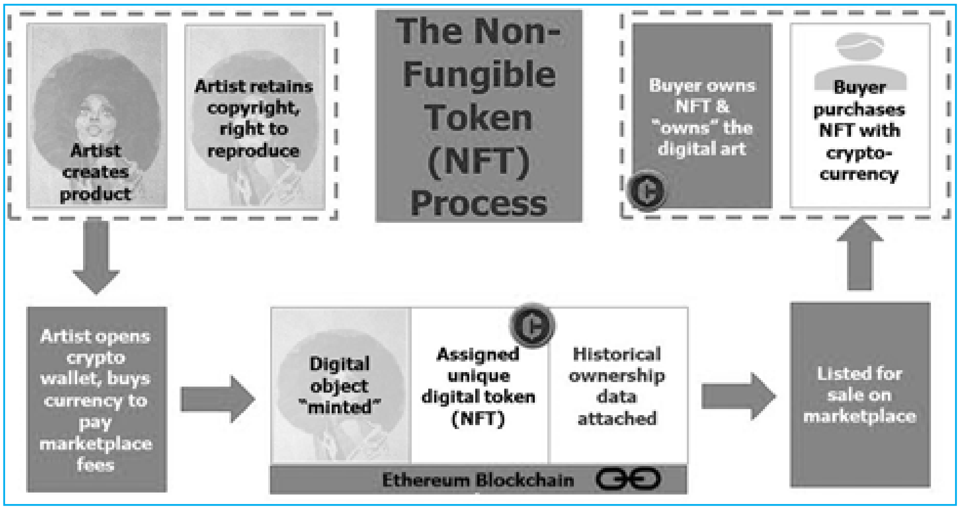
In addition to above, digital assets may also include Non-Fungible Tokens, Private Cryptocurrency, Stablecoins which are immensely popular in today's digital age.

A. Non-Fungible Tokens (NFTs)

Non-fungible tokens (NFTs) are cryptographic assets on a blockchain with unique identification codes and metadata that distinguish them from each other. Unlike cryptocurrencies (which are fungible as each unit of cryptocurrency represent same value and characteristics), these are non-fungible as each NFT is unique. Non-fungible tokens can digitally represent any asset, including online-only assets like digital artwork and real assets such as real estate. Today, however, much of the current market for NFTs is centered around collectibles, such as digital artwork, sports cards, and rarities. Perhaps the most hyped space is NBA Top Shot, a place to collect non-fungible tokenized NBA moments in digital card form. Some of these cards have sold for millions of dollars.

NFTs are created through a process called 'asset tokenization'. Asset tokenization is the process by which an issuer creates digital tokens on a distributed ledger or blockchain (Ethereum being most popular), which represent either digital or physical assets. Blockchain guarantees that once you buy tokens representing an asset, no single authority can erase or change your ownership — your ownership of that asset remains entirely immutable.

NFTs can be bought and sold in NFT marketplace such as Rarible, OpenSea, Foundation. However, to buy NFTs from this marketplace, one will require a wallet and need to fund it. In most of the platforms wallets are required to be funded by cryptocurrencies and the widely accepted cryptocurrency in this context is the Ethereum.



Exchanges and wallet services like MetaMask & MyEtherWallet facilitate transactions

Figure 17.5: NFTs - Creation and Sale

B. Private Cryptocurrencies

Concept of Cryptocurrency

Cryptocurrency, sometimes called crypto-currency or crypto, is any form of currency that exists digitally or virtually and uses cryptography to secure transactions. It's a peer-to-peer system that can enable anyone anywhere to send and receive payments. Instead of being physical money carried around and exchanged in the real world, cryptocurrency payments exist purely as digital entries to an online database describing specific transactions. When you transfer cryptocurrency funds, the transactions are recorded in a public ledger.

Working of Cryptocurrencies

Cryptocurrencies run on a distributed public ledger called blockchain, a record of all transactions updated and held by currency holders.

Units of cryptocurrency are created through a process called mining, which involves using computer power to solve complicated mathematical problems that generate coins. Users can also buy the currencies from brokers, then store and spend them using cryptographic wallets.

