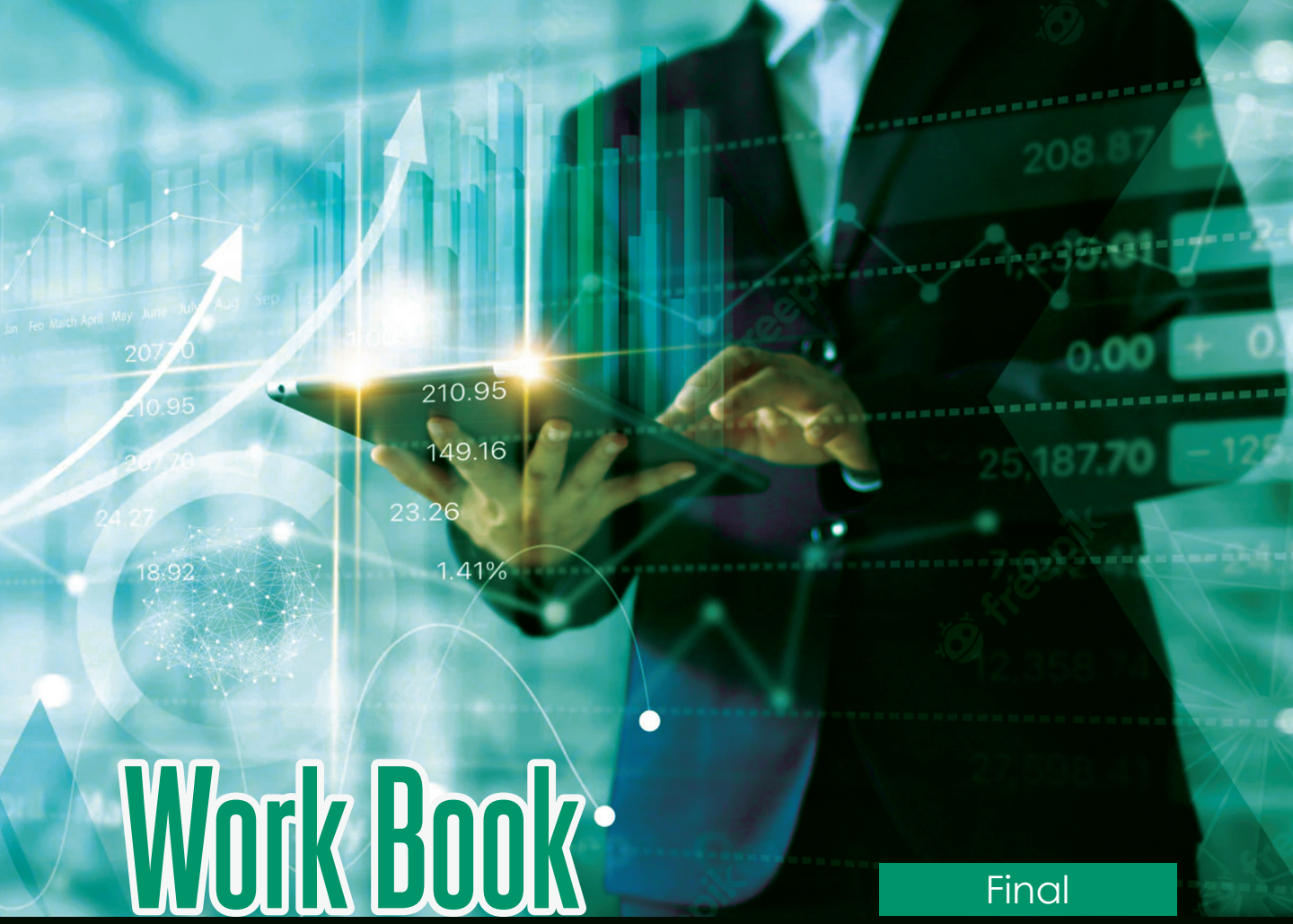

Work Book

Final

Strategic Financial Management

Paper 14

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WORK BOOK

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FINAL

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The Institute of Cost Accountants of India

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Preface

The landscape of professional education is undergoing a profound transformation, driven by the evolving demands of a globally integrated economy. In this dynamic environment, it is imperative to equip students not only with technical knowledge but also with the analytical skills and professional acumen essential for success.

Effective learning extends beyond theoretical understanding—it necessitates the development of strong conceptual foundations, critical thinking abilities, and disciplined study habits. These attributes are cultivated through continuous practice and engagement with thought-provoking academic material. To facilitate this process, the curriculum, instructional methods, and assessments must be designed to provide comprehensive, structured, and intellectually stimulating learning experiences.

Building on the success of the previous editions, we are pleased to present the new edition of our 'Workbook' in an e-distributed format. This edition has been meticulously developed to enhance students' comprehension and application of key concepts. Each chapter is structured to offer a seamless learning experience and integrating practical illustrations in a phased manner to align with the evolving regulatory framework.

We are confident that this new edition will continue to serve as a valuable academic resource, empowering students to achieve their professional aspirations with confidence and competence.

The Directorate of Studies,

The Institute of Cost Accountants of India

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1 Investment Decisions, Project Planning and Control [Study Material - Module 1]

Illustration 1

NTPC GREEN ENERGY LIMITED is going to start a new project in North Bihar. The following CFAT are expected over its estimated economic life of 6 years:

Year	CFAT (₹)
1	10,20,000
2	11,00,000
3	12,50,000
4	14,10,000
5	16,00,000
6	20,20,000

The amount of initial investment is ₹ 60,00,000. Please compute the following:

a) Pay-back period

b) Discounted Pay-back period @ 10% per annum

c) Net present value @ 10% per annum

d) IRR @ 10% per annum.

e) Comment whether the project should be accepted or not.

Solution:

Year	CFAT (₹)	Cumulative CFAT (₹)	PVIF @ 10%	PV of CFAT (₹)	Cum. PV of CFAT
	(A)		(B)	(C) = (A × B)	
1	10,20,000	10,20,000	0.9091	9,27,282	9,27,282
2	11,00,000	21,20,000	0.8264	9,09,040	18,36,322
3	12,50,000	33,70,000	0.7513	9,39,125	27,75,447
4	14,10,000	47,80,000	0.6830	9,63,030	37,38,477
5	16,00,000	63,80,000	0.6209	9,93,440	47,31,917
6	20,20,000	84,00,000	0.5645	11,40,290	58,72,207
Total PV of CFAT				58,72,207	

(a) Pay-back period = $4 + \frac{(60,00,000 - 47,80,000)}{16,00,000} \times 1 = 4.7625$ years.

(b) Discounted Pay-back period does not exist during the economic life of the project. It is more than 6 years.

(c) NPV = PV of CFAT – PV of Cash outflow = ₹ (58,72,207 – 60,00,000) = (₹ 1,27,793)

(d) IRR = $\frac{\text{PV of Cash inflows}}{\text{PV of Cash outflows}} = \frac{58,72,207}{60,00,000} = 0.9787 < 1$

(e) As the NPV is negative, the project should not be accepted.

Illustration 2

CESC supplies the following data to determine NPV of the project to be set up at Sonarpur, West Bengal:

Initial investment	₹ 80,00,000
Annual cash flow from the project without inflation, i.e., Real cash flow	₹ 30,00,000
Economic useful life	4 years
Cost of Capital (Including inflation premium of 10%)	12%

Solution:

Since inflation rate is 10% p.a., real cash flows is converted into nominal cash flows as follows:

Nominal Cash Flows = Real Cash Flows × (1 + Inflation Rate)

Year	Real cash flows (₹)	Nominal cash flows (₹)	PVF @ 12%	PV of NCF (₹)
1	30,00,000	30,00,000 × (1.10) = 33,00,000	0.8929	29,46,570
2	30,00,000	30,00,000 × $(1.10)^2$ = 36,30,000	0.7972	28,93,836
3	30,00,000	30,00,000 × $(1.10)^3$ = 39,93,000	0.7118	28,42,217
4	30,00,000	30,00,000 × $(1.10)^4$ = 43,92,300	0.6355	27,91,307
Total PV of Cash inflows				114,73,930
Less: Total PV of Cash outflows i.e., the amount of initial investment				80,00,000
NPV of the Project				34,73,930

Illustration 3

VISHAL MEGA MART is investing ₹ 1,100 lakhs in a project. The risk-free rate of return is 6%. The Management is expecting a risk premium of 7%. The life of the project is 5 years. Following are the cash flows that are estimated over the life of the project:

Year	CFAT (₹)
1	125
2	330
3	360
4	410
5	340

Please calculate the NPV of the project based on—

(a) Risk free rate of return and also

(b) on the basis of Risks adjusted discount rate of return.

(c) Advise whether the project should be undertaken or not on the above bases.

Solution:

Risk adjusted rate of return = 6% + 7% = 13%

		(a)		(b)	
Year	**CFAT (₹) [A]**	**PVF @ 6% [B]**	**PV of CFAT (₹) [A×B]**	**PVF @ 13% [C]**	**PV of CFAT (₹) [A×C]**
1	125	0.9434	117.925	0.8850	110.625
2	330	0.8900	293.700	0.7831	258.423
3	360	0.8396	302.256	0.6931	249.516
4	410	0.7921	324.761	0.6133	251.453
5	340	0.7473	254.082	0.5428	184.552
Total PV of cash inflows			1,292.724		1,054.569
Less: PV of cash outflows			1,100.000		1,100.000
NPV			**192.724**		**(45.431)**

(c) Recommendation:

(i) If the rate of return is 6%, the project should be undertaken as the NPV is positive.

(ii) If the risk adjusted rate of return is 13%, the project should not be undertaken.

Illustration 4

CO. ANDAZ APNA -APNA has selected two machines for its project. The two machines are designed differently but have identical capacity and do exactly the same job. Machine P costs ₹30,50,000 and will last for 3 years. It costs 7,20,000 per year to run. Machine Q is comparatively cheaper but costs ₹20,00,000, but will last only for 2 years. It costs ₹11,60,000 per year to run. These are real cash flows and estimated in rupees of constant purchasing power.

Ignore tax. The cost of capital is 10 per cent per annum.

Which machine the company should buy?

Solution:

Particulars	Machine P	Machine Q
Purchase price of the machine (₹) [A]	30,50,000	20,00,000
Life of the machine (years)	3	2
Running costs per annum (₹) [B]	7,20,000	11,60,000

$PVIFA_{(10\%, n\ years)}$ [C]	$PVIFA_{(10\%, 3\ years)}$ = 2.4869	$PVIFA_{(10\%, 2\ years)}$ = 1.7355
Total PV of running costs (₹) [B×C]	17,90,568	20,13,180
Total PV of cash outflows [A+ B×C] = [D]	48,40,568	40,13,180
Equivalent PV of cash outflows (or annualised PV of cash outflows) [DC](₹)	19,46,426	23,12,406

Recommendation: The company should buy Machine P as it has lower annualised PV of cash outflows.

Illustration 5

ZOMATO LIMITED decides to adopt either Project A or Project B on the basis of NPV of the projects. They are mutually exclusive projects. The initial investment of both the projects is ₹300 lakhs and the salvages are nil for both the projects after their economic life. The company adopts straight line method for charging depreciation. The economic life of project A is 5 years whereas that of Project B is 4 years. The corporate tax rate is 34% and cost of capital is 10% per annum. The cash flows before depreciation and tax are as follows:

Year	Project A (₹ In lakh)	Project B (₹ In lakh)
1	200	300
2	300	350
3	380	390
4	210	180
5	100	NIL

Please select the project on the basis of net present value.

Solution:

Project A; Depreciation per annum = ₹ (300/5) = ₹ 60 lakhs

Year	CFBDT	EBT = CFBTD - D	EAT=EBT×(1–0.34)	CFAT = EAT+D	PVIF @ 10%	PV of CFAT
1	200	140	92.40	152.40	0.9091	138.54684
2	300	240	158.40	218.40	0.8264	180.48576
3	380	320	211.20	271.20	0.7513	203.75256
4	210	150	99.00	159.90	0.6830	109.21170
5	100	40	26.40	86.40	0.6209	53.64576
Total PV of Cash inflows						685.64262
Less: PV of cash outflows						300.00000
Net Present Value (NPV)						385.64262
PVIFA						3.7907
Annualised NPV = [NPV ÷ PVIFA]						101.73388

Project B: Depreciation per annum= ₹ (300 / 4) = ₹ 75 lakhs.

Year	CFBDT	EBT=CFBTD-D	EAT=EBT×(1– 0.34)	CFAT = EAT+D	PVIF @10%	PV of CFAT
1	300	225	148.50	223.50	0.9091	203.18385
2	350	275	181.50	256.50	0.8264	211.97160
3	390	315	207.50	282.50	0.7513	212.24225
4	180	105	69.30	144.30	0.6830	98.55690
Total PV of cash inflows						725.95460
Less: PV of cash outflows						300.00000
NPV						425.95460
PVIFA						3.1698
Annualised NPV = [NPV ÷ PVIFA]						134.37901

Recommendation:

(a) If the projects are repetitive, then Project B should be undertaken as it has higher Annualised NPV.

(b) If the projects are non-repetitive, then also Project B should be undertaken due to higher NPV.

Illustration 6

CO. SMART IDEA LTD. is operating an old machine that is expected to produce a net cash inflow of ₹ 40,000 in the coming year and ₹ 40,000 next year. Current salvage value is ₹ 80,000 and next year's value is ₹ 70,000. The machine can be replaced now with a new machine, which costs ₹1,50,000 but is much more efficient and will provide a cash inflow of ₹ 80,000 a year for 3 years. The company wants to know whether it should replace the machine now or wait a year with the clear understanding that the new machine is the best of the available alternatives and that it in turn be replaced at the optimal point. Ignore tax. The opportunity cost of capital as 10%. Advise with proper reasons.

Solution:

Statement showing the present value of cash inflow of new machine when it replaces the old machine now

Year	Cash flows (₹)	PV factor @ 10%	PV of cash flows (₹)
0	—1,50,000 + 80,000 = — 70,000	1.0000	— 70,000
1	80,000	0.9091	72,728
2	80,000	0.8264	66,112
3	80,000	0.7513	60,104
NPV			**1,28,944**

Equivalent annual NPV = (1,28,944 ÷ 2.4868) = ₹ 51,851.

Illustration 7

TATA POWER is contemplating an investment project of 5 years with an initial outlay of ₹ 180,00,000.

The expected cash inflows with their respective re-investment rates are as follows:

Year	CFAT (₹)	Re-investment rate
1	45,00,000	8%
2	60,00,000	9%
3	50,00,000	10%
4	54,00,000	12%
5	62,00,000	10%

The cost of capital is 10% p.a.

Please recommend whether the project is viable or not under the **"Terminal value method".**

Solution:

Year	**CFAT (₹)**	**Re-investment rate**	**Years of re-investment**	**Future value**
1	45,00,000	8%	4	$45,00,000 \times (1.08)^4 = 61,22,200$
2	60,00,000	9%	3	$60,00,000 \times (1.09)^3 = 77,70,174$
3	50,00,000	10%	2	$50,00,000 \times (1.10)^2 = 60,50,000$
4	54,00,000	12%	1	$54,00,000 \times (1.12)^1 = 60,48,000$
5	62,00,000	10%	0	$62,00,000 \times (1.10)^0 = 62,00,000$
Terminal value				321,90,374
PVIF @ 10% for 5th year				0.6209
PV of Terminal value				199,87,003
Less: PV of cash outflow				180,00,000
Modified NPV				19,87,003

Comment: As the modified NPV is positive, the project is viable. The project should be undertaken.

Illustration 8

An analyst intends to value **INFOTECH LTD.,** an IT company in terms of the future cash generating capacity.

Year	1	2	2	4	5
Cash Flows (₹ Million)	176	48	64	86	117

It is further estimated that beyond 5th year, cash flows will perpetuate at a constant growth rate of 7% per annum, mainly on account of inflation. The perpetual cash flow is estimated to be ₹ 1026 million at the end of the 5th year.

(i) What is the value of the company in terms of expected future cash flows? You may assume a cost of capital of 20% for your calculation.

(ii) The company has outstanding debt of ₹362 million and cash/bank balance of ₹271 million. Calculate shareholder value, if the number of outstanding shares is 15.15 million.

(iii)The company has received a takeover bid of ₹201 per share. Is it good offer? [Given; PVIF at 20% for year 1 to year 5: 0.833, 0.694, 0.579, 0.482, 0.402]

Solution:

Present value of perpetual cash flows at the beginning of 6th year, i.e. Terminal value (T.V.) $= \frac{CFAT \times (1+g)}{K_{e-g}} = \frac{1,026 \times (1 + 0.07)}{0.20 - 0.07} = 8,444.7692$

Year	Cash flow	PV factor @ 20%	PV of cash flows
1	176	0.833	146.608
2	48	0.694	33.312
3	64	0.579	37.056
4	86	0.482	41.452
5	117	0.402	47.034
5 (T.V.)	8,444.7692	0.402	3394.797
Total present value of cash inflows			3700.259

Particulars	
Total present value of cash inflows	3700.259
Add: Bank	271.000
Total value of the company	3,971.259
Less: Value of debt	362.000
Shareholders' value	3,609.259
Value per share (3,609.259 ÷ 15.15)	238.23 (approx.)

Comments: The offer price is ₹201 but the calculated value is ₹238.23 per share. Hence, it is not a good offer and it should not be accepted.

Illustration 9

NEW INDIA LTD. is considering the replacement of one of its molding machines. The existing machine is in good operating condition, but is smaller than required if the firm is to expand its operations. The old machine is 5 years old, and has remaining depreciable life of 10 years. The machine was originally purchased for ₹ 1,50,000 and is being depreciated by ₹10,000 per year for tax purposes.

The new machine will cost ₹ 2,20,000 or ₹ 1,70,000 if exchanged with existing machine. It will be depreciated on a straight-line basis for 10 years with no salvage value. The management anticipates that, with the increased operations, there will be need for an additional net working capital of ₹30,000. The new machine will allow the company to expand current operations, thereby increasing annual revenue by ₹60,000 and variable operating costs from ₹2,00,000 to ₹ 2,20,000.

The company's tax rate is 35% and its cost of capital is 10 %.

Should the company replace its existing machine? Assume that the loss on exchange of existing machine can be claimed as short-term capital loss in the current year itself.

Solution:

Evaluation of replacing the existing machine

Cash outflows:	₹
Cost of the new machine	2,20,000
Less: Sale value of old machine	50,000
	1,70,000
Less: Tax saving on loss on sale of old machine [(1,50,000—10,000×5)—50,000] ×35%	17,500
	1,52,500
Add: Additional working capital	30,000
Net cash outflows	**1,82,500**
Cash inflows:	
Increase in sales revenue	60,000
Less: Increase in operating costs 20,000	
Additional depreciation (22,000 — 10,000) 12,000	32,000
Profit before tax	28,000
Less: Tax @ 35%	9,800
Profit after tax	18,200
Add: Additional depreciation	12,000
CFAT p.a. for 1 to 10 years	30,200

Year	CFAT (₹)	P.V. factor @ 10%	P.V. of CFAT (₹)
1 to 10	30,200	6.145	1,85,579
10 (Recovery of working capital)	30,000	0.386	11,580
Total present value of cash inflows			1,97,159
Less: Present value of cash outflows			1,82,500
Net present value (NPV)			14,659

Recommendation: As the NPV is positive, the existing machine should be replaced.

Illustration 10

MR. INDIA LTD. requires ₹160,00,000 for a project. Useful life of project: 4 years. Salvage value - Nil. Depreciation Charge ₹ 40,00,000 p.a. Expected revenues & costs (before depreciation) ignoring inflation.

Year	Without inflation		Rates of inflation	
	Revenues (₹)	Costs (₹)	Revenues (%)	Costs (%)
1	120,00,000	60,00,000	10	12
2	140,00,000	80,00,000	9	10
3	160,00,000	80,00,000	8	9
4	160,00,000	80,00,000	7	8

Applicable Tax Rate is 40% and cost of capital is 10% (including inflation premium).

Please calculate the net present value of the project and give recommendation.

Solution:

Depreciation p.a. = ₹ (160,00,000 ÷ 4) = ₹ 40,00,000

Tax shield on depreciation = 40% of ₹ 40,00,000 = ₹ 16,00,000

Year	Inflation adjusted Revenues (₹)	Inflation adjusted Costs (₹)
1	120,00,000×1.1=132,00,000	60,00,000×1.12=67,20,000
2	140,00,000×1.1×1.09=167,86,000	80,00,000×1.12×1.1=98,56,000
3	160,00,000×1.1×1.09×1.08=207,18,720	80,00,000×1.12×1.1×1.09=107,43,040
4	160,00,000×1.1×1.09×1.08×1,07=221,69,030	80,00,000×1.12×1.1×1.09×1.08=116,02,483

Year	Net profit (₹)	Tax @ 40%	EAT (₹) = (NPTax)	CFAT = (EAT +Tax shield on Dep.)	PVF @ 10%	PV of CFAT (₹)
1	64,80,000	25,92,000	30,88,000	46,88,000	0.9091	42,61,861
2	69,30,000	27,72,000	41,58,000	57,58,000	0.8264	47,58,411
3	99,75,680	39,90,272	59,85,408	75,85,408	0.7513	56,98,917
4	105,66,547	42,26,619	63,39,928	79,39,928	0.6830	54,22,971
Total present value of cash inflows						201,42,160
Less: Present value of cash outflows						160,00,000
NPV						41,42,160

Recommendation: The project should be undertaken as the NPV is positive.

Illustration 11

BRAIN POWER LIMITED has an old machine having book value zero – which can be sold for ₹ 2,50,000. The company is thinking to choose one from the following two alternative proposals:

(i) To incur additional cost of ₹ 50,00,000 to upgrade the old existing machine.

