

GROUP II / PAPER-10

DECISION MAKING
BUDGETARY CONTROL
VARIANCE ANALYSIS
COST RECORDS
MANAGERIAL ECONOMICS

COST & MANAGEMENT ACCOUNTANCY

INTERMEDIATE



The Institute of Cost Accountants of India
(Statutory body under an Act of Parliament)

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INTERMEDIATE : PAPER -

10

COST AND MANAGEMENT ACCOUNTANCY

INTERMEDIATE

STUDY NOTES



The Institute of Cost Accountants of India

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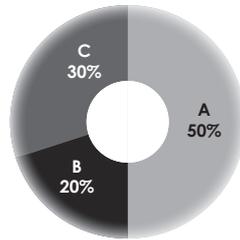
Syllabus

PAPER 10: COST & MANAGEMENT ACCOUNTANCY (CMA)

Syllabus Structure:

The syllabus comprises the following topics and study weightage:

A	Cost & Management Accounting – Methods & Techniques	50%
B	Cost Records and Cost Audit	20%
C	Economics for managerial decision-making	30%



ASSESSMENT STRATEGY

There will be written examination paper of three hours

OBJECTIVES

To provide an in depth knowledge of the detailed procedures and documentation involved in cost ascertainment systems. Acquire knowledge and skills for application of economics for managerial decision making.

Learning Aims

The syllabus aims to test the student's ability to:

- Understand the cost and management accounting techniques for evaluation, analysis and application in managerial decision making;
- Compare and contrast marginal and absorption costing methods in respect of profit reporting;
- Apply marginal and absorption costing approaches in job, batch and process environments;
- Prepare and interpret budgets and standard costs and variance statements;
- Understand CARR and CAR;
- Understand the application of economics in managerial decision-making.

Skill Set required

Level B: Requiring the skill levels of knowledge, comprehension, application and analysis.

Section A : Cost & Management Accounting – Methods & Techniques	50%
1. Cost Accounting Methods and Systems	
2. Decision Making Tools	
3. Budgeting and Budgetary Control	
4. Standard Costing	
Section B : Cost Records and Cost Audit	20%
5. Cost Accounting Records and Cost Audit	
Section C : Economics for managerial decision-making	30%
6. Economics for managerial decision-making	

SECTION A: COST & MANAGEMENT ACCOUNTING – METHODS & TECHNIQUES (50 MARKS)

1. Cost Accounting Methods and Systems

- (a) Necessity and importance of cost accounting, what management expects of cost accounting, cost department organization and relationship with other departments, installation of a costing system and modification thereof; planning and progressing of accounting, design of forms and records

- (b) Accounting entries for an integrated accounting system- cost ledgers; Reconciliation between cost and Financial profit and loss account; Integrated and non-integrated accounting and reporting
- (c) Job, batch, contract costing, process costing (including establishment of equivalent units in stock, work-in-progress and abnormal loss accounts and use of various methods like first-in-first out), operation costing, operating costing, unit costing, multiple costing, by-product and joint products

2. Decision Making Tools (advanced level)

- (a) Marginal Costing : basic concepts; break even analysis and cost-volume-profit analysis; break-even charts and profit charts; differential cost analysis; stock valuation under marginal costing techniques versus absorption costing techniques; applications of marginal costing in decision making
- (b) Throughput Accounting (TA) – as a system of profit reporting and stock valuation
- (c) Activity-Based Costing (ABC) for profit reporting and stock valuation
- (d) Integration of Standard Costing with Marginal Cost Accounting, Absorption Cost Accounting and Throughput Accounting
- (e) Transfer Pricing – determination of inter-departmental or inter-company transfer price
- (f) Treatment of special expenses in costs such as – research and development expenses, preliminary expenses, rectification expenses, costs of obsolescence, etc.
- (g) Accounting and control of waste, scrap, spoilage, defective, etc

3. Budgeting and Budgetary Control

- (a) Budget Concepts and Budget Preparation
- (b) Fixed and Flexible Budgets
- (c) Fixed, variable, semi-variable and activity-based categorizations of cost and their application in projecting financial results
- (d) Zero Base Budgeting (ZBB)
- (e) Budgetary Control

4. Standard Costing

- (a) Concept and uses; accounting – methods and reconciliation – stock valuation
- (b) Variance Analysis: Cost, Profit and Sales Variances – presentation of variances, investigation of variances, revision of standards
- (c) Reporting – requisites of reports – interpretation and uses for Managerial decision-making activities
- (d) Uniform Costing and Inter-firm comparison

SECTION B: COST RECORDS AND COST AUDIT (20 MARKS)

5. Cost Accounting Records and Cost Audit

- (a) Cost Accounting Records and Cost Audit under Companies Act, 2013
- (b) Nature and scope of Cost Audit
- (c) Cost Compliance Reports – by Cost Accountants
- (d) Companies (Cost Accounting Record) Rules, 2011 and Companies (Cost Audit Report) Rules, 2011 [To be substituted by relevant Rules of 2014]

SECTION C: ECONOMICS FOR MANAGERIAL DECISION-MAKING (30 MARKS)

6. Economics for Managerial Decision-Making

- (a) Concepts of Markets, analysis of market demand and empirical estimation of demand
- (b) Government Intervention and effect
- (c) Business and economic forecasting
- (d) Empirical production function and cost analysis
- (e) Factor demand and input decisions
- (f) Pricing Policies

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Section – A
COST AND MANAGEMENT
ACCOUNTING – METHODS &
TECHNIQUES



Study Note - 1

COST ACCOUNTING METHODS AND SYSTEMS



This Study Note Includes

- 1.1 Importance of Cost Accounting
- 1.2 Integrated Accounting System
- 1.3 Methods (or) Types of Costing

1.1 IMPORTANCE OF COST ACCOUNTING

1.1.1 Cost Accounting: Cost Accounting may be defined as “Accounting for costs classification and analysis of expenditure as will enable the total cost of any particular unit of production to be ascertained with reasonable degree of accuracy and at the same time to disclose exactly how such total cost is constituted”. Thus Cost Accounting is classifying, recording and appropriate allocation of expenditure for the determination of the costs of products or services, and for the presentation of suitably arranged data for the purposes of control and guidance of management.

Cost Accounting can be explained as follows:

- (i) Cost Accounting is the process of accounting for cost which begins with recording of income and expenditure and ends with the preparation of statistical data.
- (ii) It is the formal mechanism by means of which cost of products or services are ascertained and controlled.
- (iii) Cost Accounting provides analysis and classification of expenditure as will enable the total cost of any particular unit of product / service to be ascertained with reasonable degree of accuracy and at the same time to disclose exactly how such total cost is constituted. For example it is not sufficient to know that the cost of one pen is ₹ 25 but the management is also interested to know the cost of *material* used, the amount of *labour* and *other expenses* incurred so as to control and reduced its cost.
- (iv) It establishes budgets and standard costs and actual cost of operations, processes, departments or products and the analysis of variances, profitability and social use of funds.

Thus cost accounting is a quantitative method that collects, classifies, summarises and interprets information for product costing, operation planning and control and decision making.

1.1.2 Costing: costing is defined as the technique and process of ascertaining costs. The technique in costing consists of the body of principles and rules for ascertaining the costs of products and services. The technique is dynamic and changes with the change of time. The process of costing is the day to day routine of ascertaining costs. It is popularly known as an arithmetic process and daily routine. For example, if the cost of producing a product say ₹ 1,500, then we have to refer material, labour and expenses and arrive at the above cost as follows:

Material	₹	800
Labour	₹	400
Expenses	₹	300
Total	₹	<u>1,500</u>

Finding out the breakup of the total cost from the recorded data is a daily process. That is why it is called daily routine. In this process we are classifying the recorded costs and summarizing each element and the total is called technique.

1.1.3 Cost Accountancy:

Cost Accountancy is defined as '**the application of Costing and Cost accounting principles, methods and techniques to the science, art and practice of cost control and the ascertainment of profitability**'. It includes the presentation of information derived there from for the purposes of managerial decision making. Thus, Cost Accountancy is the science, art and practice of a Cost Accountant.

- (a) It is **science** because it is a systematic body of knowledge having certain principles which a cost accountant should possess for proper discharge of his responsibilities.
- (b) It is an **art** as it requires the ability and the skills with which a cost accountant is able to apply the principles of cost accountancy to various managerial problems.
- (c) **Practice** includes the continuous efforts of a cost accountant in the field of cost accountancy. Such efforts of a cost accountant also include the presentation of information for the purpose of managerial decision making and keeping statistical records.

1.1.4 Objectives of Cost Accounting:

The following are the main objectives of Cost Accounting:

- (a) To ascertain the costs under different situations using different techniques and systems of costing.
- (b) To determine the selling prices under different circumstances.
- (c) To determine and control efficiency by setting standards for Materials, Labour and Overheads.
- (d) To determine the value of closing inventory for preparing financial statements of the concern.
- (e) To provide a basis for operating policies which may be determination of Cost Volume relationship, whether to close or operate at a loss, whether to manufacture or buy from market, whether to continue the existing method of production or to replace it by a more improved method of production....etc.

To appreciate the objectives and scope of Cost Accounting, it would be useful to examine the position of Cost Accounting in the organisation and its relationship with other functions. In the organisation chart, the Costing Department occupies an important position, as it is responsible for the following:

- (a) For maintaining the records connected with material, labour and expenses.
- (b) For analysing the all costs of manufacturing, marketing, administration and research and development.
- (c) For issuing control reports and data for decision making to the executives, departmental heads, sectional heads and supervisors. When management is provided with useful reports, they assist in controlling costs and optimize the operations.

The effectiveness of the control of cost depends upon proper communication through control reports from the cost accountant to the various levels of the operating management. The cost accountant must devise a cost system into which data are marshalled to fit the numerous problems confronting management. The cost department is intimately connected with the other departments in the organisation. The relationship of costing department with other departments can be briefly explained as follows:

Manufacturing Department:

Controls the scheduling, manufacturing and inspection of each job or processed products to their finished stage in terms of efficiency norms established. Costs incurred at each stage are measured and compared with norms.

Production Planning and Designing Department:

Designing Department involves Costing Department for cost estimates needed for each type of material, labour and machine process before a decision can be reached in accepting or rejecting a design.



Human Resource Department:

Human Resource Department is interested in maintaining the employee records including the employee cost upto date. The wage rate and methods of remuneration agreed with the employees form the basis for computing the payroll. Costing Department collects all the data from Human Resource Department and computes the labour cost per hour or per unit of product / service.

Marketing Department:

Marketing Department needs a good product at a competitive price, while the cost cannot decide the price, it can influence fixation of price. Besides accurate cost data helps sales manager to distinguish profitable with non-profitable products and compare cost of marketing against sales volume.

Public Relation Department:

Public Relation Department establishes good relations with the public in general and customers, creditors, shareholders and employees in particular. The Costing Department provides information concerning price, cost, etc.

Legal Department:

Legal Department works very closely with Costing Department to keep many affairs of the company in conformity with the law, specially excise, customs, sales tax and other legislations regarding maintenance of accounts and cost records.

Finance Department:

The Finance Department relies on the Costing Department for accounting, valuation of inventory, cash flow statement, etc. Where Finance Department is composed of general accounting and cost accounting besides taxation and funds management department, it is usual to consider Costing Department providing unit cost of goods manufactured and sold to General Accounting Department.

1.1.5 Cost Accounting and Management Accounting:

Management Accounting is primarily concerned with the requirements of the management. It involves application of appropriate techniques and concepts, which help management in establishing a plan for reasonable economic objective. It helps in making rational decisions for accomplishment of management objectives. Any workable concept or techniques whether it is drawn from Cost Accounting, Financial Accounting, Economics, Mathematics and Statistics, can be used in Management Accountancy. The data used in Management Accountancy should satisfy only one broad test. It should serve the purpose that it is intended for. A management accountant accumulates, summarises and analysis the available data and presents it in relation to specific problems, decisions and day-to-day task of management. A management accountant reviews all the decisions and analysis from management's point of view to determine how these decisions and analysis contribute to overall organisational objectives. A management accountant judges the relevance and adequacy of available data from management's point of view.

The scope of Management Accounting is broader than the scope of Cost Accountancy. In Cost Accounting, primary emphasis is on cost and it deals with its collection, analysis, relevance interpretation and presentation for various problems of management. Management Accountancy utilizes the principles and practices of Financial Accounting and Cost Accounting in addition to other management techniques for efficient operations of a company. It widely uses different techniques from various branches of knowledge like Statistics, Mathematics, Economics, Laws and Psychology to assist the management in its task of maximising profits or minimizing losses. The main thrust in Management Accountancy is towards determining policy and formulating plans to achieve desired objective of management. Management Accountancy makes corporate planning and strategy effective.

From the above discussion we may conclude that the Cost Accounting and Management Accounting are interdependent, greatly related and inseparable.

1.1.6 Importance of Cost Accounting

Importance of Cost Accounting may be considered under the following headings:

(A) Importance to Management:

A good Cost Accounting system serves the management in the following ways;

- (i) **Classification and sub-division of costs:** Costs are collected and classified by various ways in order to provide information to the management for control purposes and to ascertain the profitability of each area of activity. It enables the concern to measure the efficiency and then to maintain and improve it.
- (ii) **Control of material, labour and overhead costs:** Various inventory control techniques or methods of costing are used to control the material cost. For example fixation of maximum level helps the management to reduce the over-stocking; use of EOQ helps the Purchase Department to order right quantity. An efficient check on labour and machines is provided by giving detailed information about availability of machine and labour capacity. The work is so planned that no section is over-worked and no section remains idle. By classifying the overheads into controllable and uncontrollable or fixed and variable, helps to control the overhead costs. Thus cost accounting provides a detailed control of material, labour and overhead costs.
- (iii) **Price determination:** Cost Accounting helps the management to fix the remunerative selling prices of various items of goods under different circumstances. During the period of depression a businessman has to become very watchful and vigilant in tracking down the concealed inefficiencies and sources of wastage, so that he may reduce the cost of production to the minimum. During depression the businessman has to cut the price to such an extent so as to recover the variable costs. Cost accounting makes the distinction between fixed and variable costs and helps the management in determination of prices. If prices are fixed without cost information, it is possible that prices quoted may be too high or too low.
- (iv) **Business policy:** Business policy may require consideration of alternative methods and procedures and this is facilitated by cost information correctly presented. Cost accounting helps the management to take vital decisions such as introduction of new product, selection of optimum product mix, utilization of spare capacity, replacement of existing assets, etc.
- (v) **Standards for measuring efficiency:** It provides the use of standards to assist management in making estimates and plans for future and to provide the basis for measuring of efficiency. Actual are compared with standards to determine the operating efficiency.
- (vi) **Best use of limited resources:** Cost accounting provides the reliable data of costs with regard to materials, wages and other expenses. This helps the management to get maximum output at the minimum cost, by indicating where economies may be affected, waste eliminated and efficiency increased.
- (vii) **Special factors:** Cost accounting informs the management about the special factors such as optimum profitability, seasonal variations in volume and costs. Idle time of labour and idle capacity of the machine, etc. It also helps to curtail the losses during the off season.

(B) Importance to Workers:

Cost accounting discloses the relative efficiencies of different workers and thereby facilitates the introduction of suitable plans of wage payment to reward efficiency and to provide adequate incentive to the less efficient workers. A good system of costing promotes prosperity of the business and thus ensures greater security of service and adequate reward to workers.



(C) Importance to Creditors and Investors:

It enables the creditors and investors to judge the financial strength and credit worthiness of the business. A sound business concern with a good system of costing can attract more investors than a similar concern without an adequate system of costing.

(D) Importance to Government:

It facilitates the assessment of excise duty and income tax and the formulation of policies regarding industry, export, import, taxation, etc. It also facilitates the preparation of national plans for economic development. It provides ready figures for use by government by application to problems like price fixation, price control, tariff protection, and wage level fixation, payment of dividends or settlement of disputes.

(E) Importance to General Public:

The ultimate aim of costing is to reduce cost of production to the minimum and maximise the profits of the business. A part of the benefit resulting from the reduction of the cost is usually passed on to the consumers in the form of lower prices. Besides the installation of a costing system will infuse confidence in the minds of the public about the fairness of the prices charged.

1.1.7 Advantages of Cost Accounting System:

Cost Accounting has manifold advantages, a summary of which is given below. It is not suggested that having installed a system of cost accounting, a concern will expect to derive all the benefits stated here. The nature and the extent of the advantages obtained will depend upon the type, adequacy and efficiency of the cost system installed and the extent to which the various levels of management are prepared to accept and act upon the advice rendered by the cost system:

- (a) A cost system reveals unprofitable activities, losses or inefficiencies occurring in any form such as
 - Wastage of man power, idle time and lost time.
 - Wastage of material in the form of spoilage, excessive scrap etc., and
 - Wastage of resources, e.g. inadequate utilization of plant, machinery and other facilities
- (b) Cost accounting locates the exact causes for decrease or increase in the profit or loss of the business. It identifies the unprofitable products or product lines so that these may be eliminated or alternative measures may be taken.
- (c) Cost accounts furnish suitable data and information to the management to serve as guide in making decisions involving financial considerations.
- (d) Cost accounting is useful for price fixation purposes. Although sale price is generally related more to economic conditions prevailing in the market than to cost, the latter serves as a guide to test the adequacy of selling prices.
- (e) With the application of standard costing and budgetary control methods, the optimum level of efficiency is set.
- (f) Cost comparison helps in cost control. Comparison may be period to period, of the figures in respect of the same unit or factory or of several units in an industry by employing uniform costs and inter-firm comparison methods. Comparison may be made in respect of cost of jobs, process or cost centres.
- (g) A cost system provides ready figures for use by the Government, wage tribunals and boards, and labour and trade unions.
- (h) When a concern is not working to full capacity due to various reasons such as shortage of demands or bottlenecks in production, the cost of idle capacity can readily worked out and reported to the management.

- (i) Introduction of a cost reduction programme combined with operations research and value analysis techniques leads to economy.
- (j) Marginal costing is employed for suggesting courses of action to be taken. It is a useful tool for the management for making decisions.
- (k) Determination of cost centres or responsibility centres to meet the needs of a cost accounting system, ensures that the organizational structure of the concern has been properly laid, responsibilities can be properly defined and fixed on individuals.
- (l) Perpetual inventory system which includes a procedure for continuous stock taking is an essential feature of a cost system.
- (m) The operation of a system of cost audit in the organization prevents manipulation and fraud and assists in furnishing correct and reliable cost data to the management as well as to outside parties like shareholders, the consumers and the Government.

1.1.8 Limitations of cost accounting system:

Like any other system of accounting, Cost Accountancy is not an exact science but an art which has developed through theories and accounting practices based on reasoning and commonsense. Many of the theories cannot be proved nor can they be disproved. They grown up in course of time to become conventions and accepted principles of cost accounting. These principles are by no means static, they are changing from day to day and what is correct today may not hold true in the circumstances tomorrow.

- (a) **Large number of Conventions, Estimates and Flexible factors:** No cost can be said to be exact as they incorporate a large number of conventions, estimations and flexible factors such as:
 - (i) Classification of costs into its elements
 - (ii) Materials issue pricing based on average or standard costs.
 - (iii) Apportionment of overhead expenses and their allocation to cost units/centres.
 - (iv) Arbitrary allocation of joint costs.
 - (v) Division of overheads into fixed and variable
- (b) Cost Accounting lacks the uniform procedures and formats in preparing the cost information of a product/service. Keeping in view this limitation, all cost accounting results can be taken as mere estimates.

1.1.9 Objections against cost accounting:

A number of objections are generally raised against the introduction of costing on various grounds. The following are some of the important objections :

- (a) **Unnecessary expenditure:** It has been argued that costing is of recent origin and that industries prospered in the past and are still prospering without the aid of costing and, therefore, expenditure incurred in installing a costing system would be unnecessary expenditure. This argument overlooks the fact that modern industries are running under highly competitive conditions.
- (b) There is no stereotyped system of costing which can be applied to all the industries. It is argued that modern methods of costing are not applicable to many types of industries.
- (c) It is argued that the adoption of costing system failed to produce the desired results.
- (d) Installation of a costing system is very expensive.

1.1.10 Installation of Cost System or Cost Accounting System:

There is no readymade cost system suitable for all the businesses. Such system has to be specially designed for an undertaking to meet its specific needs. Before installing a cost system proper care should be taken



to study and taken into account all the aspects involved as otherwise the system will be a misfit and full advantages will not be realized from it. The following points should be looked into and the prerequisites satisfied before installing a cost system are :

- (a) The nature, method and stages of production, the number of varieties and the quantity of each product and such other technical aspects should be examined. It is to be seen how complex or how simple the production methods are and what is the degree of control exercised over them.
- (b) The designer should consider the objectives of costing system, i.e the expectations of the management
- (c) The size, layout and organisation of the factory should be studied.
- (d) Organisation structure should be studied to determine the manner in which costing system could be introduced, without altering or extending the organisation
- (e) The methods of purchase, receipt, storage and issue of materials should be examined and modified wherever considered necessary.
- (f) The wage payment methods should be studied.
- (g) The policy adopted by the management towards cost control should be kept in view.
- (h) The cost of the system to be installed should be considered. It is needless to emphasise that the installation and operation of system should be economic.
- (i) The system should be simple and easy to operate.
- (j) The system can be effectively run if it is appropriate and properly suited to the organisation.
- (k) Forms and records of original entry should be so designed that it involve minimum clerical work and expenditure.
- (l) The system should be so designed that cost control can be effectively exercised.
- (m) The system should incorporate suitable procedure for reporting to the various levels of management. This should be based on the principles of exception.

1.1.11 Practical difficulties in installing a costing system:

Apart from the technical costing problems, the cost accountant has to face the below mentioned practical difficulties also

(a) **Lack of support from top management:**

In most cases cost accounting system is introduced without the support of the top management in all the functional areas. Even the managing director or chairman often introduces the costing system without consulting the departmental heads. The departmental managers treat this as interference in their work. Thus it creates a fear in the minds of the departmental managers.

(b) **Resistance from the existing staff:**

Whenever a new system is introduced, resistance is natural as the existing staff may feel that they would loose their importance and may feel insecured of their position in the organization.

(c) **Shortage of trained staff:**

There may be shortage of trained staff to handle the work of cost analysis, cost control, and cost reduction. The work of costing department cannot be handled without trained staff having knowledge about the overall industry in general and organization in particular.