Examples of Cryptocurrencies

There are thousands of cryptocurrencies. Some of the best known include:

a. **Bitcoin:** Founded in 2009, Bitcoin (BTC) was the first cryptocurrency and is still the most commonly traded. The currency was developed by Satoshi Nakamoto – widely believed to be a pseudonym for an individual or group of people whose precise identity remains unknown.

b. **Ethereum:** Developed in 2015, Ethereum (ETH) is a blockchain platform with its own cryptocurrency, called Ether (ETH) or Ethereum. It is the most popular cryptocurrency after Bitcoin.

c. **Litecoin:** This currency is most similar to bitcoin but has moved more quickly to develop new innovations, including faster payments and processes to allow more transactions.

d. **Dogecoin:** Originally created as a joke after the run-up in Bitcoin, Dogecoin (DOGE) takes its name from an internet meme featuring a Shiba Inu dog. Unlike many digital currencies limiting the number of coins in existence, Dogecoin has unlimited issuance. It can be used for payments or sending money.

Figure 17.6: Popular Cryptocurrencies

Advantages of Cryptocurrency

a. Cryptocurrencies represent a new, decentralized paradigm for money. In this system, centralized intermediaries, such as banks and monetary institutions, are not necessary to enforce trust and police transactions between two parties.

b. It ensures easy and faster transfer of funds directly between two parties, without the need for a trusted third party like a bank or a credit card company.

c. Cryptocurrency investments can generate profits. These can be easily traded on crypto exchanges and offers high liquidity and diversification.

Disadvantages of Cryptocurrency

a. Though they claim to be an anonymous form of transaction, cryptocurrencies are actually pseudonymous. They leave a digital trail.

b. Cryptocurrencies may facilitate money laundering and hence are popular tool with criminals.

c. In reality, cryptocurrency ownership is highly concentrated. For example, an MIT study found that just 11,000 investors held roughly 45% of Bitcoin's surging value.

d. Mining popular cryptocurrencies requires considerable energy, sometimes as much energy as entire countries consume. So, cryptocurrencies are not environment friendly.

e. Cryptocurrencies traded in public markets suffer from extreme price volatility.

f. Though cryptocurrency blockchains are highly secure, other crypto repositories, such as exchanges and wallets, can be hacked. Many cryptocurrency exchanges and wallets have been hacked over the years, sometimes resulting in millions of dollars' worth of "coins" stolen.

C. Stablecoins

Concept of Stablecoin

A Stablecoin is a cryptocurrency which is pegged to any reserve asset like a fiat currency, commodity, or other cryptocurrencies. It is a tokenized version of the asset and can be introduced subtly into a blockchain ecosystem to facilitate seamless pass transactions, improved arbitrage, and exchange of value.

Many a times it is referred to as a utility token because it allows you to quickly buy and sell on decentralized exchanges that do not accept fiat currencies. However, these can also be used in centralized exchanges and reduce the processing time.

Uses of Stablecoin

a. Stablecoin can be used as an everyday currency. Unlike traditional crypto coins, which are subject to high degree of price fluctuations and volatility, stablecoins do not fluctuate rapidly because they are backed by national currencies, commodities etc.

b. Stablecoins also have a great potential for smart contracts. Smart contracts are frequently based on other cryptocurrencies, such as Ethereum. Frequent price changes of cryptocurrencies can have an unpredictable impact on the contract's terms. Therefore, the use of stablecoins like Tether can provide contract stability to both parties, by reducing market volatility and ensuring more secure contracts enforced by the blockchain.

Variants of Stablecoin

There are the following variants of Stablecoins.

a. Fiat-collateralized stablecoins

This type of stablecoin is linked to the sovereign legal tenders of countries. Some of the most well-known fiat-collateralized stablecoins, for instance, include Tether and TUSD (True USD). However, these stablecoins are not created by the central authority. The issuer issues these tokens by depositing an equal amount of fiat in its reserves.

b. Commodity-backed stablecoins

These are backed by reserved assets other than fiat currencies—by commodities. Real estate, gold, silver, and various other precious metals are examples of commodities. Kitco Gold, for example, is backed by the company's gold reserves, and the token itself is based on the Ethereum-backed ERC-20 blockchain ecosystem.