(ii) To replace old machine with a new machine costing ₹ 100,00,000 plus installation cost ₹ 2,50,000.

Both above proposals envisage useful life to be five years with salvage value to be nil.

The expected after-tax profits for the above three alternatives are as under:

Year	Existing machine (₹)	Upgrade the machine (₹)	Install new machine (₹)
1	26,00,000	28,00,000	38,00,000
2	27,00,000	30,50,000	41,20,000
3	29,50,000	32,00,000	35,00,000
4	32,20,000	34,50,000	39,00,000
5	33,00,000	36,00,000	42,50,000

The tax rate is 40 per cent. The company follows straight line method of depreciation. Assume cost of capital to be 15%

You are required to advise the company as to which alternative is to be adopted.

Solution:

Depreciation per annum

- Upgrading the machine = 50,00,000 / 5 = ₹ 10,00,000
- Install new machine = 102,50,000 / 5 = ₹ 20,50,000

Year	Upgrading the machine		Existing machine	Incremental	PVF	PV of Incr.
	EAT	CFAT = EAT+Dep.	CFAT	CFAT	@15%	CFAT
1	28,00,000	38,00,000	26,00,000	12,00,000	0.8696	10,43,520
2	30,50,000	40,50,000	27,00,000	13,50,000	0.7561	10,20,735
3	32,00,000	42,00,000	29,50,000	13,50,000	0.6575	8,87,625
4	34,50,000	44,50,000	32,20,000	12,30,000	0.5718	7,03,314
5	36,00,000	46,00,000	33,00,000	13,00,000	0.4972	6,46,360
Total PV of Cash inflows						43,01,554
Less: PV of Cash outflows						50,00,000
NPV						(6,98,446)

Year	Install the new machine		Existing machine	Incremental	PVF	PV of Incr.
	EAT	CFAT=EAT+Dep.	CFAT	CFAT	@15%	CFAT
1	38,00,000	58,50,000	26,00,000	32,50,000	0.8696	28,26,200
2	41,20,000	61,70,000	27,00,000	34,70,000	0.7561	26,23,667
3	35,00,000	55,50,000	29,50,000	26,00,000	0.6575	17,09,500
4	39,00,000	59,50,000	32,20,000	27,30,000	0.5718	15,61,014
5	42,50,000	62,50,000	33,00,000	29,50,000	0.4972	14,66,740
Total PV of cash inflows						101,87,121
PV of cash outflows					102,50,000	
Less: Sale value of existing machine Tax on gain on sale [2,50,000 40% of 2,50,000]					1,50,000	101,00,000
NPV						87,121

Recommendation: The company should install the new machine.

Illustration 12

CHHOTA BHIM LTD uses certainty equivalent (CE) approach to evaluate risky projects. The company provides you the following information in relation to its new project:

Year	Expected CFAT	CE Quotient
1	32,00,000	0.8
2	29,00,000	0.7
3	25,50,000	0.6
4	24,00,000	0.4
5	15,90,000	0.3

The initial investment is calculated as ₹ 54,20,000. The cost of equity share capital is 16%, cost of debt capital is 10% and the riskless rate of interest on the Government Bond is 6%. Please recommend whether the project should be accepted or not.

Solution:

Year	CFAT	CE Quotient	Adjusted CFAT	PVF @ 6%	PV of CFAT
	(A)	(B)	(A×B) = (C)	(D)	(C × D)
1	32,00,000	0.8	25,60,000	0.9434	24,15,104
2	29,00,000	0.7	20,30,000	0.8900	18,06,700
3	25,50,000	0.6	15,30,000	0.8396	12,84,588
4	24,00,000	0.4	9,60,000	0.7921	7,60,416
5	15,90,000	0.3	4,77,000	0.7473	3,56,462

Total PV of cash inflows	66,23,270
Less: PV of cash outflows	54,20,000
NPV	12,03,270

Recommendation: As the NPV is positive, the project should be accepted.

Illustration 13

NTPC Ltd. is considering one of two mutually exclusive proposals, Projects **ALPHA** and Project **BETA**, which require cash outlays of ₹ 17,00,000 and ₹ 16,55,000 respectively. The certainty-equivalent (C.E) approach is used in incorporating risk in capital budgeting decisions. The current yield on government bonds is 6% and this is used as the risk-free rate. The expected net cash flows and their certainty equivalents are as follows:

Year	Project ALPHA		PROJECT BETA	
	CFAT	CE Quotient	CFAT	CE Quotient
1	9,10,000	0.8	9,00,000	0.9
2	11,00,000	0.7	9,20,000	0.8
3	10,50,000	0.5	10,10,000	0.6

(a) Which project should be acceptable to the company?

(b) Which project is riskier?

(c) If the company uses the risk-adjusted discount rate method, which project will be analysed with higher rate?

Solution:

(a) Computation of NPV

Project ALPHA:

Year	CFAT (A)	CE Quotient (B)	Adjusted CFAT (A×B) =(C)	PVF @ 6% (D)	PV of CFAT (C×D)
1	9,10,000	0.8	7,28,000	0.9434	6,86,795
2	11,00,000	0.7	7,70,000	0.8900	6,85,000
3	10,50,000	0.5	5,25,000	0.8396	4,40,790
Total PV of cash inflows					18,12,585
Less: PV of cash outflows					17,00,000
NPV					1,12,585

Project BETA:

Year	CFAT (A)	CE Quotient (B)	Adjusted CFAT (A×B)= (C)	PVF @ 6% (D)	PV of CFAT (C × D)
1	9,00,000	0.9	8,10,000	0.9434	7,64,154
2	9,20,000	0.8	7,36,000	0.8900	6,55,040
3	10,10,000	0.6	6,06,000	0.8396	5,08,798
Total PV of cash inflows					19,27,992
Less: PV of cash outflows					16,55,000
NPV					2,72,992

Recommendation: Project BETA should be accepted.

(a) The CE Quotients of CFAT associated with Project ALPHA are lower than those of Project BETA. Thus, Project ALPHA is riskier.

(b) Project ALPHA should be analysed with higher rate as it is more risky.

Illustration 14

SURAT PAPER MILLS is considering setting up a cogeneration power plant to minimise production losses that occurs due to frequent interruption of power supply. The proposed plant is contemplated to meet the power requirement of the Duplex Board Paper manufacturing continuous process plant. The capital cost of the cogeneration plant is estimated to be ₹126 million with phasing of expenditure as given below:

Year	0	1
Capital expenditure (₹ Million)	84	42

The capital cost is met through company's own capital of ₹ 38 million and borrowing of the balance amount from the financial institution at an interest rate of 8.85%. The savings in electricity cost is projected as under:

Year	Generation in million Kwh	Present supply cost (₹ Per Kwh)	Cogeneration cost (₹ Per Kwh)
1	7.55	4.88	3.87
2	24.53	5.07	3.99
3	24.53	5.26	4.11
4	24.53	5.47	4.23
5	24.53	5.68	4.36
6	24.53	5.90	4.49
7	24.53	6.14	4.62
8	24.53	6.37	4.76
9	24.53	6.63	4.90

Required:

(i) Do you think setting up a cogeneration plant a viable option for the company? Support your answer with necessary calculations.

(ii) Estimate the levelised cost of generation per unit using the cogeneration plant. You may ignore tax effect and assume cost of equity to 16%. [ICWAI—FINAL]

Solution:

Computation of composite cost of capital

Sources	Amount (₹ Million)	Specific cost of capital	Weighted Cost (₹ Million)
Equity	38	16%	6.08
Loan	88	**8.85%**	**7.79**
	126		**13.87**

Composite cost of capital = (13.87 ÷ 126) × 100 = 11% (approx.)

(i)

Year	Generation in million Kwh	Present supply cost (₹ Per Kwh)	Cogeneration cost (₹ Per Kwh)	Savings (₹ in million)	PV factor @ 11%	PV of savings (₹ in million)
1	7.55	4.88	3.87	7.63	0.9009	6.873867
2	24.53	5.07	3.99	26.49	0.8116	21.499284
3	24.53	5.26	4.11	28.21	0.7312	20.627152
4	24.53	5.47	4.23	30.42	0.6587	20.037654
5	24.53	5.68	4.36	32.38	0.5935	19.217530
6	24.53	5.90	4.49	34.59	0.5346	18.491814
7	24.53	6.14	4.62	37.29	0.4817	17.962593
8	24.53	6.37	4.76	39.49	0.4339	17.134711
9	24.53	6.63	4.90	42.44	0.3909	16.589796
Total						158.434401

Total present value of cash inflows ₹ 158.434401

Less: Total present value of cash outflows (84 + 42 × 0.9009) ₹ 121.837800

Net Present Value (NPV) **₹36.596601**

Comment: The project is viable as the NPV is positive.

Note: Savings = (Present supply cost − Cogeneration cost) × generation in million.

(ii) Computation of levelised cost of production

Year	Computation of levelised Rs. Per Kwh	Cost of production PV factor	PV of Costs (Rs.)
1	3.87	0.9009	3.4865
2	3.99	0.8116	3.2383
3	4.11	0.7312	3.0052
4	4.23	0.6587	2.7863
5	4.36	0.5935	2.5877
6	4.49	0.5346	2.4004
7	4.62	0.4817	2.2255
8	4.76	0.4339	2.0654
9	4.90	0.3909	1.9154
Total PV of costs			**23.7105**

Levelised cost of generation = ₹ (23.7105 ÷ 5.5370) = ₹ 4.28 (approx.).

Illustration 15

SMALL SCREEN LIMITED is a growing company. It's Free cash flows for equity holders (FCFE) have been growing at a rate of 25 per cent in recent years. This abnormal growth rate is expected to continue for another 5 years, then these FCFE are likely to grow at the normal rate of 8 per cent. The required rate of return on these shares, by the investing community is 15 per cent, the firm' weighted average cost of capital is 12 per cent.

The amount of FCFE per share at the beginning of the current year is ₹30. The issue price of the share is ₹ 500.

Determine the maximum price an investor should be willing to pay, based on free cash flow approach.

P.V. factors at 15% discount rate are:

Year	1	2	3	4	5
P.V.	0.870	0.756	0.658	0.572	0.497

Solution:

Year	FCFE per share	PV factor @ 15%	PV of FCFE
1	30 × 1.25 = 37.50	0.870	32.625
2	37.50 ×1.25 = 46.88	0.756	35.441
3	46.88 ×1.25 = 58.60	0.658	38.559
4	58.60 × 1.25 = 73.25	0.572	41.899
5	73.25 × 1.25 = 91.56	0.497	45.505
5	1,412.64	0.497	702.082
Total present value of cash inflows			896.111

Terminal value of perpetual cash flows (T.V.) = $\frac{CFAT \times (1 + g)}{K_e - g} = \frac{91.56 \times (1 + 0.8)}{0.15 - 0.08}$ = ₹1,412.64.

Decision: The maximum price the investor should be willing to pay is ₹896.11.

2 Evaluation of Risky Proposal for Investment Decisions [Study Material - Module 2]

Illustration 1

From the following details relating to a project of JI LE JINDEGI LIMITED, analyse the sensitivity of the project to changes in initial project cost, annual cash inflow and cost of capital:

Initial project costs	₹ 60,00,000
Annual cash inflows	₹ 22,00,000
Project's economic life	4 years
Cost of capital	10%

Please determine the most sensitive factor.

[Given, $PVIFA_{(10\%, 4 \text{ years})} = 3.169$ and $PVIFA_{(11\%, 4 \text{ years})} = 3.103$]

Solution

Step 1: Computation of NPV:

PV of cash inflows [22,00,000 × 3.169]	69,71,800
Less: PV of cash outflows	60,00,000
NPV	9,71,800

Step 2: Effect on NPV if the parameters are changed by 10%:

(a) If initial project costs increase by 10%, the revised NPV will be ₹ (69,71,800 - 66,00,000) = ₹ 3,71,800.

Therefore, decrease in NPV = $\frac{(9,71,800 - 3,71,800)}{9,71,800} \times 100 = 61.74\%$.

(b) If annual cash inflows decrease by 10% --

PV of cash inflows [19,80,000 × 3.169] = 62,74,620

Less: PV of cash outflows 60,00,000

NPV 2,74,620

Therefore, decrease in NPV = $\frac{(9,71,800 - 2,74,620)}{9,71,800} \times 100 = 71.74\%$

(c) If cost of capital increases by 10%, the new cost of capital will be 11% and NPV will be –

Total PV of cash inflows [22,00,000 × 3.103]	= 68,26,600
Less: PV of cash outflows	60,00,000
NPV	8,26,600

Therefore, decrease in NPV = $\frac{(9,71,800 - 8,26,600)}{9,71,800} \times 100 = 14.94\%$

Comment: The most sensitive factor is annual cash inflow.

Illustration 2

COMPANY BAHUBALI is considering taking up one of the two projects-Project-A and Project-B. Both the projects having same life require equal investment of ₹ 400 lakhs each. Both are estimated to have almost the same yield. As the company is new to this type of business, the cash flow arising from the projects cannot be estimated with certainty. An attempt was therefore, made to use probability to analyse the pattern of cash flow from other projects during the first year of operations. This pattern is likely to continue during the life of these projects. The results of the analysis are as follows:

Project A		Project B	
Cash flows	Probability	Cash flows	Probability
55	0.10	45	0.10
65	0.20	65	0.25
75	0.40	85	0.30
85	0.20	105	0.25
95	0.10	125	0.10

You are required to:

(i) Calculate variance, standard deviation and co-efficient of variation for both the projects.

(ii) determine which of the two projects is riskier?

Solution:

Project A: (i)

Expected cash flows or Mean value = 55 × 0.10 + 65 × 0.20 + 75 × 0.40 + 85 × 0.20 + 95 × 0.10 = 75

Variance =$(55 -75)^2 \times 0.10 + (65 -75)^2 \times 0.20 + (75 -75)^2 \times 0.40 + (85 -75)^2 \times 0.20 + (95 -75)^2 \times 0.10$
= 40 + 20 + 0 + 20 + 40 = 120

Standard deviation (σ) = $\sqrt{\text{Variance}} = \sqrt{120} = 10.95$

Coefficient of variation = $\frac{\text{Standard deviation}}{\text{Mean}} = \frac{10.95}{75} = 0.146$

Project B:

Expected cash flows or Mean value = 45 × 0.10 + 65 × 0.25 + 85 × 0.30 + 105 × 0.25 + 125 × 0.10 = 85

Variance = $(45 -85)^2 \times 0.10 + (65 -85)^2 \times 0.25 + (85 -85)^2 \times 0.30 + (105 -85)^2 \times 0.25 + (125 -85)^2 \times 0.10$
= 160 + 100 + 0 + 100 + 160 = 520

Standard deviation (σ) = $\sqrt{\text{Variance}} = \sqrt{520} = 22.80$

Coefficient of variation = $\frac{\text{Standard deviation}}{\text{Mean}} = \frac{22.80}{85} = 0.268$

(ii) Project B is riskier as it has higher coefficient of variation.

Illustration 3

CO. GALAXY-IN-CONTROL LIMITED has two investment proposals, viz., Project P and Project Q. Project P has a standard deviation of ₹ 32,500 while Project Q has a standard deviation of ₹ 36,000. The finance manager is not willing to take more risk and wants to know which project to choose, given each of the following combinations of the expected values;

(a) Project P and Project Q both have expected net present value of ₹ 75,000.

(b) Project P has expected NPV of ₹ 90,000 while Project Q has ₹ 110,000.

Solution:

Here, the decision should be taken on the basis of co-efficient of variation. The project with lower co-efficient of variation is less risky.

(a) Co-efficient of variation = $\frac{\text{Standard deviation}}{\text{Mean}} \times 100$

Project P: Co-efficient of variation = $\frac{32,500}{75,000} \times 100 = 43.33\%$

Project Q: Co-efficient of variation = $\frac{36,000}{75,000} \times 100 = 48\%$

Recommendation: Project P is less risky.

(b) Project P: Co-efficient of variation = $\frac{32,500}{90,000} \times 100 = 36.11\%$

Project Q: Co-efficient of variation = $\frac{36,000}{1,10,000} \times 100 = 32.73\%$

Recommendation: Project Q is less risky.

Illustration 4

From the following details relating to a project of CO. BLACK-HOLE LIMITED, analyse the sensitivity of the project to changes in initial project cost, annual cash inflow and cost of capital:

Initial project costs	₹ 60,00,000
Annual cash inflows	₹ 22,00,000
Project's economic life	4 years
Cost of capital	10%

Please determine the most sensitive factor.

[Given, $PVIFA_{(10\%, 4 \text{ years})}$ = 3.169 and $PVIFA_{(11\%, 4 \text{ years})}$ = 3.103]

Solution:

Step 1: Computation of NPV:

PV of cash inflows [22,00,000 × 3.169]	69,71,800
Less: PV of cash outflows	60,00,000
NPV	9,71,800

Step 2: Effect on NPV if the parameters are changed by 10%:

(a) If initial project costs increase by 10%, the revised NPV will be ₹ (69,71,800 - 66,00,000) = ₹3,71,800.

Therefore, decrease in NPV = $\frac{(9,71,800 - 3,71,800)}{9,71,800} \times 100 = 61.74\%$.

(b) If annual cash inflows decrease by 10% --

PV of cash inflows [19,80,000 × 3.169] = 62,74,620

Less: PV of cash outflows 60,00,000

NPV 2,74,620

Therefore, decrease in NPV = $\frac{(9,71,800 - 2,74,620)}{9,71,800} \times 100 = 71.74\%$

(c) If cost of capital increases by 10%, the new cost of capital will be 11% and NPV will be –

Total PV of cash inflows [22,00,000 × 3.103] = 68,26,600

Less: PV of cash outflows 60,00,000

NPV 8,26,600

Therefore, decrease in NPV = $\frac{(9,71,800 - 8,26,600)}{9,71,800} \times 100 = 14.94\%$

Comment: The most sensitive factor is annual cash inflow.

Alternative Method:

Step 1: Computation of NPV:

PV of cash inflows [22,00,000 × 3.169]	69,71,800
Less: PV of cash outflows	60,00,000
NPV	9,71,800

Step 2: Determination of most sensitive factor: NPV will be nil, if

(a) Cash inflow per annum decreases by $\frac{9,71,800}{69,71,800} \times 100 = 13.94\%$

(b) Initial project cost increases by = $\frac{9,71,800}{60,00,000} \times 100 = 16.20\%$

(c) IRR as per estimation method is rate of return where the PVIFA for 5 years = $\frac{60,00,000}{22,00,000}$ =2.7273. Against this, the approximate rate of return [from PVIFA Table] is calculated as follows:

$PVIFA_{(24\%, 5 \text{ years})} = 2.7454$ and $PVIFA_{(25\%, 5\text{years})} = 2.6893$

Therefore, IRR = $24 + \frac{(2.7454 - 2.7232)}{(2.7454 - 2.6893)} \times 1 = 24.40\%$.

So, the NPV will be zero, if the rate of return increases by $\frac{(24.40 - 10)}{10} \times 100 = 144\%$.

Comment: The most sensitive factor is annual cash inflow due to lowest percentage change, the NPV becomes nil.

Illustration 5

CO. AASMAN SE JAMIN TAK is considering a project with the following cash flows:

Year	Purchase of Plant	Running Cost	Savings
0	(7,000)	Nil	Nil
1	Nil	2,000	6,000
2	Nil	2,500	7,000

The cost of capital is 8%. Measure the sensitivity of the project to changes in the levels of plant value, running cost and savings (considering each factor at a time) such that NPV becomes zero. Which factor is most sensitive to affect the sensibility of the project? The PV factors at 8% are as follows:

Year : 0 1 2

Factor : 1.00 0.9259 0.8573

Solution:

Year	PVF @ 8%	PV of Plant cost	PV of Running Cost	PV of Savings
0	1.00	(7,000)	Nil	Nil
1	0.9259	Nil	1,851.80	5,555.40
2	0.8573	Nil	2,143.25	6,001.10
			3,995.05	11,556.50

NPV = ₹ [11,556.50 (7,000 + 3,995.05)] = ₹ 561.45

Degree of Sensitivity Analysis: NPV will be zero if—

(a) Plant cost increases by $\frac{561.45}{7,000} \times 100 = 8.021\%$

(b) Running cost increases by $\frac{561.45}{3,995.05} \times 100 = 14.05\%$

(c) Savings decreases by $\frac{561.45}{11,556.50} \times 100 = 4.86\%$

Comment: Saving is the most sensitive factor.

Illustration 6

NO CONFUSION LIMITED, an investment corporation wants to study the investment project based on three factors: Market demand in units, Contribution per unit and investment required. These factors are felt to be independent of each other. In analyzing a new consumer product for a washing powder factory, the corporation estimates the following probability distributions:

Annual demand		Contribution per unit		Required investment	
Units	Probability	₹	Probability	₹	Probability
20,000	0.05	3	0.10	17,50,000	0.25
25,000	0.10	5	0.20	20,00,000	0.50
30,000	0.20	7	0.40	25,00,000	0.25
35,000	0.30	9	0.20		
40,000	0.20	10	0.10		
45,000	0.10				
50,000	0.05				

Using Monte-Carlo simulation for 10 runs, estimate the percentage of return on investment (ROI %) defined by—

ROI = $\frac{\text{Cash inflow}}{\text{Investment}} \times 100$

For each run, recommend an optimum investment strategy based on model value of ROI %.

Use the following sets of random numbers:

28, 57, 60, 17, 64, 20, 27, 58, 61, 30, 19, 07, 90, 02, 57, 28, 29, 83, 58, 41, 18, 67, 16, 71, 43, 68, 47, 24, 19, 97. Use first 10 random numbers for demand, next 10 random numbers for contribution and last 10 random numbers for investment.