(d) **Heavy cost of operating the system:**

The cost of operating a system may be huge unless the costing system is properly designed according to the requirements of the each case separately. The system should be able to provide information which is required by all levels of management.

(e) **Non cooperation from other staff:**

The foreman, supervisors and other staff may also resent the additional paper work, which may arise because of introduction of costing system and may not cooperate with costing and other departments in providing the information which is absolutely necessary for smooth and efficient functioning of the costing system

The person in-charge of costing department has to overcome the above mentioned difficulties through interpersonal skills & demonstrating the expertise in installing a costing system.

1.1.12 Design of Forms and Records:

As a part of installation of cost system, the cost accountant has to design various forms & records to accumulate the cost data and present it in proper reports. The forms and records should be designed after considering the following:

- (a) These forms and records should be designed in such a way that all the cost data should be collected;
- (b) Forms should be easy to understand & user friendly to other functions;
- (c) Cost reports should meet the objectives of the management;
- (d) Cost reports and records should meet the statutory requirements. In view of the recent statutory requirements such as compliance report and cost audit report rules 2011, the forms and records should meet these requirements also. The form of compliance report is shown below.
- (e) The forms, records and reports should be flexible enough to update the necessary changes in the future.

1.1.13 Reports provided by costing department to management:

The following are the various reports provided by costing department to management :

- (a) Cost Sheets setting out the total cost, analyzed into various elements, giving comparative figures of the previous period and for other plants under the same management.
- (b) Consumption of material statement, showing total quantity of materials issued for production, material actually consumed in production and scrapped as waste.
- (c) Labour utilization statements providing details about the total number of hours paid for, standard hours for the output, idle time and causes thereof.
- (d) Overheads incurred compared with budgets, overheads actually charged to production and the difference between the amount actually incurred and the amount so charged.
- (e) Sales effected compared with budgets, showing the differences between the two because of quality being different from those taken into account while budgeting
- (f) Reconciliation of actual profit earned with the estimated or budgeted profit.
- (g) The total cost of abnormally spoiled work in the factory and abnormal losses in the store.
- (h) The total cost of inventory carried, analyzed into raw materials in chief stores and other stores. The total no of months for which stocks would be sufficient.
- (i) Labour turnover, and the cost of recruitment and training of new employees.
- (j) Expenses incurred on research & development as compared with the budget.
- (k) Any information relating to cost audit, cost accounting records and *cost compliance report* etc.



1.1.14 Classification based on Costs For Management Decision Making:

Ascertainment of cost is essential for making managerial decisions. On this basis costing may be classified into the following types

(a) Marginal Cost:

Marginal cost is the aggregate of variable costs, i.e. prime cost plus variable overhead. Marginal cost per unit is the change in the amount at any given volume of output by which the aggregate cost changes if the volume of output is increased or decreased by one unit. Marginal costing system is based on the system of classification of costs into fixed and variable. The fixed costs are excluded and only the marginal costs, i.e the variable costs are taken into consideration for determining the cost of products and the inventory of work-in-progress and completed products.

(b) Differential Cost:

Differential cost is the change in the cost due to change in activity from one level to another.

(c) Opportunity Cost:

Opportunity cost is the value of alternatives foregone by adopting a particular strategy or employing resources in specific manner. It is the return expected from an investment other than the present one. These refer to costs which result from the use or application of material, labour or other facilities in a particular manner which has been foregone due to not using the facilities in the manner originally planned. Resources (or input) like men, materials, plant and machinery, finance etc., when utilised in one particular way, yield a particular return (or output). If the same input is utilised in another way, yielding the same or a different return, the original return on the forsaken alternative that is no longer obtainable is the opportunity cost. For example, if fixed deposits in the bank are proposed to be withdrawn for financing project, the opportunity cost would be the loss of interest on the deposits. Similarly when a building leased out on rent to a party is got vacated for own purpose or a vacant space is not leased out but used internally, say, for expansion of the production programme, the rent so forgone is the opportunity cost.

(d) Replacement Cost:

Replacement cost is the cost of an asset in the current market for the purpose of replacement. Replacement cost is used for determining the optimum time of replacement of an equipment or machine in consideration of maintenance cost of the existing one and its productive capacity. This is the cost in the current market of replacing an asset. For example, when replacement cost of material or an asset is being considered, it means that the cost that would be incurred if the material or the asset was to be purchased at the current market price and not the cost at which it was actually purchased earlier, should be take into account.

(e) Relevant Costs:

Relevant costs are costs relevant for a specific purpose or situation. In the context of decision making, only those costs are relevant which are pertinent to the decision making only those costs are considered. Since we are concerned with future costs only while making a decision, historical costs, unless they remain unchanged in the future period are irrelevant to the decision making process.

(f) Imputed Costs:

Imputed costs are hypothetical or notional costs, not involving cash outlay computed only for the purpose of decision making. In this respect, imputed costs are similar to opportunity costs. Interest on funds generated internally, payment for which is not actually made is an example of imputed cost. When alternative capital investment projects are being considered out of which one or more are to be financed from internal funds, it is necessary to take into account the imputed interest on own funds before a decision is arrived at.

(g) Sunk Costs:

Sunk costs are historical costs which are incurred i.e sunk in the past and are not relevant to the particular decision making problem being considered. Sunk costs are those that have been incurred for a project and which will not be recovered if the project is terminated. While considering the replacement of a plant, the depreciated book value of the old asset is irrelevant as the amount is sunk cost which is to be written-off at the time of replacement.

(h) Normal & Abnormal Costs:

Normal cost is a cost that is normally incurred at a given level of output in the conditions in which that level of output is achieved. Abnormal cost is an unusual a typical cost whose occurrence is usually irregular and unexpected and due to some abnormal situation of the production.

(i) Avoidable Costs & Unavoidable Costs:

Avoidable costs are those which under given conditions of performance efficiency should not have been incurred. Costs which are escapable costs and which are not essentially to be incurred, within the limits or norms provided for. Unavoidable cost are those costs that must be incurred under a programme of business restriction. It is fixed in nature and inescapable.

(j) Uniform Costing:

This is not a distinct system of costing. The term applies to the costing principles and procedures which are adopted in common by a number of undertakings which desire to have the benefits of a uniform system. The methods of uniform costing may be extended so as to be useful in inter-firm comparison.

(k) Engineered Cost:

Engineered cost relates to an item where the input has an explicit physical relationship with the output. For instance in the manufacture of a product, there is a definite relationship between the units of raw material and labour time consumed and the amount of variable manufacturing overhead on the one hand and units of the products produced on the other. The input-output relationship can be established by the form of standards by engineering analysis or by an analysis of the historical data. It should be noted that the variable costs are not engineered cost but some administration and selling expenses may be categorized as engineered cost.

(l) Out-of-Pocket Cost:

This is the portion of the cost associated with an activity that involves cash payment to other parties, as opposed to costs which do not require any cash outlay, such as depreciation and certain allocated costs. Out-of-Pocket costs are very much relevant in the consideration of price fixation during trade recession or when a make-or-buy decision is to be made.

(m) Managed Cost

Managed (Programmed or discretionary costs) all opposed to engineering costs, related to such items where no accurate relationship between the amount spent on input and the output can be established and sometimes it is difficult to measure the output. Examples are advertisement cost, research and development costs, etc.

(n) Common Costs:

These are costs which are incurred collectively for a number of cost centers and are required to be suitably apportioned for determining the cost of individual cost centers. Examples are: Combined purchase cost of several materials in one consignment, and overhead expenses incurred for the factory as a whole.



(o) Controllable and Uncontrollable Costs:

Controllable cost is that cost which is subject to direct control some level of managerial supervision. Non-controllable cost is the cost is not subject to control at any level of managerial supervision. Also controllable costs are the costs, which are influenced by the action of specified member of an undertaking. Uncontrollable costs are those costs which are not influenced by the action of specified member of an undertaking.

(p) Shut down costs:

Shut down costs includes costs which need to be incurred even when the plant is temporarily shut-down. Example: rent, depreciation, rates, etc. These costs cannot be eliminated with the closure of the plant. They are all fixed costs which cannot be avoided during the temporary closure of plant.

1.1.15 Integrated Accounting System

While installing effective costing system, the management must also decide the appropriate accounting system. i.e. Integrated or Non-Integrated. Where cost and financial accounting records are integrated, the system so evolved is known as integrated or integral accounting. In case cost and financial transactions are kept separately, the system is called Non-integrated accounting or Cost Control system. If the organisation adopts non-integrated accounting, then reconciliation between financial and cost records need to be done. If the organisation adopts integrated system of accounting, then there is no need for any reconciliation.

1.1.16 Non-Integrated Accounting System:

A system of accounting under which separate ledgers are maintained for cost and financial accounts is called Non-Integrated System. This system is also referred as Cost Ledger Accounting System. Features of Non-Integrated Accounting System are as follows:

- (a) Cost Accounting restricts itself to record only those transactions which relate to the product or service.
- (b) Cost Ledger Control Account is maintained in the financial books and a General Ledger Adjustment Account is maintained in costing books.
- (c) Certain expenses like interest, bad debts, revenue from sale of product, etc are not at all recorded in cost accounts.
- (d) Items which are excluded in cost accounts are represented by an account known as Cost Ledger Account.

The important ledgers to be maintained under non-integrated accounting system in the cost accounting department are the following:

- (a) Cost Ledger:** This is the principal ledger. It contains all impersonal accounts. It is made self-balancing by maintaining therein a control account for each of the other ledgers
- (b) Stores Ledger:** This contains all the stores accounts. A separate account is opened for each item of stores
- (c) Work-in-Progress Ledger:** This contains accounts of various jobs. Each job, unit, or process is given a job number and separate account is opened for each job.
- (d) Finished Goods ledger:** This contains accounts of all types of finished goods. A separate account is opened for each type of finished product

Thus, cost ledger is the principal book of account. It contains all the impersonal accounts. In small concerns, only cost ledger is maintained. In large concerns subsidiary ledgers such as stores ledger, WIP ledger, finished goods ledger, etc. subsidiary ledgers are maintained, the cost ledger should be made

self-balancing by the use of control accounts. For this purpose, a control account should be opened in the cost ledger for each of the other subsidiary ledgers.

1.1.17 Control Accounts: In order to facilitate handling of numerous transactions instead of being posted in general ledger are recorded in subsidiary ledgers. Transactions kept in detail in one or more account of subsidiary ledger are posted in totals at the end of the period to control accounts. Control accounts are the total accounts maintained in cost ledger. Each total account represents a subsidiary ledger in which individual accounts are maintained. Stores ledger control account for instance, represents the stores ledger in which individual stock cards are maintained. Individual debits and credits in stock cards are abstracted, totalled and taken into control account in cost ledger. At any time, the total balance in control account and aggregate of individual balances in subsidiary ledger accounts should agree.

The following are the important accounts in the cost ledger:

- (a) **General Ledger Adjustment (Cost Ledger Control Account):** All items of income or expenditure extracted from the financial accounts are posted into this account. The object of this account is to complete the double entry in the cost ledger. The balance on this account represents the total of all the balances of the impersonal accounts
- (b) **Stores Ledger Control Account:** This account is debited for the purchase of material and credited for the issue of materials from stores. The balance in this account indicates the total balances of all the individual stores accounts. Abnormal losses or gains if any in this account are transferred to costing profit and loss account. Entries are made on the basis of goods received notes and stores requisitions
- (c) **Work-in-Progress Control Account:** This account is debited with the total cost of production which includes direct materials, direct labour, direct expenses, production overhead recovered and is credited with the amount of finished goods completed and transferred. The balance in this account represents total balances of jobs / WIP are shown by several job accounts.
- (d) **Finished goods control Account:** This account is debited with the value of goods transferred from WIP control account, administration costs recovered. This account is credited with the cost of goods sold and cost of sales account debited. The balance in this account represents the value of finished goods in hand.
- (e) **Wages Control Account:** This account is debited with the total wages paid, direct wages are further transferred to Work-in-Progress account and indirect wages to Production overheads, administration overhead or selling overheads as the case may be. Wages paid for abnormal idle time are transferred to costing profit and loss account.
- (f) **Manufacturing / Production / Works Overhead Control Account:** This account is debited with indirect costs of production such as indirect material, indirect labour, indirect expenses. Overhead recovered is credited to this account. The difference between overheads incurred and recovered is transferred to costing profit and loss account.
- (g) **Administrative overhead control Account:** This account is debited with overhead incurred and credited with overhead recovered. The overhead recovered are debited to finished goods account. The difference between administrative overhead incurred and recovered is transferred to costing profit and loss account.
- (h) **Selling and Distribution Overhead Account:** This account is debited with selling and distribution overhead incurred and credited with recovered overhead. The difference between incurred and recovered overhead is transferred usually to costing profit and loss account.
- (i) **Cost of Sales Account:** This account is debited with the cost of finished goods transferred from finished goods account for sale as well as with the amount of selling and distribution overhead cost recovered. The balance of this account is ultimately transferred to sales account or costing profit and loss account



- (j) **Costing Profit and Loss Account:** This account is debited with cost of goods sold, under absorbed overheads and abnormal losses. This account is credited with sales value, over-absorbed overhead and abnormal gains. The net profit or loss in this account is transferred to cost ledger control account

1.2 INTEGRATED ACCOUNTING SYSTEM

Integrated accounting system is the name given to a system of accounting, where by cost and financial accounts are kept in the same set of books. Obviously, then there will be no separate set of books for costing and financial records. Integral accounts provide or meet the information required by costing and financial accounts.

1.2.1 Features of Integrated Accounting System:

- (a) Complete analysis of costs and sales are kept.
- (b) Complete details of all payments in cash are kept.
- (c) Complete details of all assets and liabilities are kept and this system does not use a notional accounts to represent all impersonal accounts.
- (d) Under this system, general ledger adjustment is not at all maintained and detailed accounts of assets and liabilities are maintained.

1.2.2 Advantages of integrated accounting system:

The main advantages of integrated accounts are as follows

- (a) No need for Reconciliation: The question of reconciling costing profit and financial profit does not arise, as there is one figure of profit only
- (b) Significant saving in the clerical efforts, as only one set of books is maintained.
- (c) Retrieving of information is easy & quick
- (d) It is economical also as it is based in the concept of centralization of accounting function

1.2.3 Essential pre-requisites for integrated accounts:

The essential pre-requisites for integrated accounts include the following steps

- (a) The managements decision about the extent of integration of the two sets of books, some concerns find it useful to integrate upto the stage of primary cost or factory cost, while others prefer full integration of the entire accounting records.
- (b) A suitable coding system must be made available so as to serve the accounting purposes of financial and cost accounts.
- (c) An agreed routine, with regard to the treatment of provision for accruals, prepaid expenses, other adjustment necessary for preparation of interim accounts.
- (d) Perfect coordination should exist between the staff responsible for the financial and cost aspects of the accounts and an efficient processing of accounting documents should be ensured.

1.2.4 The following table shows the comparative journal entries in financial accounts, cost accounts and integral accounts:

Sl. No.	Transaction	Financial Accounts	Cost Accounts	Integral Accounts
(i)	Credit purchase of Material	Purchases A/c To, Creditors A/c	Dr Material Control A/c To, General Ledger A/c	Dr Material Control A/c To, Creditors
(ii)	Cash purchase of materials	Purchases A/c To, Bank / Cash. A/c	Dr Material Control A/c To, General Ledger A/c	Dr Material Control A/c To, Cash
(iii)	Purchase of special material for direct use in job	Purchases A/c To, Cash / Creditors. A/c	Dr WIP Control A/c To, General Ledger Adj A/c	Dr WIP Control A/c To, Cash or Creditors A/c
(iv)	Purchase of materials for repairs	Purchases A/c To, Cash/Creditors. A/c	Dr Factory OH control A/c To, General Ledger Adj A/c	Dr Factory OH control A/c To, Cash / Creditors A/c
(v)	Materials returned to suppliers	Creditors A/c To, Purchases A/c	Dr General Ledger Control A/c. To Material control A/c	Dr Creditors A/c To, Material Control A/c
(vi)	Payments to creditors for supplies made	Creditors A/c To, Cash A/c	Dr No Entry	Dr Creditors A/c To, Cash A/c
(vii)	Issue of direct materials to production shops	No Entry	Dr WIP Control A/c To, Materials Control A/c	Dr WIP Control A/c To, Materials Control A/c
(viii)	Issue of indirect materials to production shops	No Entry	Dr Factory OH Control A/c To, Material Control A/c	Dr Factory OH control A/c To, Material Control A/c
(ix)	Return of direct materials to stores	No Entry	Dr Material Control A/c To, WIP Control A/c	Dr Material Control A/c To, WIP Control A/c
(x)	Return of indirect materials to stores	No Entry	Dr Material Control A/c To, Factory Overheads A/c	Dr Material Control A/c To, Factory Overheads A/c
(xi)	Materials transferred from one Job to another	No Entry	No Entry	No Entry
(xii)	Adjustment of normal depreciation in material stocks	No Entry	Dr Factory Overheads Control A/c To, Material Control A/c	Dr Factory Overheads Control A/c To, Material Control A/c
(xiii)	Adjustment of normal surplus in material stocks	No Entry	Dr Material Control A/c To, Factory OH Control A/c	Dr Material Control A/c To, Factory OH Control A/c
(xiv)	Payment of wages & Salaries	Wages & Salaries A/c To Cash / Bank A/c	Dr Wages Control A/c To, General Ledger A/c	Dr Wages & Salaries A/c To, Cash / Bank A/c
(xv)	Analysis of distribution of wages	No Entry	Dr WIP Control A/c POH Control A/c Admin OH Control A/c Sellings Dis OH Control A/c To, Wages Control A/c.	Dr WIP Control A/c Dr POH Control A/c Dr Admin OH Control A/c Dr Sellings Dis OH Control A/c To, Wages Control A/c.



Sl. No.	Transaction	Financial Accounts	Cost Accounts	Integral Accounts
(xvi)	Payment of Expenses	Expenses A/c To, Cash A/c	Dr POH Control A/c Admin OH Control A/c Selling & Dis OH Control A/c To, General Ledger Adj A/c	Dr POH Control A/c Admin OH Control A/c Selling & Dis OH Control A/c To, Cash A/c
(xvii)	Recording of Depreciation	Depreciation A/c To, Asset A/c	Dr POH Control A/c Admin OH Control A/c Selling & Dis OH Control A/c To, General Ledger Adj A/c	Dr POH Control A/c Admin OH Control A/c Selling & Dis OH Control A/c To, Asset A/c
(xviii)	Absorption of Factory Overheads	No Entry	WIP Control A/c To, Factory Overheads A/c	Dr WIP Control A/c To, Factory Overheads A/c
(xix)	Spoiled / Defective Work	No Entry	Costing Profit & Loss A/c To, WIP Control A/c	Dr Costing Profit & Loss A/c To, WIP Control A/c
(xx)	Recording of Cost of Jobs completed	No Entry	Finished Goods Control A/c To, WIP Control A/c	Dr Finished Goods Control A/c To, WIP Control A/c
(xxi)	Recording of Cost of goods sold	No Entry	Cost of Sales A/c To, Finished goods A/c	Dr Cost of Sales A/c To, Finished goods Control A/c
(xxii)	Recording of sales	Cash/ Debtor A/c To, Sales A/c	Dr General Ledger Control A/c To, Costing P&L A/c	Dr Cash / Debtors A/c To, P&L A/c
(xxiii)	Absorption of Administration Overheads	No Entry	Finished Goods Control A/c To, Admin OH Control A/c	Dr Finished Goods Control A/c To, Admin OH control A/c
(xxiv)	Absorption of Selling Overheads	No Entry	Cost of Sales A/c To, Selling & Dis. Overheads Control A/c	Dr Cost of Sales A/c To, Selling & Dis. OH Control A/c
(xxv)	Under absorption of overheads	No Entry	Costing Profit & Loss A/c To, OH Control A/c	Dr Profit & Loss A/c To, OH control A/c
(xxvi)	Over absorption of overheads	No Entry	OH Control A/c To, Costing P&L A/c	Dr OH Control A/c To, Costing P&L A/c

Illustration 1 :

Journalise the following transactions assuming that cost and financial accounts are integrated:

Particulars	₹
Raw material purchased	40,000
Direct materials issued to production	30,000
Wages paid (30% indirect)	24,000
Wages charged to production	16,800
Manufacturing expenses incurred	19,000
Manufacturing overhead charged to Production	18,000
Selling and distribution cost	4,000
Finished products (at cost)	40,000
Sales	58,000
Closing stock	Nil
Receipts from debtors	13,800
payments to creditors	12,000

Solution:

Journals

Particulars		Dr. ₹	Cr. ₹
Material Control A/c To, Creditors A/c	Dr	40,000	40,000
Work In Progress Control A/c To, Material Control A/c	Dr	30,000	30,000
Wages Control A/c To, Cash A/c	Dr	24,000	24,000
Factory Overheads Control A/c To, Wages Control A/c	Dr	7,200	7,200
Work-in-Progress Control A/c To, Wages Control A/c	Dr	16,800	16,800
Factory Overhead Control A/c To, Cash A/c	Dr	19,000	19,000
Work-in-Progress Control A/c To, Factory overhead Control A/c	Dr	18,000	18,000
S & D O.H. Control A/c To, Cash A/c	Dr	4,000	4,000
Cost of Sales A/c To, Selling & Distribution Overhead Control A/c	Dr	4,000	4,000
Finished Goods Control A/c To, Work-in-progress control A/c	Dr	40,000	40,000
Debtors A/c To, Profit & Loss A/c	Dr	58,000	58,000
Cash A/c To, Debtors A/c	Dr	13,800	13,800
Creditors A/c To, Cash A/c	Dr	22,000	22,000



Illustration 2 :

Pass the journal entries for the following transactions in a double entry cost accounting system:

Particulars	₹
a) Issue of material : Direct	5,50,000
Indirect	1,50,000
b) Allocation of wages and salaries : Direct	2,00,000
Indirect	40,000
c) Overheads absorbed in jobs : Factory	1,50,000
Administration	50,000
Selling	30,000
d) Under/over absorbed overheads : Factory (Over)	20,000
Admn . (Under)	10,000

Solution:

Journals

Particulars		Dr.	Cr.
		₹	₹
Work In Progress Control A/c	Dr	55,000	
Factory Overheads Control A/c	Dr	15,000	
To Material Control A/c			70,000
Work In Progress Control A/c	Dr	2,00,000	
Factory Overheads Control A/c	Dr	40,000	
To Wages Control A/c			2,40,000
Work In Progress Control A/c	Dr	1,50,000	
Finished goods Control A/c	Dr	50,000	
Cost of Sales A/c	Dr	30,000	
To Factory Overhead Control A/c			1,50,000
To Administrative Overhead Control A/c			50,000
To Selling Overhead Control A/c			30,000
Costing Profit & Loss A/c	Dr	10,000	
To Administrative Overhead Control A/c			10,000
Factory Overhead Control A/c	Dr	20,000	
To Costing Profit & Loss A/c			20,000

Illustration 3 :

Messrs Essbee Ltd. maintains Integrated Accounts of Cost and Financial Accounts. From the following details write up Control Accounts of a factory and prepare a Trial Balance.