c. Crypto-backed stablecoins

This type of stablecoins is backed by any other cryptocurrency. Due to the volatile nature of cryptocurrencies, these stablecoins must be overcompensated in order to be collateralized. For example, to buy $500 worth of the crypto-backed stablecoin, Maker DAO's Dai, one needs to deposit $1,000 in ETH.

d. Algorithmic stablecoins

These are primarily non-backed stablecoins in which prices, token numbers, and other variables are manipulated with the help of special algorithms, software, and code in order to better manage supply and demand. This strategy allows the company to maintain the reserve peg in the event of price fluctuations.

Limitations of Stablecoins

a. The value of stablecoins is based on people's trust in the company holding the collateralized reserve asset, and that trust may waver on occasion.

b. Stablecoins may lose value if the company goes bankrupt.

c. It is critical for the holders to declare solvency to maintain trust in the coin and its value.

d. Unless there is a sense of unrest in the fiat or commodity markets, stablecoins aren't meant for trading gains.

17.2.4 Digital Financial Services – Wallets, UPI, Neo-Banks, FinTech

Concept of Digital Financial Services

Digital Financial Services (DFS) are financial services (e.g., payments, remittances, and credit) accessed and delivered through digital channels, including via mobile devices. These encompass established instruments (e.g., debit and credit cards) offered primarily by banks, as well as new solutions built on cloud computing, digital platforms, and distributed ledger technologies (DLT), spanning mobile payments, and peer-to-peer (P2P) applications.

Advantages of Digital Financial Services

The advantages of digital financial services include the following:

a. Improved customer experience: Digital technologies have changed the way financial services were provided. Now, customers enjoy a whole lot of information before the services can be availed.

b. Ease of access: Because of the intervention of digital technology services can be accessed very easily. The customers need not to visit the branches of the service providers anymore. Everything is possible a click of a mouse.

c. Streamlined operations: Financial services in this digital era is much more streamlined. Everything is so well planned. For example, in case of insurance services, from enquiry to customer on boarding, claim management to settlement – everything is now being done online and with minimum requirement of submission of physical documents. Even KYC (Know Your Customer) is also being done electronically.

d. Reduction in cost of delivery: Due to enhanced use of digital technology, companies are operating with minimum physical facilities and manpower. This has contributed heavily towards the profitability of the organisations. This savings is being shared with the customers in form of reduction in fees.

Major Developments in Digital Financial Services

A. Payment System

Among various financial services, development in the sphere of payment system is most noteworthy in the recent times. While existing services (such as debit and credit cards and net-banking through NEFT and RTGS) have been improved a lot with the application of digital technology, a number of new payment instruments or modes have also been emerged. For example –

I. Digital Wallets:

These are basically a type of prepaid payment instruments. A prepaid payment instruments refer to certain instruments that facilitate purchase of goods and services against the value stored in them. Wallets are closed or semi-open system payment instruments which are reloadable and accepted by specified service providers or merchants with which the wallet license holder has the contract. A customer may open a digital wallet with valid credentials (email and password). While a basic wallet may not ask for KYC, the customer may need to comply with the same for an increased wallet limit. The wallets can be loaded by transferring money from bank account directly. Often the wallet service providers offer cashback for using the wallet services. Some examples of popular digital wallets are Amazon Pay, Paytm, Mobikwik, Freecharge etc.

II. Unified Payment Interface:

Another immensely popular digital payment instrument is Unified Payment Instrument or UPI. Unified Payments Interface (UPI) is a system that powers multiple bank accounts into a single mobile application (of any participating bank), merging several banking features, seamless fund routing & merchant payments into one hood.

(a) Unique Features of UPI: UPI has the following unique features:

(i) Immediate money transfer through mobile device round the clock.

(ii) Single mobile application for accessing multiple bank accounts.

(iii) Single Click 2 Factor Authentication aligned with the Regulatory guidelines.

(iv) Virtual address of the customer for Pull & Push provides for incremental security with the customer not required to enter the details such as Card no, Account number; IFSC etc.

(v) QR Code enabled

(vi) Best answer to Cash on Delivery hassle, running to an ATM or rendering exact amount.