Solution:

Step 1: Allocation of Random numbers:

Annual demand			
Units	**Probability**	**Cumulative probability**	**Random numbers**
20,000	0.05	0.05	00 – 04
25,000	0.10	0.15	05 – 14
30,000	0.20	0.35	15 – 34
35,000	0.30	0.65	35 – 64
40,000	0.20	0.85	65 – 84
45,000	0.10	0.95	85 – 94
50,000	0.05	1.00	95 – 99

Contribution per unit			
₹	**Probability**	**Cumulative probability**	**Random numbers**
3	0.10	0.10	00 – 09
5	0.20	0.30	10 – 29
7	0.40	0.70	30 – 69
9	0.20	0.90	70 – 89
10	0.10	1.00	90 – 99

Required investment			
₹	**Probability**	**Cumulative probability**	**Random numbers**
17,50,000	0.25	0.25	00 – 24
20,00,000	0.50	0.75	25 – 74
25,00,000	0.25	1.00	75 – 99

Step 2: Computation of ROI considering the random numbers:

Demand (units)		Contribution per unit		Total contribution	Investment		ROI
RND	Units	RND	₹	[P]	RND	Investment (₹)[Q]	$\frac{P}{Q}$ ×100
28	30,000	19	5	150,000	18	17,50,000	8.57%
57	35,000	07	3	105,000	67	20,00,000	5.25%
60	35,000	90	10	350,000	16	17,50,000	20%
17	30,000	02	3	90,000	71	20,00,000	4.5%
64	35,000	57	7	245,000	43	20,00,000	12.25%
20	30,000	28	5	150,000	68	20,00,000	7.5%
27	30,000	29	5	150,000	47	20,00,000	7.5%
58	35,000	83	9	315,000	24	17,50,000	18%
61	35,000	58	7	245,000	19	17,50,000	14%
30	30,000	41	7	210,000	97	25,00,000	8.4%

Illustration 7

THREE SIXTY DEGREE LTD manufactures 30 items per day. The sales volume depends upon demand of the product which has the following probability distribution:

Sales volume (units)	27	28	29	30	31	32
Probability	0.10	0.15	0.20	0.35	0.15	0.05

The production cost and selling price of each unit are ₹40 and ₹50 respectively. Any unsold product is to be disposed off at a loss of ₹15 per unit. There is a penalty of ₹5 per unit of the demand is not met.

(a) Use the following random numbers and estimate the total profit or loss for the next 10 days:

10, 99, 65, 96, 95, 01, 79, 11, 16, 20.

(b) If the company decides to produce 29 items per day, what is the advantage/ loss to the company? Use the same random numbers.

Solution:

(a) Step 1: Allocation of Random numbers:

Sales volume (units)	Probability	Cumulative probability	Random numbers
27	0.10	0.10	00 – 09
28	0.15	0.25	10 – 24
29	0.20	0.45	25 – 44
30	0.35	0.80	45 – 79
31	0.15	0.95	80 – 94
32	0.05	1.00	95 – 99

Step 2: Computation of sales volume, unsold stock and shortages using the random numbers:

Day	Production (units)	RND	Demand (units)	Sale (units)	Unsold (units)	Shortage (units)
1	30	10	28	28	2	0
2	30	99	32	30	0	2
3	30	65	30	30	0	0
4	30	96	32	30	0	2
5	30	95	32	30	0	2
6	30	01	27	27	3	0
7	30	79	30	30	0	0
8	30	11	28	28	2	0
9	30	16	28	28	2	0
10	30	20	28	28	2	0
Total	**300**			**289**	**11**	**6**

Computation of simulated profits:

Profit on sale [289 × 10]	₹ 2,890
Less: Loss on unsold units [11 × 15]	₹ 165
Gross profit	₹ 2,725
Less: Penalty on shortage [6 × 5]	₹ 30
Net simulated profit	**₹ 2,695**

(b) Step 2: Computation of sales volume, unsold stock and shortages using the random numbers:

Day	Production (units)	RND	Demand (units)	Sale (units)	Unsold (units)	Shortage (units)
1	29	10	28	28	1	0
2	29	99	32	30	0	3
3	29	65	30	29	0	1
4	29	96	32	29	0	3
5	29	95	32	29	0	3
6	29	01	27	27	2	0
7	29	79	30	29	0	1
8	29	11	28	28	1	0
9	29	16	28	28	1	0
10	29	20	28	28	1	0
Total	**300**			**285**	**6**	**11**

Computation of simulated profits:

Profit on sale [285 × 10]	₹ 2,850
Less: Loss on unsold units [6 × 15]	₹ 90
Gross profit	₹ 2,760
Less: Penalty on shortage [11 × 5]	₹ 55
Net simulated profit	**₹ 2,705**

Illustration 8

You are given the following pay-offs of three acts A1, A2 & A3 and the states of nature S1, S2 & S3:

States of nature	A_1	A_2	A_3
S_1	25	−10	−125
S_2	400	440	410
S_3	650	740	750

The probabilities of the states of nature are respectively 0.1, 0.7 and 0.2. Calculate EMV and conclude which of the acts should be chosen.

Solution:

States of nature	Probability	A_1	A_2	A_3
S_1	0.1	2.5	-1	-12.5
S_2	0.7	280	308	287
S_3	0.2	130	148	150
Expected monetary value (EMV)		412.5	455	424.5

Conclusion: State A2 should be chosen as it has highest EMV.

Illustration 9

OM SHIVAI NOMO LIMITED has estimated the following demand level of its product:

Sales volume (units)	**Probability**
10,000	0.10
12,000	0.15
14,000	0.25
16,000	0.30
18,000	0.20

It has been assumed that the sales price will be ₹6 per unit, marginal cost ₹3.50 per unit and fixed cost ₹34,000.

What is the probability that:

(1) the company will break-even in the period?

(2) the company will make a profit of at least ₹ 10,000?

Solution:

(1) BEP = $\frac{\text{Fixed Costs}}{\text{Contribution per unit}} = \frac{34,000}{(6 - 3.50)}$ = 13,600 units.

Therefore, the probability that the company will break-even = Probability (Demand ≥ 13,600 units) = 0.25+0.30+0.20 = 0.75 i.e., 75%.

(2) Sales volume required to earn a profit of Rs 10,000 = $\frac{\text{Fixed Costs + Profit}}{\text{Contribution per unit}} = \frac{(34,000+10,000)}{(6 - 3.50)}$ = 17,600 units.

Therefore, the probability to make a profit of at least ₹ 10,000

= Probability (Demand ≥ 17,600 units) = 0.20 i.e., 20%

Illustration 10

ANTI-GRAVITY LIMITED observes that its sales for the past few years and its profits have been around the following figures:

Particulars	₹
Sales	15,00,000
Less: Marginal costs	5,00,000
Contribution	10,00,000
Less: Fixed costs	8,00,000
Profit	2,00,000

In preparing the budget for the next year there is uncertainty about several important points:

(i) It has submitted offer for two overseas contracts:

Contract	Sales value (₹)
A	8,00,000
B	3,00,000

For each of these orders, variable costs (including selling and shipping costs) would 40% of sales value. Total fixed costs would be unaffected by the order. The company hopes to win both the contracts but thinks it more likely that it will win contract A but not contract B.

(ii) A new product is due to be introduced next year. Expected sales are ₹30,000 per month with variable costs 50% of sales and fixed costs of ₹ 5,000 per month. The most likely date for introduction of the new product is middle of next year but could be introduced at the end of fourth month as late as at the end of ninth month.

(iii)Although it is expected on balance that sale price and costs will not go up there is a reasonable possibility that variable costs on the current product range will go up by 10%.

Please prepare a pessimistic and an optimistic budget for the next year.

Solution:

Particulars	**Pessimistic Budget**	**Optimistic Budget**
(i) Contract expected to win	None	Both
(ii) New product (months of sales)	3 months	8 months
(iii) variable costs	Increase by 10%	No increase
	₹	₹
Present sales value	15,00,000	15,00,000
Less: Variable costs	5,50,000	5,00,000
Contribution	9,50,000	10,00,000
Less: Fixed costs	8,00,000	8,00,000
Profit (A)	**1,50,000**	**2,00,000**
(i) Sales value	NIL	11,00,000
Less: Variable costs @ 40%	NIL	4,40,000
Contribution from contracts (B)	**NIL**	**6,60,000**
(iii) Sales value	90,000	2,40,000
Less: Variable costs @ 50%	45,000	1,20,000
Contribution	45,000	1,20,000
Less: Fixed costs	15,000	40,000
Profit from New product (C)	**30,000**	**80,000**
Total budgeted profits [A+B+C]	**1,80,000**	**8,80,000**

Illustration 11

BUDGET HO TO AISA Ltd. is preparing their budget for 2025-26. In the preparation of the budget, they would like to take no chances, but would like to envisage all sorts of possibilities and incorporate them in the Budget. Their considered estimates are as under:

(a) If the worst possible happens, sales will be 80,000 units at a price of ₹ 19 per unit. The material cost will be ₹ 9 per unit, direct labour ₹ 2 per unit, and the variable overhead will be ₹1.50 per unit. The fixed cost will be ₹600,000 per annum.

(b) If the best possible happens, sales will be 150,000 units at a price of ₹20 per units. The material cost will be ₹ 7 per unit, direct labour ₹3 per unit and the variable overhead will be ₹1 per unit. The fixed cost will be ₹ 480,000 per annum.

(c) It is most likely, however that the sales will be 120,000 units above the worst possible level at a price of ₹ 20 per unit. The material cost will be ₹8 per unit, direct labour ₹ 3 per unit and the variable overhead will be ₹1 per unit. The fixed cost will be ₹500,000 per annum.

(d) There is a 20% probability that the worst will happen, a 10% probability that the best will happen and a 70% chance that the most likely outcome will occur.

What will be the expected value of profit as per the budget for 2025-26?

Solution:

	Worst possible	Best possible	Most likely
Sales volume (units)	80,000	150,000	120,000
Selling price per unit	19	20	20
Direct Material costs	9.00	7.00	8.00
Direct Labour costs	2.00	3.00	3.00
Variable overhead	1.50	1.00	1.00
Variable cost per unit	12.50	11.00	12.00
Contribution per unit	6.50	9.00	8.00
Total contribution	5,20,000	13,50,000	9,60,000
Less: Fixed costs	6,00,000	4,80,000	5,00,000
Budgeted Profit / (Loss) (P)	(80,000)	8,70,000	4,60,000
Probability (Q)	0.20	0.10	0.70
Expected profit [P × Q]	(16,000)	87,000	3,22,000

Total expected profit = ₹ (-16,000 + 87,000 + 3,22,000) = ₹ 3,93,000

Illustration 12

CO. SOFT MOUNTAIN has an investment proposal, requiring an initial cash outflow of ₹ 400,000. The investment proposal is expected to have 2 years economic life with zero value. In year 1, there is a 40% probability that cash inflow after tax will be ₹ 250,000 and 0.6 probability that cash inflow after tax will be ₹ 300,000. The probability assigned to cash inflow after tax for the year 2 is as follows:

Cash inflow in year 1	₹ 2,50,000		₹ 300,000	
Year 2	CFAT (₹)	Probability	CFAT (₹)	Probability
	130,000	0.2	210,000	0.4
	165,000	0.3	265,000	0.5
	170,000	0.5	320,000	0.1

The firm uses a 10% discount rate for this type of investment.

Required:

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

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

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

(d) Will the project be accepted?

Solution:

(a)

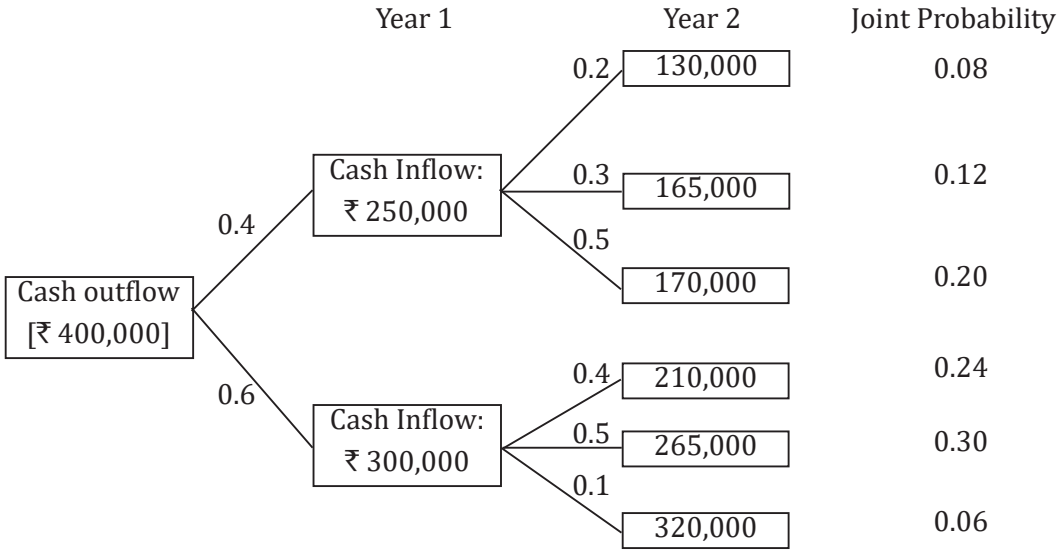


Fig.: **Decision Tree**

Expected CFAT:

Year 1: 250,000 × 0.4 + 300,000 × 0.6 = 280,000

Year 2: 130,000 × 0.08 + 165,000 × 0.12 + 170,000 × 0.20 + 210,000 × 0.24 + 265,000 × 0.30 + 320,000 × 0.06 = 10,400 + 19,800 + 34,000 + 50,400 + 79,500 + 19,200 = 213,300

Year	CFAT (₹)	PVF @ 10%	PV of CFAT (₹)
1	280,000	0.9091	254,548
2	213,300	0.8264	176,271
Total PV of CFAT			430,819
Less: PV of cash outflow			400,000
Expected NPV			**30,819**

		(b) Worst outcome		(C) Best outcome	
Year	PVF @ 10%	CFAT	PV of CFAT	CFAT	PV of CFAT
1	0.9091	250,000	227,275	300,000	272,730
2	0.8264	130,000	107,432	320,000	264,448
Total PV of CFAT			334,707		537178
Less: PV of cash outflow			400,000		400,000
NPV			**65,293**		**137,178**

Illustration 13

COMPANY MARIANA TRENCH follows risk-adjusted rate of return for computing NPV of its projects. Please determine the risk adjusted net present value of the following projects:

	Project P	Project Q	Project R
Net cash outlays (₹)	200,000	250,000	430,000
Project life (years)	5	5	5
Cash inflows p.a. (CFAT) (₹)	60,000	85,000	150,000
Co-efficient of variation	0.4	0.8	1.2

Coefficient of Variation	Risk-adjusted rate of return
0.0	10%
0.4	12%
0.8	14%
1.2	16%
1.6	19%
2.0	21%
Above 2.0	24%

Solution:

	Project P	Project Q	Project R
Co-efficient of variation	0.4	0.8	1.2
Risk-adjusted rate of return	12%	14%	16%
PVIFA for 5 years	3.6048	3.4331	3.2743
Cash inflows p.a. (CFAT) (₹)	60,000	85,000	150,000
Total PV of cash inflows (₹)	216,288	291,814	491,145
Less: PV of cash outflow (₹)	200,000	250,000	430,000
NPV	**16,288**	**41,814**	**61,145**

Recommendation: Project R should be selected as it has highest NPV.

Illustration 14

FULL CONFIDENT LIMITED is considering an investment proposal in a project at Jharkhand. The project requires an initial net investment of ₹ 3,000 lakh and expected cash flows over the next 3 years are as follows: (₹ In lakh)

Year 1		Year 2		Year 3	
CFAT	**Probability**	**CFAT**	**Probability**	**CFAT**	**Probability**
800	0.1	800	0.1	800	0.2
1,000	0.2	1,000	0.3	1,000	0.5
1,500	0.4	1,500	0.4	1,500	0.2
2,000	0.3	2,000	0.2	2,000	0.1

The standard deviation of the CFAT of the project is 622. The risk-free rate of return is 5%.

Please compute the following:

(a) Expected NPV (ENPV) of the project.

(b) What is the probability that the ENPV will be –

(i) Zero or less,

(ii) Greater than zero,

(iii) Between 500 and 750

(iv) At least 300

(v) At least 1,000

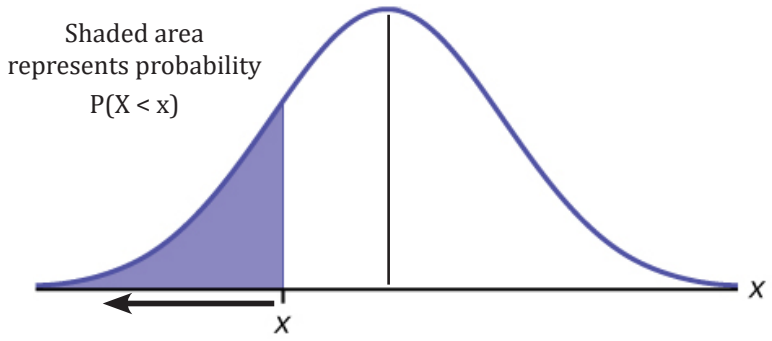
Solution: (a)

Year 1			Year 2			Year 3		
CFAT	**Prob.**	**CFAT×P**	**CFAT**	**Prob.**	**CFAT×P**	**CFAT**	**Prob.**	**CFAT×P**
800	0.1	80	800	0.1	80	800	0.2	160
1,000	0.2	200	1,000	0.3	300	1,000	0.5	500
1,500	0.4	600	1,500	0.4	600	1,500	0.2	300
2,000	0.3	600	2,000	0.2	400	2,000	0.1	200
Expected CFAT		1,480			1,380			1,160

Year	CFAT [A]	PVF @ 5% [B]	PV of CFAT [A × B]
1	1,480	0.9524	1,409.552
2	1,380	0.9070	1,251.660
3	1,160	0.8638	1,002.008
Total PV of CFAT			3.663.22
Less: PV of cash outflow			3,000.00
ENPV			**663.22**

(b) (i) $P(ENPV \le 0) = P(Z \le \frac{0 - 663.22}{622}) = P(Z \le -1.07) = 0.50 - 0.3577 = 0.1423$ i.e., 14.23%

[From the Normal Distribution Table, value of Z is available]



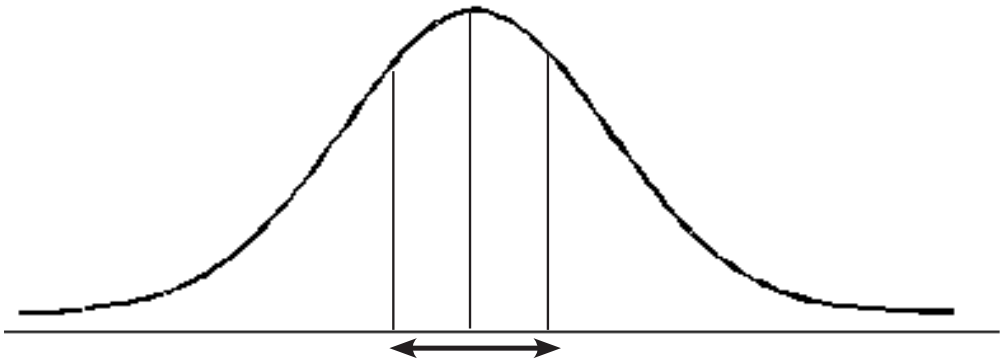
(ii) $P(ENPV > 0) = 1 - 0.1423 = 0.8577$ i.e., 85.77%

(iii) $P(500 < ENPV < 750) = P(\frac{500 - 663.22}{622} < Z < \frac{750 - 663.22}{622})$

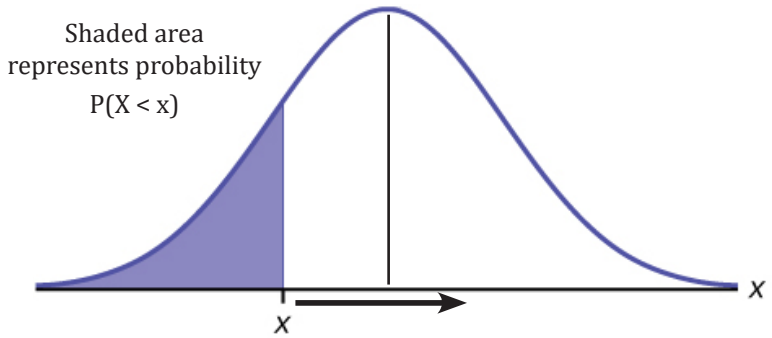
$= P(-0.26 < Z < 0.14)$

$= 0.1026 + 0.0557$

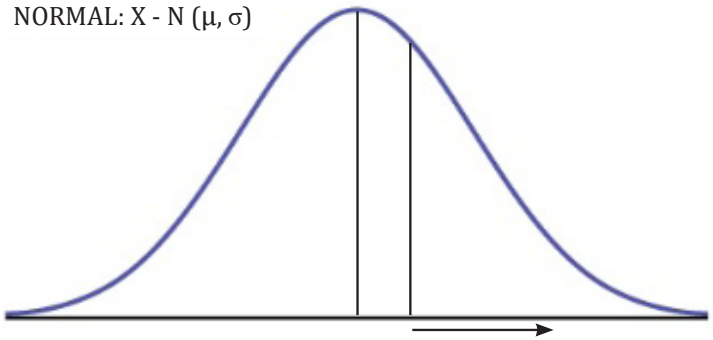
$= 0.1583$ i.e., 15.83%



(iv) $P(ENPV > 300) = P(Z > \frac{300 - 663.22}{622}) = P(Z > -0.58) = 0.50 + 0.2190 = 0.7190$ i.e., 71.90%



(v) $P(ENPV > 1{,}000) = P\left(Z > \frac{1{,}000 - 663.22}{622}\right) = P(Z > 0.54) = 0.50 - 0.2054 = 0.2946$ i.e., 29.46%



3 Leasing Decisions [Study Material - Module 3]

Illustration 1

GOOD MANNER LTD. gives you the following details for its project at Newtown:-

(i) Investment outlay: ₹ 1,000 lakhs;

(ii) Term of lease : 8 years;

(iii) Cost of capital : 12%;

(iv) Lease rentals are payable at ₹ 1,800 per ₹ 10,000.