Particulars	₹
Share Capital	3,00,000
Reserve	2,00,000
Sundry Creditors	5,00,000
Plant and Machinery	5,75,000
Sundry Debtors	2,00,000
Closing Stock	1,50,000
Bank & Cash Balance	75,000

TRANSACTIONS DURING THE YEAR WERE AS FOLLOWS:

Particulars	₹
Stores purchased	10,00,000
stores issued to production	10,50,000
Stores in hand	95,000
Direct wages incurred	6,50,000
Direct wages charged to production	6,00,000
Manufacturing expenses incurred	3,00,000
Manufacturing expenses charged to production	2,75,000
Selling and distribution expenses	1,00,000
Finished stock production (at cost)	18,00,000
Sales at selling price	22,00,000
Closing stock	95,000
Payments to creditors	11,00,000
Receipts from debtors	21,00,000

Solution:

Dr.		Creditors Account		Cr.	
Particulars	₹	Particulars	₹		
To, Cash A/c	11,00,000	By, Balance b/d	5,00,000		
To, Balance c/d	4,00,000	By, Material Control A/c	10,00,000		
	15,00,000		15,00,000		
		By, Balance b/d	4,00,000		

Dr.		Debtors Account		Cr.	
Particulars	₹	Particulars	₹		
To, Balance b/d	2,00,000	By, Cash A/c	21,00,000		
To, P & L A/c	22,00,000	By, Balance c/d	3,00,000		
	24,00,000		24,00,000		
To, Balance b/d	3,00,000				

Dr.		Material Control A/c (or) Stores Ledger Control Account		Cr.	
Particulars	₹	Particulars	₹		
To, Balance b/d	1,50,000	By, Work-in-Progress Control A/c	10,50,000		
To, Creditors A/c	10,00,000	By, Manufacturing Overhead Control A/c	5,000		
		By, Balance c/d	95,000		
	11,50,000		11,50,000		
To, Balance b/d	95,000				

Dr.		Cash & Bank Account		Cr.	
Particulars	₹	Particulars	₹		
To, Balance b/d	75,000	By, Wages Control A/c	6,50,000		
To, Debtors A/c	21,00,000	By, Manufacturing Overhead Control A/c	3,00,000		
		By, Selling and Distribution O.H. Control A/c	1,00,000		
		By, Creditors A/c	11,00,000		
		By, Balance c/d	25,000		
	21,75,000		21,75,000		
To, Balance b/d	25,000				



Dr. Work-in-Progress Control Account Cr.

Particulars	₹	Particulars	₹
To, Material Control A/c	10,50,000	By, Fixed Goods Control A/c	18,00,000
To, Wages Control A/c	6,00,000	By, Balance c/d	1,25,000
To, Manufacturing Overhead Control A/c	2,75,000		
	19,25,000		19,25,000
To, Balance b/d	1,25,000		

Dr. Wages Control Account Cr.

Particulars	₹	Particulars	₹
To Cash & Bank A/c	6,50,000	By, Work-in-Progress Control A/c	6,00,000
		By, Manufactures Overhead Control A/c	50,000
	6,50,000		6,50,000

Dr. (Factory) Manufacturing Overhead Control Account Cr.

Particulars	₹	Particulars	₹
To, Cash	3,00,000	By, Work-in-Progress Control A/c	2,75,000
To, Material Control A/c	5,000	By, Profit & Loss A/c	80,000
To, Wages Control A/c	50,000		
	3,55,000		3,55,000

Dr. Selling & Distribution Overhead Control Account Cr.

Particulars	₹	Particulars	₹
To, Cash A/c	1,00,000	By, Cost of Sales A/c	1,00,000
	1,00,000		1,00,000

Dr. Finished goods Control Account Cr.

Particulars	₹	Particulars	₹
To, Work-in-Progress Control A/c	18,00,000	By, Cost of Sales	17,05,000
		By, Balance c/d	95,000
	18,00,000		18,00,000
To, Balance b/d	95,000		

Dr. Profit & Loss Account Cr.

Particulars	₹	Particulars	₹
To, Factory Overheads Control A/c	80,000	By, Debtors A/c (Sale)	22,00,000
To, Cost of Sales	18,05,000		
To, Reserve A/c (Profit)	3,15,000		
	22,00,000		22,00,000

Dr. Cost of Sales Account Cr.

Particulars	₹	Particulars	₹
To, Selling & Distribution Control A/c	1,00,000	By, Profit & Loss A/c	18,05,000
To, Finished Goods Control A/c	17,05,000		
	18,05,000		18,05,000

Trial Balance

Particulars	Debit ₹	Credit ₹
Share Capital		3,00,000
Reserves (2,00,000 + 3,15,000)		5,15,000
Creditors		4,00,000
Plant & Machinery	5,75,000	
Debtors	3,00,000	
Closing Stock:		
Material	95,000	
Work-in-progress	1,25,000	
Finished goods	95,000	
Cash & bank	25,000	
	12,15,000	12,15,000

Illustration 4 :

From the following data write up the various accounts as you envisage in the cost ledger and prepare a Trial Balance as on 31st March, 2012.

Balances as on 1st april, 2011

Particulars	(₹ in '000)
Material control	1,240
Work-in progress	625
Finished goods	1,240
Production overhead	84
Administration overhead	120 (Cr.)
Selling and distribution overheads	65
General Ledger Control	3,134

Transactions for the year ended 31st march, 2012

Particulars	₹
Materials:	
Purchases	4,801
Issued to:	
Jobs	4,774
Maintenance works	412
Administration offices	34
Selling department	72
Direct wages	1,493
Indirect wages	650
Carriage inward	84
Production overhead:	
Incurring	2,423
Absorbed	3,591
Administration overheads:	
Incurring	740
Allocation to production	529
Allocated to sales	148
Sales overheads:	
Incurring	642
Absorbed	820
Finished goods produced	9,584
Finished goods sold	9,773
Sales realisation	12,430



Solution:

Dr.		Material Control Account		Cr.	
Particulars	₹	Particulars	₹		
To, Balance b/d	1,240	By, Work-in-Progress Control A/c	5,292		
To, General Ledger Adjustment A/c	4,801	By, Balance c/d	749		
	6,041		6,041		
To balance b/d	749				

Dr.		Work-in-Progress Control Account		Cr.	
Particulars	₹	Particulars	₹		
To, Balance b/d	625	By Finished Goods Control A/c	9,584		
To, Material Control A/c	4,774	By Balance c/d	1,428		
To, Wages Control A/c	1,493				
To, Production Overhead Control A/c	3,591				
To, Administrative Overhead Control A/c	529				
	11,012		11,012		
To, balance b/d	1,428				

Dr.		Finished goods Control Account		Cr.	
Particulars	₹	Particulars	₹		
To, Balance b/d	1,240	By, Cost of Sales	9,773		
To, Work-in-progress Control A/c	9,584	By, Balance c/d	1,051		
	10,824		10,824		
To balance b/d	1,051				

Dr.		(Factory) Production Overhead Control Account		Cr.	
Particulars	₹	Particulars	₹		
To, Balance b/d	84	By, Work-in-progress Control A/c	3,591		
To, Material Control A/c	412	By, Balance c/d	62		
To, Wages Control A/c	650				
To, General Ledger Adjustment A/c	84				
To, General Ledger Adjustment A/c	2,423				
	3,653		3,653		
To Balance b/d	62				

Dr.		Administration Overhead Control Account		Cr.	
Particulars	₹	Particulars	₹		
To, Material Control A/c	34	By, Balance c/d	120		
To, General Ledger Adjustment A/c	740	By, Work-in-progress Control A/c	529		
To, Balance c/d	23	By, Cost of Sales A/c	148		
	797		797		
		By, balance b/d	23		

Dr.		Selling and Distribution Overhead Control Account		Cr.	
Particulars	₹	Particulars	₹		
To, Balance b/d	65	By, Cost of Sales A/c	820		
To, Material Control A/c	72				
To, General Ledger Adjustment A/c	642				
To, Balance c/d	41				
	820				820
		By, Balance b/d	41		

Dr.		General Ledger Adjustment Account		Cr.	
Particulars	₹	Particulars	₹		
To, Costing P & LA/c	12,430	By, Balance b/d	3,134		
To, Balance c/d	3,226	By, Material Control A/c	4,801		
		By, Wages Control A/c	2,143		
		By, Production Overhead Control A/c	84		
		By, Production Overhead Control A/c	2,423		
		By, Administration Overhead Control A/c	740		
		By, Selling and Distribution Overhead Control A/c	642		
		By, Costing Profit & Loss A/c	1,689		
	15,656				15,656
		By Balance b/d	3,226		

Dr.		Wages Control Account		Cr.	
Particulars	₹	Particulars	₹		
To, General Ledger Adjustment A/c	2,143	By, Work-in-Progress Control A/c	1,493		
		By, Production Overhead Control A/c	650		
	2,143				2,143

Dr.		Cost of Sales Account		Cr.	
Particulars	₹	Particulars	₹		
To, Administration Overhead Control A/c	148	By, Costing Profit & Loss A/c	10,741		
To, Selling & Distribution Control A/c	820				
To, Finished Goods Control A/c	9,773				
	10,741				10,741

Dr.		Costing Profit & Loss Account		Cr.	
Particulars	₹	Particulars	₹		
To, Cost of Sales A/c	10,741	By, General Ledger Adjustment Control A/c (Sales)	12,430		
To, General Ledger Adjustment Control A/c (profit)	1,689				
	12,430				12,430



Trial Balance

Particulars	Debit ₹	Credit ₹
Material Control	749	
Work-in-Progress Control	1,428	
Finished Goods Control	1,051	
Production Overhead Control	62	
Administration Overhead Control		23
Selling and Distribution Overhead Control		41
General Ledger Adjustment		3,226
	3,290	3,290

Illustration 5 :

The following balances are shown in the Cost Ledger of Vinak Ltd. as on 1st October, 2011:

Particulars	Dr. (₹)	Cr. (₹)
Work in progress Account	7,056	
Factory overheads suspense Account	360	
Finished stock Account	5,274	
Stores Ledger Control Account	9,450	
Administration Overheads Suspense A/C	180	
General Ledger Adjustment Account		22,320

Transactions for the year ended 30th september, 2012

Particulars	₹
Stores issued to production	45,370
Stores purchased	52,400
Material purchased for direct issued to production	1,135
Wages paid (including indirect labour ₹ 2,520)	57,600
Finished goods sold	1,18,800
Administration expenses	5,400
Selling expenses	6,000
Factory overheads	15,600
Store issued for Capital work-in-Progress	1,500
Finished goods transferred to warehouse	1,08,000
Store issued for factory repairs	2,000
Factory overheads recovered to production	16,830
Administration overheads charged to production	4,580
Factory overheads applicable unfinished work	3,080
selling overheads allocated to sales	5,500
Stores lost due to fire in store (not insured)	150
Administration expenses on unfinished work	850
Finished goods stock on 30.9.1989	14,274

You are required to record the entries in the cost ledger for the year ended 30th September, 2012 and prepare a Trial Balance as on that date.

Solution:

Dr.		Work-in-Progress Control Account		Cr.	
Particulars	₹	Particulars		₹	
To, Balance b/d	7,056	By, Finished Goods Control A/c		1,08,000	
To, Material Control A/c	45,370	By, Balance c/d			
To, General Ledger Adjustment A/c	1,135	Factory Overhead	3,080		
To, Wages control A/c	55,080	Admn. O.H.	850		
To, Factory overhead control A/c	16,830	Material & Wages	<u>22,051</u>	25,981	
To, Administrative Overhead Control A/c	4,580				
To, Factory Overhead Control A/c	3080				
To, Administrative Overhead Control A/c	850				
	1,33,981			1,33,981	
To Balance b/d	25,981				

Dr.		Factory Overhead Suspense Account		Cr.	
Particulars	₹	Particulars		₹	
To, Balance b/d	360	By, Work-in-Progress Control A/c		3,080	
To, Wages Control A/c	2,520	By, Work-in-Progress Control A/c		16,830	
To, General Ledger Adjustment A/c	15,600	By, Balance c/d		570	
To, Material Control A/c	2,000				
	20,480			20,480	
To, Balance b/d	570				

Dr.		Finished Goods Control Account		Cr.	
Particulars	₹	Particulars		₹	
To, Balance b/d	5,274	By, Cost of Sales A/c		99,000	
To, Work-in-progress Control A/c	1,08,000	By, Balance c/d		14,274	
	1,13,274			1,13,274	
To, Balance b/d	14,274				

Dr.		Material Control Account		Cr.	
Particulars	₹	Particulars		₹	
To, Balance b/d	9,450	By, Work-in-Progress Control A/c		45,370	
To, General Ledger Adjustment A/c	52,400	By, Capital Work-in-Progress Control A/c		1,500	
		By, Factory Overhead Suspense A/c		2,000	
		By, Costing Profit & Loss A/c		150	
		By, Balance c/d		12,830	
	61,850			61,850	
To, Balance b/d	12,830				



Administrative Overhead Control Account

Particulars	₹	Particulars	₹
To, Balance c/d	180	By, Work-in-Progress Control A/c	4,580
To, General Ledger Adjustment A/c	5,400	By, Work-in-Progress Control A/c	850
		By, Balance c/d	150
	5,580		5,580
To, balance b/d	150		

General Ledger Adjustment (GLA) Account

(or) Cost Ledger Control (CLC) Account

Particulars	₹	Particulars	₹
To, Costing Profit & Loss A/c	1,18,800	By, Balance b/d	22,320
To, Balance c/d	55,805	By, Material Control A/c	52,400
		By, Work-in-Progress Control A/c	1,135
		By, Wages Control A/c	57,600
		By, Administrative Overhead Control A/c	5,400
		By, Factory Overhead Control A/c	15,600
		By, Selling and Distribution Overhead Control A/c	6,000
		By, Costing Profit & Loss A/c	14,150
	1,74,605		1,74,605
		By Balance b/d	55,805

Wages Control Account

Particulars	₹	Particulars	₹
To, General Ledger Adjustment A/c	57,600	By, Work-in-Progress Control A/c	55,080
		By, Factory Overhead Control A/c	2,520
	57,600		57,600

Costing Profit & Loss Account

Particulars	₹	Particulars	₹
To, Material Control A/c	150	By, General Ledger Adjustment Control A/c (Sales)	1,18,800
To, Cost of Sales	1,04,500		
To, General Ledger Adjustment Control A/c (profit)	14,150		
	1,18,800		1,18,800

Selling and Distribution Overhead Control Account

Particulars	₹	Particulars	₹
To, General Ledger Adjustment A/c	6,000	By, Cost of Sales A/c	5,500
		By, Balance c/d	500
	6,000		6,000
To Balance b/d	500		

Dr.		Capital Work-in-progress Account		Cr.	
Particulars	₹	Particulars	₹		
To, Material Control A/c	1,500	By, Balance c/d	1,500		
	1,500		1,500		
To, balance b/d	1,500				

Dr.		Cost of Sales Account		Cr.	
Particulars	₹	Particulars	₹		
To, Selling & Distribution Control A/c	5,500	By, Costing Profit & Loss A/c	1,04,500		
To, Finished Goods Control A/c	99,000				
	1,04,500		1,04,500		

Trial Balance

Particulars	Debit ₹	Credit ₹
Work-in-Progress Control	25,981	
Factory overhead Suspense	570	
Finished Goods Control	14,274	
Material Control	12,830	
Administrative Overhead Control	150	
General Ledger Adjustment		55,805
Selling and Distribution Overhead Control	500	
Capital Work-in-Progress	1,500	
	55,805	55,805

1.2.5 Reconciliation of cost and financial accounts

Where no separate accounts are maintained for costing and finance, the question of reconciliation does not arise. But where the cost and financial accounts are maintained independently of each other, it is indispensable to reconcile them. Though both the sets of accounts are same as far as the basic transactions are concerned but there are differences in the profits of two sets of books.

Reasons for difference in profits of cost and financial accounts:

(i) Items shown in Financial Accounts:

There are a number of items which are included in financial accounts but do not find place in cost accounts. They may be items of income or expenses, the former increases the profit and latter reduces the profit.

A. Purely Financial Charges

- (a) Loss arising from the sale of fixed assets.
- (b) Loss on sale of investments, discount on debentures, etc.
- (c) Interest on bank loan, mortgage and debentures.
- (d) Expenses of companies 'Share Transfer Office'.

B. Appropriation of Profits

- (a) Donations and Charities
- (b) Income Tax
- (c) Dividend Paid
- (d) Transfer to Reserves



C. Writing off Intangible and Fictitious Assets

- (a) Goodwill
- (b) Patents & Copyrights
- (c) Advertisement
- (d) Preliminary Expenses

D. Pure Financial Incomes

- (a) Rent received or Profit on Sale of Fixed Assets
- (b) Share transfer fee received
- (c) Interest received on Bank Deposits
- (d) Dividend received etc.

(ii) Items shown only in Cost Accounts:

There are certain items which are included in cost accounts and not in financial accounts. Such items are very few.

E.g. Interest on capital employed, rent for own premises etc.

(iii) Over or Under Absorption of Overheads.

Overheads are absorbed in Cost Accounts on a certain predetermined estimated basis and in Financial Accounts, actual amounts incurred are recorded. If there is any over or under absorption it leads to difference in the profits of both sets of books.

(iv) Differences due to different basis of stock valuation and depreciation methods.

Objects of Reconciliation:

- (a) To assure the mathematical accuracy and reliability of cost accounts.
- (b) To have proper cost control and ascertainment.
- (c) To find out the reasons for the profit or loss shown by the financial accounts.
- (d) To ensure correct profit or loss in financial accounts.
- (e) To ensure true and fair view of balance sheet of the business concern.

Procedure for reconciliation

Take Profits as per Financial Accounts.

Add :

- (a) Items of income included in Cost Accounts but not in Financial Accounts.
- (b) Items of expenditure included in Financial and not in Cost Accounts.
- (c) Amounts by which items of income have been shown in excess in Cost Accounts over the corresponding entries in Financial Accounts.
- (d) Amounts by which items of expenditure have been shown in excess in Financial Accounts over the corresponding entries in Cost Accounts.
- (e) Under absorption of overheads in Cost Accounts.
- (f) The amount by which closing stock of inventory is overvalued in Cost Accounts.
- (g) The amount by which opening stock of inventory is undervalued in Cost Accounts.

Less :

- (a) Items of income included in Financial Accounts but not in Cost Accounts.
- (b) Items of expenditure (as interest on Capital, Rent on owned premises etc.) included in Cost Accounts but not in Financial Accounts.
- (c) Amounts by which items of expenditure have been shown in excess in Cost Accounts as compared to the corresponding entries in Financial Accounts.
- (d) Amounts by which items of incomes have been shown in excess in Financial Accounts as compared to the corresponding entries in Cost Accounts.
- (e) Over absorption of overheads in Cost Accounts.
- (f) The amount by which closing stock of inventory is undervalued in Cost Accounts.
- (g) The amount by which opening stock of inventory is overvalued in Cost Accounts.

Illustration 6 :

The net profits of a manufacturing company appeared at ₹ 64,500 as per financial records for the year ended 31st December, 2012. The cost books however, showed a net profit of ₹ 86,460 for the same period. A careful scrutiny of the figures from both the sets of accounts revealed the following facts.

	₹
(i) Income-tax provided in financial books	20,000
(ii) Bank Interest (Cr) in financial books	250
(iii) Work overhead under recovered	1,550
(iv) Depreciation charged in financial records	5,600
(v) Depreciation recovered in cost	6,000
(vi) Administrative overheads over-recovered	850
(vii) Loss due to obsolescence charged in financial accounts	2,800
(viii) Interest on Investments not included in cost accounts	4,000
(ix) Stores adjustments (Credit in financial books)	240
(x) Loss due to depreciation in stock value	3,350

Prepare Reconciliation Statement.

Solution:

Statement showing reconciliation of profit shown by cost and financial accounts as on 31-12-2012:

Particulars	Amount ₹	Amount ₹
Profit as per Financial Accounts		64,500
Add: Income tax provided in financial books only.	20,000	
Works overhead under recovered	1,550	
Loss to obsolescence considered. Financial A/c only.	2,800	
Loss due to depreciation in stock	3,350	27,700
		92,200
Less: Bank interest credited in financial books.	250	
Over recovery of depreciation	400	
Administration OH's over recovered	850	
Interest on investment not included in cost books	4,000	
Stores adjustment	240	5,740
Profit as per Cost Accounts		86,460



Illustration 7 :

The net profits shown by financial accounts of a company amounted to ₹18,550 whilst the profits disclosed by company's cost account for that period were ₹ 28,660. On reconciling the figures, the following difference were noted.

	₹
(i) Director's fee not charged in cost accounts	650
(ii) A provision for bad and doubtful debts	570
(iii) Bank interest (cr.)	30
(iv) Income-tax	8,300
(v) Overheads in the cost accounts were estimated at ₹8,500. The charges shown by the financial books was ₹8,320.	
(vi) Work was started during the year on a new factory and expenditure ₹16,000 was incurred. Depreciation of 5% was provided in financial accounts.	

Prepare a Statement Reconciling the figures shown by the cost and financial accounts.

Solution:

Statement showing reconciliation of profit shown by cost and financial accounts

Particulars	Amount ₹	Amount ₹
Profit as per Financial Accounts		18,550
Add: Directors fee	650	
Provision for bad debts	570	10,320
Income tax	8,300	
Depreciation in financial books only	800	
		28,870
Less: Bank interest	30	
Over recovery of overheads	180	210
Profit as per Cost Accounts		28,660

Illustration 8 :

M/s Mysore Petro Ltd. showed a net loss of ₹2,08,000 as per their financial accounts for the year ended 31st March, 2012. The cost accounts, however, disclosed a net loss of ₹1,64,000 for the same period. The following information was revealed as a result of the scrutiny of the figures of both the sets of books.