(vii) Merchant Payment with Single Application or In-App Payments.

(viii) Utility Bill Payments, Over the Counter Payments, QR Code (Scan and Pay) based payments.

(ix) Raising Complaint from Mobile App directly.

(b) Benefits of UPI: The benefits of UPI to various parties are as follows:

To the Banks	**To the Customers**
(i) Single click Two Factor authentication (ii) Universal Application for transaction (iii) Leveraging existing infrastructure (iv) Safer, Secured and Innovative (v) Payment basis Single/ Unique Identifier (vi) Enable seamless merchant transactions	(i) Round the clock availability (ii) Single Application for accessing different bank accounts (iii) Use of Virtual ID is more secure, no credential sharing (iv) Single click authentication (v) Raise Complaint from Mobile App directly
To the Merchants (i) Seamless fund collection from customers - single identifiers (ii) No risk of storing customer's virtual address like in Cards (iii) Tap customers not having credit/debit cards (iv) Suitable for e-Com & m-Com transaction (v) Resolves the COD collection problem (vi) Single click 2FA facility to the customer - seamless Pull (vii)In-App Payments (IAP)	

(c) Some Examples of UPI Service Providers: In India, some popular UPI services are BHIM UPI, AXIS Bank UPI, PhonePe, Paytm, Google Pay etc.

III. Neo-Banks

A neobank (also known as an online bank, internet-only bank, virtual bank or digital bank) is a type of direct bank that operates exclusively online without traditional physical branch networks. They leverage technologies such as artificial intelligence and machine learning to offer personalised and customised financial services to end-users and minimise the overall operating cost. Besides these, neobanks have many more benefits.

(a) Benefits of Neo-Banks: Following are the benefits of Neo-Banks:

(i) Highly convenient and user-friendly banking services

(ii) Built for a niche audience

(iii) Cost-effective alternative to challenger and traditional banks

(iv) Offers digital banking services, such as, savings accounts, prepaid cards, bill payments, and money transfers

(v) Provide financial management services

(vi) 24×7 customer support

(vii) High-security features

(viii) Simple and user-friendly mobile app interface

(ix) Transparent structure with real-time notification feature

(b) Top Neo-Banks in India

Top Neo-Banks in India's financial services sector are Jupiter, InstantPay, PayZollo, Freo, Chqbook, Neo-bank, Fi Money, Niyo, Finin, FamPay, North Loop, Fold, Tide, Mahila Money, Mool, OCareNeo.

B. Fintech

The technological revolution has led to the evolution of a new breed of tech-enabled firms that are constantly putting their efforts to redefine the financial solutions. These firms are collectively called Fintech firms.

According to the Financial Stability Board (FSB), 'Fintech' may be defined as 'technologically enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and the provision of financial services'. In other words, it is the umbrella term which refers to all tech-enabled financial innovations targeted at improving the accessibility and quality of financial services. In that sense, all digital applications in the sphere of financial services may be included in fintech, but, to be specific, by 'fintech' we shall mean the tech-enabled start-ups.

(a) Types of Fintech Services

Fintech encompasses the following services:

(i) Alternative Lending (e.g., retail lending, aggregators)

(ii) Insurtech (e.g., digital insurers, insurance aggregators)

(iii) Payments (e.g., Prepaid payment instruments

(iv) Wealthtech (e.g., Investment portfolio management services)

(v) Regtech (e.g., Accounting, taxation etc.)

(b) Fintech in India

In India, the fintech movement, in its popular sense, started in the second half of 1990s. PineLabs, a digital payment solution provider, was founded in 1998 followed by BillDesk in 2000. Policybazar, the online insurance aggregator came in 2008. Thereafter India saw a huge growth in fintech firms in the next 20 years. As of June 2020, India has around 2174 fintech start-ups. Bengaluru and Mumbai contribute to most of these companies. According to Hurun Global Unicorn List 2020, India was the home to 21 unicorns with a collective valuation of $73.2 Bn as on 31.03.2020.

Digital Finance Landscape

In the light of the discussion on Digital Finance Ecosystem, the digital finance landscape may be described in form of a Digital Finance Cube (Concept Source: CPA Digital Finance Program, Australia).