You are requested to calculate the present value of lease rentals if—

(a) Lease Rentals are payable at the end of the year;

(b) Lease Rentals are payable at the beginning of the year.

Solution:

(a) Present value of lease rentals = ₹ 180,00,000 × $PVIFA_{(12\%,\ 1\ to\ 8\ years)}$

= ₹ 180,00,000 × 4.9676

= ₹ 894,16,800

(b) Present value of lease rentals = ₹ 180,00,000 × $PVIFA_{(12\%,\ 0\ to\ 7\ years)}$

= ₹ 180,00,000 × (1+4.5638)

= ₹ 1001,48,400

Illustration 2

SAFE JOURNEY LIMITED desires to acquire a truck for which it is considering the following two options:

(a) Buy the truck for ₹ 25,00,000 by borrowing the amount @12% interest and repaying the same together with interest in 4 equal annual instalments.

(b) Acquire the asset on lease with a lease rental payment of ₹ 800,000 for 4 years.

The company follows straight line method of depreciation and is under the income tax bracket of 35%. Life of the asset is 4 years. Salvage value of the machine after 4 years is assumed to be nil.

Please compute the Break-even lease rental per annum.

Solution:

(a) Buying option:

Amount of instalment per annum = 25,00,000 / $PVIFA_{(12\%, 4\ Years)}$ = 25,00,000 / 3.0373 = 8,23,099

Year	Opening Balance	Instalment	Interest payment	Principal repayment	Tax shield on interest	PVIF @7.8%	PV of Int. tax shield	Closing balance
1	25,00,000	823099	300000	523099	105000	0.9276	97403	1976901
2	19,76,901	823099	237228	585871	83030	0.8605	71449	1391030
3	13,91,030	823099	166924	656175	58423	0.7983	46637	734855
4	7,34,855	823099	88183	734855	30864	0.7405	22855	0
						Total	238343	

PV of principal repayment [8,23,099 × 3.3269]	₹ 27,38,368
Less: (i) PV of interest tax shield	₹ 2,38,343
(ii) PV of depreciation tax shield [(6,25,000 × 35%)×3.3269]	₹ 7,27,759
PV of costs of buying option	₹ 17,72,266

(b) Lease option:

Lease rent per annum	₹ 8,00,000
Less: Tax shield on lease rent [8,00,000 × 35%)]	₹ 2,80,000
Net lease rent per annum	₹ 5,20,000
PV of net lease rent [5,20,000 × 3.3269]	₹17,29,988

Comment: Lease option should be chosen as it has lower present value of net costs.

Illustration 3

CO. SMILE FACE supplies the following information:

(i) Cost of the equipment: ₹ 500 lakhs

(ii) Borrowing rate : 12%

(iii)Term of Loan : 5 years.

Please prepare a table showing Principal and interest payments and the total amount payable over a period of 5 years if—

(a) Principal is payable in equal instalments over the period of 5 years;

(b) Amount of loan is payable equally over the period of 5 years.

Solution:

(a) Repayment of principal per annum = $\frac{₹500,00,000}{5}$ = ₹ 100,00,000

Year	Opening balance	Payment of interest	Principal repayment	Closing balance
1	500,00,000	12% of 500,00,000 = 60,00,000	100,00,000	400,00,000
2	400,00,000	48,00,000	100,00,000	300,00,000
3	300,00,000	36,00,000	100,00,000	200,00,000
4	200,00,000	24,00,000	100,00,000	100,00,000
5	100,00,000	12,00,000	100,00,000	NIL
Total		180,00,000		

Total amount payable = ₹ (500,00,000 + 180,00,000) = ₹ 680,00,000

(b) $PVIFA_{(12\%, 5years)}$ = 3.6048

Amount of each instalment = $\frac{₹500,00,000}{3.6048}$ = ₹ 138,70,395

Year	Opening balance	Instalment	Payment of interest	Principal repayment	Closing balance
1	500,00,000	138,70,395	60,00,000	78,70,395	421,29,605
2	421,29,605	138,70,395	50,55,556	88,14,839	333,14,766
3	333,14,766	138,70,395	39,97,772	98,72,623	234,42,143
4	234,42,143	138,70,395	28,13,057	110,57,338	123,84,805
5	123,84,805	138,70,395	14,85,590	123,84,805	NIL
Total		693,51,975	193,51,975	500,00,000	

Note: The last year's interest = Instalment Principal = ₹ (138,70,395 123,84,805)

Total amount payable = ₹ (500,00,000 + 193,51,975) = ₹ 693,51,975.

Illustration 4

KIND HEARTED LTD. requests you to calculate the lease rentals in the following cases:

(i) Cost of the asset: 200 lakhs;

(ii) Term of the lease: 5 years;

(iii) Salvage value: Nil

(iv) Lessor requires a return of 12%.

Case (a): Rentals are stepped up by 10%;

Case (b): Rentals are stepped down by 10%;

Case (c): Ballooned with lease rentals for years 1 to 4 at ₹ 10 lakhs.

Solution:

Case (a): Let the first-year lease rental be ₹ L.

Therefore,

Year	Lease rental (₹)	PVIF @ 12%	PV of Lease rentals
1	L	0.8929	0.8929L
2	(1.10) × L = 1.1×L	0.7972	0.87692L
3	×L = 1.21×L	0.7118	0.861278L
4	×L = 1.331×L	0.6355	0.8458505L
5	×L = 1.4641×L	0.5674	0.83073034L
Total			4.30767884L

Therefore, 4.30767884L = 200,00,000; i.e., L = Rs, 46,42,872 (approx.)

Case (b):

Year	Lease rental (₹)	PVIF @ 12%	PV of Lease rentals
1	L	0.8929	0.8929L
2	(0.9) × L = 0.9×L	0.7972	0.71748L
3	×L = 0.81×L	0.7118	0.576558L
4	×L = 0.729×L	0.6355	0.4632795L
5	×L = 0.6561×L	0.5674	0.37227114L
			3.02248864L

Therefore, 3.02248864L = 200,00,000; i.e., L = 66,17,064 (Approx.)

Case (c): Let the last year lease rental be ₹ L.

Therefore, 10,00,000 × PVIFA(12%, 4 Years) + L × PVFA(12%, 5TH Year) = 200,00,000

i.e., 10,00,000 × 3.0373 + L × 0.5674 = 200,00,000

30,37,300 + L × 0.5674 = 200,00,000

i.e., L × 0.5674 = 169,62,700

i.e., L = 298,95,488

Illustration 5

The following data relate to GREAT INDIA LTD.:

(1) Investment outlay cost: ₹ 100 lakhs;

(2) Pre-tax required rate of return: 20% p.a.

(3) Primary lease period: 5 years; The secondary lease period is 2 years with lease rentals of 5% of the primary lease amount per annum.

(4) Residual value (after primary lease period): Nil;

(5) Assumptions regarding alternative rental structures:

(A) Equated;

(B) Stepped (15% increase p.a.) during the primary lease period and 10% of the first-year lease rental for the secondary period;

(C) Ballooned (annual rental of ₹ 10 lakhs p.a. for years 1 to 4);

(D) Deferred (deferment period of 2 years) and the secondary lease payment is 5% of the first primary lease payment.

Please calculate the annual lease rentals under the above four alternatives.

Solution:

(A) Let the annual lease amount during the primary lease period be ₹ L.

Therefore, L × PVIFA (20%, 5 Years) + 0.05L × 0.3349 + 0.05L × 0.2791L= 100,00,000

i.e., L × 2.9906 + 0.0307L = 100,00,000

i.e., 3.0213L = 100,00,000

i.e., L = 33,09,834

(B) Let the first-year lease amount during the primary lease period be ₹ L.

Therefore, L × 0.8333 + 1.15L × 0.6944 + L × 0.5787 + L × 0.4823 + L × 0.4019 + 0.1L × 0.3349 + 0.1L × 0.2791 = 100,00,000

i.e., 0.8333L + 0.79856L + 0.765331L + 0.733518L + 0.702926L + 0.03349L + 0.02791L = 100,00,000

i.e., 3.895035L = 100,00,000

i.e., L = 25,67,371

(C) Let the last year lease rental be ₹ L.

Therefore, 10,00,000 × PVIFA(20%, 4 Years) + L × PVFA(20%, 5TH Year) = 100,00,000

i.e., 10,00,000 × 2.5887 + L × 0.4019 = 100,00,000

i.e., L × 0.4019 = 74,11,300

i.e., L = 184,40,657

(D) Let the 3rd year lease rent be ₹ L (as it starts from 3rd year).

Therefore, L × [PVIFA(20%, 3 to 7 years)] + 0.05L× [PVIFA(20%, 8 to 9 years)] = 100,00,000

i.e., L × [0.5787 + 0.4823 + 0.4019 + 0.3349 + 0.2791] + 0.05L × [0.2326 + 0.1938] = 100,00,000

i.e., 2.0769L + 0.02132L = 100,00,000

i.e., 2.09822L = 100,00,000

i.e., L = 47,65,944

Illustration 6

HANDSOME LTD. is in the tax bracket of 35% and discounts its cash flow at 15%. In the acquisition of an asset worth ₹100,00,000, it is given that there are two offers—either to acquire the asset by taking a Bank loan @ 15% p.a. repayable in 5 yearly installments of ₹ 20,00,000 each plus interest or to lease in the asset at yearly rentals of ₹ 32,40,000 for 5 years. In both the cases, the installment is payable at the end of the year. Applicable rate of depreciation is 15% using WDV method.

Solution:

Option 1: acquire the asset by taking a Bank loan @ 15% p.a.:

Year	1	2	3	4	5
Depreciation @ 15% p.a. WDV [A]	15,00,000	12,75,000	10,83,750	9,21,188	7,83,009
Bank interest [B]	15,00,000	12,00,000	9,00,000	6,00,000	3,00,000
Total amount [C = A+B]	30,00,000	24,75,000	19,83,750	15,21,188	10,83,009
Tax benefit @ 35% on C = [D]	10,50,000	8,66,250	6,94,313	5.32,416	3,79,053
Repayment of Principal [E]	20,00,000	20,00,000	20,00,000	20,00,000	20,00,000
Total cash outflow [F = B - D + E]	24,50,000	23,33,750	22,05,687	20,67,584	19,20,947
PVIF @ 15%	0.8696	0.7561	0.6575	0.5718	0.4972
PV of cash outflow	21,30,520	17,64,548	14,50,239	11,82,245	9,55,095

PV of total cash flows = ₹ 74,82,647

Option 2: Acquire the asset on lease (pay lease rent)

Lease rent p.a. (₹)	32,40,000
Less: Tax benefit @ 35%	11,34,000
Net Lease rent p.a. [P]	21,06,000
$PVIFA_{(15\%, 5\ YEARS)}$ [Q]	3.3522
PV of Lease rentals (₹) [P × Q]	70,59,733

Recommendation: The asset should be acquired on lease rental basis as it would be cheaper.

Illustration 7

MODERN OUTLOOK LTD., a small manufacturing company, is considering the acquisition of a machine. After evaluating equipments offered by seven different manufacturers, it has come to the conclusion that 'Z' was the most suitable machine for its needs. Consequently, it has asked the manufacturer's sales personnel to provide information on alternative financing plans available through their financing subsidiary. The subsidiary presented the following two alternatives:

Alternative 1: Lease the equipment for 7 years which was the machine's expected useful life. The annual lease payments would be ₹1,47,000 and would include service and maintenance. Lease payments would be due at the beginning of the year. Lease payments are fully tax-deductible in the year of payment.

Alternative 2: Purchase the 'Z' equipment through 100 % loan from the financing subsidiary. The cost of the machine is ₹ 5,00,000. It would make seven annual payments of ₹ 99,350 each year-end to repay the loan of ₹ 5,00,000.

The company's marginal tax rate is 44%. It has estimated that the equipment has an expected salvage value of ₹10,000. The company plans to depreciate the equipment by using straight line method. The service and maintenance would cost ₹ 37,000 annually.

You are required to advise MODERN OUTLOOK LTD. on the desirability of the alternative plans, assuming the rate of interest is 9%. The PV factors are:

Year	0	1	2	3	4	5	6	7
PVF	1.000	0.952	0.907	0.864	0.823	0.784	0.746	0.711

PVF for salvage value is 0.452. Total PVF From 0 to 6 years: 6.076

Solution:

Alternative 1:

Present value of lease payments for 7 years = ₹ 1,47,000 × (1 - 0.44) × 6.076 = ₹ 5,00,176

Alternative 2:

Year	1	2	3	4	5	6	7
Payment p.a. (P)	99,350	99,350	99,350	99,350	99,350	99,350	99,350
Balance	5,00,000	4,45,650	3,86,409	3,21,836	2,51,451	1,74,732	91,108
Interest @ 9% p.a. (a)	45,000	40,109	34,777	28,965	22,631	15,726	8,242
Principal repayment	54,350	59,241	64,573	70,385	76,719	83,624	91,108
Depreciation (b)	70,000	70,000	70,000	70,000	70,000	70,000	70,000
Service & maintenance (c)	37,000	37,000	37,000	37,000	37,000	37,000	37,000
Tax shield @ 44%×(a+b+c) = (d)	66,880	64,728	62,382	59,825	57,038	54,000	50,706
Net cash outflows [P+c - d]	69,470	71,622	73,968	76,525	79,312	82,350	85,644
PV Factors	0.952	0.907	0.864	0.823	0.784	0.746	0.711
PV of cash outflows	66,135	64,961	63,908	62,980	62,181	61,433	60,893

Total PV of cash outflows ₹ 4,42,492

Less: PV of salvage value [10,000 × 0.711] = ₹ 7,110

Net PV of cash outflows ₹ 4.35.382

Recommendation:

Alternative 2 is cheaper. So, the machine should be purchased by the company.

Illustration 8

The following data relate to an investment proposal of KAKATUA THE GREAT LTD.:

- Investment outlay: ₹ 180 lakhs
- Useful life: 3 years
- Net salvage value after 3 years: ₹ 18 lakhs
- Annual tax relevant rate of depreciation: 40%

The company has two alternatives to choose from to finance the investment:

Alternative 1: Borrow and buy the equipment. The cost of capital is 12%, marginal rate of tax is 35% and cost of debt is 17% p.a.

Alternative 2: Lease the equipment from BIG-BIRD LEASING LTD. on a three-year full payout basis @ ₹444 per ₹ 1,000 payable annually in arrears (year-end). The lease can be renewed for a further period of three years at a rental of ₹18 per ₹ 1,000, payable annually in arrears.

Which alternative should KAKATUA THE GREAT LTD. choose and why?

Solution:

Decision Analysis (Computation of NAL):

Particulars	₹ in lakhs
Investment outlay	180.00
Less: PV of lease rentals [180 ×0.444 × 2.210]	(176.61)
Add: PV of tax shield of lease rentals [180 × 0.444 × 0.35 × 2.402]	67.19
Less:	
* PV of tax shield on depreciation [72 × 0.893 + 43.2 × 0.797 + 25.92 × 0.712] × 35%	(41.01)
* PV of tax on interest [30.03 × 0.893 + 21.54 × 0.797 + 11.61 × 0.712] × 35%	(18.29)
* PV of net salvage value [18 × 0.712]	(12.81)
NAL or NPVL	(1.53)

Decision: As the NAL is negative, the company should borrow and buy the equipment.

Displaced debt (Present value of Lease Rentals) Amortisation Schedule (₹ in lakhs)

Year	Loan outstanding at the beginning = PV of L.R.	Interest content @17%	Capital content	Instalment 176.61 ÷ 2.210
1	176.61	30.03	49.89	79.92
2	126.72	21.54	58.38	79.92
3	68.34	11.61	68.34	79.92

Illustration 9

SWEET DREAM LIMITED, a leasing company, has been approached by MR. STRANGER, a prospective customer intending to acquire a machine whose cash down price is ₹ 9 crores. The customer, with a view to leverage his tax position, has requested the company to make a quotation for a 4-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. The company charges depreciation on straight line basis with no salvage value. The corporate tax rate is 35%. The target rate of return for SWEET DREAM LIMITED on this transaction is 12% p.a.

You are required to compute the Break-even Lease Rentals (BELR) for the machine.

Solution:

Effective discount rate i.e., discount rate after tax = 12 (1 - 0.35) = 7.8% p.a.

Cost of the asset = ₹ 9 crores.

Depreciation under SLM = $\frac{9 \text{ Crores}}{4}$ = 2.25 Crores

PV of tax shield on depreciation = 2.25 crores × 0.35 × $PVIFA_{(7.8\%, 4 \text{ years})}$

= 2.25 crores × 0.35 × 3.3269 = ₹ 2.61993375 crores.

Net cash outflow = ₹ (9 - 2.61993375) = 6.38006625

Let the BELR for the 4th year be ₹ L.

Year	PVF @ 7.8%	Lease Rentals	After-tax lease rentals	PV of after-tax lease rentals
	(A)	(B)	(C) = (B × 65%)	[A × C]
1	0.9276	4L	2.6L	2.411760L
2	0.8605	3L	1.95L	1.677975L
3	0.7983	2L	1.3L	1.037790L
4	0.7405	L	0.65L	0.481325L
Total PV of after-tax lease rentals				5.608850L

Therefore, at the BELR,

5.60885L = 6.38006625 i.e., L = 1.1375 (Approx.)

Therefore, the lease rentals are as follows:

Year	Lease Rentals (₹ in crores)
1	4 × 1.1375 = 4.5500
2	3 × 1.1375 = 3.4125
3	2 × 1.1375 = 2.2750
4	1 × 1.1375 = 1.1375

Illustration 10

COLD FIRE LIMITED is considering the possibility of purchasing a multipurpose machine which cost ₹ 20,00000. The machine has an expected life of 5 years. The machine generates ₹ 12,00,000 per year before depreciation and tax and the management wishes to dispose of the machine at the end of 5 years which will fetch ₹ 2,00,000. The depreciation allowable for the machine is 25% on diminishing balance method and the company's tax rate is 50%.

The company approached a Scheduled Bank for a five-year lease for financing the asset which quoted a rate of 25 per thousand per month. The cost of capital of the company is 12% and for lease option it wants you to consider a discount rate of 16%.

The company seeks your advice whether to purchase or acquire the machine on lease.

Solution:

(a) Buying option (₹)

	Year1	Year 2	Year 3	Year 4	Year 5
EBIDT	12,00,000	12,00,000	12,00,000	12,00,000	12,00,000
Less: Depreciation	5,00,000	3,75,000	2,81,250	2,10,938	1,58,203
EBIT	7,00,000	8,25,000	9,18,750	9,89,062	10,41,797
Less: Tax @ 50%	3,50,000	4,12,500	4,59,375	4,94,531	5,20,899
EAT	3,50,000	4,12,500	4,59,375	4,94,531	5,20,898
Add: Depreciation	5,00,000	3,75,000	2,81,250	2,10,938	1,58,203
CFAT	8,50,000	7,87,500	7,40,625	7,05,469	6,79,101
PVF @ 12%	0.8929	0.7972	0.7118	0.6355	0.5674
PV of CFAT	7,58,965	6,27,795	5,27,177	4,48,326	385,322

WDV of the machine after 5 years [20,00,000 $((1 -0.25)^5$] ₹ 4,74,609

Less: Sale value ₹ 2,00,000

Gain on sale of machine ₹ 2,74,609

Tax on gain (assuming the same rate of 50%) ₹ 1,37,305

Net sale value [2,00,000 - 1,37,305] ₹ 62,695

Total PV of CFAT ₹ 27,47,584

Add: [62,695 × 0.5674] ₹ 35,573

Total PV of CFAT ₹ 27,83,157

Less: PV of cash outflow ₹ 20,00,000

Net present value ₹ 7,83,157

(b) Leasing option

EBITD	₹ 12,00,000
Less: Lease rent p.a. [25 × $\frac{20,00,000}{1,000}$ × 12]	₹ 6,00,000
Balance	₹ 6,00,000
Less: Tax @ 50%	₹ 3,00,000
CFAT p.a.	₹ 3,00,000
PVIFA (15%, 5 years)	3.3522
PV of CFAT [3,00,000 × 3.3522]	₹ 10,05,660

Comment: The machine should be acquired on lease as it gives more PV of CFAT.

4 Equity and Bond Valuation and Evaluation of Performance [Study Material - Module 6]

Illustration 1

BHARAT PETROLIUM CORPORATION LIMITED paid a dividend of ₹28 per share. The average growth rate of dividend is 10% per annum. If the expected rate of return of the equity-shareholders is 20% per annum, what is the estimated value of the stock after 1 year?

Solution:

Estimated value of the stock after 1 year = $\frac{D_0 \times (1+g)}{K_e - g} = \frac{28 \times (1+0.10)}{0.20 - 0.10} = ₹ 308$

Illustration 2

KALYAN JEWELLERS issues a 7-years 12% Coupon bond at a nominal value of ₹ 20,000. The bond is redeemable at a premium of 10%. Compute the value of the bond if the required rate of return on this bond is 15%.