	₹
(i) Factory overhead under recovered	3,000
(ii) Administration overhead over recovered	2,000
(iii) Depreciation charged in financial books	60,000
(iv) Depreciation recovered in costs	65,000
(v) Interest on investment not included in costs	10,000
(vi) Income-tax provided	60,000
(vii) Transfer fee (in financial Books)	1,000
(viii) Stores adjustment (credit in financial books)	1,000

Prepare Reconciliation Statement.

Solution:

Statement Showing Reconciliation of Profit Shown by Cost and Financial Accounts

Particulars	Amount	Amount
	₹	₹
Profit as per Financial Accounts		(2,08,000)
Add: Under recovery of factory overheads	3,000	
Income tax	60,000	63,000
		(1,45,000)
Less: Over recovery of Administration OH	2,000	
Over recovery of depreciation	5,000	
Interest on investments considered in Financial A/c	10,000	
Transfer fee	1,000	
Stores adjustment	1,000	19,000
Loss as per Cost Accounts		1,64,000

Illustration 9 :

During a particular year, the auditors certified the financial accounts, showing profit of ₹1,68,000 whereas the same, as per costing books was coming out to be ₹ 2,40,000. Given the following information you are asked to prepare a Reconciliation Statement showing the reasons for the gap.

Dr.		Trading and Profit and Loss Account		Cr.	
Particulars	₹	Particulars	₹		
To, Opening stock A/c	8,25,000	By, Sales	34,65,000		
To, Purchases A/c	24,72,000	By, Closing stock A/c	7,50,000		
To, Direct wages A/c	2,30,000				
To, Factory overhead A/c	2,10,000				
To, G.P. C/d	4,83,000				
	42,15,000		42,15,000		
To, Admn. Expenses A/c	95,000	By, G.P. b/d	4,83,000		
To, Selling Expenses A/c	2,25,000	By, Sundry Income A/c	5,000		
To, Net profit	1,68,000				
	4,88,000		4,88,000		

The costing records show:

- (i) Book value of closing stock ₹7,80,000
- (ii) Factory overheads have been absorbed to the extent of ₹1,89,800
- (iii) Sundry income is not considered
- (iv) Total absorption of direct wages ₹2,46,000
- (v) Administrative expenses are covered at 3% of selling price.
- (vi) Selling prices include 5% for selling expenses.



Solution:

Statement Showing Reconciliation of Profit Shown by Cost and Financial Accounts

Particulars	Amount ₹	Amount ₹
Profit as per Financial Accounts		1,68,000
Add: Over valuation of Closing stock in Cost Accounts	30,000	
Under recovery of works overhead	20,200	
Under recovery of selling expenses in Cost Accounts. (2,25,000 – 1,73,250)	51,750	1,01,950
		2,69,950
Less: Sundry income not considered in Cost Accounts	5,000	
Over recovery of wages	16,000	
Over recovery Administration expenses (1,03,950-95,000)	8,950	29,950
Profit as per Cost Accounts		2,40,000

Illustration 10 :

A transistor manufacturer, who commenced his business on 1st June, 2012 supplies you with the following information and asks you to prepare a statement showing the profit per transistor sold. Wages and materials are to be charged at actual cost, works overhead at 75% of wages and office overhead at 30% of works cost. Number of transistors manufactured and sold during the year was 540.

Other particulars:

Materials per set ₹ 240

Wages per set ₹ 80

Selling price per set ₹ 600

If the actual works expenses were ₹32,160 and office expenses were ₹61,800, prepare a Reconciliation Statement.

Solution:

Cost Sheet (or) Statement of Cost and Profit

Particulars	Unit ₹	Total ₹
Material	240	1,29,600
Wages	80	43,200
Prime cost	320	1,72,800
(+) Works overhead (75% of wages)	60	32,400
Works cost	380	2,05,200
(+) Office overheads	114	61,560
Total cost	494	2,66,760
(+) Profit *	106	57,240
Sales	600	3,24,000

Dr.		Trading and Profit & Loss Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, Materials A/c	1,29,600	By, Sales A/c	3,24,000		
To, Wages A/c	43,200				
To, Works Overheads A/c	32,160				
To, Gross Profit	1,19,040				
	3,24,000				3,24,000
To, Office Expenses	61,800	By, Gross Profit b/d	1,19,040		
To, Net Profit	57,240				
	1,19,040				1,19,040

Statement of Reconciliation

Particulars	Amount ₹	Amount ₹
Profit as per Financial Accounts		57,240
(-) Over recovery of works overheads		(240)
(+) Under recovery of office expenses		240
Profit as per Cost Accounts		57,240

Illustration 11 :

Given below is the Trading and Profit and Loss Account of Vikas Electronics for the accounting year ended 31st March, 2012.

Dr.		Trading and Profit & Loss Account		Cr.	
Particulars	₹	Particulars	₹		
To, Direct Materials consumed	3,00,000	By, Sales A/c (2,50,000 units)	7,50,000		
To, Direct Wages A/c	2,00,000				
To, Factory expenses A/c	1,20,000				
To, Office Expenses A/c	40,000				
To, Selling & Distribution Exp. A/c	80,000				
To, Net profit	10,000				
	7,50,000				7,50,000

Normal output of the factory is 2,00,000 units. Factory overheads are fixed upto ₹60,000 and office expenses are fixed for all practical purposes, selling and distribution expenses are fixed to the extent of ₹50,000 the rest are variable. Prepare a Statement of Reconciliation of Profit as per Cost Accounts and Financial Accounts.



Solution:

Cost Sheet (or) Statement of Cost and Profit

Particulars	Amount	Amount
	₹	₹
Material consumed		3,00,000
Direct wages		2,00,000
Prime cost		5,00,000
(+) Works/Factory expenses		
Fixed	60,000	
Variable (60,000 x 2,50,000/2,00,000)	75,000	1,35,000
Works cost		6,35,000
(+) Office expenses (40,000 x 2,50,000/2,00,000)		50,000
Cost of production		6,85,000
(+) Selling & Distribution expenses		
Variable (30,000 x 2,50,000/2,00,000)	37,500	
Fixed	50,000	87,500
Cost of sales/Total cost		7,72,500
(-) Loss		(22,500)
Sales		7,50,000

Statement of Reconciliation

Particulars	Amount	Amount
	₹	₹
Profit as per Financial Accounts		10,000
Add:		
Less: Over recovery of factory overheads	15,000	
Over recovery of office expenses	10,000	32,500
Over recovery of Selling & Distribution overheads	7,500	
Loss as per Cost Accounts		22,500

Illustration 12 :

The following is the Trading and Profit and Loss account of M/s. Time and Trading limited for the year ended 31.12.2011.

Dr. Trading and profit & Loss Account Cr.

Particulars	₹	Particulars	₹
To, Materials consumed	7,08,000	By, Sales A/c (30,000 units)	15,00,000
To, Direct Wages A/c	3,71,000	By, Finished stock A/c (1,000 units)	40,000
To, Works overheads A/c	2,13,000	By, Work-in-progress:	
To, Admn. overheads A/c	95,500	Materials	17,000
To, Selling and Distribution overheads A/c	1,13,500	Wages	8,000
To, Net profit	69,000	Works OH	5,000
	15,70,000		15,70,000

Manufacturing a standard unit, the company's cost records show that:

- (i) Works overheads have been charged to work-in-progress at 20% on prime cost.
- (ii) Administration overheads have been recovered at ₹3 per finished unit.
- (iii) Selling and distribution overheads have been recovered at ₹4 per unit sold.
- (iv) The unabsorbed or over absorbed overheads have not been adjusted into costing profit and loss account.

Prepare:

- (a) A Costing Profit and Loss Account indicating Net Profit.
- (b) A Statement Reconciling the Profit as disclosed by Cost Accounts and that shown in Financial Accounts.

Solution:

Costing Profit & Loss Account

Particulars	Amount ₹	Particulars	Amount ₹
To, Materials	7,08,000	By, Sales	15,00,000
To, Direct wages	3,71,000		
Prime Cost	10,79,000		
To, Works OH (20%)	2,15,800		
	12,94,800		
(-) Closing WIP	30,000		
Works cost	12,64,800		
To, Administration OH's (31,000 x 3)	93,000		
Cost of Production	13,57,800		
(-) Closing stock (13,57,800 x 1,000/31,000)	43,800		
Cost of goods sold	13,14,000		
To, Selling expenses (30,000 x 4)	1,20,000		
	14,34,000		
To Profit	66,000		
	15,00,000		15,00,000

Statement of Reconciliation

Particulars	Amount ₹	Amount ₹
Profit as per Financial Accounts		69,000
Add: Under recovery of Admn. overheads	2,500	
Over valuation of closing stock in Cost A/c's	3,800	6,300
Less: Over recovery of Works overheads	2,800	
Over recovery of Selling & Distribution overheads	6,500	9,300
Profit as per Cost Accounts		66,000



Illustration 13 :

The financial profit and loss account of a manufacturing company for the year ended 31st March, 2011 is given below:

Trading and Profit & Loss Account				
Dr.	₹	₹	Cr.	
Particulars			Particulars	
To, Opening stock A/c			By, Sales A/c	4,60,000
Raw Materials	25,000		By, Closing stock A/c	
Finished Stock	40,000		Materials	30,000
W.I.P.	12,500	77,500	Finished stock	15,000
To, Purchases A/c		1,20,000	W.I.P.	20,700
To, Wages (Factory) A/c		30,000		
To, Electric Power (Factory) A/c		65,000		
To, Gross Profit c/d		1,82,200		
		5,25,700		5,25,700
To, Administration Expenses A/c		20,500	By, Gross Profit b/d	1,88,200
To, Selling Expenses A/c		46,500	By, Misc. Revenue A/c	26,800
To, Bad Debts A/c		15,600		
To, Net Profit A/c		1,32,400		
		2,15,000		2,15,000

The cost accounts of the concern showed a net profit of ₹ 1,32,200. It is seen that the costing profit and loss account is arrived at on the basis of figures furnished below:

Opening stock of raw materials, finished stock and work-in-progress ₹ 90,800

Closing stock of raw materials, finished stock and work-in-progress ₹ 69,500

You are required to prepare a Memorandum Reconciliation Account and reconcile the difference in the profit and loss account.

Solution:

Memorandum Reconciliation Account				
Dr.	Amount	Amount	Cr.	
Particulars	₹	₹	Particulars	
To, Over valuation of op. stock in Cost A/c	13,300		By, Profit as per financial A/c	1,32,400
To, Miscellaneous revenue	26,800		By, Over valuation of closing Stock in cost A/c	3,800
To, Profit as per cost A/c	1,32,200		By, Bad debts not considered in cost A/c.	15,600
			By, Admn. expenses not considered in cost A/c	20,500
	1,72,300			1,72,300

Illustration 14 :

The following figures have been extracted from financial accounts of a manufacturing firm for the first year of its operation.

	₹
Direct material consumption	50,00,000
Direct wages	30,00,000
Factory OH	16,00,000
Administration OH	7,00,000
Selling and distribution OH	9,60,000
Bad debts	80,000
Preliminary expenses written off	40,000
Legal charges	10,000
Dividends received	1,00,000
Interest on deposit received	20,000
Sales (1,20,000 units)	1,20,00,000
Closing stock	
Finished stock - 4,000 units	3,20,000
Work-in-progress	2,40,000

The cost accounts for the same period reveal that the direct material consumption was ₹56,00,000. Factory OH recovered at 20% on prime cost; Administration OH is recovered @ ₹6 per unit of production; Selling and Distribution OH are recovered at ₹8 per unit sold.

You are required to prepare Costing and Financial Profit and Loss Accounts and reconcile the difference in the profit in the two sets of accounts.

Solution:

Dr.	Costing P & L Account	Cr.	
Particulars	Amount ₹	Particulars	Amount ₹
To, Materials	56,00,000	By, Sales	1,20,00,000
To, Direct wages	30,00,000		
To, Prime cost	86,00,000		
To, Factory OH's (20%)	17,20,000		
	1,03,20,000		
(-) Closing WIP	2,40,000		
Factory Cost	1,00,80,000		
To, Admin. OH's (1,24,000 x 6)	7,44,000		
Cost of Production	1,08,24,000		
(-) Closing stock of FG (1,08,24,000 x 4,000/1,24,000)	3,49,161		
Cost of goods sold	1,04,74,839		
To, Selling overheads	9,60,000		
To, Profit	5,65,161		
	1,20,00,000		1,20,00,000



Financial Trading and P & L Account

Dr. Particulars	Amount ₹	Cr. Particulars	Amount ₹
To, Materials A/c	50,00,000	By, Dividend A/c	1,00,000
To, Wages A/c	30,00,000	By, Interest on deposit	20,000
To, Factory OH A/c	16,00,000	By, Sales A/c	1,20,00,000
To, Admn. OH A/c	7,00,000	By, Closing stock A/c	3,20,000
To, S & D OH A/c	9,60,000	Finished goods	2,40,000
To, Bad debts A/c	80,000	WIP	
To, Preliminary expenses written off	40,000		
To, Legal charges A/c	10,000		
To, Net Profit	12,90,000		
	12,68,000		12,68,000

Statement of Reconciliation

Particulars	Amount ₹	Amount ₹
Profit as per Financial Accounts		12,90,000
Add: Over valuation of cl. Stock of Finished goods in Cost Accounts	29,161	
Pure financial expenses not considered in Cost Accounts (80,000 + 40,000 + 10,000)	1,30,000	1,59,161
Less: Over recovery of material	6,00,000	
Over recovery of FOH	1,20,000	8,84,000
Over recovery of AOH	44,000	
Financial incomes not considered in Cost Accounts.	1,20,000	
Profit as per Cost Accounts		5,65,161

Illustration 15 :

XY Ltd. maintains its accounts on a non-integrated basis. Both the financial accountant and cost accountant have completed their accounts for the year ended 30.6.2011 and a memorandum account reconciling the profit figures has been prepared. During the year Production overheads has been absorbed in the cost accounts as a percentage of direct wages at a rate of 250%.

You are required to prepare a detailed statement showing how the profit as shown in the cost accounts was arrived at any difference not explainable from the available data should be treated as being due to the difference in "Administrative Expenses".

The financial account has prepared the following account.

Dr.		Manufacturing Trading and P & L Account for The Year Ended 30.6.2011		Cr.	
Particulars	(₹)	(₹)	Particulars	(₹)	(₹)
To, Raw materials consumed:			By, Trading A/c		
Opening stock	51,296		Cost of goods manufactured		4,74,772
Purchases	1,99,334				
	2,50,630				
Less: Closing stock	47,382	2,03,248			
To, Direct wages		80,072			
To, Production Overhead A/c		1,90,680			
Work in Progress					
Opening Stock	24,496				
Less: Closing stock	23,724	772			
		4,74,772			4,74,772
Finished Goods:			By, Sales		6,25,600
Opening stock	63,890				
Cost of goods manufactured	4,74,772				
	5,38,662				
Less: Closing stock	65,702	4,72,560			
Gross Profit c/d		1,52,640			
		6,25,600			6,25,600
To, Debenture Interest		2,000	By, Gross Profit b/d		1,52,640
To, Discount allowed		2,964	By, Discount received		1,790
To, Distribution expenses		16,926			
To, Sales Expenses		30,562			
To, Net Profit c/d		48,920			
		1,54,430			1,54,430

The Memorandum account reconciling the profit shown in the financial and cost accounts for the year ended 30th June, 2011 is as follows:

Particulars	(₹)	(₹)	Particulars	(₹)	(₹)
Profit shown in the Financial A/c		48,920	Profit as shown in the Cost A/c		1,00,300
Difference in stock valuation :			Difference in stock valuation:		
Opening stock:			Opening stock:		
Work -in- progress	350		Raw material	320	
Finished goods	652				
Closing stock:			Closing stock:		



Work-in-progress	296		Finished goods	682	1,002
Raw Material	422				
		1,720			
Sales Expenses		30,562	Discount received		1,790
Distribution Expenses		16,926			
Debenture Interest		2,000			
Discount Allowed		2,964			
		1,03,092			1,03,092

Solution:

Statement of Cost and Profit (Or) Cost Sheet

Particulars	Amount ₹	Amount ₹
Opening Stock of material	51,296	
(+) Difference	320	51,616
(+) Purchases		1,99,334
		2,50,950
(-) Closing stock of raw material	47,382	
(+) Difference	422	47,804
Material consumed		2,03,146
(+) Direct wages		80,072
Prime cost		2,83,218
(+) Factory OH's (250% of wages)		2,00,180
		4,83,398
(+) Opening stock of WIP	24,496	
(-) Difference	350	24,146
		5,07,544
(-) Closing stock of WIP	23,724	
(+) Difference	296	24,020
Works Cost		4,83,524
(+) Administration overheads (53,058 – 9,500) (bal. figure)		43,558
Cost of Production		5,27,082
(+) Opening stock of finished goods (63,890 – 652)		63,238
		5,90,320
(-) Less: Cl. Stock of finished goods	65,702	
(-) Difference	682	65,020
Cost of goods sold		5,25,300
Selling expenses		--
Cost of sales (or) Total cost		5,25,300
Profit		1,00,300
Sales		6,25,600

Illustration 16 :

From the accounts of M/s ABCD Co.ltd. The following manufacturing, Trading and profit and loss account for the year ended 31st December, 2010 is extracted:

Dr.		Manufacturing, Trading and Profit Loss Account for the year ended 2010		Cr.	
Particulars	₹	Particulars	₹		
To, Raw materials A/c		By, Raw materials A/c			
Opening stock	59,000	Closing stock	64,000		
To, Purchases A/c	3,73,000	Work in Progress			
To, Wages Paid	5,62,000	Materials	8,000		
To, Wages Accrued	34,000	Wages	11,000		
To, Factory Expenses A/c	3,81,500	Factory Expenses	6,600		
		Cost of goods (18,000 units manufactured)	13,19,900		
	14,09,500		14,09,500		
To, Cost of goods sold A/c	13,19,900	By, Sales (15,200units)	18,24,000		
To, Admn. Expenses A/c	2,45,000	By, Interest on Investments	2,600		
To, Selling Expenses A/c	3,28,000	By, Dividend received	11,000		
To, Preliminary Expenses A/c (written off)	20,000	By, Finished stock A/c (2,800 Units)	2,35,200		
To, Good will written off	15,000				
To, Net profit	1,44,900				
	20,72,800		20,72,800		

The following procedure is adopted in connection with the costing of the product:

- (a) Factory expenses are allocated to production at 60% of direct labour cost.
- (b) Administration expenses are applied at ₹ 12 per unit over the units produced.
- (c) Selling and distribution expenses are charged so as to work out @ 20% of selling price.

Prepare Costing Profit and Loss account and the statement of reconciliation between the profit or loss as per the two sets of books.

Solution:

Dr.		Costing P & L Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, Op. stock of material	59,000	By, Sales	18,24,000		
(+) Purchases	3,73,000				
(-) Closing stock	(64,000)				
To, Material consumed	3,68,000				
To, Direct wages	5,96,000				
Prime Cost	9,64,000				
To, Factory OH	3,57,600				
	13,21,600				
(-) Cl. Stock of WIP	25,600				
Works cost	12,96,000				



To Admn. OH's	2,16,000		
Cost of goods sold	15,12,000		
(-) Cl. Stock of Finished goods. (15,12,000 x 2800/18000)	2,35,200		
Cost of goods sold	12,76,800		
To S & D expenses	3,64,800		
To Profit	1,82,400		
	18,24,000		18,24,000

Statement of Reconciliation

Particulars	Amount ₹	Amount ₹
Profit as per Financial Accounts		1,44,900
Add: Factory OH unabsorbed	23,900	
Administration OH unabsorbed	29,000	
Preliminary Expenses	20,000	
Goodwill	15,000	87,900
Less: S & D Overheads	36,800	
Interest on Investments	2,600	
Dividend received	11,000	(50,400)
Profit as per Cost Accounts		1,82,400

Illustration 17 :

Organic products Co., keeps their financial accounts separate from their cost accounts. In the cost ledger on 1st January, 2011. The balances were as follows:

		₹
Stores ledger control		15,000
Work-in-progress control		23,250
Finished stock control		5,250
Cost ledger control		43,500
Transactions for the year ending 31st Dec 2011 were:		
Purchase of raw materials		82,500
Wages-Direct	1,18,500	
Indirect	31,500	
		1,50,000
Factory overhead expenses: Incurred		54,000
Absorbed		82,500
Administrative overhead expenses : Incurred		18,750
Absorbed		18,600
Selling overhead expenses : Incurred		11,250
Absorbed		11,400
Materials Issued to production		86,250
Sales		3,97,500
Work-in-progress: Value at 31.12.2011		20,250
Finished goods stock value at 31.12.2011		6,000

The value of stock and work-in-progress in the company's balance sheet were as follows:

As on 1.1.2011 ₹ 46,500; As on 31.12.2011 ₹ 36,750.

The following items have been recorded in the financial accounts only:

Debenture interest paid	12,000
Loss on sale of Investment	3,750
Dividend received	4,500

You are required to:

- Show the account in the Cost Ledger for the year ended 31st Dec 2011.
- Prepare a statement reconciling the profit disclosed by the Cost Accounts with the profit shown in the Financial Accounts.

Solution:

Dr.		Stores Ledger Control Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, Balance b/d	15,000	By, WIP Control A/c	86,250		
To, GLA A/c	82,500	By, Balance c/d	11,250		
	97,500		97,500		
To Balance b/d	11,250				

Dr.		WIP Control Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, Balance b/d	23,250	By, FG control A/c	2,90,250		
To, Wages control A/c	1,18,500	By, Balance c/d	20,250		
To, FOH control A/c	82,500				
To, SLC A/c	86,250				
	3,10,500		3,10,500		
To Balance b/d	20,250				

Dr.		Finished Goods Control Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, Balance b/d	5,250	By, Cost of sales A/c	3,08,100		
To, Admn. Control A/c	18,600	By, Balance c/d	6,000		
To, WIP control A/c	2,90,250				
	3,14,100		3,14,100		
To balance b/d	6,000				

Dr.		Cost Ledger Control Account		Dr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, Costing P & L A/c	3,97,500	By, Balance b/d	43,500		
To, Balance c/d	37,500	By, SLC A/c	82,500		
		By, Wage control A/c	1,50,000		
		By, FOH control A/c	54,000		
		By, AOH control	18,750		
		By, SOH A/c	11,250		
		By, Costing P & L A/c	75,000		
	4,35,000		4,35,000		
		By Balance b/d	37,500		



Dr. FOH Control Account Cr.