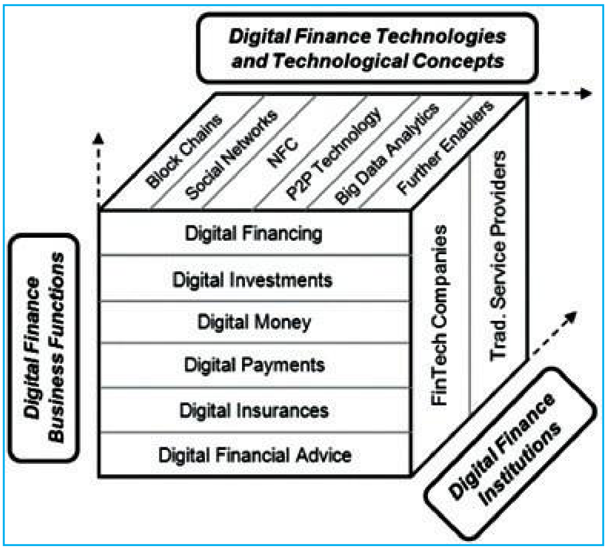


Figure 17.7: Digital Finance Cube

A digital finance cube has three dimensions (I) Digital Finance business functions, (II) Digital Finance Technologies and Technological Concepts, and (III) Digital Finance Institutions. Each dimension is further classified into a number of constituents.

(I) Digital Finance Business Functions:

(a) Digital Financing: Digital financing include –

(i) Invoice financing and invoice factoring i.e., borrowing against or selling its accounts receivables to any third party.

(ii) Electronic Invoicing i.e., generating and automated processing of invoices.

(iii) Lease Financing i.e., use of assets that is owned by the finance provider.

(iv) Crowdfunding i.e., raising money through small contributions from a large number of people.

(b) Digital Investments: This includes investment advisory services including arrangement of transactions. For example, online brokerage, mobile and social trading in B2C area, high frequency and algorithmic B2B trading.

(c) Digital Money: It includes all digital innovations in how money and currency are created, stored, valued, regulated or exchanged.

(d) Digital Payments: This refers to electronic payments through wallets or UPIs.

(e) Digital Insurance: In B2B space, digital insurance platforms provide a number of value-added services including data analytics. In B2C space, it provides innovative services to customers.

(f) Digital Finance Advice: This includes aggregators who provide comparative quotes of financial services.

(II) Digital Finance Technologies and Technological Concepts

(a) Blockchain: It is a type of distributed ledger which provide an ordered, timestamped and highly secure record of transactions. The entire history of verified and valid transactions between network users is contained in the blockchain ledger.

(b) Social Networks: This enables the interaction and the development of networks via social media platforms.

(c) Near Field Communication: It is a standardized protocol that enables two devices to communicate when brought close to each other.

(d) Peer to Peer Technology: A P2P system is intended to share resources and data in such a way that avoids reliance on a central intermediary. These are built on a technology architecture in which participants (peers) enable other participants to access and interact with their technology infrastructure and data processing power. Resources are thus shared.

(e) Big Data Analytics: This refers to the enormous volume and variety of data generated by pervasive interconnectivity. the insights that can be generated from big data have great potential value for business. The business, however, needs advanced analytical skills.

(f) Enablers: Enablers are mobile devices, cloud technologies, information security technologies, automation and AI. Important enablers include fast and mobile internet connections, AI worldwide connectivity, simple user interface, security technologies and automation technologies.

(III)Digital Finance Institutions

They include FiinTech companies (both start-ups and established technology driven companies) entering the financial domain and the incumbent traditional service providers.

(a) FinTech Companies: They emerge either as FinTech start-ups or technology companies without a history in financial services that have developed FinTech offerings.

(b) Traditional Service Providers: They include AMCs, banks, insurance companies and brokerage companies. These service providers encompass a broad range of services including cash accounts, savings, money management, investment management, payments, financial advice, lending, foreign currency exchange, equity trading, brokerage and pension planning.