Solution:

Value of the bond $= \sum_{n=1}^{7} \frac{2,400}{(1+0.15)^n} + \frac{20,000 \times (1+0.10)}{(0.20 + 0.15)^7}$

$= 2,400 \times PVIFA_{(15\%, 7years)} + 22,000 \times PVIF_{(15\%, 7years)}$

$= 2,400 \times 4.1604 + 22,000 \times 0.3759$

$= ₹ 18,254.76$

Illustration 3

Mr. Jagatram Chaturvedi, an investor is considering of purchasing the following Bond:

Face value	₹ 10,000
Coupon rate	10%
Maturity period	3 years

Please answer the following questions:

a) If he desires to earn an effective income of 12%, what is the maximum price he should pay for the Bond?

b) If the Bond is selling at ₹ 9,750, what would be his effective yield?

Solution:

(a) The maximum price he should pay for the Bond

$= 1,000 \times PVIFA_{(12\%, 3years)} + 10,000 \times PVIF_{(12\%, 3years)}$

$= (1,000 \times 2.4018) + (10,000 \times 0.7118)$

$= ₹ 9,519.80$

(b) Computation of effective yield or Yield to Maturity (YTM)

$$= \frac{I + \frac{(RV - SV)}{n}}{\frac{(RV + SV)}{2}}$$

$$= \frac{1,000 + \frac{(10,000 - 9,750)}{3}}{\frac{(10,000 + 9,750)}{2}}$$

$$= \frac{1,083.33}{9875}$$

$= 0.1097$ i.e., 10.97%

Illustration 4

A convertible bond with a face value of ₹ 20,000 is issued at ₹ 27,000 with a coupon rate of 10.5%. The conversion rate is 14 shares per bond. The current market price of bond is ₹ 28,000 and share is ₹ 1,560 respectively. What is the premium over conversion value?

Solution:

Conversion value = 14 × ₹ 1,560 = ₹ 21,840

Current Market price of the Bond = ₹ 28,000

Premium over conversion value = $\frac{28,000 - 21,840}{21,840} \times 100 = 28.21\%$

Illustration 5

XCHANGING SOLUTION LIMITED pays a dividend of ₹ 12 per share and its required rate of return is 14% per annum. The average growth rate of dividend is 10% per annum for the first 3 years. After 3rd year, the average growth rate of dividend is expected to decline linearly to 7%. After 6th year, it is assumed to grow @7% for ever. Please compute the value of the stock.

Solution:

Year	DPS (₹)	PV factor @ 14%	PV of DPS (₹)
1	12(1.10) = 13.20	0.8772	11.5790
2	13.20(1.10) = 14.52	0.7695	11.1731
3	14.52(1.10) = 15.972 = 15.97	0.6750	10.7798
4	15.972(1.09) = 17.40948 = 17.41	0.5721	9.9603
5	17.40948(1.08) = 18.80224 = 18.80	0.5194	9.7647
6	18.80224(1.07) = 20.139968 = 20.14	0.4556	9.1758
7	307.85 (see note)	0.4556	140.2565
Total	**Expected value of the stock**		**202.6892**

Note: Terminal value of perpetuity = $\frac{D_6\ (1+g)}{K_e - g} = \frac{20.14\ (1 + 0.07)}{0.14 - 0.07}$ = ₹ 307.85.

Illustration 6

NTPC has an EPS of ₹ 35 for the current year and dividend pay-out ratio is 40%. The growth rate of the earnings and dividends during the past four years was 8% and expected to grow at 10% a year in the long run. Currently, it is trading at 10 times its earnings per share. If the required rate of return is 15%, 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) Present DPS = D_0 = ₹ 35 × 40% = ₹ 14

The present MPS = $P_0 = \frac{D_0 \times (1+g)}{K_e - g} = \frac{14 \times (1 + 0.10)}{0.15 - 0.10}$ = ₹ 308

Therefore, the P/E Ratio = $\frac{₹308}{10}$ = ₹ 30.80

(b) Given that, P/E Ratio = 10

i.e., $\frac{P_0}{E} = \frac{1}{E} \times \frac{D_0 \times (1+g)}{K_e - g} = 10$

i.e., $\frac{1}{35} \times \frac{14 \times (1+g)}{0.15 - g} = 10$

i.e., $\frac{14 \times (1+g)}{0.15 - g} = 350$

i.e., $\frac{(1+g)}{0.15 - g} = 25$

i.e., $(1+g) = 3.75 - 25g$

i.e., $26g = 2.75$

i.e., $g = \frac{2.75}{26} = 0.1058$, i.e., 10.58%

Therefore, the long-term growth rate = 10.58%

Illustration 7

BAJAJ FINANCE LIMITED issued 9% Bonds of face value ₹10,000, redeemable at a premium of 12% The bonds are presently trading at par. The yield to maturity of the bond to an investor as of now, is approximately 12%. What will be the approximate maturity period for the bonds?

Solution:

Yield to Maturity (YTM) = $\frac{I + \frac{(RV - SV)}{n}}{\frac{(RV + SV)}{2}}$

i.e., $0.12 = \frac{900 + \frac{(11,200 - 10,000)}{n}}{\frac{(11,200 + 10,000)}{2}}$

i.e., $1,272 = 900 + \frac{1,200}{n}$

i.e., $372 = \frac{1,200}{n}$

i.e., $n = \frac{1,200}{372} = 3.23$ years (approx.).

Illustration 8

MR. SMART is confused with the effective annual interest rate of the following two securities:

a) A 3-month T-Bill selling at ₹ 96,200 with a nominal value of ₹ 1,00,000;

b) A Coupon Bond selling at par and paying interest @ 9% semi-annually.

Solution:

(a) The duration of the T-Bill is 3-months. Therefore, $n = \frac{12}{3} = 4$

Therefore, the effective annual interest rate (EIR) $= (\frac{1,00,000}{96,200})^4 - 1 = 0.1676$ i.e., 16.76%

(b) Effective annual interest rate for Coupon Bond = $(1+\frac{0.09}{2})^2 - 1 = 0.0920$ i.e., 9.20%

Comment: The T-Bill has the higher effective annual interest rate.

Illustration 9

The market price per share of DHATRE UDYOJ LIMITED is ₹ 26.50. There are 20,00,000 shares in the capital structure of the company. The company is deciding to raise ₹ 40,00,000 from the market by the issue of right shares for the expansion of the project.

Please compute the value of right and the ex-right price of shares, if—

a) The company offers one right share for every two shares held

b) The company offers one right share for every four shares held

c) MR. CHANDRA holds 500 shares. How does his wealth change from (a) to (b)?

Solution:

(a) No. of right shares to be issued = 20,00,000 / 2 = 10,00,000

Issue price per right share = ₹ (40,00,000/10,00,000) = ₹ 4

Ex-right price = $\frac{26.50 \times 20,00,000 + 40,00,000}{20,00,000 + 10,00,000}$ = ₹ 19

Value of a right = ₹ (19 – 4) = ₹ 15

Value of a right per share basis = $\frac{₹15}{2}$ = ₹ 7.50.

(b) No. of right shares to be issued = 20,00,000 / 4 = 5,00,000

Issue price per right share = ₹ (40,00,000 / 5,00,000) = ₹ 8

Ex-right price = $\frac{26.50 \times 20,00,000 + 40,00,000}{20,00,000 + 5,00,000}$ = ₹ 22.80

Value of a right = ₹ (22.80 – 8) = ₹ 14.80

Value of a right per share basis = $\frac{₹14.80}{4}$ = ₹ 3.7

(c)

	(a)	(b)
Number of original shares	20,00,000	20,00,000
Add: No. of right shares	10,00,000	5,00,000
Total No. of shares [A]	30,00,000	25,00,000
Value per share after right issue [B]	₹ 19	₹ 22.80
Total value [A×B] [₹]	570,00,000	570,00,000
Total value before right issue [26.50×20,00,000] [₹]	530,00,000	530,00,000
Increase in wealth [₹]	40,00,000	40,00,000

Illustration 10

MNS LIMITED supplies the following data for a Bond:

Face value or Nominal value	₹ 10,000
Coupon rate	10%
Years to maturity	5
Redemption price (at par)	₹ 10,000
Yield to maturity	15%

Compute the following:

a) Current market price;

b) Duration of the Bond

c) Volatility of the Bond

d) Expected market price of the Bond if increase in required yield is by 75 basis points [100 basis points = 1%].

Solution:

(a) Current market price of the bond $= \sum_{n=1}^{5} \frac{1,000}{(1+0.15)^n} + \frac{10,000}{(1+0.15)^6}$

$= 1,000 \times PVIFA_{(15\%,\ 5\ years)} + 10,000 \times PVIF_{(15\%,\ 5\ years)}$

$= 1,000 \times 3.352 + 10,000 \times 0.4972$

$= ₹\ 8,324$

(b) Computation of duration of the Bond:

Year	Cash flow (₹)	PVIF @ 15%	PV of Cash flow	
(A)	(B)	(C)	(D = B×C)	[E = A×D]
1	1,000	0.8696	869.60	869.60
2	1,000	0.7561	756.10	1,512.20
3	1,000	0.6575	657.50	1,972.50
4	1,000	0.5718	571.80	2,287.20
5	11,000	0.4972	5,469.20	27,346.00
Total			8,324.20	33,987.50

Duration of the Bond = $\frac{33,987.50}{8,324.20}$ = 4.083 years (approx.)

(c) Volatility of the Bond = $\frac{\text{Duration}}{(1+0.15)} = \frac{4,083}{1.15}$ = 3.5504

5 Mutual Funds [Study Material - Module 7]

Illustration 1

MR. JOYPRAKASH invests ₹ 200,000 in a mutual fund that provides an annual return of 11%. If he invests this amount for 5 years, what will be the worth of his fund after 5 years?

Solution:

As per the Compound interest formula, $A = P(1+i)^n$, Here, A = Compound amount,

P = Principal amount = ₹ 2,00,000; i = Rate of interest ÷ 100 = 0.11 and n = No. of years = 5

Therefore, $A = 2,00,000 \times (1+0.11)^5$ = ₹ 3,37,011.63 i.e., ₹ 3,37,012 (approx.)

Illustration 2

Invesco India Infra Fund that had a Net Asset Value of ₹17 at the beginning of a month, made income and capital gain distribution of ₹ 1.04 and ₹ 0.53 respectively per unit during the month, and then ended the month with a Net Asset Value of ₹ 17.28. Calculate monthly and annual rate of return.

Solution:

Monthly rate of return of the Mutual Fund $= \dfrac{(NAV_t - NAV_{t-1}) + I_t + CG_t}{NAV_{t-1}}$

$= \dfrac{(17.28 - 17.00) + 1.04 + 0.53}{17} \times 100 = 10.88\%$

Annual rate of return of the Mutual Fund = (12 × 10.88)% = 130.56%

Illustration 3

MISS CHANDNI wants a return of ₹ 1,00,000 per annum for 5 years. She expects a return of 14% per annum. How much should she invest now to get the above yearly returns?

Solution:

$PVIFA_{(14\%, 5 \text{ Years})} = 3.43308$

Therefore, the amount she should invest now $= ₹ 1,00,000 \times PVIFA_{(14\%, 5 \text{ Years})}$

$= ₹ 1,00,000 \times 3.43308 = ₹ 3,43,308$

Illustration 4

The unit price of Equity Linked Savings Scheme (ELSS) of a mutual fund is ₹ 15/-. The public offer price (POP) of the unit is ₹ 15.40 and the redemption price is ₹ 14.80.

Calculate:

(i) Front-end Load

(ii) Back-end Load

Solution:

(i) Front-end load or Entry load = $\frac{(15.40 - 15.00)}{15} \times 100 = 2.67\%$

(ii) Back-end load or Exit load = $\frac{(15.00 - 14.80)}{15} \times 100 = 1.33\%$

Illustration 5

Please compute the NAV of **VERY GREEN FUND** from the following data:

Size of the scheme	₹ 200 Crores
Face value of the shares	₹ 10
Market value of the fund's investments	₹ 280 Crores
Receivables	₹ 2 Crores
Accrued Income	₹ 2 Crore
Liabilities	₹ 1 Crore
Accrued Expenses	₹ 1 Crore

[Ans.: ₹ 14.10 per unit]

Solution:

	Crores
Market value of the fund's investments	₹ 280
Receivables	₹ 2
Accrued income	₹ 2
Total	₹ 284
Less: Liabilities	₹ 1
Accrued expenses	₹ 1
Net assets [Crores]	₹ 282
Size [200 ÷ 10] [Crores]	20
NAV per unit	₹ 14.10

Illustration 6

MR. TIME-MACHINE expects to earn a return of 15% by investing in equity shares on his own. Now he is considering a recently announced equity based mutual fund scheme by **HIGH-SPEED LIMITED** in which initial expenses are 4.5% and annual recurring expenses are 1.5%.

How much should the mutual fund earn to provide **MR. TIME-MACHINE** a return of 15%?

Solution:

MR. TIME-MACHINE's personal earnings = R_1 = 15% (given)

Let the earnings from Mutual Fund be R_2

$$R_2 = \frac{1}{(100\% - \text{Initial expenses }\%)} \times R_1 + \text{Recurring expenses (\%)}$$

$$= \frac{1}{(1 - 0.045)} \times 15\% + 1.5\% = 17.21\%$$

The Mutual Fund should earn 17.21% to provide MR. TIME-MACHINE a return of 15%.

Illustration 7

You can earn a return of 13% by investing in equity shares on your own. You are considering a recently announced equity mutual fund scheme where the initial issue expense is 7%. You believe that the mutual fund scheme will earn 16.5%.

At what recurring expenses (in percentage terms) will you be indifferent between investing on your own and investing through the mutual fund?

Solution:

$$\text{Rate of return from the Mutual Fund} = \frac{\text{Investor's expectation}}{(100\% - \text{Initial expenses})} + \text{Recurring Expenses}$$

$$\therefore \text{Recurring Expenses} = \text{Rate of return from the Mutual Fund} - \frac{\text{Investor's expectation}}{(100\% - \text{Initial expenses})}$$

$$= 16.5\% - \frac{13}{100 - 7} \times 100$$

$$= 2.52\%$$

Illustration 8

GROWTH FUND has the following portfolio details:

Stock	No. of Shares	Price (₹)
A	200,000	105
B	300,000	120
C	400,000	60
D	600,000	75

The fund accrued management fees with the portfolio manager totalling ₹ 98,000. There are 40,00,000 units outstanding.

a) Please compute the NAV of the fund.

b) If the fund is sold with a front-end load of 5%, compute the sale price.

Solution:

(a)

Stock	No. of Shares	Price (₹)	Value (₹)
A	200,000	105	210,00,000
B	300,000	120	360,00,000
C	400,000	60	240,00,000
D	600,000	75	450,00,000
Total value			1260,00,000
Less: Accrued Management Fees			98,000
Total Net Asset Value [P]			1259,02,000
No. of units [Q]			40,00,000
NAV [P ÷ Q]			31.4755

(b) Selling price per unit = ₹ 31.3755 × (1 + 5%) = ₹ 33.05 (approx.)

Illustration 9

From the following details, please compute the NAV of the **FLEXI Fund**:

Opening NAV: ₹ 21; Total number of units outstanding: 250 Crores; Face value: ₹ 10; Expenses: ₹40 Crores.

Depreciation of portfolio today	₹ 240 Crores
Fresh subscription of units	NIL
Redemption of units	10 Crore
Unrealised gains	₹ 280 Crores
Unrealized losses	₹ 160 Crores

It is given that sales NAV and Repurchase NAV to be ₹ 21.

Solution:

	In Crores
Opening NAV [250 × 21]	5,250
Add: Net unrealised gains (280 160)	120

Total	5,370
Less: (i) Redemption of units [10 × 21]	210
(ii) Depreciation	240
(iii) Expenses	40
Total Net Asset Values	4,880
NAV [4,880 ÷ 240]	20.33

Illustration 10

MR. GENTLEMAN has investment in three Mutual fund (MF) schemes as per the following details:

	MF P	MF Q	MF R
Date of investment	01.11.2023	01.12.2023	01.03.2023
Opening NAV (₹)	21.50	20.00	20.50
Amount of investment (₹)	1,07,500	2,00,000	100,450
Dividend received (₹)	2,000	2,800	3,920
NAV as on 31.03.2024 (₹)	21.40	20.50	19.50

Compute the effective yield per annum of MR. GENTLEMAN from the above mutual funds.

Solution:

	MF P	MF Q	MF R
Opening number of units	107500÷21.50=5,000	2,00,000÷20=10,000	100,450÷20.50=4,900
Dividend received (₹)	2,000	2,800	3,920
Dividend per unit (₹)	0.40	0.28	0.80
Capital gain/(capital loss) per unit	(21.40 - 21.50) = 0.10	20.50 - 20.00 = 0.50	(19.50-20.50) = -1.00
Net gain	0.30	0.78	- 0.20
Holding period (months)	5	4	1
Effective yield p.a.	$\frac{0.30}{21.50} \times 100 \times \frac{12}{5}$ = 3.35%	$\frac{0.78}{20.00} \times 100 \times \frac{12}{4}$ = 11.7%	$\frac{-0.20}{20.50} \times 100 \times \frac{12}{1}$ = = -11.71%

Illustration 11

MR. PERFECT on 1.7.2019, during the initial offer of some mutual fund invested in 10,000 units having face value of ₹ 10 for each unit. On 31.3.2020 the dividend operated by the Mutual Fund was 10% and **MR. PERFECT** found that his annualized yield was 153.33%. On 31.12.2021, 20% dividend was given. On 31.3.2022 **MR. PERFECT** redeemed all his balance of 11,296.11 units when his annualized yield was 73.52%.

What are the NAVs as on 31.3.2020, 31.12.2021 and 31.3.2022?

Solution:

Particulars	₹
Annualised Yield:	153.33%
Yield for 9 months [From 1.7.2019 till 31.03.2020] [153.33% × 9 ÷ 12]	115%
Return for 9 Months [Investment ₹ 1,00,000 × 115%]	₹ 1,15,000
Less: Dividends at 10% of Opening Value [10,000 Units × ₹ 10 × 10%]	(₹ 10,000)
Net capital appreciation	₹ 1,05,000
Closing NAV (Investment ₹ 1,00,000 + Capital Appreciation ₹ 1,05,000)	₹ 2,05,000
No. of Units Outstanding	10,000
NAV per Unit	₹ **20.50**
Dividends are reinvested at ₹ 20.50. therefore, additional Units purchased as at 31.03.2020 [Dividends ₹ 10,000 ÷ NAV per unit. ₹ 20.50)	487.80
Total no. of Units as at 31.03.2020 (after reinvestment of dividend)	10,487.80

Particulars	₹
Units Outstanding as at 31.12.2021	10,487.80
Face Value at ₹ 10 (10,487.80 Units × ₹ 10 per unit.)	₹ 1,04,878
Dividend distributed at 20% (₹ 1,04,878 × 20%)	₹ 20,975.6
No. of Units as at 31.03.2022 (given)	11,296.11
Less: No. of Units as at 31.12.2021	10,487.80
No. of Units issued against reinvestment of dividend [20,975.60 ÷ 25.95]	**808.31**
Dividends will be reinvested at the NAV as at 31.12.2021.	
Therefore, NAV = Dividends ÷ no. of Units reissued = ₹ 20,975.60 ÷ 808.31 Units	₹ **25.95**

Particulars	₹
annualized Yield as on 31.03.2022	73.52%
Yield for 33 months [From 1.7.2019 till 31.03.2022] [73.52% × 33 ÷ 12]	202.18%
Return for 33 Months [Investment ₹ 1,00,000 × 202.18%]	₹ 2,02,180
Add: Opening Investment	₹ 1,00,000
Closing Fund Value (Dividends need not be excluded, since they are reinvested)	₹ 3,02,180
no. of Units Outstanding as at 31.03.2022	11,296.11
NAV per Unit (₹ 3,02,180 ÷ 11,296.11 Units)	₹ **26.75**

Illustration 12

Four investors **VEERU, JOY, KALIA** and **GABBAR** have invested equivalent amount of money in different funds in tune with their attitude to risk. **VEERU** prefers to play aggressive and keen on equity funds. **JOY** is moderately aggressive with a desire to invest upto 49% of his funds in equity, whereas **KALIA** does not invest anything beyond 18% in equity. **GABBAR**, 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 funds are given below:

Funds invested	Return for the year	Beta factor
Money Multiplier Fund (100% Equity)	25.50%	2.00
Balanced Fund [49% Equity--51% Debt Fund]	15.50%	1.30
Safe Money Fund [18% Equity—82% Debt Fund]	11.90%	0.60

If the market return was 16% and the risk-free rate of return is 7%, which of the four investors were rewarded better per unit of risk taken?

Solution:

As per the given data, Treynor's Ratio which is also called "Reward to risk ratio" should be used as follows:

Particulars	VEERU	JOY	KALIA	GABBAR
Rate of return [K_e]	25.50%	15.50%	11.90%	16%
Risk-free rate of return [R_F]	7%	7%	7%	7%
Beta factor [β_e]	2.00	1.30	0.60	1
Treynor's Ratio [$\frac{R_e - R_F}{\beta_e}$]	9.25	6.54	8.17	9
Ranking	1	4	3	2

Illustration 13

FINANCIAL INVESTMENT have floated an equity-based fund scheme called **"Delta-Cube",** the funds of which will be invested only in stocks and bonds of infrastructure and construction companies. 60% of the Fund Value is invested in Companies engaged in Commercial Construction Services and the other 40% in companies engaged in developing Residential Colonies/Townships.

Average Beta of return from development of Residential Townships is measured at 1.9 and that from commercial construction is measured at 1.4.

The benchmark index yields 11.20% return and RBI Bonds carry an interest rate of 4.25%.