Particulars	Amount ₹	Particulars	Amount ₹
To, Wage control A/c	31,500	By, WIP control A/c	82,500
To, GLA A/c	54,000	By, Costing P & L A/c	3,000
	85,500		85,500

Dr. AOH Control Account Cr.

Particulars	Amount ₹	Particulars	Amount ₹
To, GLA A/c	18,750	By, FG control A/c	18,600
		By, Costing P & L A/c	150
	18,750		18,750

Dr. SOH Control Account Cr.

Particulars	Amount ₹	Particulars	Amount ₹
To, GLA A/c	11,250	By, Cost of sales A/c	11,400
To, Costing P & L A/c	150		
	11,400		11,400

Dr. Cost of Sales Account Cr.

Particulars	Amount ₹	Particulars	Amount ₹
To, SOH A/c	11,400	By, Costing P & L A/c	3,19,500
To, FG control A/c	3,08,100		
	3,19,500		3,19,500

Dr. Costing P & L Account Cr.

Particulars	Amount ₹	Particulars	Amount ₹
To, cost of sales	3,19,500	By, GLA A/c	3,97,500
To, FOH control A/c	3,000	By, SOH A/c	150
To, AOH control A/c	150		
To, Cost ledger control A/c (profit)	75,000		
	3,97,650		3,97,650

Dr. General Ledger Adjustment Account Cr.

Particulars	Amount ₹	Particulars	Amount ₹
To, SLC A/c	11,250	By, CLC A/c	37,500
To, WIP A/c	20,250		
To, FG control A/c	6,000		
	37,500		37,500

Dr.		Trading and P & L Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, opening stock A/c	46,500	By, Sales A/c	3,97,500		
To, purchases A/c	82,500	By, Dividend received	4,500		
To, wages A/c	1,50,000	By, Closing stock A/c	36,750		
To, FOH A/c	54,000				
To, AOH A/c	18,750				
To, SOH A/c	11,250				
To, Debentures interest	12,000				
To, Loss on sale of investment	3,750				
To, Net Profit.	60,000				
	4,38,750				4,38,750

Statement of Reconciliation

Particulars	Amount ₹	Amount ₹
Profit as per Financial Accounts		60,000
Add: Undervaluation of opening stock in cost accounts	3,000	
Overvaluation of closing stock in cost accounts	750	19,500
Debenture Interest	12,750	
Loss on sale of Investment	3,000	
Less: Dividend received		4,500
Profit as per Cost Accounts		75,000

Illustration 18 :

The following represent the Trading and Profit and Loss Account of a manufacturer of a standard fire extinguisher:

Dr.		Trading and P & L Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, Materials used	29,150.00	By, Sales A/c	75,000.00		
To, Productive Wages A/c	18,610.00	By, Stock of Finished Goods A/c			
To, Factory Expenses A/c	14,055.00		1,812.50		
To, Gross Profit c/d	20,527.50	By, Work-in-progress:			
		Materials	2,800.00		
		Labour	1,560.00		
		Overheads	1,170.00		
	82,342.50		82,342.50		
To, Administration expenses A/c	13,650.00	By, Gross Profit b/d	20,527.00		
To, Net Profit	6,877.50				
	20,527.50				20,527.50

1,550 Extinguishers were manufactured during the year, and 1,500 were sold during the same period. The cost records showed that Factory overheads work out at ₹ 8.25 and Administrative overheads at ₹ 9.0625 per article produced: the Cost Accounts showing an estimated total profit of ₹ 7,031.25 for the year.



From the forgoing information you are required to prepare

- Factory Overhead Control of Account
- Administration overheads Control Account in costing books and
- An account showing reconciliation between the total net profit as per the Cost Accounts and the net profit shown in Financial Books.

Solution:

Dr.		Factory Overhead Control Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, GLA A/c	14,055	By, FG control (1550 x 8.25)	12,787.50		
		By, WIP	1,170.00		
		By, Under recovery	97.50		
	14,055		14,055		

Dr.		Administration Overhead Control Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, GLA A/c	13,650.000	By, FG (1550 x 9.0625)	14,046.875		
To, Over recovery	396.875				
	14,046.875		14,046.875		

Dr.		Memorandum Reconciliation Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, Over recovery of AOH	396.875	By, Profit as per Financial A/c	6,877.500		
To, Profit as per Cost Accounts	7,031.250	By, Under recovery of FOH	97.500		
		By, Over Valuation of Closing Stock in Cost Accounts (50 x 9.0625)	453.125		
	7,428.125		7,428.125		

1.3 METHODS (OR) TYPES OF COSTING

1.3.1 Methods or Types of Costing

Costing is the technique and process of ascertaining costs. In order to do the same, it is necessary to follow a particular method of ascertaining cost. Different methods of costing are applied to different industries depending upon the type of manufacture and their nature. Broadly the costing methods are classified into the following:

- a) Specific Order Costing (Job or Terminal Costing)
- b) Operation Costing or Process or Period Costing

Specific Order Costing: Specific order costing is the category of basic costing methods applicable where the work consists of separate jobs, batches or contracts each of which is authorised by a specific order or contract. It includes job costing consisting batch costing and contract costing.

Operation Costing: Operation costing is the category of basic costing method applicable where standardised goods or services result from a sequence of repetitive and more or less continuous operations or process to which costs are charged before being averaged over the units produced during the period. In this category we include process costing and service costing.

1.3.2 Job Order Costing:

Industries which manufacture products or render services against specific orders as distinct from continuous production for stock or sales use the job costing or job order method of cost accounting. The method is also known under various other names, such as specific order costing, production order costing, job lot costing or lot costing. Every order in job costing is separate and it is not essential that the same manufacturing operations be carried out or the same materials be utilized in respect of each. However, a number of identical orders or identical products may be combined together to form lots or batches, each such lot or batch constituting a job order. In the job costing system, an order or a unit, lot, or batch of a product may be taken as a cost unit, i.e. a job.

In job costing, there is no averaging of costs except to the extent that in the ascertainment of unit cost, the cost of a lot of products in one order is obtained. A job or an order may extend to several accounting periods and job costs are, therefore, not related to particular periods.

Job cost accounting is followed in three types of manufacturing organisations:

- (i) Jobbing concerns.
- (ii) Small firms.
- (iii) Large enterprises manufacturing a variety of products.

(i) Jobbing concerns:

Some concerns manufacture a variety of products according to customer's specifications and do not generally confine their activities to producing uniformly any specific product for sale in the market. The jobs, products or services are dissimilar or unique and non-repetitive having different specifications and methods of manufacture, and each one requires different types, sizes and quantities of materials and equipments and utilizes different labour hours. Such concerns must of necessity to use job cost accounting.

(ii) Small firms:

Though manufacturing a number of specific products, small manufacturing concerns may find process costing difficult to apply because due to small sales, no product can have a run long enough to establish a product line. On account of the frequent changes from one product to another, job costing would be suitable for determining the cost of each lot of products.



(iii) Large enterprises manufacturing a variety of products:

A single department would be manufacturing several products, perhaps all at a time, so that none of the departments is specialized for continuous runs of product lines. As definite process departments cannot be established, job costing is more suitable in such cases.

Job costing is applicable to engineering concerns, construction companies, ship-building, furniture making, hardware and machine manufacturing industries, repair shops, automobile garages and several such other industries where jobs or orders can be kept separate.

1.3.2.1 Procedure for Job Cost Accounting:

On receipt of an order from the customer or an indication from the sales department for manufacturing a particular product, the production planning department prepares a suitable design for the product or job. It also works out the requirements of materials for the product and prepares a list of operations indicating the various operations to be carried out and their sequence, and the shops, departments, plants or machines to be entrusted with each of the operations.

A Production Order is issued giving instructions to the shops to proceed with the manufacture of the product. The production order constitutes the authority for work. Usually a production order contains all relevant information regarding production, such as detailed particulars of the job or product, the quantity or units to be manufactured, date of start of production, probable date of completion, details of materials required as per the bill of materials, the operations and the various shops involved in performing them and the route of the job should take.

The production order usually lays down only the quantities of materials required and the time allowed for the operations, but the values of materials and labour are also sometimes indicated. In the later case, the production order serves the combined purpose of an order for manufacture as well as the cost sheet on which the cost of the order is compiled.

The production order also provides for the material and labour on account of normal wastage or spoilage of the product in the final stage or during the various stages of manufacture.

Production orders may, in general, be of three types:

- (i) Assembly type of order.
- (ii) Sub-assembly type of order.
- (iii) Components or parts production type.

(i) Assembly type of order:

Where components are purchased and assembled into a product in the factory. A production order for assembly only is required.

(ii) Sub-assembly type of order:

Components are purchased and sub-assemblies and assemblies are made in the factory. Production orders for each sub-assembly and final assembly will be necessary.

(iii) Components or parts production type:

Components are manufactured and sub-assembled and the sub-assemblies are assembled into the final product. Separate production orders for each component, sub-assembly and final assembly are issued.

1.3.2.2 Copies of Production Orders May be Distributed as Follows:

- (a) One copy to the stores for provisioning and issue of materials on demand.
- (b) One copy each to the departments or shops concerned to undertake production by demanding materials and employing men and machines on the operations.
- (c) One copy to the cost department for working out the cost of the job.

Separate job cost sheets are maintained for each job. If a job consists of several major or important operations, separate cost sub-sheets for recording the costs of the various operations may be maintained and the aggregate cost, in summary, shown in the main cost sheet.

Material Cost:

On receipt of a production order, the shop draws the requisite materials from the stores. Surplus, excess or incorrect materials are returned from the shops to the stores on materials return notes. Scrap and waste arising in the course of manufacture are returned in a similar manner. The materials requisitions, materials return notes and materials transfer notes are 'costed' in accordance with the methods of pricing adopted by the concern.

Labour Cost:

Labour summaries or wages analysis sheets are prepared for each accounting period and the totals of these statements are debited to Work-in-Progress Account or Overhead Control Account by credit to Wages Control Account. Amounts on account of overtime, idle time, shift differential and fringe benefits may also be included in the wages analysis sheet. Direct labour costs are posted on the respective cost sheets and indirect labour is treated in the manner indicated for indirect material.

Manufacturing Overhead:

Overhead costs are accumulated against standing order numbers and against cost centres. Overhead rates, predetermined or actual as the case may be, are worked out for each such centre. The overhead applied to each job is obtained by multiplying the overhead rate by the actual base variable spent on the job.

Completion of Jobs:

Postings of direct material, direct labour, direct expenses and manufacturing overhead costs to the cost sheet for a job or production order are made periodically throughout the run of the job or order. The completion report is an indication that the manufacturing operations are over and further expenditure on the job should cease so that the cost sheet may not be closed.

Work-in-Progress:

The cost of an incomplete job i.e., a job on which some manufacturing processes or operations are still due before it can be made into the finished product is termed Work-in-Progress or Work-in-Process. If a production order has been only partly completed by the end of an accounting period, it is essential that the closing stock of the work-in-progress be determined.

1.3.2.3 Cost Control in Job Order System:

Control over job costs may be exercised by comparison of the actual costs with the estimated costs established as basis for fixing job prices. Here again, adequate cost control is available for direct material and direct labour only; overhead costs cannot be controlled in terms of individual jobs. Control of overhead is, therefore, confined to the department as a whole for which predetermined overhead rate has been determined.

Comparison may also be made with the costs of previous periods or of earlier batches of production, if any.

Standard costs may be used in job type plants, particularly where the product or the particular operations of the job are of a standardised nature.

1.3.2.4 Advantages of Job Costing:

Job costing offers the following advantages:

- (a) The cost of material, labour and overhead for every job or product in a department is available daily, weekly or as often as required while the job is still in progress.



- (b) On completion of a job, the cost under each element is immediately ascertained. Costs may be compared with the selling prices of the products in order to determine their profitability and to decide which product lines should be pushed or discontinued.
- (c) Historical costs for past periods for each product, compiled by orders, departments, or machines, provide useful statistics for future production planning and for estimating the costs of similar jobs to be taken up in future. This assists in the prompt furnishing of price quotations for specific jobs.
- (d) The adoption of predetermined overhead rates in job costing necessitates the application of a system of budgetary control of overhead with all its advantages.
- (e) The actual overhead costs are compared with the overhead applied at predetermined rates; thus, at the end of an accounting period, overhead variances can be analyzed.
- (f) Spoilage and defective work can be easily identified with specific jobs or products.
- (g) Job costing is particularly suitable for cost-plus and such other contracts where selling price is determined directly on the basis of costs.

1.3.2.5 Limitations of Job Costing:

The limitations of job costing are:

- (a) Job costing is comparatively more expensive as more clerical work is involved in identifying each element of cost with specific departments and jobs.
- (b) With the increase in the clerical processes, chances of errors are enhanced.
- (c) The cost as ascertained, even where they are compiled very promptly, are historical as they are compiled after incidence.
- (d) The cost compiled under job costing system represents the cost incurred under actual conditions of operation. The system does not have any scientific basis.

1.3.2.6 Reports in Job Costing System:

Report on profits on completed jobs:

A statement may be prepared monthly to indicate the gross profit earned on all jobs completed during the month. This statement is useful for the management for evaluating past performances. Net profit analysis may also be made in a similar manner if administration, selling and distribution overheads for the job are included in the statement.

Report on cost variances:

If cost estimates are developed, a cost variance report showing the deviations of actual costs from the estimated costs may be prepared in order that significant differences may be brought to light and investigated. The report may be prepared separately for a job, or for a department showing the variances in respect of all jobs undertaken by the department during a period.

Illustration 19:

As newly appointed Cost Accountant, you find that the selling price of Job No. 9669 has been calculated on the following basis:

Particulars	₹
Materials	12.08
Direct Wages – 22 hours at 25 paise per hour	5.50
Department	
A – 10 hours,	
B – 4 hours	
C – 8 hours	
	17.58
Plus 33% on Prime Cost	5.86
	23.44

An analysis of the previous year's profit and loss account shows the following:

Particulars	₹	Particulars	₹
Materials Used	77,500	Factory Overheads:	2,500
Direct Wages:	5,000	A	4,000
A	6,000	B	1,000
B	4,000	C	30,000
C		Selling Costs	

You are required to:

- Draw up a Job Cost Sheet;
- Calculate and enter the revised costs using the previous year's figures as a basis;
- Add to the total job cost 10% for profit and give the final selling price.

Solution:

In order to draw up Job Cost Sheet, the factory overhead rates of different departments and percentage of selling cost will have to be determined first on the basis of previous year's figures as follow:

Factory Overhead Rates:

Particulars	Department		
	A	B	C
	₹	₹	₹
Factory Overheads	2,500	4,000	1,000
Direct Labour Hours (D.W. x 4)	20,000	24,000	16,000
Factory Overhead Rates per hour	0.125	0.167	0.063

$$\text{Percentage of Selling Cost on Works Cost} = \frac{\text{₹ } 30,000}{\text{₹ } 1,00,000} = 30\%$$

Cost Sheet

Job No. 9669		Period
Particulars		₹
Materials		12.08
Direct Wages:		
Dept. A	2.50	
Dept. B	1.00	
Dept. C	2.00	5.50
Prime Cost		17.58
Factory Overheads:		
Dept. A	(10 hours. @ ₹ 0.125)	1.25
Dept. B	(4 hours. @ ₹ 0.167)	0.67
Dept. C	(8 hours. @ ₹ 0.063)	0.50
Works Cost		20.00
Selling Cost (30% of Works Cost)		6.00
Cost of Sales		26.00
Profit (10% on Cost)		2.60
Selling Price		28.60



Illustration 20:

A work order for 100 units of a commodity has to pass through four different machines of which the machine hour rates are: Machine P – ₹ 1.25, Machine Q – ₹ 2.50, Machine R – ₹ 3 and Machine S – ₹ 2.25

Following expenses have been incurred on the work order – Materials ₹ 8,000 and Wages ₹ 500.

Machine - P has been engaged for 200 hours. Machine - Q for 160 hours, Machine - R for 240 hours and Machine - S for 132 hours.

After the work order has been completed, materials worth ₹ 400 are found to be surplus and are returned to stores.

Office overhead used to be 40% of works costs, but on account of all-round rise in the cost of administration, distribution and sale, there has been a 50% rise in the office overhead expenditure.

Moreover, it is known that 10% of production will have to be scrapped as not being upto the specification and the sale proceeds of the scrapped output will be only 5% of the cost of sale.

If the manufacturer wants to make a profit of 20% on the total cost of the work order, find out the selling price of a unit of commodity ready for sale.

Solution:

Statement showing the selling price of a unit

Particulars		₹
Materials used (₹ 8,000 – ₹400)		7,600
Direct Wages		500
Prime Cost		8,100
Works Overhead at machine hour rate:		
Machine - P For 200 hours @ ₹ 1.25 per hour	250	
Machine - Q For 160 hours. @ ₹ 2.50 per hour	400	
Machine - R For 240 hours. @ ₹ 3 per hour	720	
Machine - S For 132 hours. @ ₹ 2.25 per hour	297	1,667
Works Cost		9,767
Administration Overhead at 60% of works cost		5,860
		15,627
Less: Sale proceeds of Scrap (5% of 10% of ₹ 15,627)		78
Total Cost of the work order		15,549
Profit at 20% of total Cost		3,110
Selling Price of 100 units		18,659
Selling Price of a unit		186.59

Note: It was known before that 10% of production will have to be scrapped, therefore, inputs must have been made taking this factor into consideration. No other adjustment is necessary except deducting the value of scrap from the cost of production.

Illustration 21:

The data pertaining to Heavy Engineering Ltd. using are as follows at the end of 31.3.2012. Direct material ₹ 9,00,000; Direct wages ₹ 7,50,000; Selling and distribution overhead ₹ 5,25,000; Administrative overhead ₹ 4,20,000, Factory overhead ₹ 4,50,000 and Profit ₹ 6,09,000.

- Prepare a cost sheet showing all the details.
- For 2012-13, the factory has received a work order. It is estimated that the direct materials would be ₹ 12,00,000 and direct labour cost ₹ 7,50,000. What would be the price of work order if the factory

intends to earn the same rate of profit on sales, assuming that the selling and distribution overhead has gone up by 15%? The factory recovers factory overhead as a percentage of direct wages and administrative and selling and distribution overheads as a percentage of works cost, based on the cost rates prevalent in the previous year.

Solution:

Statement of cost and profit

Particulars	₹
Direct Materials	9,00,000
Direct Wages	7,50,000
Prime Cost	16,50,000
Factory Overheads (60% of wages)	4,50,000
Works Cost	21,00,000
Administration Overhead (20% of works cost)	4,20,000
Cost of Production	25,20,000
Selling & Distribution Overheads (25% of Works Cost)	5,25,000
Cost of Sales	30,45,000
Profit (1/5 of Cost)	6,09,000
Sales	36,54,000

Estimated price of work order

Particulars	₹
Direct Materials	12,00,000
Direct Wages (or labour)	7,50,000
Prime Cost	19,50,000
Factory Overheads (60% of wages)	4,50,000
Works Cost	24,00,000
Administration Overhead (20% of works cost)	4,80,000
Cost of Production	28,80,000
Selling & Distribution Overheads (40% i.e., 25 % + 15% of Works Cost)	9,60,000
Total Cost	38,40,000
Profit (1/5 of Total Cost)	7,68,000
Estimated Sales price	46,08,000

Illustration 22:

A manufacturing company is divided into three production departments – A, B and C. All production is to customers' orders. All orders are dissimilar and they go through all the three departments.

Manufacturing Costs for a given period were as follows:

Particulars	Dept A	Dept B	Dept C	Total
	₹	₹	₹	₹
Direct material				1,80,000
Direct labour	40,000	20,000	30,000	90,000
Indirect manufacturing costs	20,000	40,000	30,000	90,000



The cost of producing a particular order was determined as follows:

Particulars	₹	₹
Direct material		1,000
Direct Labour:	₹	
Department A	120	
Department B	280	
Department C	200	600
Indirect manufacturing Costs		600
		2,200

The General Manager had a hazy idea that the jobs executed on orders of this nature are under-priced. So, the services of a firm of cost accountants, of which you are a member, have been acquired for a thorough investigation.

Can you detect, after a careful perusal of the limited available information, the fundamental fallacy of the company's method assuming that the direct labour cost is an acceptable basis for distributing indirect manufacturing costs?

Prepare a revised cost for order distributing indirect manufacturing costs in a manner you consider more correct than the company's procedure.

Solution:

The predominant fault is the adoption of a blanket rate for the distribution of the indirect manufacturing costs for all the three departments, i.e., 100% of total direct labour cost. This has been done despite of the fact that there are glaring differences of the direct labour cost of three departments. For calculating the revised cost of jobs, departmental rates based on indirect manufacturing cost percentage to direct labour costs are calculated:

Particulars	Departments		
	A	B	C
Indirect Mfg. Cost (₹)	20,000	40,000	30,000
Direct Labour (₹)	40,000	20,000	30,000
% of Mfg. Cost to Labour Cost $(1/2) \times 100$	50%	200%	100%

On the assumption that direct labour cost method is considered to be a reasonable method of absorption of overheads, it is quite possible that departmental application of overhead may be able to resolve the difficulty faced by the manager regarding the costing of the job given. On this basis the amended job cost sheet will be as under:

Revised Cost of Job

Particulars	₹	₹
Direct Materials (Given)		1,000
Direct Labour:		
Dept. A	120	
Dept. B	280	
Dept. C	200	600
		1,600
Indirect Manufacturing Cost: (Revised)		
Dept. A	50% of Direct Labour	60
Dept. B	200% of Direct Labour	560
Dept. C	100% of Direct Labour	200
		820
Total Cost		2,420

Illustration 23:

A shop floor supervisor of a small factory presented the following cost for Job no.555 to determine selling price.

Particulars	Per unit (₹)
Materials	70
Direct Wages 18 hours at 2.5	45
Dept. X-8 hours	
Dept. Y-6 hours	
Dept. Z-4 hours	
Chargeable expenses (special stores items)	5
	120
Plus 33% Overheads	40
	160

Analysis of the Profit/Loss Account for 2012 shows the following

Particulars	₹	₹	Particulars	₹	₹
Materials		1,50,000	Sales		2,50,000
Direct Wages:					
Dept. X	10,000				
Dept. Y	12,000				
Dept. Z	8,000	30,000			
Special stores items		4,000			
Overheads:					
Dept. X	5,000				
Dept. Y	9,000				
Dept. Z	2,000	16,000			
		2,00,000			
Gross profit c/d		50,000			
		2,50,000	Gross profit b/d		2,50,000
Selling expenses		20,000			50,000
Net profit c/d		30,000			
		50,000			50,000

It is also noted that average hourly rates for the 3 departments, X, Y and Z are similar.