Regulation and Governance in a Digital Finance Environment

17.3

Digital Finance – Role of Regulators

Enabling regulation is critical for the success of digital finance. While the shift to a digital ecosystem brings new entrants, technologies, and innovative business models, it also brings with it new challenges to policymakers and regulators who want to manage the risks to stability and integrity without stifling innovation.

Two aspects are likely to be most important in defining the role of regulators in the context of digital finance - consumer protection and the relationship between competition and innovation.

With the rise of innovative technologies and new services, regulators will continue to be responsible for ensuring that the issue of consumer protection and digital finance is increasingly on their radar. Additionally, without appropriate treatment of consumers and their trust in digital finance, the digital ecosystem is unlikely to thrive. As business models transform and the complexity of offerings increases, it will be harder to regulate and ensure consumer protection. This puts regulators in a difficult position: they must weigh social inclusion and commercial benefit against protecting citizen privacy, choice, and control. There are three goals when it comes to consumer protection regulation:

a. Ensure consumers are informed,

b. Prevent unfair practices by providers, and

c. Ensure consumers have access to dispute and complaint mechanisms (while balancing onerous provider restrictions).

Regulators have a role to play in addressing digital finance competition bottlenecks, which can include 1) connectivity and channel issues, particularly for USSD; 2) agent network issues, such as exclusivity; 3) account-level barriers, such as interoperability; and 4) application level issues, such as APIs. More recently, CGAP also identified data sharing as a key competition issue, explaining that improving standards for permitted and non-permitted uses of consumer data should be a priority, adding that authorities will likely need to coordinate how data is owned, accessed, and shared.

To avoid stifling innovation and to encourage safe and responsible development, a growing number of regulators are turning to a 'sandbox' approach. Initially launched by the FCA in the UK in 2014, a sandbox allows businesses to test out new services, business models, and delivery channels in a live environment where consumers are protected. Sandboxes are an important complement to policymakers' existing approaches to dealing with innovation.

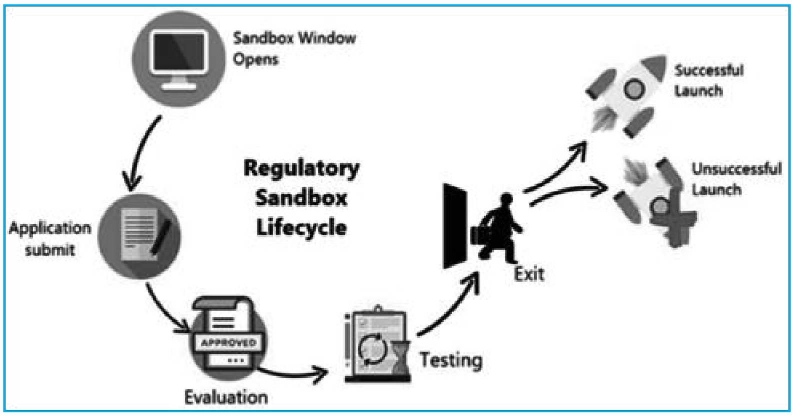


Figure 17.8: Regulatory Sandbox

Also, RegTech is gaining momentum as new solutions are developed and tested. A portmanteau of 'regulatory technology,' RegTech was first established as a subset of FinTech in 2015 by the UK's FCA and has since gained momentum for financial policymaking and supervision. RegTech is centered around technology that allows financial service providers to meet regulatory requirements in a more effective and efficient way—this includes risk identification, management tools, and quantitative- and information-based obligations. Generally, four key characteristics are attributed to RegTech: it is agile, fast, integrative, and it relies on analytics. RegTech has the potential to change the financial supervisory landscape.