Ascertain Jensen's Alpha from the following monthly particulars relating to **"Delta-Cube"**

Month	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Cl. NAV	18.60	17.80	18.20	18.00	17.80	16.80	17.20	17.80	17.90	18.10	18.80	18.50
Dividend payout		0.75				1.20						

Opening NAV for April was ₹ 17.75. **[Jenson's Alpha =** Actual rate of return – Return under CAPM].

Solution:

Month	Op. NAV	Cl. NAV	Dividend	Total Return	Return %
A	B	C	D	E = (C -- B) + D	F = (E/B)*100
APR	17.75	18.6		0.85	4.79
MAY	18.60	17.8	0.75	-0.05	-0.27
JUN	17.80	18.2		0.4	2.25
JULY	18.20	18		-0.2	-1.10
AUG	18.00	17.8		-0.2	-1.11
SEP	17.80	16.8	1.2	0.2	1.12
OCT	16.80	17.2		0.4	2.38
NOV	17.20	17.8		0.6	3.49
DEC	17.80	17.9		0.1	0.56
JAN	17.90	18.1		0.2	1.12
FEB	18.10	18.8		0.7	3.87
MAR	18.80	18.5		-0.3	-1.60
TOTAL	214.75	215.5	1.95	2.7	15.50

Therefore, Actual Rate of Return = 15.50%

Weighted Average beta of "Delta-Cube" = 0.60 × 1.40 + 0.40 × 1.90 = 1.60

Expected Rate of Return under CAPM = $R_f + \beta \times (R_M - R_f)$ = 4.25 + 1.60 × (11.20 – 4.25) = 15.37%

∴ Jensen's Alpha (α) = Actual ROR – ROR under CAPM = 15.50% - 15.37% = 0.13%.

Illustration 14

An aggressive mutual fund promises an expected return of 18% with a possible volatility (standard deviation) of 20 %. On the other hand, a conservative mutual fund promises an expected return of 17% and volatility of 19%.

(a) Which fund would you like to invest in?

(b) Would you like to invest in both if you have money?

(c) Assuming you can borrow money from your provident fund at an opportunity cost of 10%, which fund you would invest your money in?

(d) Would you consider both funds if you could lend or borrow money at 10%?

Solution:

(a) It depends on your preference and risk-taking attitude.

(b) You can achieve diversification gains if you invest in both.

(c) The slopes of the capital market line for two funds are [Concept of Sharpe Ratio is used]:

- Aggressive fund = (18 - 10)/20 = 0.40; and
- Conservative fund: (17 - 10)/19 = 0.368.

  Aggressive fund is preferable.

(d) Benefits of diversification can be obtained if you invest in both funds and also lend and borrow at the NPV.

Note: Sharpe Ratio = $\frac{\text{Expected Return - Risk-free rate of Return}}{\text{Standard Deviation}}$,

Here, in place of Risk-free rate of return, opportunity cost of capital has been used.

Illustration 1

MERCURY HOLDINGS LTD., an investment company has invested in equity shares of a blue-chip company. Following data is available:

Risk-free return = 10%,

Expected rate of return on market portfolio = 16%,

Market sensitivity index i.e., β_e = 1.50 (of individual security)

Please calculate:

a) The expected rate of return on the investment made in the security.

b) Market risk premium and risk premium of the security.

c) Comment on the nature of the security.

Solution:

(a) $E(R_e) = R_f + \beta_e (R_M - R_f) = [10 + 1.50.(16 - 10)]\% = 19\%$.

(b) Market risk premium = $(R_M - R_f) = 16\% - 10\% = 6\%$.

Risk premium of the security = $\beta_e (R_M - R_f) = 1.50\ (16 - 10)\% = 9\%$.

(c) As the value of beta is greater than 1, it is an aggressive security.

Illustration 2

From the following data please compute the value of beta of security A:

$$\sigma_A = 12\%;\ \sigma_M = 9\% \text{ and } r_{AM} = +0.72$$

Solution:

$$\beta = \frac{\sigma_A}{\sigma_M} \times r_{AM} = \frac{0.12}{0.09} \times 0.72 = 0.96$$

Illustration 3

MR. SABJANTA owns a stock portfolio equally invested in a risk-free asset and two stocks. If one of the stocks has a beta of 0.8 and the portfolio is as risky as the market what must be the beta of the other stocks in the portfolio?

Solution:

Beta of risk-free asset = $\beta_{RF} = 0$; Beta of stock A = $\beta_A = 0.8$

Let the beta of stock B = $\beta_B = x$

Beta of the portfolio = $\beta_P = \frac{1}{3} \times \beta_{RF} + \frac{1}{3} \times \beta_A + \frac{1}{3} \times \beta_B$

Therefore, $\frac{1}{3} \times (0) + \frac{1}{3} \times (0.8) + \frac{1}{3} \times x = 1$

i.e. x = 2.2.

i.e., $\beta_B = x = 2.2$

Illustration 4

The beta coefficient of Target Ltd. is 1.4. The company has been maintaining 8% rate of growth in dividends and earnings. The last dividend paid was ₹4 per share. Return on GOI securities is 10%. Return on market portfolio is 15%. The current market price of one share of Target Ltd. is ₹ 36.

a) What will be the equilibrium price per share of Target Ltd.?

b) Would you advise purchasing the share?

Solution:

(a) As per Capital Asset Pricing Model,

$K_e = R_f + \beta \times (R_M - R_f) = 0.10 + 1.4 \times (0.15 - 0.10) = 0.17$ i.e. 17%.

$P_o = \frac{D_0 (1+g)}{K_e - g} = \frac{₹4 \times (1 + 0.08)}{0.17 - 0.08} = ₹ 48.$

(b) As the calculated price i.e. fair price of the share is more than market price of share, it is worth purchasing the share.

Illustration 5

An investor, MR. JAGANNATH TARKAPANCHANAN is holding 1,000 shares of SUPERB & UNBELIEVABLE MEMORY LTD. Presently the rate of dividend paid by the company is ₹ 2 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
Risk-free rate of return	12%	10%
Market risk premium	6%	4%
Beta value	1.4	1.25
Expected growth rate	5%	9%

In view of the above factors, please show whether the investor should buy, hold or sell the shares? Why?

Solution:

As per the Capital Asset Pricing Model, $K_e = R_f + \beta \times (R_M - R_f)$ & as per the dividend growth model, $P = \frac{D_0 (1+g)}{K_e - g}$. The computation is shown as below:

	Existing	Revised
Cost of equity share (Ke)	0.12 + 1.4 × 0.06 = 0.2040 i.e., 20.40%	0.10 + 1.25 × 0.04 = 0.15 i.e., 15%
Price of the equity share (P_0)	$\frac{2 \times (1.05)}{0.2040 - 0.05}$ = ₹ 13.63	$\frac{2 \times (1.09)}{0.15 - 0.09}$ = ₹ 36.33
Comments	The market price is overvalued. So, he should sell the shares now.	The market price is undervalued. So, he should hold the shares and if his pocket permits, he should purchase more shares now.

Illustration 6

MAHAPRABHU SREECHAITANYA LTD. gives the following information relating to stocks L and M for the past two years:

Years	Rate of Return (%)	
	Stock L	Stock M
2009-10	12	14
2010-11	18	12

a) What is the expected return on portfolio made up of 60% of L and 40% of M?

b) Calculate the standard deviation of each stock.

c) What is the co-relation co-efficient and co-efficient of variation between stock L and stock M?

d) What is the portfolio risk of a portfolio made up of 60% of L and 40% of M?

Solution:

(a) Expected rate of return = $E(R) = \frac{\sum R}{n}$, where, R is the rate of return and

n = Number of observations

$E(R_L) = \frac{12 + 18}{2} = 15,$

$E(R_M) = \frac{14 + 12}{2} = 13,$

Expected return of portfolio $E(R_p) = 0.60 \times 15 + 0.40 \times 13 = 14.2.$

(b) Standard deviation of stock = $\sigma = \sqrt{\frac{\sum[R - E(R)]^2}{n}}$

$\sigma_L = \sqrt{\frac{(12 - 15)^2 + (18 - 15)^2}{2}} = 3$

$\sigma_M = \sqrt{\frac{(14 - 13)^2 + (12 - 13)^2}{2}} = 1$

(c) Covariance between Stock L and Stock M $= Cov_{L,M} = \sqrt{\frac{\sum[R_L - E(R_L)] \times [R_M - E(R_M)]}{2}}$

$= \frac{(12 - 15)(14 - 13) + (18 - 15)(12 - 13)}{2} = -3$

Correlation co-efficient = $r_{L,M} = \frac{Cov_{L,M}}{\sigma_L . \sigma_M} = \frac{-3}{3 \times 1} = -1.$

(d) Portfolio risk = $\sigma P = \sqrt{(P_L)^2(\sigma_L)^2 + (P_M)^2(\sigma_M)^2 + 2.P_L.P_M.\sigma_L.\sigma_M.r_{L,M}}$

$= \sqrt{(0.6)^2 \times (0.6)^2 + (0.6)^2 \times (0.6)^2 + 2 \times (0.6)(0.4) \times (3) \times (1) \times (-1)}$

$= 1.4$

Illustration 7

Stock X & Stock Y display the following returns over the past three years:

Year	Rate of Return	
	Stock X	Stock Y
2008-09	15	12
2009-10	16	18
2010-11	20	15

a) What is the expected return on portfolio made up of 40% of stock X and 60% of stock Y?

b) What is the standard deviation of each stock?

c) Determine the correlation co-efficient of stock X and stock Y.

d) What is the portfolio risk of a portfolio made up of 40% of stock X and 60% of stock Y?

Solution:

$E(R_X) = (15 + 16 + 20) \div 3 = 17\%$

$E(R_Y) = (12 + 18 + 15) \div 3 = 15\%$

(a) Expected return of portfolio = E(RP) = (0.40).(17) + (0.60).(15) = 15.8%.

(b) Standard deviation = $\sigma = \sqrt{\frac{\sum[R - E(R)]^2}{n}}$

$$\sigma_X = \sqrt{\frac{(15 - 17)^2 + (16 - 17)^2 + (20 - 17)^2}{3}} = 2.16$$

$$\sigma_Y = \sqrt{\frac{(12 - 15)^2 + (18 - 15)^2 + (15 - 15)^2}{3}} = 2.45$$

(c) Covariance between X and Y is

$$COV_{X,Y} = \frac{\sum \left(R_X - \overline{R_X}\right)\left(R_Y - \overline{R_Y}\right)}{n}$$

$$= \frac{(15 - 17)(12 - 15) + (16 - 17)(18 - 15) + (20 - 17)(15 - 15)}{3} = 1$$

Correlation co-efficient = $\frac{COV_{X,Y}}{\sigma_X . \sigma_Y} = \frac{1}{(2.16) \times (2.45)} = 0.19$ (approx.)

(d) Portfolio risk = $\sigma_P = \sqrt{(P_X)^2 (\sigma_X)^2 + (P_Y)^2 (\sigma_Y)^2 + 2.P_X.P_Y.\sigma_X.\sigma_Y.r_{X,Y}}$

$$= \sqrt{(0.40)^2 \times (2.16)^2 + (0.60)^2 \times (2.45)^2 + 2 \times (0.40)(0.60) \times (2.16) \times (2.45) \times (0.19)}$$

$$= 1.84$$

Illustration 8

SKY & BIRD CORPORATION has the following risk and return inputs for the following year:

$R_A = 15\%$; $\sigma_A^2 = 16\%$

$R_B = 18\%$; $\sigma_B^2 = 25\%$; $r_{AB} = 0.6$.

The portfolio risk (standard deviation) for a portfolio of 50% in each asset is 4.00.

(a) Determine the correlation co-efficient that will be necessary to reduce the level of portfolio risk by 75%.

(b) What is the expected return of the equally weighted portfolio?

Solution:

(a) Portfolio risk = $\sigma_P = \sqrt{(P_A)^2 (\sigma_A)^2 + (P_B)^2 (\sigma_B)^2 + 2.P_A.P_B.\sigma_A.\sigma_B.r_{A,B}}$

$$25\% \text{ of } 4 = \sqrt{(0.5)^2 \times (16) + (0.5)^2 \times (25) + 2 \times (0.5)(0.5) \times (4) \times (5) \times r_{A,B}}$$

Or, $1 = 4 + 6.25 + 10.r_{A,B}$

Or, $r_{A,B} = -0.925$

(b) $E(R_p) = (0.5 \times 15 + 0.5 \times 18) = 16.5\%$.

Illustration 9

MANGO-TREE LTD. has been specially formed to undertake two investment opportunities. The risk and return characteristics of the two projects are shown below:

	A	B
Expected return	12%	20%
Risk	3%	7%

The company plans to invest 80% of its available funds in project A and 20% in B. The directors believe that the correlation co-efficient between the returns of the projects is +1.0.

Required:

a) Calculate the returns from the proposed portfolio of projects A and B.

b) Calculate the risk of the portfolio.

c) 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:

(a) E(R) = $P_A.R_A + P_B.R_B$

= (0.80)(12) + (0.20)(20) = 13.6%.

(b) Portfolio risk = σ P = $\sqrt{(P_A)^2(\sigma_A)^2 + (P_{B)})^2(\sigma_B)^2 + 2.P_{A.}P_B.\sigma_A.\sigma_B.r_{A,B}}$

= $\sqrt{(0.8)^2\times(3)^2 + (0.2)^2\times(7)^2 + 2\times(0.8)(0.2)\times(3)\times(7)\times(+1)\ r_{A,B}}$

(c) Given, $\sqrt{(P_A)^2(\sigma_A)^2 + (P_{B)})^2(\sigma_B)^2 + 2.P_{A.}P_B.\sigma_A.\sigma_B.r_{A,B}}$ = 0

$\Rightarrow (P_A)^2\times(9)+(1+P_A)^2(49)+2(P_A)(1-P_A)\times(3)\times(7)\times(-1) = 0$

$\Rightarrow 9\times P_A^2 + 49 - 98 \times P_A + 49 \times P_A^2 - 42 \times P_A + 42 \times P_A^2 = 0$

$\Rightarrow 100\times P_A^2 - 140 \times P_A + 49 = 0$

$\Rightarrow (10\times P_A - 7)^2 = 0$

$\Rightarrow 10\times P_A = 7$

$\Rightarrow P_A = 0.7$ and $P_B = 0.3$

Illustration 10

YUVRAJ holds the following securities:

Particulars of securities	Costs (₹)	Dividends (₹)	Market price (₹)	Beta
Stock of CO. X	8,000	800	8,200	0.8
Stock of CO.Y	10,000	800	10,500	0.7
Stock of CO. Z	16,000	800	22,000	0.5
PSV Bonds	34,000	3,400 (Interest)	32,300	1.0

Assuming a risk-free rate of return of 10%, please calculate—

a) Expected rate of return in each, using the Capital Asset Pricing Model.

b) Average rate of return of the portfolio.

Solution:

(a) Total cost = ₹ 68,000; Total dividends = ₹ 5,800; Total market price = ₹ 73,000

Total market price	73,000
Less: Total cost	68,000
Capital gain	5,000
Add: Total dividends	5,800
Total gain	10,800

Expected return on market portfolio = (10,800 ÷ 68,000) × 100 = 15.88%

Computation of expected rate of return of each security [$E(R_e) = R_f + \beta_e (R_m - R_f)$]

Stock of CO. X = [10 + 0.8 × (15.88 − 10)] = 14.704%

Stock of CO. Y = [10 + 0.7 × (15.88 − 10)] = 14.116%

Stock of CO. Z = [10 + 0.5 × (15.88 − 10)] = 12.94%

PSV Bonds = [10 + 1.0 × (15.88 − 10)] = 15.88%

Total rate of return 57.64%

(b) Average rate of return = (57.64 ÷ 4)% = 14.41%.

Illustration 11

LEMON LTD. & MANGO LTD. has the following risk and return estimates—

R_L	R_M	σ_L	σ_M	$r_{L,M}$
20%	22%	18%	15%	− 1

Please compute the proportion of investment in LEMON LTD. & MANGO LTD. to minimize the risk of portfolio.

Solution:

Proportion of investment in LEMON LTD., WL = $\frac{\sigma_M^{\ 2} - COV_{L,M}}{\sigma_L^{\ 2} + \sigma_M^{\ 2} - 2COV_{L,M}}$

$= \frac{15^2 - (-270)}{18^2 + 15^2 - 2 \times (270)} = 0.45$

Proportion of investment in MANGO LTD. = $W_M = 1 - 0.45 = 0.55$.

Illustration 12

The following details are given for stocks of CO. HA-HA and CO. HI-HI and the Mumbai sensex for a period of 1 year.

a) Please compute the Systematic risk and Unsystematic risk for the stocks of two companies.

b) If equal amount of money is invested in the above two stocks, what would be the portfolio risk?

	Stock HA-HA	Stock HI-HI	Sensex
Average Return	0.15	0.25	0.06
Variance of Return	6.30	5.86	2.25
Beta (β)	0.71	0.27	
Correlation Co-efficient	0.424		
Co-efficient of Determination = r^2	0.18		

Solution:

The co-efficient of determination (r^2) gives the percentage of the variation in the securities return that is explained by the variation of the market index return. In the return of Stock HA-HA, 18% of the variation is explained by the variation of the index and 82% is not explained by the index.

Explained by the index = Variance of security return × Co-efficient of determination

$= 6.3 \times 0.18 = 1.134.$

Unexplained by the index = Variance of security return × $(1 - r^2)$

$= 6.3 \times (1 - 0.18) = 5.166$

Note:

(a) According to Sharpe, the variance explained by the index is the measurement of systematic risk. The unexplained variance or the residual variance is the unsystematic risk.

	CO. HA-HA	CO. HI-HI
Systematic Risk = $\beta^2.\sigma^2$	$(0.71)^2 \times 2.25 = 1.134$	$(0.27)^2 \times 2.25 = 0.1640$
Unsystematic Risk	$6.30 - 1.134 = 5.166$	$5.86 - 0.1640 = 5.696$

(b) $\sigma P = \sqrt{(P_X)^2(\sigma_X)^2 + (P_Y)^2(\sigma_Y)^2 + 2.P_X.P_Y.\sigma_X.\sigma_Y.r_{X,Y}}$

$= \sqrt{(0.5)^2 \times 6.30 + (0.5)^2 \times 5.86 + 2 \times 0.5 \times 0.5 \times 2.51 \times 2.4207 \times 0.424}$ = 2.08 (approx.).

Illustration

MR. INNOCENT has a portfolio of ₹ 6,75,000 and the value of beta (β) is 1.32. the desired level of beta is 1.95. compute the value of risk-free investment to be sold to increase the value of systematic risk to the desired level.

Solution:

The value of risk-free investment to be sold = Portfolio Value × [Desired Value of Beta – Present Beta of the Portfolio] = ₹ 6,75,000 × [1.95 - 1.32] = ₹ 4,25,250.

Illustration 2

From the following data, please compute the beta of the security-**THUNDERSTORM Z:**

- Standard deviation of the security: 12%;
- Standard deviation of the market portfolio: 9%;
- Correlation coefficient between them: + 0.75

Solution:

$\beta = (\sigma_e/\sigma_m) \times r_{e,m} = 0.12/0.09 \times 0.75 = 1.00$

Illustration 3

The capital structure of **EXCELLENT LTD** for a special project consists of equity shares of ₹ 300,00,000 and 12% Debt capital of ₹ 200,00,000. The equity beta is 1.6 and debt beta is 1.1. The company is under 35% tax bracket. Please compute the project beta of the company.

Solution:

$$\text{Project beta } (\beta P) = \frac{\text{Equity}}{\text{Equity} + \text{Debt} \times (1 - t)} \times \beta_E + \frac{\text{Debt} \times (1 - t)}{\text{Equity} + \text{Debt} \times (1 - t)} \times \beta_D$$

$$= \frac{300,00,000}{300,00,000 + 200,00,000 \times (1 - 0.35)} \times 1.6 + \frac{200,00,000 \times (1 - 0.35)}{300,00,000 + 200,00,000 \times (1 - 0.35)} \times 1.1$$

$$= 1.1163 + 0.3326 = 1.4489 \text{ i.e., } 1.45$$

Illustration 4

SHREEMAN QUESTION MARK has invested ₹ 20,00,000 in four securities, the particulars of which are given below: —

Particulars	Stock A	Stock B	Stock C	Stock D
Amount invested (₹)	4,00,000	5,00,000	6,50,000	4,50,000
Beta factor of the stock (β)	0.80	1.20	1.50	0.60

The rate of interest on RBI Bond is 7% and the yield on NIFTY is 15%.

a) Compute the expected return on his portfolio?

b) If investment in Stock D is replaced by investment in RBI Bonds, what is the corresponding change in Portfolio Beta and expected return?

Solution:

(a) First, we are to compute the portfolio beta which is the weighted average beta of the stocks.

Stock	Amount (₹)	Beta (β)	Weighted Beta = Amount × β
A	4,00,000	0.80	3,20,000
B	5,00,000	1.20	6,00,000
C	6,50,000	1.50	9,75,000
D	4,50,000	0.60	2,70,000
Total	**20,00,000**		**21,65,000**

Portfolio Beta (β_P) = $\frac{21,65,000}{20,00,000}$ = 1.0825

Expected return on his portfolio (E_p or R_p) = $R_f + \beta_p \times (R_m - R_f)$ = 7 + 1.0825 × (15 - 7) = 15.66%.