You are required:

- Draw up a job cost sheet;
- Calculate the entire revised cost using 2012 actual figures as basis;
- Add 20% to total cost to determine selling price.



Solution:

Calculation of Departmental Overhead Rates

Particulars	Departments		
	X ₹	Y ₹	Z ₹
(i) Direct Wages	10,000	12,000	8,000
(ii) Rate of wages per hour	2.5	2.5	2.5
(iii) Hours	4000	4800	3200
(iv) Actual Overheads in 8%	5000	9000	2000
(v) Department Overhead Rates per hour (iv ÷ iii)	1.250	1.875	0.625

Revised job cost sheet

Particulars			₹
Materials			70
Labour:			
Dept. X	8 x 2.5	20	
Dept. Y	6 x 2.5	15	
Dept. Z	4 x 2.5	10	45
Direct Expenses			5
Prime Costs			120
Overheads:			
Dept. X	8 x 1.250	10.00	
Dept. Y	6 x 1.875	11.25	
Dept. Z	4 x 0.625	2.50	23.75
Total Cost			143.75
Add: Profit 20%			28.75
Selling Price			172.50

Illustration No 24 :

In a factory following the Job Costing Method, an abstract from the work in process as at 30th September, was prepared as under.

Job No.	Materials	Direct Labour	Factory Overheads Applied (₹)
115	1,325	400 hrs 800	640
118	810	250 hrs. 500	400
120	765	300 hrs 475	380
	2,900	1,775	1,420

Materials used in October were as follows:

Material requisitions No.	Job no.	Cost (₹)
54	118	300
55	118	425
56	118	515
57	120	665
58	121	910
59	124	720
		3,535

A summary of Labour Hours deployed during October is as under:

JOB NO.	NUMBER OF HOURS	
	SHOP A	SHOP B
115	25	25
118	90	30
120	75	10
121	65	-
124	20	10
	275	75
Indirect Labour:		
Waiting for material	20	10
Machine breakdown	10	5
Idle time	5	6
Overtime premium	6	5
	316	101

A shop credit slip was issued in October, that material issued under requisition No.54 was returned back to stores as being not suitable. A material transfer note issued in October indicated that material issued under requisition No.55 for Job 118 was directed to Job 124.

The hourly rate in shop A per labour hour is ₹3 while at shop B it is ₹ 2 per hour. The factory overhead is applied at the same rate as in September; Jobs 115, 118 and 120 were completed in October.

You are asked to compute the factory cost of the completed jobs. It is practice of the management to put a 10% on the factory cost to cover administration and selling overheads and invoice the job to the customer on a total cost plus 20% basis what would be the invoice price of these three jobs?

Solution:

Calculation of selling price of the Job

Job No.	115	118	120
	₹	₹	₹
Costs in September:			
Material	1,325	810	765
Labour	800	500	475
Overheads	640	400	380
Total (A)	2,765	1,710	1,620
Costs in October:			
Material	-	515	665
Labour			
(25 x 3)+(25 x 2)	125		
(90 x 3)+(30 x 2)		330	
(75 x 3)+(10 x 2)			245
Overheads (80%)	100	264	196
Total (B)	225	1,109	1,106
Total Factory Cost (A+B)	2,990	2,819	2,726
Add: Admn. Overheads' 10%	299.0	281.9	272.6
	3,289.0	3,100.9	2,998.6
Profit 20%	651.80	620.18	599.72
Selling Price	3,946.80	3,721.08	3,598.32



1.3.3 Batch Costing

1.3.3.1 Meaning

Batch Costing is that form of specific order costing under which each batch is treated as a cost unit and costs are accumulated and ascertained separately for each batch. Each batch consists of a number of like units.

1.3.3.2 Basic Features

- (a) Each batch is treated as a cost unit.
- (b) All costs are accumulated and ascertained for each batch.
- (c) A separate Batch Cost Sheet is used for each batch and is assigned a certain number by which the batch is identified.
- (d) The cost per unit is ascertained by dividing the total cost of a batch by the number of items produced in that batch.

1.3.3.3 Applications

Batch Costing is applied in those industries where the similar articles are produced in definite batches for internal consumption in the production of finished products or for sale to customers generally. It is generally applied in –

- a) Read made Garments Manufacturing Industries
- b) Pharmaceutical/ Drug Industries
- c) Spare parts and Components Manufacturing Industries
- d) Toys Manufacturing Industries
- e) Tyre and Tubes Manufacturing Industries.

1.3.3.4 Economic Batch Quantity (EBQ)

Meaning

Economic Batch Quantity refers to the optimum quantity batch which should be produced at a point of time so that the Set up & Processing Costs and Carrying Costs are together optimized.

Setting up & Processing Costs

The setting up and processing costs refer to the costs incurred for setting up and processing operations before the start of production of a batch. There is an inverse relationship between batch size and set up & processing costs.

Large the Batch size : Lower the set up costs because of few batches

Smaller the Batch Size : Higher the set up costs because of more batches

Carrying Costs

The carrying costs refer to the costs incurred in maintaining a given level of inventory. There is positive relationship between batch size and carrying costs.

Large the Batch size : Higher the carrying costs because of high average inventory

Smaller the Batch Size: Lower the carrying costs because of low average inventory

Trade off

The optimum quantity of batch which should be produced at a point of time determined after achieving a **trade off between set up costs and carrying costs**. Such batch size is known as EBQ because annual total cost of set up and carrying is minimum at this batch size.

FORMULA

$$E.B.Q = \sqrt{\frac{2AS}{C}}$$

Where, E.B.Q = Economic Batch Quantity

A = Annual Demand

S = Set up Cost per batch

C = Carrying Costs per unit per year

Illustration 25:

From the following information, calculate Economic Batch Quantity for a company using batch costing:

Annual Demand for the components	2400 units
Setting up cost per batch	₹ 100
Manufacturing cost per unit	₹ 200
Carrying cost per unit	6% p.a.

Solution :

$$EBQ = \sqrt{\frac{2AS}{C}} = \sqrt{\frac{2 \times 2,400 \times 100}{6\% \text{ of } 200}} = 200 \text{ Units}$$

Illustration 26:

A customer has been ordering 60,000 special design metal columns at the columns at the rate of 18,000 per order during the past years. The production cost comprises ₹120 for material, ₹ 60 for labour and ₹20 for fixed overheads. It costs ₹ 1500 to set up for one run of 18,000 column and inventory carrying cost is 15% since this customer may buy at least 5000 columns this year, the company would like to avoid making five different production runs. Find the most economic production run.

Solution :

Economic Production Run

$$= \sqrt{\frac{2 \times \text{Annual Output} \times \text{Setup Cost per Production run}}{\text{Inventory Carrying Cost per unit p.a.}}} = \sqrt{\frac{2 \times 90,000 \times 1,500}{30}} = 30,000 \text{ units}$$

Illustration 27:

AB Ltd.is committed to supply 24,000 bearings per annum to CD Ltd. On a steady basis. It is estimated that it costs 10 paise as inventory holding cost per bearing per month and that the set-up cost per run of bearing manufacture is ₹ 324.

- What would be the optimum run size for bearing manufacture?
- What is the minimum inventory holding cost at optimum run size?
- Assuming that the company has a police of manufacturing 6000 bearing per run, how much extra costs would the company be incurring as compared to the optimum run suggested in (a)?



Solution :

(a) Optimum production Run Size (Q) = $\sqrt{\frac{2AO}{C}}$

Where, A = No. of units to be produced within one year

O = Set-up cost per production run

C = Carrying cost per unit per annum

$$= \sqrt{\frac{2 \times 24,000 \times 324}{0.10 \times 12}} = 36,000 \text{ units}$$

(b) Minimum inventory Holding Cost, if run size is 3600 bearings

= Average inventory x carrying cost per unit

$$= (3600/2) \times (.10 \times 12) = ₹ 2160$$

(c) Statement showing Total Cost at Production Run sizes of 3600 and 6000 bearings

A.	Annual requirements	24000	24000
B.	Run size	3600	6000
C.	No. of runs (A/B)	6.667	4
D.	Set up cost per run	₹ 324	₹ 324
E.	Total set up cost (C X D)	₹ 2160	₹ 1296
F.	Average inventory (B/2)	1800	3000
G.	Carrying cost per unit p.a.	1.20	1.20
H.	Total carrying cost (F x G)	2160	3600
I.	Total cost (E + H)	4320	4896

Extra cost incurred , if run size is of 6000 = ₹ 4896 – ₹ 4320 = ₹ 576

Illustration 28:

Component 'Gold' is made entirely in cost centre 100. Material cost is 6 paise per component and each component takes 10 minutes to produce. The machine operator is paid 72 paise per hour, and machine hour rate is ₹ 1.50. The setting up of the machine to produce the component 'Gold' takes 2 hours 20 minutes.

On the basis of this information, prepare a cost sheet showing the production and setting up cost, both in total and per component, assuming that a batch of :

- (a) 10 components,
- (b) 100 components, and
- (c) 1000 components is produced.

Solution :

Cost Sheet Component 'Gold'

Particulars	Batch Size					
	10 components		100 components		1000 components	
	Total ₹	Per component ₹	Total ₹	Per component ₹	Total ₹	Per component ₹
A. Setting up Cost:						
Machine Operators wages (2 hours 20minutes @ ₹72 p.h)	1.68	0.168	1.68	0.0168	1.68	0.00168
Overheads 2 hours 20minutes @ ₹1.50 p.h)	3.50	0.350	3.50	0.0350	3.50	0.00350
B. Production Cost:						
Material Cost @ Re. 0.06 per component	0.60	0.060	6.00	0.0600	60.00	0.06000
Machine Operators Wages [(Refer to Working Note (i))]	1.20	0.120	12.00	0.1200	120.00	0.12000
Overheads [(Refer to Working Note (ii))]	2.50	0.250	25.00	0.2500	250.00	0.25000
C. Total Cost : (A + B)	9.48	0.948	48.18	0.4818	43518	0.43518

Working Notes:

	10 Components	100 Components	1000 Components
i) Operators Wages Time taken in minutes by machine operators and machine @10minutes per component Operators Wages @ ₹ 0.72 per hour (₹)	100 [100/60 x 0.72]	1000 [1000/60 x 0.72]	1000 [10000/60 x 0.72]
ii) Overhead expenses Total overhead expenses @ ₹ 1.50 per Machine hour	2.50 [100/60 x ₹ 1.50]	25.00 [1000/60 x ₹1.50]	250.00 [10000/60x₹ 1.50]



Illustration 29:

Pink Limited undertakes to supply 1000 units of a component per month for the months of January, Feb. and March 20X1. Every month a batch order is opened against which materials and labour cost are booked at actual. Overheads are levied at a rate per labour hour. The selling price is contracted at ₹15 per unit.

From the following data, present the cost and profit per unit of each batch order and the overall position of the order for the 3000 units.

Month	Batch Output(Numbers)	Material Cost ₹	Labour cost ₹
January 20X1	1250	6250	2500
February 20X1	1500	9000	3000
March 20X1	1000	5000	2000

Labour is paid at the rate of ₹ 2 per hour. The other details are:

Month	Overheads	total Labour Hours
January 20X1	₹12000	4000
February 20X1	₹9000	4500
March 20X1	₹15000	5000

Solution :

Statement of Cost and profit per unit of each Batch

Particulars	January	February	March	Total
A. Batch output (Number)	1250	1500	1000	3750
B. Sales Value (A x ₹ 15)	₹ 18,750	₹ 22,500	₹ 15,000	₹ 56,250
C. Material	6,250	9,000	5,000	20,250
Wages	2,500	3,000	2,000	7,500
Overheads	3,750	3,000	3,000	9,750
Total Cost	12,500	15,000	10,000	37,500
D. Profit per batch (B-C)	6,250	7,500	5,000	18,750
E. Cost per Unite (C/A)	10	10	10	10
F. Profit per Unite (D/A)	5	5	5	5

Working Notes :

Particulars	Jan. 20X1	Feb. 20X1	March 20X1
A. Labour Hours (Labour Cost/ Labour rate per hour)	₹ 2500/2 = 1250	₹ 3000/2 = 1500	₹ 2000/2 = 1000
B. Overheads per hour (Total overheads/ Total Labour Hours)	₹ 12000/4000 = ₹ 3	₹ 9000/4 = ₹ 2	₹ 15000/5000 = ₹ 3
C. Overheads for the batch (A x B)	₹ 3750	₹ 3000	₹ 3000

Particulars	₹
A. Sales Value (3000 units x ₹ 15)	45,000
B. Less: Total cost (3000 units x ₹ 10)	30,000
Profit (A- B)	15,000

1.3.4 Contract costing

Contract Costing or Terminal Costing as it is often termed, is a variant of the job costing system, which is applied in businesses engaged in building or other construction work. The jobs are usually the contracts entered into with the customers. As the number of such contracts handled at a time by a business may not be usually large, Contract Costing is comparatively simpler in operation than job costing system. The basic principles applied in Contract Costing are the same as those used in job costing except that these are modified to suit the particular requirements of the contracts.

1.3.4.2 Differences between Job costing and Contract costing:

- While the number of jobs in hand at any time in a concern may be large, only a few contracts may be undertaken at a time.
- The accumulation, analysis, apportionment, allocation and control of costs is simplified in Contract Costing.
- Most of the expenses are chargeable direct to the Contract Account. Direct allocation to such an extent is not possible in job costing.
- As contracts may run for long periods, there arises the problem of assessment and crediting of profits on incomplete contracts at the end of the accounting period.

Contract Costing is a type of costing used in constructional activities such as construction of buildings, roads, bridges etc. The person who takes contract for a price is called the **Contractor** and the person from whom it is taken is called the **Contractee**. We are mainly concerned with the books of the contractor.



To find out profit earned or loss incurred on the contract, the contractor prepares a nominal account in his books called 'Contract Account'. In this account, all the expenses incurred by the contractor are debited and the income i.e mainly work certified is credited; the difference represents profit or loss.

The items generally debited are materials, wages, establishment expenses & other expenses. Depreciation of assets used in the contract will also be debited, but unlike in other types of accounts it is customary in Contract Accounts to debit the opening balance of the assets and credit the closing balance of the same instead of depreciation, wherever it is convenient to do so. Amounts credited are work-in-progress, which consists of work certified and cost of work uncertified and any scrap of materials etc. Further some special items which are discussed here under will also be taken care of.

The contracts run for or number of years; however it is necessary to find out the profit or loss at the end of every year. The profit earned on a Contract Account is primarily called **Notional Profit** and a portion of which would be kept on reserve against contingencies. The profit to be transferred to Profit & Loss Account out of notional profit is ascertained by taking into consideration the degree of completion of the work, cash received etc.

1.3.4.3 Some special items under contract accounting are explained below:

(i) Sub-Contract:

Sub-contracting, usually of a part of the work, is another essential feature which we frequently come across in contract work. Sub-contracting may be necessary under the following circumstances:

- (a) Work of a specialized nature for which facilities are not internally available within the concern is offered to a sub-contractor.
- (b) It may be advantageous to get a part or component from outside, if it is costlier to manufacture it.
- (c) Consideration of opportunity cost; the management may not like to invest capital which may be utilized for other more profitable lines.
- (d) The capacity of the firm may be limited and in order to keep time schedule, work may be speeded by offering it to sub-contractors.

The payments made to sub-contractors are charged in totals to the concerned Contract Account as direct expense and no detailed records or break-up of the sub-contract amount is necessary for cost purposes.

(ii) Surveyor's Certificate and Retention Money:

In the case of contracts running for long periods of time, it is customary for the contractor's firm to get 'on account' payments against the portion of contract completed. The amount received depends upon the extent of work certified by the technical assessor i.e. on the surveyor's certificates, as these are called. Normally such payments are not received to the full extent of the work completed but a small percentage is held back as retention money, payable on completion of the contract. The retention money is a sort of safeguard available to the contractee in case the contractor is not able to fulfill one or more of the conditions laid down in the contract.

(iii) Defective Work:

Defective work will not evidently be paid for by the contractee but the cost of such defective work should be charged to the Contract Account. Sometimes, rectification of the defective work is required to be made at the contractor's cost; the cost of such rectification should also be charged to the Contract Account but shown separately.

(iv) Escalation Clause:

Escalation clauses are often provided in contracts as safeguards against any likely changes in price or utilisation of material and labour. Such a clause in a contract would provide that in the event of a specified contingency happening, the contract price would be suitably enhanced. This clause is particularly necessary where the price of certain raw materials are likely to rise, where labour rates are anticipated to increase, or where the quantity of material or labour time cannot be properly assessed or estimated unless the work has sufficiently advanced. There may also be '**De-escalation or Reserve Clause**' to provide for any future decrease in price etc. so that the benefit may be passed on to the contractee.

(v) Work-in-progress:

In Contract Accounts, the value of the work-in-progress consists of:-

- (a) the cost of work completed, both certified and uncertified,
- (b) the cost of work not yet complete, and
- (c) the amount of profit taken as credit.

In the Balance Sheet, the work-in-progress is usually shown under two heads, viz. certified and uncertified. The cost of work completed and certified and the profit credited will appear under the head 'certified' work-in-progress, while the completed work not yet certified and the cost of labour, material and expenses of work which has not reached the stage of completion are shown under the head 'uncertified' work-in-progress.

(vi) Profit on incomplete contracts:

For the purpose of finding out the portion of the profit out of notional profit to be transferred to Profit and Loss Account, the contracts are divided in the following manner:-

(A) Contracts which have just commenced:

In this case no portion of the notional profit shall be transferred to Profit and Loss Account and the entire amount is kept as reserve. There are no hard and fast rules to determine that a particular contract is just commenced or reasonably advanced or almost complete. However, as per general norms, the contracts in which less than 1/4th work is done are regarded as the contracts which have just commenced.

(B) Contracts which have reasonably advanced:

In this case the profit to be transferred to Profit and Loss Account out of notional profit is based on the degree of completion of the contract. The degree of completion of the contract can be found out by comparing work certified and the contract price.

- (a) If the degree of the completion of the contract is less than or equal to 1/4th no portion of the notional profit shall be transferred to Profit and Loss Account and the entire amount would be kept as reserve.
- (b) If the degree of completion of work is ($> 1/4$ and $< 1/2$), 1/3 of the notional profit shall be transferred to Profit and Loss Account and the remaining amount would be kept as reserve.
- (c) If the degree of completion of work is more than or equal to 1/2, 2/3rd of the notional profit shall be transferred to Profit and Loss Account and the remaining amount would be kept as reserve.



The profit so arrived in the above manner shall further be reduced in the ratio of cash received to work certified. Thus, the formula is as follows:

$$\text{(Notional Profit} \times \frac{2}{3} \text{ or } \frac{1}{3} \text{ (as the case may be) } \times \frac{\text{(Cash received)}}{\text{(Work certified)}}$$

(C) Contracts which are almost complete:

In this case the portion of the profit to be transferred to Profit and Loss Account is calculated by using the estimated total profit which is ascertained by subtracting the total cost to date and the additional cost to complete the contract from the contract price. The different formulas for such computations of profit are as follows:-

- (i) Estimated Profit $\times \frac{\text{(Work certified)}}{\text{(Contract price)}}$
- (ii) Estimated Profit $\times \frac{\text{(Work certified)}}{\text{(Contract price)}} \times \frac{\text{(Cash received)}}{\text{(Work certified)}}$
- (iii) Estimated Profit $\times \frac{\text{(Total cost to date)}}{\text{(Total cost)}}$
- (iv) Estimated Profit $\times \frac{\text{(Total cost to date)}}{\text{(Total cost)}} \times \frac{\text{(Cash received)}}{\text{(Work certified)}}$

Illustration 30:

A firm of Builders, carrying out large contracts kept in contract ledger, separate accounts for each contract on 30th June, 2012, the following were shown as being the expenditure in connection with Contract No. 555.

	₹
Materials purchased	1,16,126
Materials issued from stores	19,570
Plant, which has been used on other contracts	25,046
Additional plant	7,220
Wages	1,47,268
Direct expenses	4,052
Proportionate establishment expenses	17,440

The contract which had commenced on 1st February, 2012 was for ₹ 6,00,000 and the amount certified by the Architect, after deduction of 20% retention money, was ₹ 2,41,600 the work being certified on 30th June, 2012. The materials on site were ₹ 19,716. A contract plant ledger was also kept in which depreciation was dealt with monthly the amount debited in respect of that account is ₹ 2260. Prepare Contract Account showing profit on the contract.

Solution:

Dr.		Contract Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹		
To, Materials purchased A/c	1,16,126	By, Work in progress A/c - Work certified	3,02,000		
To, Material issued A/c	19,570				
To, Depreciation A/c	2,260				
To, Wages A/c	1,47,268	By, Material stock A/c	19,716		
To, Direct expenses A/c	4,052				
To, Proportionate estab. expenses A/c	17,440				
To, P & L A/c [15,000 x 2/3 x 4/5]	8,000				
To, Reserve c/d	15,000				
	3,21,716			3,21,716	

Illustration 31:

A contractor has undertaken a construction work at a price of ₹ 5,00,000 and begun the execution of work on 1st January, 2012. The following are the particulars of the contract up to 31st December, 2012.

Particulars	Amount ₹	Particulars	Amount ₹
Machinery	30,000	Overheads	8,252
Materials	1,70,698	Materials returned	1,098
Wages	1,48,750	Work certified	3,90,000
Direct expenses	6,334	Cash received	3,60,000
Uncertified work	9,000	Materials on 31.12.2012	3,766
Wages outstanding	5,380		
Value of plant on 31.12. 2012	22,000		

It was decided that the profit made on the contract in the year should be arrived at by deducting the cost of work certified from the total value of the architects certificate, that 1/3 of the profit so arrived at should be regarded as a provision against contingencies and that such provision should be increased by taking to the credit of Profit and Loss Account only such portion of the 2/3rd profit, as the cash received to the work certified.