Fintech Laws and Regulations in India

The regulatory landscape governing FinTech in India is largely fragmented. There is hardly a single set of regulations or guidelines which uniformly govern various FinTech products available in India. The following sources are important in this respect.

a. **Payment and Settlement Systems Act, 2007:** The Payment and Settlement Systems Act. 2007 ("PSS Act") is the principal legislation governing payments regulation in India. It prohibits the commencement and operation of a "payment system" without prior authorisation of the RBI. The Act defines a "payment system" as "a system that enables payment to be effected between a payer and a beneficiary, involving clearing, payment or settlement service of all of them, but does not include a stock exchange". Accordingly, payment systems include the systems enabling credit card operations, debit card operations, smart card operations, money transfer operations, PPls, etc.

b. **Master Direction on issuance and Operation of Prepaid Payment Instruments:** The Master Direction on Issuance and Operation of Prepaid Payment instruments issued by the RBI on October 11, 2017 and amended from time to time ("PPI Master Direction") prescribes the eligibility criteria for PPI issuers, permissible debits and credits from PPIs and other operational guidelines to be followed by PPI issuers while issuing PPIs to their customers in India. PPIs fall within the definition of a "payment system" under the PSS Act and are therefore required to comply with the PSS Act and the PPI Master Direction.

c. **NPCI Guidelines governing UPI Payments:** UPI Payments in India are primarily governed by the DPI Procedural Guidelines issued by the NPCI. Under the current framework, only banks can directly integrate with the UPI platform to provide money transfer services to their customers. Banks are, however, permitted to engage technology providers for the design and operation of mobile applications for the purpose of UPI Payments, subject to compliance with certain eligibility and prudential norms prescribed by the NPCI.

d. **Reserve Bank of India Act, 1934 allowing NBFCs in this space:** NBFCs are primarily governed by the Reserve Bank of India Act, 1934 and a series of master directions and circulars regulating the licensing and operation of NBFCs in India. Most digital lenders operating in India are licensed as NBFCs. The key regulations governing NBFCs In India include the Master Direction - NBFC - Systemically Important Non-Deposit taking Company and Deposit taking Company (Reserve Bank) Directions dated September 1, 2016. Master Direction - NBFC - Non-Systemically Important Non-Deposit taking Company (Reserve Bank) Directions dated September 1, 2016, and Master Direction - NBFC - Acceptance of Public Deposits (Reserve Bank) Directions dated August 25, 2016, each as amended from time to time.

e. **Guidelines regulating P2P lending platforms:** P2P lending platforms are primarily governed by the Master Directions - NBFC - Peer to Peer Lending Platform Directions 2017, which prescribe lender exposure norms and aggregate borrowing limits in relation to the operation of P2P lending platforms in the country.

f. **Guidelines governing payment aggregators/gateways:** The Circular on Guidelines on Regulation of Payment Aggregators and Payment Gateways dated March 17, 2020 ("Payment Intermediary Guidelines"), recently updated on March 31, 2021, sets out the legal framework applicable to payment intermediaries (such as payment aggregators and payment gateways) operating in India. While the RBI has sought to directly regulate payment aggregators, it has stipulated only baseline technology-related recommendations for payment gateways, given that payment gateways do not handle funds.

g. **Anti-money laundering laws:** The regulator primarily responsible for overseeing and enforcing anti-money laundering regulations and measures is the RBI. Regulations governing entities offering financial products in India are the Prevention of Money Laundering Act, 2002, the Prevention of Money Laundering (Maintenance of Records) Rules, 2005 and the RBI's Master Directions on KYC dated February 25, 2016 (as amended from time to time).

h. **Acts protecting data privacy and protection:** Access to customer data, data privacy and protection have each become an increasingly important issue with FinTech platforms collecting and storing various forms of customers' personal, financial, and behavioural data. India does not today have a comprehensive data privacy framework. The Information Technology Act, 2000 and the IT (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011 are the two key regulations governing protection of personal data.

Governance in Digital Finance – The Initiatives

Digital innovation in finance is happening at a tremendous pace and often regulators efforts to keep up with it fall short by a mile.

The key governance issues that pose challenge for the regulators include:

a. Governance of the internet economy and the global internet

b. Management of intellectual property rights with innovation drive competition

c. Taxation

d. Customer Privacy

e. Owning and sharing data

Traditionally, financial services are highly regulated, but increasingly, legacy models of regulation and supervision, where a static set of rules is set for industry to comply with, are no longer sufficient, thus requiring a broader view of governance that goes beyond just governments: looking at collaborative, principle-based ways of ensuring positive outcomes for consumers and society.