(b) Computation of revised portfolio beta and expected return:

Stock	Amount (₹)	Beta (β)	Weighted Beta = Amount × β
A	4,00,000	0.80	3,20,000
B	5,00,000	1.20	6,00,000
C	6,50,000	1.50	9,75,000
RBI Bonds	4,50,000	0.00	0
Total	**20,00,000**		**18,95,000**

Portfolio Beta (β_P) = $\frac{18,95,000}{20,00,000}$ = 0.9475

Expected return on his portfolio (E_p or R_p) = $R_f + \beta_p \times (R_m - R_f)$ = 7 + 0.9475 × (15 - 7) = 14.58%.

Illustration 5

An investment, whose beta is 0, generates a return of 6%. Another investment, whose beta is 1, generates a return of 15%. What will be the return of an investment whose beta is 0.75?

Solution:

Here, R_f = 0.06; R_M = 0.15 & β_e = 0.75

$E(R_e) = R_f + \beta_e (R_M - R_f) = 0.06 + 0.75(0.15 - 0.06) = 0.1275.$

Illustration 6

MR. EVERGREEN owns a stock portfolio equally invested in a risk-free asset and two stocks. If one of the stocks has a beta of 0.8 and the portfolio is as risky as the market what must be the beta of the other stocks in the portfolio?

Solution:

Beta of risk-free asset = β_{RF} = 0; Beta of stock A = β_A = 0.8

Let the beta of stock B = β_B = X

Beta of the portfolio = $\beta_P = (1/3)\times\beta_{RF} + (1/3)\times\beta_A + (1/3)\times\beta_B$

Therefore, $\frac{1}{3}(0) + \frac{1}{3}(0.8) + \frac{1}{3}.x = 1$

i.e. x = 2.2.

Illustration 7

MR. ARDHASAMAPTI is holding the following securities:

Investments	Initial price (₹)	Dividends (₹)	Market price at the end of the year (₹)	Beta factor
Gold Ltd.	10,000	1,725	9,800	0.6
Silver Ltd.	15,000	1,000	16,200	0.8
Bronze Ltd.	14,000	700	20,000	0.6
GOI Bonds	36,000	3,600	34,500	1.0

Average return of the portfolio (Re) is 15.7%. Please calculate (considering simple average beta)—

(a) Expected return of each stock using CAPM approach, and

(b) Risk-free rate of return.

Solution:

Investments	Initial price (₹)	Dividends (₹)	Market price at the end of the year (₹)	Beta factor
Gold Ltd.	10,000	1,725	9,800	0.6
Silver Ltd.	15,000	1,000	16,200	0.8
Bronze Ltd.	14,000	700	20,000	0.6
GOI Bonds	36,000	3,600	34,500	1.0
Total	75,000	7,025	80,500	

Rate of return on market portfolio (R_m) = $\frac{(80,500 - 75,000) + 7,025}{75,000} \times 100 = 16.7\%$

Expected return of each stock using CAPM can be computed as follows:

$E(R_e) = R_f + \beta_e (R_M - R_f)$

(b) Simple Average beta $(\beta_e) = \frac{0.6 + 0.8 + 0.6 + 1.0}{75,000} = 0.75$

Therefore, $R_f = R_e - \beta_e(R_M - R_f) = 15.7 - 0.75 \times (16.7 - R_f)$

$R_f - 0.75R_f = 15.7 - 12.525 = 3.175$

$0.25\ R_f = 3.175$

$R_f = 12.70$

(a) Computation of Expected return of each stock using CAPM approach:

Investments	Beta factor	Stock Return (%)
Gold Ltd.	0.6	12.70 + 0.60×(16.70 12.70) = 15.10
Silver Ltd.	0.8	12.70 + 0.80×(16.70 12.70) = 15.90
Bronze Ltd.	0.6	12.70 + 0.60×(16.70 12.70) = 15.10
GOI Bonds	1.0	12.70 + 1.00×(16.70 12.70) = 16.70

Illustration 8

SHREEMAN MAHAMANAV is holding the following securities:

Investments	Costs (₹)	Dividends (₹)	Market price at the end of the year (₹)	Beta factor
MATH Ltd.	50,000	17,250	48,000	0.7
STAT Ltd.	75,000	10,000	81,000	0.9
PHYSICS Ltd.	70,000	7,000	100,000	0.6
CHEMISTRY Ltd.	180,000	36,000	172,500	1.0

Average return of the portfolio (R_e) is 24.07%. Please calculate (considering weighted average beta)—

(a) Risk-free rate of return, and

(b) Expected return of each stock using CAPM approach.

Solution:

Investments	Costs (₹)	Dividends (₹)	Market price at the end of the year (₹)	Beta factor	Weighted Beta (A ×B)
MATH Ltd.	50,000	17,250	48,000	0.7	35,000
STAT Ltd.	75,000	10,000	81,000	0.9	67,500
PHYSICS Ltd.	70,000	7,000	100,000	0.6	42,000
CHEMISTRY Ltd.	180,000	36,000	172,500	1.0	180,000
Total	375,000	70,250	402,500		324,500

Rate of return on market portfolio (R_m) = $\frac{(402,500 - 375,000) + 70,250}{375,000} \times 100 = 26.07\%$

Weighted Average Beta = $\frac{324,500}{375,000} = 0.8653$

$R_e = R_f + \beta_e (R_M - R_f)$

Therefore, $R_f = R_e - \beta_e (R_M - R_f) = 24.07 - 0.8653 \times (26.07 - R_f)\lambda\beta$

$R_f - 0.8653Rf = 24.07 - 22.56 = 1.51$

$0.1347\ R_f = 1.51$

$R_f = 11.21$

(b) Computation of Expected return of each stock using CAPM approach:

Investments	Beta factor	Stock Return (%)
MATH Ltd.	0.6	11.21 + 0.7 × (26.07 11.21) = 21.612
STAT Ltd.	0.8	11.21 + 0.9 × (26.07 11.21) = 26.970
PHYSICS Ltd.	0.6	11.21 + 0.6 × (26.07 11.21) = 20.126
CHEMISTRY Ltd	1.0	11.21 + 1.0 × (26.07 11.21) = 26.070

Illustration 9

MR. HALF-CONFUSION is confused with the buying or selling of **stock of CO. DDT.** The following information is provided to him for better understanding:

Expected return (%)	Probability	Factor		
16	0.2	Interest rate risk	0.80	0.95
20	0.4	Purchasing power risk	0.90	1.60
15	0.3	Inflation risk	1.35	1.40
10	0.1	Market risk	0.70	- 1.50

Risk-free rate of return is 6%. Please advise MR. HALF-CONFUSION whether to buy or sell the stock.

Solution:

Expected return = (16 × 0.2 + 20 × 0.4 + 15 × 0.3 + 10 × 0.1)% = 16.7%

As per APT Model, the expected return = $\lambda_0 + (\lambda_1 \times \beta_1 + \lambda_2 \times \beta_2 + \lambda_3 \times \beta_3 + \lambda_4 \times \beta_4)$

= 6+[0.80 × 0.95 + 0.90 × 1.60 + 1.35 × 1.40 + 0.70 × (-1.50)]

= 9.04%

Recommendation: As the expected return is higher than return under APT Model, **MR. HALF-CONFUSION** should buy more stock of CO. DDT.

Illustration 10

MR. DISCRETE VARIABLE holds stock of UNTITLED LIMITED worth ₹ 234,00,000. The standard deviation for market price per day is 3%. Please determine the amount of maximum possible loss (with 99% confidence level) over the period of –

a) 1 trading day;

b) 16 trading days.

Solution:

Value-at-Risk (VAR) = Z Score (from Normal distribution table) × Standard deviation

From Normal Distribution Table, for 99% Confidence level, value of Z = 2.33 [Area under the Normal Curve]

Variance for n days = No. of days × variance per day = n × variance

(a) Variance for 1 day = 1 × (3% of ₹ 234,00,000)^2 = √1 × Standard deviation.

Therefore, Standard deviation for 1 trading day = $+\sqrt{\text{Variance}} = +\sqrt{(3\% \text{ of Rs. } 234,00,000)2}$

= ₹ 7,02,000.

This is the maximum possible loss per 1 trading day.

(b) Maximum possible loss for 16 trading days = ₹ 7,02,000 × $\sqrt{16}$ = ₹ 28,08,000.

Illustration 11

MISS PARROT has a portfolio consisting of ₹ 400,00,000 in Stock TEE and another ₹ 200,00,000 in Stock BEE. The standard deviation of both the shares for each trading day is 1.5%. The correlation coefficient between the two stocks is 0.3.

Compute the 10 trading days value at risk for the above portfolio at 99% confidence level.

Solution:

Standard deviation per trading day =

- Stock TEE = 1.5% of 400 lakhs = 6 lakhs = σ_1
- Stock BEE = 1.5% of 200 lakhs = 3 lakhs = σ_2

Therefore, the daily change variance for the portfolio $= (\sigma_1)^2 + (\sigma_1)^2 + 2 \times \sigma_1 \times \sigma_2 \times r_{1,2}$

$= 36 + 9 + 2 \times 6 \times 3 \times 0.3$

$= 55.8$

Therefore, Standard deviation for 1 trading day = $+\sqrt{\text{Variance}} = +\sqrt{55.8} = 7.47$ lakhs.

Value-at Risk = 2.33 × 7.47 × $\sqrt{10}$ = 55.04 lakhs.

Illustration 1

An option buyer buys a call option at a premium of ₹12 with a strike price of ₹250, expiration period becomes 1 month. Compute the—

a) Break-even price;

b) The range of MPS on the expiration day where it will be profitable for the option writer, i.e., option seller;

c) The range of MPS on the expiration day where it will be profitable for the option buyer and loss for the option seller.

Solution:

a) Break-even price = Strike price + Premium = ₹ (250 + 12) = ₹ 262.

b) If the MPS is less than ₹ 262 on the expiration day, it will be profitable for the option writer, i.e., option seller.

c) If the MPS is more than ₹ 262, it will be profitable for the option buyer and loss for the option seller.

Illustration 2

An option buyer buys a Put option at a premium of ₹ 14 with a strike price of ₹ 270, expiration period becomes 1 month. Compute the—

a) Break-even price;

b) The range of MPS on the expiration day where it will be profitable for the option writer, i.e., option seller;

c) The range of MPS on the expiration day where it will be profitable for the option buyer and loss for the option seller.

d) What is the maximum amount of loss to the Option buyer?

Solution:

a) Break-even price = Strike price Premium = ₹ (270 - 14) = ₹ 256.

b) If the MPS is more than ₹256 on the expiration day, it will be profitable for the option writer, i.e., option seller.

c) If the MPS is less than ₹256, it will be profitable for the option buyer and loss for the option seller.

d) The maximum amount of loss to the option buyer is the amount of premium paid.

Illustration 3

MR. JADUGAR established the following spread on the stock of MAJIC-TREE LIMITED:

a) Purchased one 3-month call option with a premium of ₹ 30 and an exercise price of ₹ 550 and

b) Purchased one 3-month put option with a premium of ₹ 5 and an exercise price of ₹ 450.

The stock of MAJIC-TREE LIMITED is currently selling at ₹ 500. Please compute the profit or loss, if the price of the stock:

(i) Remains at ₹ 500 after 3 months.

(ii) Falls to ₹ 350 after 3 months.

(iii)Rises to ₹ 600.

Assume the size of the option is 100 shares of MAJIC-TREE LIMITED.

Solution:

Total premium paid = 30 × 100 + 5 × 100 = ₹ 3,500

MPS	Exercise Option	Gross Margin (₹)	Premium paid (₹)	Net gain or (loss) [GM _ Premium]
500	Lapse	NIL	3,500	(3,500)
350	Put	(450 - 350) × 100 = 10,000	3,500	6,500
600	Call	(600 - 550) × 100= 5,000	3,500	1,500

Illustration 4

Spot price of a commodity is ₹800. From the following determine the intrinsic value and time value:

Option	Call option (₹)		Put option (₹)	
	Strike	Premium	Strike	Premium
1	790	25	810	28
2	800	15	800	18
3	810	5	790	8

Solution:

	Call Option		Put Option	
Option	Intrinsic value (₹)	Time value (₹)	Intrinsic value (₹)	Time value (₹)
1	800 — 790 = 10	25 — 10 = 15	810 — 800 = 10	28 — 10 = 18
2	800 — 800 = 0	15 — 0 = 15	800 — 800 = 0	18 — 0 = 18
3	800 — 810 = (10) i.e. 0	5 — 0 = 5	790 — 800 = 0	8 — 0 = 8

Illustration 5

Current price of SONE KA SIKKA LIMITED's shares is ₹ 380. The continuously compounded risk-free rate of return (CCRRI) is 12%.

a) Please determine the minimum value of 3-month European put if strike price is ₹ 400.

Solution:

Present value of strike price = $S.e^{-r.n}$ = $400 \times e^{-0.12 \times 3/12}$ = ₹ 388.16.

Minimum value of European Put = present value of strike price — Current price = ₹ 8.16.

Illustration 6

An option dealer took short positions in a call and put options on dollar at the strike price of ₹ 47.00. He received premiums of ₹ 2.50 for each option. For the dealer to make a gain in this option strategy, what should be the range of price? **[Ans: ₹ 42.00 to ₹ 52.00]**

Solution:

The required range of price is ₹ (47.00 - 2×2.50) to ₹ (47.00 + 2×2.50) i.e., ₹ 42.00 to 52.00.

Illustration 7

The premium for a call option is ₹ 3.25 per share with a strike price of ₹62. It is due to mature and the share is selling in the market at ₹ 66. Please show the arbitrage opportunity. Lot size is 200.

Solution:

Here the intrinsic value is ₹ (66 – 62) = ₹ 4. Call option premium < Intrinsic value. Thus, opportunity gain exists. An arbitrageur may buy the call option paying ₹ 650 (=200 × 3.25), exercise it and get the share by paying ₹ 62 × 200 = ₹ 12,400. He may immediately sell the shares in the market at ₹ 66 each and receive ₹ 13,200.

Therefore, his amount of arbitrage gain = ₹ (13,200 – 12,400 – 650) = ₹ 150.

Illustration 8

Calculate the price of a 3-month RIL, if RIL (FV ₹10) quotes ₹ 520 on NSE, and the 3-month future price quotes at ₹ 542. The 3-month borrowing rate is given as 15% p.a. and the expected annual dividend yield is nil p.a. payable before expiry.

Solution:

Future's price = Spot price + Cost of carry—Dividend.

$= (520 + 520 \times 15\% \times \frac{3}{12} - \text{Nil}) = ₹ 539.50.$

Comment: As the fair value of Futures is less than the actual Futures price, the Arbitrageurs should sell futures and buy stocks in the cash market.

Illustration 9

On 5th April, 2019, MISS BEAUTIFUL bought an April Nifty Futures contract that cost her ₹ 5,38,000. She paid an initial margin of ₹ 43,040 to her broker. Each Nifty Futures contract is for the delivery of 200 Nifty Futures. On 25th April ,2019, the index closed at ₹2,800. How much profit or loss did she make?

Solution:

Purchase price per Nifty Future = ₹(5,38,000 ÷ 200) = ₹2,690. The futures closing price is ₹ 2,800. Thus, the amount of profit she would have made = ₹ (2,800 — 2,690) × 200 = ₹22,000.

Illustration 10

MR. HALF-BROWN is bearish about the index. Spot Nifty stands at ₹1,150. He decides to sell one three-month Nifty Call Option contract (having a market lot of 200) with a strike price of ₹1,175 for a premium of ₹28.90. Three months later, the index closes at ₹ 1,195. What is his net pay off in the position?

Solution:

Premium received ₹ 28.90 × 200	= ₹ 5,780
Less: Loss due to rise in Index (1,195 —1,175) × 200	= ₹ 4,000
Net Gain to MR. HALF-BROWN	₹ 1,780

Illustration 11

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

Requested: Calculate the Mark to Market Cash Flows and daily closing balances in the account of:

(A) An investor who has gone long at 4,585.

(B) An investor who has gone short at 4,585.

Solution:

Initial Margin (IM) = 8% of ₹ (4,585 × 100) = ₹ 36,680.

Maintenance Margin (MM) = 6% of ₹ (4,585 × 100) = ₹ 27,510.

(A) Status of Investor Who has Gone Long

Margin Account (₹)

Day	Settlement Price	Opening Balance	Mark to Market C/F	Margin Call	Closing Balance
1	4,690	36,680	+10,500	-	47,180
2	4,760	47,180	+7,000	-	54,180
3	4,550	54,180	—21,000	-	33,180
4	4,480	33,180	—7,000	10,500	36,680
5	4,570	36,680	+9,000	-	45,680

Note: At the end of the 4th day Margin Account becomes (33,180 — 7,000) = ₹ 26,180, which is less than MM. Hence Margin Call of ₹ 10,500 is made to make the closing balance equal to the IM.

Net loss to the investor = ₹ (21,000 + 7,000 — 10,500 — 7,000 — 9,000) = ₹ 1,500.

(B) Status of Investor Who has Gone Short

Margin Account (₹)

Day	Settlement Price	Opening Balance	Mark to Market C/F	Margin Call	Closing Balance
1	4,690	36,680	(—) 10,500	10,500	36,680
2	4,760	36,680	(—) 7,000	-	29,680
3	4,550	29,680	(+) 21,000	-	50,680
4	4,480	50,680	(+) 7,000	-	57,680
5	4,570	57,680	(—) 9,000	-	48,680

Note: At the end of the 1st day Margin Account falls below MM. Hence a Margin Call of ₹ 10,500 is made to make the balance equal to the Initial Margin (IM).

Net gain = ₹ 1,500.

Illustration 12

Which position on the index future gives a speculator, a complete hedge against the following transactions:

(i) The share of RIGHT LTD. is going to rise. He has a long position on the cash market of ₹50 lakhs on RIGHT LTD. The beta of RIGHT LTD. is 1.25.

(ii) The share of WRONG LTD. is going to depreciate. He has a short position on the cash market of ₹25 lakhs of the WRONG LTD. The beta of WRONG LTD. is 0.90.

(iii)The share of FAIR LTD. is going to stagnant. He has a short position on the cash market of ₹20 lakhs of the FAIR LTD. The beta of FAIR LTD. is 0.75.

Solution:

Company name	Market trend	Amount (₹)	Value of beta	Index value (₹)	Position
RIGHT LTD.	Rise	50,00,000	1.25	62,50,000	Short
WRONG LTD.	Depreciate	25,00,000	0.90	22,50,000	Long
FAIR LTD.	Stagnant	20,00,000	0.75	15,00,000	Long
			Net effect	25,00,000	Short

Illustration 13

Determine the value of 6-month futures on KOLKATA CO.'s share from the following data:
Current price = ₹80

Dividend after 3 months = ₹3

CCRRI (Continuously compounded risk-free rate of interest) = 10%.

Solution:

n = 6 / 12 = 0.5 years, m = 3 / 12 = 0.25 years, r = 0.10, P = ₹80

Present value of dividend foregone = $3\{2.7183^{-0.025}\}$ = ₹2.93 = I

Fair value of futures = (P − I). $e^{r.n}$ = ₹81.

Illustration 14

The share of MISS WORLD LTD. is currently selling for ₹300. Risk free interest rate is 0.8% p.m. A 3-month futures contract is selling for ₹312. Please develop an arbitrage strategy and show what your riskless profit will be 3 months hence assuming that the company will not pay any dividend in the next three months.

Solution:

The appropriate value of 3 months future contract = F_0 = ₹300 × $(1 + .008)^3$ = ₹307.26.

Since the future price is greater than the appropriate value, the arbitrage strategy can be developed as follows:

Step 1: Borrow ₹300 @ 0.8% p. m. and buy a share from the market at ₹300.

Step 2: Sell a futures contract for ₹312 to be delivered after 3 months.

Step 3: After 3 months, receive ₹312 from the futures contract and repay the borrowed amount along with interest paying ₹307.26.

Net arbitrage gain = ₹ (312 − 307.26) = ₹4.74 per share.

Illustration 15

MR. NIGRA FALLS, a trader wishes to sell 100 shares of A Ltd. at current price of ₹25 per share. The put option premium per A Ltd. share at strike price of ₹25, maturing after 2 months is ₹ 1.50. This is at-the-money put option. The trader can hedge his position by taking a put (long put) option or by taking a short put option in futures market at ₹25. The at-the-money put option used for hedging is called a protective put.

Please show the price realized by the trader at different maturity price if—

a) Protective put is taken, and

b) Short position is taken in the future market.

Solution:

(a) If protective put is taken:

Maturity price (P)(₹)	Exercise option or not	Price differential received (₹)	Realised from sale (₹)	Premium paid (₹)	Net price realized (₹)
35	No	Nil	35	1.50	33.50
32	No	Nil	32	1.50	30.50
30	No	Nil	30	1.50	28.50
28	No	Nil	28	1.50	26.50
27	No	Nil	27	1.50	25.50
26	No	Nil	26	1.50	24.50
25	No	Nil	25	1.50	23.50
24	Yes	1.00	24	1.50	23.50
23	Yes	2.00	23	1.50	23.50
10	Yes	15.00	10	1.50	23.50
5	Yes	20.00	5	1.50	23.50
1	Yes	24.00	1	1.50	23.50

(b) If short position is taken in future market:

Maturity price (P) (₹)	Price differential		Realised from sale (₹)	Net price realized (₹)
	Received	Paid		
35	Nil	10.00	35	25
32	Nil	7.00	32	25
30	Nil	5.00	30	25
28	Nil	3.00	28	25
27	Nil	2.00	27	25
26	Nil	1.00	26	25
25	Nil	Nil	25	25
24	1.00	Nil	24	25
23	2.00	Nil	23	25
10	15.00	Nil	10	25
5	20.00	Nil	5	25
1	24.00	Nil	1	25

Illustration 16

CO. NO CORRUPTION LTD. gives the following information:

- BSE Index : 5000
- Value of portfolio : ₹ 10,10,000
- Risk-free interest rate : 9%
- Dividend yield on index : 6%
- Beta of portfolio : 1.5
- It is given that a future contract on the BSE index with four months maturity is used to hedge the value of portfolio over the next 3 months. One future contract is for delivery of 50 times the index.