Solution:

Dr.		Contract Account		Cr.	
Particulars	Amount ₹	Particulars		Amount ₹	
To, Machinery A/c	30,000	By, Plant & Machinery A/c		22,000	
To, Materials A/c	1,70,698	By, Materials returned A/c		1,098	
To, Wages incl. outstanding A/c	1,54,130	By, Materials on hand A/c		3,766	
To, Direct Expenses A/c	6,334	By, W.I.P A/c			
To, Overheads A/c	8,252	Work certified	3,90,000		
To, P & L A/c	34,738	Work uncertified	<u>9,000</u>	3,99,000	
To, Reserve c/d	21,712				
	4,25,864			4,25,864	

Illustration 32:

A contractor commenced the work on a particular contract on 1st April, 2012 he usually closes his books of accounts for the year on 31st December of each year. The following information is revealed from his costing records on 31st December, 2012.

	₹
Materials sent to site	43,000
Jr. Engineer	12,620
Labour	1,00,220

A machine costing ₹ 30,000 remained in use on site for 1/5th of year. Its working life was estimated at 5 years and scrap value at ₹ 2,000

A supervisor is paid ₹ 2,000 per month and had devoted one half of his time on the contract.

All other expenses were ₹14,000 the materials on site were ₹ 2,500.

The contract price was ₹ 4,00,000. On 31st December, 2012 2/3rd of the contract was completed however, the architect gave certificate only for ₹ 2,00,000. On which 80% was paid. Prepare Contract Account.

Solution:

Dr.		Contract Account		Cr.	
Particulars	Amount ₹	Particulars		Amount ₹	
To, Material A/c	43,000	By, W.I.P A/c			
To, Jr. Engineer A/c	12,620	Work certified	2,00,000	2,44,365	
To, Labour A/c	1,00,220	Work uncertified	<u>*44,365</u>		
To, Dep. On plant A/c [(30,000-2,000)/5] x 1/5	1,120	By, Material at site		2,500	
To, Supervisor (2,000 x 9 x 1/2)	9,000				
To, Other expenses A/c	14,000				
To, P & L A/c	35,683				
To, Reserve c/d	31,222				
	2,46,865			2,46,865	

Working notes:

Work uncertified:

For 2/3rd - 1,77,460

For 1/6th - ? (2/3 - 1/2 = 1/6)

* [(1,77,460 ÷ 2/3) × 1/6] = 44,365

Illustration 33:

The following figures are supplied to you by contractor for the year ending 31st December, 2012.

Particulars	₹
Work-in-Progress on 31-12-2011	₹ 85,000
Less: Cash received from contractee	₹ <u>55,000</u>
During the year:	
Wages	8,500
Materials bought	6,000
Working expenses	1,500
Materials issued from stores	10,500
Administrative expenses (₹250 are chargeable to Profit and Loss Account)	1,250
Plant	2,500
Material returned to supplier	450
Material returned to stores	550
Work certified	15,000
Contracts finished	22,500
Profits taken upon contracts	11,500
Advances from contractee	40,000

Prepare Contract Ledger Accounts, and the total contractee's and show the work-in-progress as it would appear in the Balance sheet.

Solution:

Dr.		Contract Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹	Particulars	Amount ₹
To, Work-in-Progress A/c	85,000	By, W.I.P A/c			
To, Wages A/c	8,500	Work certified	15,000		
To, Materials A/c	6,000	Work uncertified	<u>88,000</u>		1,03,000
To, Materials A/c	10,500	By, Material returned (supplier)			450
To, Working Expenses A/c	1,500	By, Material returned (stores)			550
To, Administration Expenses A/c	1,000	By, Contractee A/c			22,500
To, Plant	2,500				
To, P & L A/c	11,500				
	1,26,500				1,26,500



Dr.		Contractee Account		Cr.	
Particulars	Amount ₹	Particulars		Amount ₹	
To, Contract A/c	22,500	By, Balance b/d		55,000	
To, Balance c/d	72,500	By, Cash A/c		40,000	
	95,000			95,000	

Balance Sheet as on

Liabilities	Amount ₹	Assets	Amount ₹
		W.I.P	1,03,000
		(-) Cash received	72,500
			30,500

Illustration 34:

The information given under has been extracted from the books of a contractor relating to contract for ₹3,75,000.

	I YEAR	II YEAR	III YEAR
	₹	₹	₹
Materials	45,000	55,000	31,500
Direct Expenses	1,750	6,250	2,250
Indirect expenses	750	1,000	---
Wages	42,500	57,500	42,500
Total work certified	87,500	2,82,500	3,75,000
Uncertified work	---	5,000	---
Plant	5,000	---	---

The value of plant at the end of I year was ₹4,000 at the end of II year ₹2,500 and at the end of III year it was ₹1,000. It is customary to pay 90% in cash of the amount of work certified. Prepare the contract Account and show how the figures would appear in the balance sheet.

Solution:

Dr.		Contract Account		Cr.	
Particulars	Amount ₹	Particulars		Amount ₹	
Ist Year					
To, Materials A/c	45,000	By, W.I.P A/c			
To, Direct Expenses A/c	1,750	Work certified	87,500		
To, Indirect Expenses A/c	750	Work uncertified	Nil	87,500	
To, Wages A/c	42,500	By, Plant A/c		4,000	
To, Plant A/c	5,000	By, P & L A/c		3,500	
	95,000			95,000	

Particulars	Amount ₹	Particulars	Amount ₹
IInd Year			
To, Work in progress A/c	87,500	By, W.I.P A/c	
To, Materials A/c	55,000	Work certified	2,82,500
To, Direct Expenses A/c	6,250	Work uncertified	<u>5,000</u>
To, Plant A/c	4,000	By, Plant A/c	2,87,500
To, Wages A/c	57,500		2,500
To, Indirect Expenses A/c	1,000		
To, P & L A/c	47,250		
To, Reserve c/d	31,500		
	2,90,000		2,90,000
IIIRD Year			
To, Work in progress A/c	2,87,500	By, Reserve b/d	31,500
To, Plant A/c	2,500	By, Contractee A/c	3,75,000
To, Materials A/c	31,500	By, Plant A/c	1,000
To, Direct expenses A/c	2,250		
To, Wages A/c	42,500		
To, P & L A/c	41,250		
	4,07,500		4,07,500

Balance Sheet as on

Liabilities	Amount ₹	Assets	Amount ₹
Ist Year			
	----	Work in progress	87,500
		(-) Cash received (90%)	<u>78,750</u>
		Plant	4,000
IIInd Year			
	----	Work in progress	2,87,500
		(-) cash received (90%)	<u>2,54,250</u>
			33,250
		(-) Reserve	31,500
IIIRD Year		Plant	2,500

Illustration 35:

A firm of engineers undertook three contracts beginning on 1st Jan, 1st May and 1st August 2012. Their accounts on 30th November, 2012 showed the following position:

Particulars	Contract I ₹	Contract II ₹	Contract III ₹
Contract price	80,000	54,000	60,000
Materials	14,400	11,600	4,000
Wages	22,000	22,500	2,800
General expenses	800	550	200
Cash received for work certified	30,000	24,000	5,400
Work certified	40,000	32,000	7,200
Work uncertified	1,200	1,600	400
Wages outstanding	700	750	350
General expenses outstanding	150	100	50
Plant installed	4,000	3,200	2,400
Materials on hand	800	800	400



On the respective dates of the contracts, the plant was installed depreciation thereon being taken at 15% p.a. You are required to prepare:

(a) Accounts in the Contract Ledger;

Solution:

Contract Account							
Dr.	I ₹	II ₹	III ₹	Cr.	I ₹	II ₹	III ₹
To, Materials A/c	14,400	11,600	4,000	By, W.I.P A/c			
To, Wages (incl. o/s) A/c	22,700	23,250	3,150	Work certified	40,000	32,000	7,200
To, Gen Expenses A/c	950	650	250	Work uncertified	1,200	1,600	400
To, Dep. On plant A/c (4,000 x 15% x 11/12) (3,200 x 15% x 7/12) (2,400 x 15% x 4/12)	550	280	120	By, Material on hand A/c	800	800	400
To, Notional profit	3,400	--	480	By, P & L A/c	--	1,380	--
	42,000	35,780	8,000		42,000	35,780	8,000
To, P & L A/c (3,400 x 2/3 x 3/4)	1,700	--	--	By, Notional profit	3,400	--	480
To, Reserve c/d	1,700	--	480				
	3,400	--	480		3,400	--	480

Illustration 36:

The following is the Trial Balance of Premier Construction Company, engaged on the execution of contract No.747, for the year ended 31st December, 2012.

Contractee's Account	₹	₹
Amount received		3,00,000
Buildings	1,60,000	
Creditors		72,000
Bank Balance	35,000	
Capital Account		5,00,000
Materials	2,00,000	
Wages	1,80,000	
Expenses	47,000	
Plant	2,50,000	
	8,72,000	8,72,000

The work on Contract No.747 was commenced on 1st January, 2012 materials costing ₹ 1,70,000 were sent to the site of the contract but those of ₹ 6,000 were destroyed in an accident. Wages of ₹1,80,000 were paid during the year. Plant with a cost of ₹ 2 lakhs was used from 1st January to 30th September and was then returned to the stores. Materials of the cost of ₹ 4,000 were at site on 31st December, 2012. The contract was for ₹ 6,00,000 and the contractee pays 75% of the work certified. Work certified was 80% of the total contract work at the end of 2012. Uncertified work was estimated at ₹ 15,000 on 31st December, 2012.

Expenses are charged to the contract at 25% of wages. Plant is to be depreciated at 10% for the entire year.

Solution:

Dr.		Contract Account		Cr.	
Particulars	Amount ₹	Particulars		Amount ₹	
To, Materials A/c	1,70,000	By, Costing P & L A/c		6,000	
To, Wages A/c	1,80,000	By, Materials returned		4,000	
To, Dep. on plant A/c [2,50,000 x 9/12 x 10/100] [50,000 x 3/12 x 10/100]	20,000	By, W.I.P A/c		4,95,000	
To, Expenses (25%)	45,000	Work certified	4,80,000		
To, P & L A/c	45,000	Work uncertified	<u>15,000</u>		
To, Reserve c/d	45,000				
	5,05,000			5,05,000	

Dr.		Profit & Loss Account		Cr.	
Particulars	Amount ₹	Particulars		Amount ₹	
To, Contract A/c	6,000	By, Profit from Contract A/c		45,000	
To, Dep. on Plant [2,00,000 x 10% x 3/12]	5,000				
To, Expenses (47,000 – 45,000) A/c	2,000				
To, Net Profit	32,000				
	45,000			45,000	

Balance Sheet as on

Liabilities	Amount ₹	Assets		Amount ₹
To, Capital A/c	5,00,000	By, W.I.P A/c	4,95,000	
To, P & L A/c	32,000	(-) Cash received	<u>3,00,000</u>	
To, Creditors A/c	72,000		1,95,000	
		(-) Reserve	<u>45,000</u>	1,50,000
		By, Buildings A/c		1,60,000
		By, Bank A/c		35,000
		By, Material stock A/c		34,000
		By, Plant A/c		2,25,000
	6,04,000			6,04,000

Illustration 37:

A company of builders took to a multi-storied structure for ₹ 40,00,000 estimating the cost to be ₹ 36,80,000. At the end of the year, the company had received ₹ 14,40,000 being 90% of the work certified; work done but not certified was ₹40,000. Following expenditure were incurred.

	₹
Materials	4,00,000
Labour	10,00,000
Plant	80,000

Materials costing ₹ 20,000 were damaged. Plant is considered as having depreciated at 25%.

Prepare Contract Account and show all the possible figures that can reasonably be credited to Profit and Loss Account.



Solution:

Dr.		Contract Account		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹	Particulars	Amount ₹
To, Material	4,00,000	By, Costing P & L A/c			20,000
To, Labour	10,00,000	By, W.I.P A/c			
To, Depreciation	20,000	Work certified	16,00,000		
To, Notional Profit	2,40,000	Work uncertified	40,000		16,40,000
	16,60,000				16,60,000

- (i) $3,20,000 \times (1,420/3,680) = 1,23,478$
(ii) $3,20,000 \times (1,420/3,680) \times 90/100 = 1,11,130$
(iii) $3,20,000 \times 16/40 = 1,28,000$
(iv) $3,20,000 \times (16/40) \times (90/100) = 1,15,200$

Illustration 38:

The following Trial Balance was extracted on 31st December, 2012 from the books of Swastik Co. Ltd contractors:

	Dr.	Cr.
Share Capital:		
Shares of ₹10 each		₹ 3,51,800
P&L A/c on 1.1. 2012		25,000
Provision for Dep. on Machinery		63,000
Cash received on account Contract7		12,80,000
Creditors		81,200
Land and Buildings (Cost)	₹ 74,000	
Machinery (Cost)	52,000	
Bank	45,000	
Contract 7:		
Materials	₹ 6,00,000	
Direct Labour	8,30,000	
Expenses	40,000	
Machinery on site (Cost)	1,60,000	
	18,01,000	18,01,000

Contract 7 was begun on 1st Jan 2012. The contract price is ₹ 24,00,000 and the customer has so far paid ₹ 12,80,000 being 80% of the work certified.

The cost of the work done since certification is estimated at ₹ 16,000. On 31st December, 2012, after the above Trial Balance was extracted machinery costing ₹ 32,000 was returned to stores, and materials then on site were value at ₹27,000.

Provision is to be made for direct labour due ₹6,000 and for depreciation of all machinery at 12 1/2 % on cost.

You are required to prepare:

- The Contract Account;
- A Statement of Profit, if any, to be properly credited to profit and loss account for 2012 and
- The Balance Sheet of Swastik Co. Ltd as on 31st December.

Solution:

Dr.		Contract Account		Cr.	
Particulars	Amount ₹	Particulars		Amount ₹	
To, Material A/c	6,00,000	By, W.I.P A/c			
To, Direct labour A/c	8,36,000	Work certified	16,00,000	16,16,000	
To, Expenses A/c	40,000	Work uncertified	<u>16,000</u>		
To, Dep. on machinery A/c	20,000	By, Material at site A/c		27,000	
To, P & L A/c	78,400				
To, Reserve c/d	68,600				
	16,43,000			16,43,000	

Dr.		Profit and Loss Account		Cr.	
Particulars	Amount ₹	Particulars		Amount ₹	
To, Dep. on plant A/c	6,500	By, Balance b/d		25,000	
To, Net profit	96,900	By, Profit from contract A/c		78,400	
	1,03,400			1,03,400	

Balance Sheet as on

Liabilities	Amount ₹	Assets		Amount ₹
Share Capital	3,51,800	Machinery	2,12,000	
P & L A/c	96,900	(-) Provision	63,000	
Creditors	81,200	C.Year Depreciation	<u>26,500</u>	1,22,500
O/s Labour	6,000	W.I.P	16,16,000	
		(-) Cash received	<u>12,80,000</u>	
			3,36,000	
		(-) Reserve	<u>68,600</u>	2,67,400
		Land & Buildings		74,000
		Bank		45,000
		Stock of materials		27,000
	5,35,900			5,35,900

Illustration 39:

Kapur Engineering Company undertakes long term contract which involves the fabrication of pre stressed concrete block and the reaction of the same on consumer's life.

The following information is supplied regarding the contract which is incomplete on 31st March, 2012

Cost Incurred:	₹
Fabrication cost to date:	
Direct materials	2,80,000
Direct Labour	90,000
Overheads	<u>75,000</u>
	4,45,000
Erection cost to date	<u>15,000</u>
Total	<u>4,60,000</u>
Contract price	8,19,000
Cash received on account	6,00,000



Technical estimate of work completed to date:

Fabrication: Direct materials	80%
Direct labour and overheads	75%
Erection	25%

You are required to prepare a statement for submission to the management indicating

- The estimated profit on the completion of the contract;
- The estimated profit to date on the contract.

Solution:

Statement showing computation of profit on completion of contract and profit to date:

Particulars	Incurred to date ₹	To be incurred ₹	Total ₹
Material	2,80,000	70,000	3,50,000
Labour	90,000	30,000	1,20,000
Overheads	75,000	25,000	1,00,000
Erection	15,000	45,000	60,000
	4,60,000	1,70,000	6,30,000
Profit *			* 1,89,000
Contract Price			8,19,000

$$\begin{aligned} \text{Profit to date} &= 1,89,000 \times (6,00,000 / 8,19,000) = 1,38,461 \quad (\text{or}) \\ &= 1,89,000 \times (4,60,000 / 6,30,000) = 1,38,000 \end{aligned}$$

Illustration 40:

The following particulars are obtained from the books of Vinay Construction Ltd. as on March, 2012.

	₹
Plant and equipment at cost	4,90,000
Vehicles at cost	2,00,000

Details of contract with remain uncompleted as on 31-3-2012.

Particulars	Contract nos.		
	V.29	V.24	V.25
	(₹lacs)	(₹lacs)	(₹lacs)
Estimated final sales value	8.00	5.60	16.00
Estimated cost	6.40	7.00	12.00
Wages	2.40	2.00	1.20
Materials	1.00	1.10	0.44
Overheads (excluding dep.)	1.44	1.46	0.58
	4.84	4.56	2.22
Value certified by architects	7.20	4.20	2.40
Progress payments received	5.00	3.20	2.00

Depreciation of plant and Equipment and Vehicle should be charged at 20% to the three contracts in proportion to work certified. You are required to prepare statements showing contract-wise and total.

- Profit/loss to be taken to the P & L A/c for the year ended 31st March, 2012.

b) Work-in-progress as would appear in the Balance Sheet as at 31-03-2012.

Solution:

(₹ in Lacs)

Dr.	Contract Account			Cr.			
Particulars	V.29	V.24	V.25	Particulars	V.29	V.24	V.25
To, Expenses other than depreciation	4.84	4.56	2.22	By, W.I.P A/c			
To, Depreciation *	0.72	0.42	0.24	Work certified	7.20	4.20	2.40
To, Notional profit	1.64	--	--	By, P & L A/c	--	0.78	0.06
	7.20	4.98	2.46		7.20	4.98	2.46
To, P & L A/c	*1.00	--	--	By Notional profit	1.64	--	--
To, Reserve A/c	0.64	--	--				
	1.64	--	--		1.64	--	--

* V.29 ⇒ [6,90,000 x 20% x 7.2/13.8] = 0.72 and similarly for V.24 & V.25 also.

Profit to be transfer to Profit and Loss A/c = EP x CR/CP = 1.60 x 5.00/8 = 1*

Illustration 41:

A company is manufacturing building bricks and fire bricks. Both the products require two processes. Brick forming and Heat treatment. The requirements for the two bricks are:

	BUILDING BRICKS	FIRE BRICKS
Forming per 100 bricks	3 hrs.	2 hrs.
Heat treatment per 100 bricks	2hrs.	5 hrs.

Total costs of the two departments in one month were:

Forming	₹ 21,200
Heat Treatment	₹48,800

Production during the month was:

Building Bricks	1,30,000 Nos.
Fire Bricks	70,000 Nos.

Prepare statement of manufacturing costs for the two varieties of bricks.

Solution:

Statement Showing Number of Hours

Particulars	Buil. Bricks	Fire Bricks	Total
Forming			
(1,30,000/100) x 3	3,900	1,400	5,300
(70,000/100) x 2			
Heat treatment	2,600	3,500	6,100
(1,30,000/100) x 2			
(70,000/100) x 5			
Total	6,500	4,900	11,400

Cost of forming per hour = 21,200 / 5,300 = 4

Cost of Heat treatment per hour = 48,800 / 6,100 = 8



Statement showing computation of manufacturing cost per two varieties of bricks:

Particulars	Buil. Bricks ₹	Fire Bricks ₹	Total ₹
Forming (3,900 x 4), (1,400 x 4)	15,600	5,600	21,200
Heat treatment (2,600 x 8), (3,500 x 8)	20,800	28,000	48,800
Total	36,400	33,600	70,000

Illustration 42:

Deluxe limited undertook a contract for ₹5,00,000 on 1st July, 2011. On 30th June 2012 when the accounts were closed, the following details about the contract were gathered:

Particulars	₹
Materials purchased	1,00,000
Wages paid	45,000
General expenses	10,000
Plant Purchased	50,000
Materials on hand 30-6-2012	25,000
Wages accrued 30-6-2012	5,000
Work certified	2,00,000
Cash received	1,50,000
Depreciation of Plant	5,000
Work uncertified	15,000

The above contract contained an escalator clauses which read as follows:

“In the event of prices of materials and rates of wages increase by more than 5% the contract price would be increased accordingly by 25% of the rise in the cost of materials and wages beyond 5% in each case”.

It was found that since the date of signing the agreement the prices of materials and wage rates increased by 25% the value of the work certify does not take into account the effect of the above clause.

Prepare the contract account. Working should form part of the answer.

Solution:

$$\begin{aligned}\text{Cost of material \& wages incurred} &= ₹ (1,00,000 + 45,000 + 5,000 - 25,000) \\ &= ₹1,25,000\end{aligned}$$

$$\begin{aligned}\text{Cost of material \& wages before increase in prices} &= ₹ (1,25,000 \times 100/125) \\ &= ₹1,00,000\end{aligned}$$

$$\begin{aligned}\text{Increase in contract price} &= ₹25/100 [1,25,000 - ₹ (1,00,000 \times 105/100)] \\ &= ₹5,000 *\end{aligned}$$

Dr.		Contract Account		Cr.	
Particulars	Amount ₹	Particulars		Amount ₹	
To, Material purchased A/c	1,00,000	By, Material on hand		25,000	
To, Wages A/c	50,000	Work certified	2,05,000	2,20,000	
To, General Expenses A/c	10,000	Work uncertified	<u>15,000</u>		
To, Depreciation on plant	5,000				
To, P & L A/c	19,512				
To, Reserve c/d	60,488				
	2,45,000			2,45,000	

1.3.5 Process Costing

Process costing is that aspect of operation costing which is used to ascertain the cost of the product at each process or stage of manufacture. This method of accounting used in industries where the process of manufacture is divided into two or more processes. The objective is to find out the total cost of the process and the unit cost of the process for each and every process. Usually the industries where process costing used are textile, oil industries, cement, pharmaceutical etc.

1.3.5.1 Features of Process Costing:

- Production is done having a continuous flow of products having a continuous flow of identical products except where plant and machinery is shut down for repairs etc.
- Clearly defined process cost centres and the accumulation of all costs by the cost centres.
- The maintenance of accurate records of units and part units produced and cost incurred by each process.
- The finished product of one process becomes the raw material of the next process or operation and so on until the final product is obtained.
- Avoidable and unavoidable losses usually arise at different stages of manufacture for various reasons.
- In order to obtain accurate average costs, it is necessary to measure the production at various stages of manufacture as all the input units may not be converted into finished goods.
- Different products with or without by-products are simultaneously produced at one or more stages or processes of manufacture. The valuation of by-products and apportionment of joint cost before joint of separation is an important aspect of this method of costing.
- Output is uniform and all units are exactly identical during one or more processes. So the cost per unit of production can be ascertained only by averaging the expenditure incurred during a particular period.