Recognizing such a need, the UN Secretary General's Task Force on Digital Financing of the SDGs (DFTF) established the Dialogue on Global Digital Finance Governance to explore the nexus of Big Fintechs (the dominant Fintechs) and sustainable development. Through its findings, the Dialogue aims to catalyze governance innovations that take greater account of the SDG impacts of Big Fintechs and are more inclusive of the voices of developing nations.

The Dialogue on Global Digital Finance Governance is hosted by the Swiss and Kenyan Governments and stewarded jointly by the United Nations Development Programme (UNDP) and United Nations Capital Development Fund (UNCDF).

The Dialogue bridges gaps in awareness of Big Fintechs' SDG-impacts by providing an overview of the pertinent issues that regulators and policymakers should consider at the nexus of sustainable development and Big Fintech governance.

Beyond embedding awareness, the Dialogue has developed a set of principles to guide policy makers, regulators and BigFintechs in the design of Big Fintech governance frameworks that support sustainable development. The toolkit also includes a series of recommendations for potential future regulatory pathways. The principles include:

a. Ensuring foundational financial regulatory objectives

b. Developing reflexive and iterative regulation

c. Fostering responsible actors

d. Ensuring oversight and enforcement

e. Instilling a commitment to sustainable development

The above principles have been further detailed keeping in mind the role of Big Fintechs. In addition, the Dialogue provides a number of recommendations to support implementation of the principles.

In India, governance norms specific to digital finance is still not existing. Regulators are addressing various issues through different acts and regulations. However, considering the nature of complexities involved, a comprehensive governance framework may be necessitated very soon.

Exercise

Theoretical Problems

Multiple Choice Questions

1. Which of the following is not a component of Digital Finance Ecosystem?
   A. Digital Infrastructure
   B. Digital Money
   C. Digital Liabilities
   D. Digital Financial Services
2. NFT stands for ____________.
   A. Non-Fungible Token
   B. Non-Fuel Token
   C. Non-Fractional Token
   D. Non-Fundamental Token
3. Digital Finance Cube has __________ dimensions.
   A. Six
   B. Four
   C. Three
   D. Two
4. In India, all payments are regulated by _______________.
   A. RBI Act, 1934
   B. Banking Regulation Act, 1949
   C. Payment and Settlement Systems Act, 2007
   D. SBI Act, 1955
5. UPI stands for ___________.
   A. United Payment Interface
   B. Unified Payment Interface
   C. Unique Payment Interface
   D. Utility Payment Interface

Answer:

1	2	3	4	5
C	A	C	C	B

State True or False

1. Non-fungible tokens (NFTs) are physical assets on a blockchain with unique identification codes and metadata.
2. Cryptocurrencies are equivalent to CBDCs.
3. The principal legislation governing payments in India is Payment and Settlement Systems Act, 2007.
4. Blockchain is a type of distributed ledger which provide an ordered, timestamped and highly secure record of transactions.
5. Invoice financing and invoice factoring i.e., borrowing against or selling its accounts receivables to any third party.

Answer:

1	2	3	4	5
False	False	True	True	True

Fill in the Blanks

1. ______________refers to generating and automated processing of invoices.
2. A ___________is a cryptocurrency which is pegged to any reserve asset like a fiat currency, commodity, or other cryptocurrencies.
3. ______________ means raising money through small contributions from a large number of people.
4. DeFi stands for ________________.
5. A ___ is a type of direct bank that operates exclusively online without traditional physical branch networks.

Answer:

1	Electronic Invoicing	2	Stablecoin
3	Crowdfunding	4	Decentralized Finance
5	neobank		

Short Essay Type Questions

1. Discuss three advantages of Digital Finance.
2. Mention the components of Digital Finance.
3. Write a short note on: Neobanks.
4. Write a short note on: Benefits of UPI.
5. Write a short note on: Non-Fungible Tokens.

Essay Type Questions

1. Describe, in brief, the Digital Finance Landscape.
2. What do you mean by Stablecoins? How are they different from Cryptocurrencies? Discuss their uses.
3. What do you mean by cryptocurrencies? Discuss its advantages and disadvantages.
4. Discuss various elements of digital infrastructure.
5. How is digital finance different from traditional finance?

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