Based on the above information, please calculate:

a) Current price of the future contract.

b) The gain on the short future position if index turns out to be 4,500 in 3 months.

Solution:

(a) Current price of the future contract

= BSE Index + BSE Index (Risk-free interest rate − Dividend yield on index) × Maturity period
= 5000 + 5000 (0.09 − 0.06) × (4 / 12) = ₹ 5050.

[Alternative method: Price of the future contract = 5,000 × $e^{(0.09 - 0.06)\times 0.3333}$ = 5,050.]

Price of the future contract = ₹ (50 × 5050) = ₹ 2,52,500.

(b) Value of index portfolio = 1.5 × ₹ 10,10,000 = ₹ 15,15,000.

Hedge Ratio = (Value of index portfolio ÷ Price of future contract)

= (15,15,000 ÷ 2,52,500) = 6.

Index, after 3 months, turns out to be 4,500.

Gain from short future position = 6 × (5,050 − 4,500) × 50 = ₹ 1,65,000.

Illustration 17

PREETI furnishes the following information about four stocks in the derivative markets:

(i) Shares of SWARGA LTD are sold in the spot market for ₹ 827. A 3-month call on the same is being traded at ₹ 100 with an exercise price of ₹ 930.

(ii) Shares of MARTYA LTD are traded at ₹ 475. A 3-month call on the same is available for ₹ 50 with an exercise price of ₹ 490.

(iii)A 3-month call on PATAL LTD is sold for ₹ 15 for an exercise price of ₹ 120. The spot price is ₹ 100.

(a) If risk free interest rate is 8%, please compute the value of Put in the following cases:

(b) What will be PREETI's courses of action if the actual prices of in all the above cases are as follows?

- SWARGA LTD: ₹ 180 or ₹ 190;
- MARTYA LTD: ₹ 52 or ₹ 60;
- PATAL LTD: ₹ 30 or ₹ 35.

Solution:

Put-call parity theorem:

Value of Call Option + PV of strike price = Value of Put Option + Current price.

Therefore, **Value of Put option** = Value of Call Option + PV of strike price - Current Proce

Solution:

(a) Computation of value of Put

Stock	Exercise price (₹)	Price of call (₹)	Present value of EP (₹)	Spot price(₹)	Value of Put (₹)
(1)	(2)	(3)	(4) = (2) × $e^{-0.08 \times 3/12}$	(5)	(6) = (3) + (4) – (5)
Swarga Ltd	930	100	930 × 0.98 = 911.40	827	184.40

Martya Ltd	490	50	490 × 0.98 = 480.20	475	55.20
Patal Ltd	120	15	120 × 0.98 = 117.60	100	32.60

Note: $e^{-0.08 \times 3/12} = 0.98$

(b) Evaluation of Put options

Stock	Theoretical value (₹)	Actual price (₹)	Position	Action
Swarga Ltd	• 184.40	• 180	Undervalued	Buy Put option & stock in Spot market
	• 184.40	• 190	Overvalued	Write Put option, sell stock in Spot market.
Martya Ltd	• 55.20	• 52	Undervalued	Buy Put option & stock in Spot market
	• 55.20	• 60	Overvalued	Write Put option, sell stock in Spot market.
Patal Ltd	• 32.60	• 30	Undervalued	Buy Put option & stock in Spot market
	• 32.60	• 35	Overvalued	Write Put option, sell stock in Spot market

Illustration 18

The shares of TIK-TIK LTD. are currently priced at ₹ 415 and call option exercisable in 3-months' time has an exercise rate of ₹ 400. Risk free rate of interest is 5% p.a. and standard deviation (volatility) of share price is 22%. Based on the assumption that the company is not going to declare any dividend over the next three months, determine the value of call and put option.

Solution:

C = Current price = ₹ 415

S = Strike price = ₹ 400;

r = CCRRI = 0.05;

σ = 0.22;

n = 0.25 years.

P.V. of strike price = S. e^{-rn} = ₹ 400 × $e^{-0.05\times(3/12)}$ = ₹ 395.

$$d_1 = \frac{\left(\ln \frac{C}{S}\right) + \left(r + 0.5\sigma^2\right)n}{\sigma.\sqrt{n}} = 0.5; \qquad d_2 = d_1 - \sigma\sqrt{n} = 0.39.$$

$N(d_1) = P(Z < 0.5) = 0.5 + 0.1915 = 0.6915$. [From Normal Distribution Table]

$N(d_2) = P(Z < 0.39) = 0.5 + 0.1517 = 0.6517$.

Value of call = $N(d_1)$ × Current price − $N(d_2)$ × Present value of strike price.

= 0.6915 × 415 − 0.6517 × 395 = ₹ 29.55.

Put-call Parity Theorem:

Value of Call option + P.V. of strike price = Value of Put option + Current price.

Value of Put option = 29.55 + 395 — 415 = ₹ 9.55.

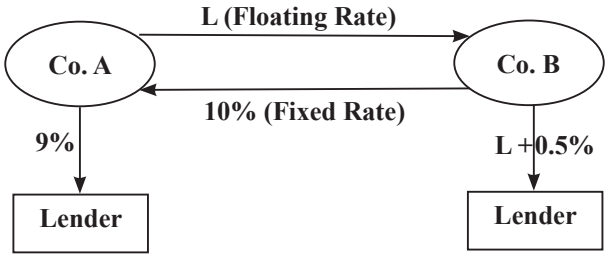
Illustration 19

CO. A (a party with superior credit rating) and CO. B (a party with inferior credit rating) can borrow at the following Fixed rate and Floating rate:

Company	Fixed Rate	Floating Rate
A	9%	LIBOR i.e. L
B	11%	LIBOR + 0.5% i.e. L + 0.5%

At present CO. A is in the fixed rate on the loan taken, whereas CO. B is in the floating rate. CO. A is interested in the floating rate whereas CO. B is interested in the fixed rate of interest. Please develop a swap strategy. The gain is shared between them in the ratio of 2 : 1.

Solution:



The net costs to CO. A and CO. B as a result of the above swap strategy is as follows:

CO. A: L + 9% — 10% = L — 1%

CO. B: L + 0.5% + 10% — L = 10.5%.

Comment: CO. A is saving 1% on its Floating rate and CO. B is saving 0.5% on its Fixed rate of interest.

9 Foreign Exchange Market [Study Material - Module 15]

Illustration 1

Following is the quotation of Axis Bank on 20TH April, 2012:

US $ 1 = ₹ 50.50 — 52.50

MR. FULL SMART, an Indian exporter wants to sell US $ 1,00,000 and MR. THINKING & DRINKING needs $ 1,00,000 to import goods from USA.

(a) Compute the amount MR. FULL SMART will get from the bank for selling $ 1,00,000.

(b) Compute the amount to be paid by MR. THINKING & DRINKING to get $ 1,00,000 for payment to American exporter?

(c) Compute the gross margin to the bank in the above transactions.

Solution:

(a) The Bid Rate is ₹ 50.50 / $. The exporter will get the bid rate by selling his US $.

MR. FULL SMART will get 1,00,000 × ₹ 50.50 = ₹ 50,50,000

(b) The Ask Rate is ₹ 52.25 / $ which will be charged by the Bank to the importer. Therefore, the amount to be paid by MR. THINKING & DRINKING is 1,00,000 × ₹ 52.50 = ₹ 52,50,000.

(c) Gross margin to the Bank in the above transactions = ₹ (52,50,000 - 50,00,000) = ₹ 2,00,000.

Illustration 2

The following bid-ask rates are given:

$ 1 = ₹ 52.50—54.80.

£ 1 = ₹ 82.40—85.10.

a) At what rate MR. FURUT will purchase USD? He needs $ 5,00,000 for importing a machine. How much he will have to pay in INR?

b) At what rate MISS TUKTUKI will sell USD? She will receive $ 2,00,000 from USA for exporting computer software. How much she will get in INR ?

c) What are the buying rate and selling rate for UKP to the foreign exchange dealer and to others?

d) MISS BIJLI exported goods worth UKP 5,00,000 to an importer at London. If the amount is credited in her account directly by the foreigner, how much amount will be credited in her account in INR ?

e) MR. BODYGUARD wanted to send UKP 2,00,000 to her son through account transfer. How much he will have to pay in INR ?

Solution:

(a) MR. FURUT will purchase USD @₹ 54.80. he will have to pay ₹ (5,00,000 × 54.80) = ₹ 27,400,000.

(b) She will sell @ ₹ 52.50 per $ 1. She will receive ₹ (2,00,000 × 52.50) i.e. ₹ 10,500,000.

(c) From the point of view of the dealer, buying rate = ₹ 82.40 and selling rate = ₹ 85.10. from the point of view of others, buying rate = ₹ 85.10 and selling rate = ₹ 82.40.

(d) 5,00,000 × ₹ 82.40 = ₹ 41,200,000.

(e) 2,00,000 × ₹ 85.10 = ₹ 17,020,000.

Illustration 3

An extract from foreign exchange rate list of a Kolkata based bank is given below:

₹ / ¥ : 0.3992 / 0.4002

(i) How many Yen will it cost for a Japanese tourist visiting India to purchase ₹ 2,500 worth of jackfruit?

(ii) How much will MR. BANBHATTA in Kolkata have to spend in Rupees, to purchase a Sony Camcorder worth ¥ 1,25,000 ?

Solution:

(i) For the Japanese tourist, the given rate is an indirect quote. The direct quote will be as follows:

Bid rate = $\frac{1}{Ask\ Rate} = \frac{1}{0.4002}$ = ¥ 2.4988 / ₹

Ask rate = $\frac{1}{Bid\ Rate} = \frac{1}{0.3992}$ = ¥ 2.5050 / ₹

Jackfruit will cost to the Japanese tourist ¥ 2.5050 × 2,500 = ¥ 6,262.50.

(ii) For the Sony camcorder, he will have to pay ₹ (1,25,000 × 0.4002) = ₹ 50,025.

Illustration 4

Spot Rate: $ 1 = ₹ 84.20—86.30

Swap points:

- 1 month: 30 / 50
- 2 months: 50 / 80
- 3 months: 50 / 30

Compute the 1 month, 2 months and 3 months forward rates.

Solution:

The forward rates can be calculated as follows:

(i) 1-month forward rate: $ 1 = ₹ (84.20 + 0.30) — (86.30 + 0.50) = ₹ 84.50 — 86.80. As the swap points are in increasing order, spread is positive and forward rates are at premium. The buying rate and selling rate both are calculated by adding the swap points.

(ii) 2 months forward rate: $ 1 = ₹ (84.20 + 0.50) — (86.30 + 0.80) = ₹ 84.70 — 87.10.

(iii) 3 months forward rate: $ 1 = ₹ (84.20 − 0.50) — (86.30 − 0.30) = ₹ 83.70 — 86.00. As the swap points are in decreasing order, spread is negative and forward rates are at discount. The buying rate and selling rate are calculated by deducting the swap points.

Illustration 5

If the spot rate of US $ is ₹ 80.00 and the 6 months forward rate is ₹ 84.50, what is the forward premium or discount on annual basis?

Solution:

It is a direct quote and the forward rate is more than spot rate. Thus, the quotation is at premium.

Spot rate = S = ₹ 84.50 per US $ and Forward rate = F = ₹ 80.00 per US $.

Forward premium = [(F - S)/S]×100×(12/n) = [(84.50 - 80.00)/80.00]×100×(12/6) = 11.25%.

Illustration 6

Following rates are available at Bank of Maharashtra at Mumbai on 15.05.2012:

- ₹ / $ = 52.50—54.00
- ₹ / £ = 82.50—84.00

Please determine the quotes for US $ / GBP and GBP / US $.

Solution:

This is a question of cross currency rate. The quotations are calculated as follows:

Bid rate = US$/GBP = (US$/INR)(INR/GBP) = (1/54.00)× 82.50 = 1.5278.

Ask rate = US$/GBP = (US$/INR)(INR/GBP) = (1/52.50)× 84.00 = 1.6000.

Illustration 7

AXIS BANK LTD. wants to calculate Rupee TT selling rate of exchange for DM since a deposit of DM 1,00,000 in a FCNR A/C. has matured, when—

€ 1 = DM 1.95583 (locked in rate)

€ 1 = US $ 1.0234 / 43

US $ 1 = ₹ 48.51 / 53

What is the rupee TT selling rate for DM currency?

Solution:

$$\text{Re./DM} = (\text{Re./\$})(\text{\$/Euro})(\text{Euro/DM}) = 48.53 \times 1.0243 \times \frac{1}{1.95583} = 25.42$$

i.e., DM 1 = ₹ 25.42.

Illustration 8

You sold Hong Kong Dollar 100,00,000 value spot to your customer @ ₹ 5.70 per HKD & covered yourself in London market on the same day, when the exchanges were:

US$ 1 = HK$ 7.5880 — 7.5920.

Local inter-bank market rates for US $ were:

Spot rate: US$ 1 = ₹ 42.70 and 42.85.

Calculate cover rate & ascertain the profit or loss in the transaction. Ignore brokerage.

Solution:

As we cover the sell with a buy, we are to calculate the Ask Rate of ₹ / HK$. We are to apply Cross Currency Rate as follows:

$$\text{Ask (INR/HK\$)} = \text{Ask (INR/\$)} \times \text{Ask (\$/HK\$)} = 42.85 \times \frac{1}{7.5880} = 5.65.$$ [As indirect quote is given, $\frac{1}{Bid\ \ Rate}$ is used as Ask Rate]. HK$ 1 = ₹ 5.65.

Therefore, he should buy HK$ applying CCR of ₹ 5.65 per HK$ and sell @ ₹ 5.70 per HK$. The amount of arbitrage gain = ₹ (5.70 − 5.65) × 100,00,000 = ₹ 5,00,000.

Illustration 9

During a year, the price of British Gilts (face value £ 100) rose from £ 105 to £ 110, while paying a coupon of £ 8. At the same time, the exchange rate moved from $ / £ of 1.80 to 1.70. What is the total return to an investor in USA who invested in this security?

Solution:

Let us assume that the US investor purchased only 1 bond at £ 105, costing him $ (1.80 × 105) i.e., $ 189.After 1 year, his position will be as follows:

Selling price of the Bond	£ 110	
Add: Interest income	£ 8	
Total inflow	£ 118 i.e. 118 × $ 1.70 =	$ 200.60
Less: Initial outflow		$ 189.00
Net return		$ 11.60

Rate of return = (11.60/189)×100 = 6.14%.

Illustration 10

An Indian importer has to settle a bill for $1,35,000. The exporter has given the company two options as follows:

(i) Pay immediately without any interest charge;

(ii) Pay after 3 months with interest @ 6% p.a.

The importer's bank charges 16% p.a. on overdrafts.

If the exchange rates are as follows, what should the company do?

Spot (₹/$): 48.35 / 48.36

3-month (₹/$): 48.81 / 48.83

Solution:

Option 1: Pay immediately:

Bill value (1,35,000 × ₹48.36)	₹65,28,600
Add: interest for 3-months (16% on ₹65,28,600 × (3/12)	₹ 2,61,144
Total amount to be paid	₹67,89,744

Option 2: Pay after 3-months with interest @ 6% p.a.:

Bill value	$ 1,35,000
Add: Interest for 3-months @ 6% p.a.	$ 2,025
Total amount	$ 1,37,025
i.e. 1,37,025 × ₹48.83	= ₹66,90,931

Recommendation: The importer should settle the bill after 3 months as it will be cheaper.

Illustration 11

Given Spot Exchange rate $ 1 = FF 7.05, compute the following missing items:

	3 months	6 months	1 year
$ Interest rate p.a.	11.5%	12.25%	E
FF Interest rate p.a.	19.5%	C	20%
Forward French Franc (FF) per $	A	D	7.52
Forward Dollar premium	B	6.3%	F

Solution:

Here, we assume that FF is home currency and US$ is foreign currency.

As per Interest Rate Parity theorem, Forward rate = Spot rate $\times \frac{(1+I_h)}{(1+I_f)}$

Rate of forward premium = $\frac{F-S}{S} \times \frac{12}{n} \times 100$

The missing figures have been calculated as follows:

3 months	6 months	1 year
Computation of A $F = S \times \frac{(1+r_h)}{(1+r_f)}$ $= 7.05 \times \frac{\left(1+\frac{0.195}{4}\right)}{\left(1+\frac{0.115}{4}\right)}$ = **7.1871** **Computation of B** Since, forward rate > spot rate, the forward rate is at a premium. Rate of forward premium $= \frac{F-S}{S} \times \frac{12}{n} \times 100$ $= \frac{(7.1871-7.05)}{7.05} \times \frac{12}{3} \times 100$ **= 7.78%.**	**Computation of D** $\frac{D-7.05}{7.05} \times \frac{12}{6} \times 100 = 6.3$ $D = \frac{6.3 \times 7.05 \times 6}{12 \times 100} + 7.05$ = **7.27.** **Computation of C** $F = S \times \frac{(1+r_h)}{(1+r_f)}$ $(1+\frac{C}{2}) = \frac{7.27}{7.05} \times (1+\frac{0.1225}{2})$ Solving **C = 18.87%.**	**Computation of E** $F = S \times \frac{(1+r_h)}{(1+r_f)}$ $(1+r_f) = \frac{7.05 \times (1+0.20)}{7.52}$ $= 1.125$ **E = r_f = 0.125 i.e. 12.50%.** **Computation of F** As F > S, the forward rate is at a premium. Rate of premium $= \frac{F-S}{S} \times \frac{12}{n} \times 100$ $= \frac{7.52-7.05}{7.05} \times \frac{12}{12} \times 100$ **= 6.67%.**

Illustration 12

Spot Rate:

- £ 1 = € 1.2525—1.2735 in UK
- € 1 = ₹ 81.25—85.50 in Belgium
- £ 1 = ₹ 95.50 – 100.15 in India

a) Does the opportunity gain exist?

b) If the Arbitrager can invest £ 100,000, show the modus operandi of making profit.

[Hints: CCR: £ 1 = ₹101.7656 – 108.8843]

Solution:

Applying CCR: Taking UK & Belgium

₹/£ = (₹/€)(€/£) = 81.25 × 1.2525 – 85.50 × 1.2735 = 101.77 – 108.88

But in India, the rate is £ 1 = ₹ 95.50 – 100.15.

There is a mismatch between the Cross Currency buying rate and the given selling rate in India. Thus, the arbitrage opportunity exists.

₹ 101.77 /£ > ₹ 100.15 / £.

The modus operandi is as follows:

Step 1: Sell £ 100,000 in UK and receive 100,000 × €1.2525 i.e., € 125,250.

Step 2: Sell the above euro in Belgium and receive 125,250 × ₹ 81.25 = ₹ 101,76,562.50

Step 3: Buy UKP in India using the above INR. Get UKP (101,76,562.50 ÷ 100.15) i.e., £101,613.21.

Result: The net arbitrage gain = £ (101,613.21 = £ 1,613.21.

Illustration 13

Please determine the arbitrage gain from the following data:

Spot rate : ₹ 62.10 / $

3-month forward rate : ₹ 62.60 / $

3-month interest rate

- In India: 6%
- In USA: 11%

Assume ₹ 12 million or $ 2,00,000 (as the case may be) borrowings are available.

Solution:

As the 3-month forward rate is more than the spot rate, it implies that the dollar is at premium.

Premium = [(62.60 - 62.10)/62.10]×(12/3)× 100 = 3.22%

Interest rate differential = 11% — 6% = 5% > 3.22%. Thus, arbitrage gain possibilities exist. An arbitrageur can take the following steps to make some arbitrage gain:

(i) He borrows ₹ 120,00,000 in Indian rupees @ 6% p.a. for 3 months and converts the same into USD to receive $ (120,00,000 ÷ 62.10) = $ 1,93,236.715.

(ii) He invests the same amount in USA @11% for 3 months (in the money market).

After 3 months:

(iii) Total sum available after 3 months = $1,93,236.715 + $(1,93,236.715 × 11% × 3/12)

= $ 1,98,550.715

(iv) He will sell the above USD at the forward rate of ₹ 62.60 and get ₹ 124,29,275.

(v) He will repay ₹ (120,00,000 + 120,00,000 × 6% × 3 / 12) = ₹ 121,80,000.

(vi) His arbitrage gain = ₹ (124,29,275— 121,80,000) = ₹ 2,49,275.

Illustration 14

A Laptop bag is priced at $ 100.00 at New York and ₹ 5250 in Mumbai.

a) Please determine the exchange rate in Mumbai.

b) If, over the next 1 year, price of the bag increases by 7% in Mumbai and by 4% in New York, please determine the price of the bag at Mumbai and New York. Also determine the exchange rate prevailing at New York for ₹ 100.

c) Determine the appreciation or depreciation of ₹ in one year from now.

Solution:

(a) Exchange rate in Mumbai = ₹ (5,250 ÷ 100) per US $ = ₹ 52.50 per US $.

(b) Price of the bag in Mumbai = ₹ 5,250 (1 + 0.07) = ₹ 5,617.50. In New York, the price

= $ 100 (1 + 0.04) = $ 104.

Exchange rate in New York = $ (104 ÷ 5,617.50) x 100 = $ 1.8514 per ₹ 100.

(c) The rupee has depreciated in 1 year time.

Rate of depreciation $= \frac{(1 + Indian\ \ Inflation\ \ Rate)}{(1 + New\ \ York\ \ Inflation\ \ Rate)} - 1$

$=[(1+0.07)/(1+0.04) - 1$

= 0.0288 i.e., 2.88%.

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