1.3.5.2 Applications of Process Costing:

The industries in which process costs may be used are many. In fact a process costing system can usually be devised in all industries except where job, batch or unit or operation costing is necessary. In particular, the following are examples of industries where process costing is applied:

Chemical works	Textile, weaving, spinning etc.
Soap making	Food products
Box making	Canning factory
Distillation process	Coke works
Paper mills	Paint, ink and varnishing etc.
Biscuit works	Meat products factory
Oil refining	Milk dairy



Difference between Job Costing and Process Costing:

	Job Costing	Process Costing
(i)	The form of specific order costing which applies where the work is undertaken to customer's special requirements.	That form of costing which applies where standardised goods are produced and production is in continuous flow, the products being homogeneous.
(ii)	The job is the cost unit and costs are collected for each job.	Costs are collected by process or department on time basis and divided by output for a period to get an average cost per unit.
(iii)	Losses are generally not segregated.	Normal losses are carefully predetermined and abnormal losses are segregated.
(iv)	Overheads are allocated and apportioned to cost centres then absorbed by jobs, in proportion to the time taken.	Units pass through the same processes. Overheades are apportioned to processes on some suitable basis, some times, pre-determined rates may be used
(v)	Joint products / By-products do not usually arise in jobbing work.	Joint products/By-products do arise and joint cost apportionment is necessary.
(vi)	Standard costing is generally not suitable for jobbing work.	The standardised nature of products and processing methods lends itself to the adoption of standard costing.
(vii)	Work-in-progress valuation is specific and is obtained from analysis of outstanding jobs.	For WIP valuation operating costs have to be spread over fully complete output and partially complete products using the concept of equivalent units.
(viii)	Each job is separate and independent of others. Costs are computed when a job is complete.	Products lose their individual identity as they are manufactured in a continuous flow. Costs are calculated at the end of cost period.
(ix)	There are usually no transfers from one job to another unless there is a surplus work or excess production.	Transfer of costs from one process to another is made, as the product moves from one process to another.
(x)	There may or may not be work-in-progress at the beginning or end of the accounting period.	There is always some work-in-process at the beginning as well as at the end of the accounting period.
(xi)	Proper control is comparatively difficult as each product unit is different and the production is not continuous.	Proper control is comparatively easier, as the production is standardised and is more stable.
(xii)	It requires more forms and details.	It requires few forms and less details.

1.3.5.3 Normal Process Loss:

It is the loss which is unavoidable on account of inherent nature of production process. Such loss can be estimated in advance on the basis of past experience or available data. The normal process loss is recorded only in terms of quantity and the cost per unit of usable production is increased accordingly. Where scrap possesses some value as a waste product or as raw material for an earlier process, the value thereof is credited to the process account. This reduces the cost of normal output; process loss is shared by usable units.

1.3.5.4 Abnormal Process Loss:

Any loss caused by unexpected or abnormal conditions such as plants breakdown, sub-standard materials, carelessness, accident etc., or loss in excess of the margin anticipated for normal process loss should be regarded as abnormal process loss. The units of abnormal loss or gain are calculated as under:

Abnormal loss (or gain) = Total Loss – Normal Loss

The valuation of abnormal loss should be done with the help of this formula:

$$\text{Value of Abnormal Loss} = \frac{(\text{Normal Cost of Normal Output})}{(\text{Normal Output})} \times \text{Units of Abnormal Loss}$$

1.3.5.5 Abnormal Gain:

We know that margin allowed for normal loss is an estimate, (i.e., on the basis of expectation in process industries in normal conditions) and slight differences are bound to occur between the actual output of a process and that anticipated. These differences will not always represent increased loss, on occasions the actual loss will be less than that expected. Thus, when actual loss in a process is smaller than that was expected, an abnormal gain results. The value of the gain will be calculated in similar manner to an abnormal loss.

The Abnormal Gain Account is to be debited for the loss of income on account of less quantity of sale of scrap available as a result of abnormal gain and Normal Process Loss Account credited accordingly. The balance is transferred to Costing Profit and Loss Account as abnormal gain.

1.3.5.6 Inter Process Profits:

Sometimes the output of one process is transferred to a subsequent process, not at cost, but at a price, showing a profit to the transferor process. Transfer price may be made at a price corresponding to current wholesale market price or at cost plus an agreed percentage. The objects are:

- (a) To show whether the cost of production competes with the market prices,
- (b) To make each process stand on its own efficiency and economies, i.e., the transferee processes are not given the benefits of economies affected in the earlier process.

This system involves a rather unnecessary complication of the accounts, as the desired comparisons could be prepared on separate cost reports for each process or by adopting a standard costing system, when standards could be set for each process. The complexity brought into the accounts arises from the fact that the inter-process profits so introduced remain included in the price of process stocks, finished stocks and work-in-progress.

1.3.5.7 Equivalent Production:

This represents the production of a process in terms of completed units. In other words it means converting the incomplete production units into its equivalent of complete units. In each process an estimate is made of the percentage completion of any work-in-progress. A production schedule and a cost schedule will then be prepared. The work-in-progress is inspected and an estimate is made of the degree of completion, usually on a percentage basis. It is most important that this estimate is as accurate as possible because a mistake at this stage would affect the stock valuation used in the preparation of final accounts. The formula for equivalent production is:

Equivalent units of work-in-progress

$$= \text{Actual no. of units in process of manufacture} \times \text{Percentage of work completed}$$

For example, if 20% work has been done on the average of 1,000 units still in process, then 1,000 such units will be equal to 200 completed units. The cost of work-in-progress will be equal to 200 completed units.

1.3.5.8 Calculation of Equivalent Production:

The following steps are worth noting in its calculation:

- (a) State the opening work-in-progress in equivalent completed units by applying the percentage of work needed to complete the unfinished work of the previous period. If the opening work-in-progress



is 100 units which is 40 percent completed, then the equivalent units of this will be $100 \times 60\%$ i.e. 60 units.

- (b) Add to (a), the number of units started and completed during the period. This can be found out by deducting the units in the closing work-in-progress from the number of units put into the process.
- (c) Add to the above, the equivalent completed units of closing work-in-progress. This can be found out by applying the percentage of work done on the finished units at the end of the period.

There are mainly three methods of calculating cost per unit, out of which FIFO method and Weighted Average Method is used in equivalent production.

1.3.5.9 First In First Out Method [FIFO]:

In this method, the assumption is that the incomplete units from the opening stock are completed first and then the units introduced in the process are completed. The costs added in each process during the current period is prorated to the production necessary to complete the opening work in progress, to complete the units added in the process and units in the work in progress. The objective of the first in first out method is to value the inventory at the current costs and as such the main problem is to calculate the equivalent production under this method.

1.3.5.10 Average Method:

Process costs are sometimes computed on the basis of average costs. Where degree of completion of opening work in progress is not given, average method is used. The average process cost is obtained by adding the cost of opening work in progress and the cost of units introduced in the process during the current period and dividing this total cost by total equivalent units obtained by adding the number of units completed and equivalent units of the closing work in progress of each element, material, labor and overheads. The main object of average method is to even out the fluctuations in prices and hence is used when the prices fluctuate widely during a particular period.

1.3.5.11 Weighted Average Method:

If a manufacturing unit is manufacturing two or more products, which are quite dissimilar to each other, weighted average method is used. Under this method, weighted average is computed and used in valuation of the incomplete units.

Illustration 43:

The following particulars for process II are given:

Particulars	UNITS	₹
Transfer to process II at cost	4,000	9,000
Direct wages		2,000
Direct material		3,000
Transfer to Finished stock	3,240	

Factory overheads in process are absorbed at a rate of 400% of direct material. Allowance for Normal loss is 20% of Units worked. Scrap value is ₹ 5 per unit.

Evaluate the cost of transfer to finished stock. Using the information supplied above, show the amount of gain or loss in the process to be taken to Cost Profit and Loss A/c.

Solution:

Dr.		PROCESS-II- Account		Cr.	
Particulars	Units	₹	Particulars	Units	₹
To, Transfer from Process	4000	9,000	By Normal Loss A/c	800	4000
To, Direct Wages A/c		2,000	(4000 x 20%) x 5		
To, Direct Material A/c		3,000	By Transfer to Finished Stock A/c	3,420	22,275
To, Factory Overheads 3000x 400%		12,000	@ 6.875 per unit		
To, Abnormal Gain A/c $\frac{(26000-4000)}{(4000-800)} \times 40$	40	275			
	4,040	26,275		4,040	26,275

Dr.		Abnormal Gain Account		Cr.	
Particulars	Units	₹	Particulars	Units	₹
To, Costing Process II A/c	40	200	By, Process II A/c	40	275
To, Costing Profit & Loss A/c	-	75			
	40	275		40	275

Illustration 44:

Product-X is obtained after it passes through three distinct processes. You are required to prepare process account from the following information:

	PROCESSES			
	TOTAL	I	II	III
Material	15,084	5,200	3,960	5,924
Direct wages	8,000	4,000	6,000	8,000
Production overheads	18,000	-	-	-

1,000 units @ ₹ 6 per unit was introduced in Process I production overhead to be distributed at 100% on direct wages.

ACTUAL OUTPUT	UNIT	NORMAL LOSS	VALUE OF SCRAP (per unit)
Process-I	950	5%	4
Process-II	840	10%	8
Process-III	750	15%	10

Prepare Process Accounts for I & II & III

Solution:

Dr.		PROCESS-I- Account		Cr.	
Particulars	Units	₹	Particulars	Units	₹
To, Material introduced 1000 @ 6%	1000	6,000	By, Normal Loss	50	200
To, Additional Material A/c		5,200	By, Transfer to Process-II A/c @ ₹20/- per unit	950	19,000
To, Direct Labour A/c		4,000			
To, Production Overheads A/c		4,000			
	1000	19,200		1000	19,200



Dr. PROCESS-II- Account			Cr.		
Particulars	Units	₹	Particulars	Units	₹
To, Transfer from Process –I A/c	950	19,000	By, Normal Loss	95	760
To, Direct Material		3,960	By, Abnormal Loss	15	600
To, Direct Labour		6,000	$\frac{34960-760}{950-95} \times 15$		
To, Production Overheads		6,000	By, Transfer to Process-III A/c @ ₹40/-	840	33,600
	950	34,960		950	34,960

Dr. PROCESS-III- Account			Cr.		
Particulars	Units	₹	Particulars	Units	₹
To, Transfer from Process –II A/c	840	33,600	By, Normal Loss	126	1,260
To, Direct Material A/c		5,924	By, Transfer to Finished Stock A/c	750	57,000
To, Direct Labour A/c		8,000	@ ₹76 per unit		
To, Production Overheads A/c		8,000			
To, Abnormal Gain A/c	36	2,736			
$\frac{55524-1260}{840-126} \times 36$					
	876	58,260		876	58,260

Illustration 45 :

A product passes through three processes— A, B and C. 10,000 units at a cost of ₹1.10 were issued to Process A. The other direct expenses were as follows:

	PROCESS-A	PROCESS-B	PROCESS-C
Sundry materials	1,500	1,500	1,500
Direct labour	4,500	8,000	6,500
Direct expenses	1,000	1,000	1,503

The wastage of process 'A' was 5% and in process 'B' 4%

The wastage of process 'A' was sold at ₹0.25 per unit and that of 'B' at ₹ 0.50 per unit and that of C at ₹ 1.00.

The overhead charges were 160% of direct labour. The final product was sold at ₹10 per unit fetching a profit of 20% on sales. Find out the percentage of wastage in Process 'C'

Solution:

Dr. PROCESS-A- Account			Cr.		
Particulars	Units	₹	Particulars	Units	₹
To, Material introduced A/c	10000	11,000	By Normal Loss A/c (10000 x 5%) x 0.25	500	125
To, Additional Material A/c		1,500	By Transfer to Process-B A/c @ ₹2.64 per unit	9500	25075
To, Direct Labour A/c		4,500			
To, Direct Expenses A/c		1,000			
To, Overheads A/c		7,200			
	10000	25,200		10000	25,200

Dr. PROCESS-B- Account			Cr.		
Particulars	Units	₹	Particulars	Units	₹
To, Transfer from Process-A A/c	9500	25,075	By, Normal Loss A/c (9,500 x 4%) x 0.5	380	190
To, Direct Material A/c		1,500	By, Transfer to Process-C A/c	9120	48,185
To, Direct Labour A/c		8,000	@ ₹ 5.283		
To, Direct Expenses A/c		1,000			
To, Overheads A/c		12,800			
	9,500	48,375		9,500	48,375

Dr. PROCESS-C- Account			Cr.		
Particulars	Units	₹	Particulars	Units	₹
To, Transfer from Process-B A/c	9120	48,185	By, Normal Loss A/c	696	696
To, Direct Material A/c		1,500	By, Transfer to Finished Stock A/c	8424	67,392
To, Direct Labour A/c		6,500	@ ₹8/- per unit		
To, Direct Expenses A/c		1,503			
To, Overheads A/c		10,400			
	9120	68,088		9120	68,088

Working Notes:

Let the No. of units of loss in Process 'C' be 'x'

Scrap value = $x \times 1 = ₹ x$

$68,088 - x = 8(9,120 - x)$ units

$68,088 = 72,960 - 7x$

$7x = 4,872$

$X = 696$ units

Required % is

$9120 - 696$

$100 - ?$

$= 7.63\%$

Illustration 46:

An oil company gives the following cost data. You are required to prepare various accounts. Purchases of 1,000 quintals of copra @ ₹ 500 per quintal.

Particulars	Crushing	Refining	Finishing
	₹	₹	₹
Cost of labour	6,600	3,000	3,000
Electric Power	1,000	500	400
Sundry Material	700	200	-
Repair to machinery and plant	500	400	400
Steam	250	150	100
Other Factory Expenses	4950	2250	2250

₹ 9,450, to be charged at 75% of wages

Cost of Casks - ₹ 580, Normal loss in 1st process was 30% of input, actual output 690 quintals.

Process II: By product 90 quintals value ₹ 6,200



Process III: Normal loss 5% Actual output 580 quintals

Scrap of 1st process realised ₹ 10 per quintal.

Solution:

Dr. Crushing Process - Account Cr.

Particulars	Units	₹	Particulars	Units	₹
To, Copra introduced	1000	5,00,000	By, Normal Loss A/c	300	3,000
To, Wages A/c		6,600	[30% x 1000] x ₹10		
To, Electric Row A/c		1,000	By, Abnormal Loss A/c	10	7,300
To, Material A/c		700	$\frac{5,14,000-3,000}{1,000-300} \times 10$		
To, Repair to Machinery and Plant A/c		500	By, Transfer to Refining Process-A/c @ ₹ 730/-per unit	690	5,03,700
To, Steam A/c		250			
To, Factory Expenses A/c		4,950			
	1000	5,14,000		1000	5,14,000

Dr. Refining Process- Account Cr.

Particulars	Units	₹	Particulars	Units	₹
To, Transfer from Crushing Process A/c	690	5,03,700	By, Stock of By-products A/c	90	6,200
To, Labour Expenses A/c		3,000	By, Transfer to Finishing Process A/c @ ₹ 840 per unit	600	5,04,000
To, Power A/c		500			
To, Material A/c		200			
To, Machinery and Plant Repairs A/c		400			
To, Steam A/c		150			
To, Other Factory Expenses A/c		2,250			
	690	5,10,200		690	5,10,200

Dr. Finishing Process- Account Cr.

Particulars	Units	₹	Particulars	Units	₹
To, Transfer from Refining Process A/c	600	5,04,000	By, Normal Loss A/c	30	-
To, Labour A/c		3,000	By, Transfer to Finished Stock A/c	580	5,19,100
To, Power A/c		400			
To, Repairs A/c		400			
To, Steam A/c		100			
To, Factory Expenses A/c		2,250			
To, Abnormal Gain A/c	10	8,950			
$\left(\frac{5,10,150}{600} \times 10 \right)$					
	610	5,19,100		610	5,19,100

Illustration 47:

Product A passes through three processes before it is transferred to finished stock. The following information is obtained for the month of July:

	PROCESSES			Finished Stock
	I ₹	II ₹	III ₹	
Opening Stock (₹)	5,000	8,000	10,000	20,000
Direct Materials (₹)	40,000	12,000	15,000	-
Direct Wages (₹)	35,000	40,000	35,000	-
Manufacturing Overhead (₹)	20,000	24,000	20,000	-
Closing Stock (₹)	10,000	4,000	15,000	30,000
Profit % on Transfer Price to next process	25%	20%	10%	-
Unrealised profit for opening stock (₹)		1,395	2,690	6,534

Stocks in process are valued at prime cost and finished stock has been valued at the price at which it is received from process III. Sales during the period were ₹ 4,00,000.

Prepare and compute:

- (a) Process Cost Accounts showing profit element at each stage,
- (b) Actual realized profit, and
- (c) Stock valuation for Balance sheet purpose.

Solution:

Dr.				PROCESS-I Account				Cr.			
Particulars	Cost ₹	Profit ₹	Total ₹	Particulars	Cost ₹	Profit ₹	Total ₹				
To, Opening Stock A/c	5,000	-	5,000	By, Transfer to Process-II A/c	90,000	30,000	1,20,000				
To, Direct Materials A/c	40,000	-	40,000								
To, Direct Wages A/c	35,000	-	35,000								
	80,000	-	80,000								
Less: Closing Stock	10,000	-	10,000								
	70,000	-	70,000								
To, Manufacturing Overheads A/c	20,000	-	20,000								
	90,000	-	90,000								
Add: Profit	-	30,000	30,000								
	90,000	30,000	1,20,000		90,000	30,000	1,20,000				



Dr. PROCESS-II- Account Cr.

Particulars	Cost ₹	Profit ₹	Total ₹	Particulars	Cost ₹	Profit ₹	Total ₹
To, Opening Stock A/c	6,605	1,395	8,000	By, Transfer to Finished Stock A/c	1,69,303	80,697	2,50,000
To, Transfer from Process-I A/c	90,000	30,000	1,20,000				
To, Direct Materials A/c	12,000	-	12,000				
To, Direct Wages A/c	40,000	-	40,000				
	1,48,605	31,395	1,80,000				
Less: Closing Stock	3,302	698	4,000				
	1,45,303	30,697	1,76,000				
To, Factory Overheads A/c	24,000	-	24,000				
	1,69,303	30,697	2,00,000				
Add: Profit	-	50,000	50,000				
	1,69,303	80,697	2,50,000		1,69,303	80,697	2,50,000

Dr. PROCESS-III- Account Cr.

Particulars	Cost ₹	Profit ₹	Total ₹	Particulars	Cost ₹	Profit ₹	Total ₹
To, Opening Stock A/c	7,310	2,690	10,000	By, Transfer to Finished Stock A/c	2,35,648	1,14,352	3,50,000
To, Transfer from Process-I A/c	1,69,303	80,697	2,50,000				
To, Direct Materials A/c	15,000	-	15,000				
To, Direct Wages	35,000	-	35,000				
	2,26,613	83,387	3,10,000				
Less: Closing Stock	10,695	4,035	15,000				
	2,15,648	79,352	2,95,000				
To, Manufacturing Overheads A/c	20,000	-	20,000				
	2,35,648	79,352	3,15,000				
Add: Profit	-	35,000	35,000				
	2,35,648	1,14,352	3,50,000		2,35,648	1,14,352	3,50,000

Dr. Finished Stock - Account Cr.

Particulars	Cost ₹	Profit ₹	Total ₹	Particulars	Cost ₹	Profit ₹	Total ₹
To, Opening Stock A/c	13,466	6,534	20,000	By, Sales A/c	2,28,916	1,71,084	4,00,000
To, Transfer from Process-III A/c	2,35,648	1,14,352	3,50,000	By, Closing Stock A/c	20,198	9,802	30,000
To, Profit	-	60,000	60,000				
	2,49,114	1,80,886	4,30,000		2,49,114	1,80,886	4,30,000

Statement showing actual realized profit

Stage	Apparent profit ₹	Opening Stock ₹	Closing Stock ₹	Net ₹	Actual Realised Profit ₹
Process-I	30,000	-	-	-	30,000
Process II	50,000	1,395	698	697 (+)	50,697
Process III	35,000	2,690	4,035	1,345 (-)	33,655
Finished Stock	60,000	6,534	9,802	3,268 (-)	56,732
	1,75,000	10,619	14,535	3,916(-)	1,71,084

Calculation of Closing Stock for balance Sheet purpose

Particulars	₹
Process-I	10,000
Process II	3,302
Process III	10,965
Finished Stock	20,198
	44,465

Illustration 48:

	Degree of completion			
Opening stock	1,600	Units	Material	70%
			Labour	60%
			Overhead	60%
Transfer from Process I	10,200	Units		
Transfer to next process	9,200	Units		
Units scrapped	800	Units		
Normal loss 10% of Input				
Closing stock	1,800	Units	Material	60%
			Labour	40%
			Overhead	40%

Prepare a Statement of Equivalent Production.

Solution:

Statement of Equivalent Production

Input	Output	Units	Material		Labour		Overheads	
			%	Units	%	Units	%	Units
1600	Opening Stock	1600	30	480	40	640	40	640
10200	Normal Loss	1000	-	-	-	-	-	-
	Finished Units	7600	100	7600	100	7600	100	7600
	Closing Stock	1800	60	1080	40	720	40	720
	Less: Abnormal Gain	200	100	200	100	200	100	200
11800		11800		8960		8760		8760



Normal Loss =			
Opening Stock	1,600	Finished Units	9,200
Add: Process – I	<u>10,200</u>		<u>1,600</u>
	11,800		7,600
Less: Closing Stock	<u>1,800</u>		
	10,000		
10,000 x 10%	<u>=1,000</u>		

Illustration 49:

From the following information compute (i) Equivalent production (ii) statement of apportionment of cost, (iii) prepare Process Account.

Work-in-progress (opening) 200 units @ ₹4 per unit	State of completion 100% Material 40% Labour & Overheads
Units introduced 1050 Transfer to next process 1100 units Closing stock 150 units	100% Material 70% Labour and Overhead

Other information:	₹
Material cost	1,050
Labour	2,250
Production Overhead	<u>1,125</u>
	4,425

Solution:

Statement of Equivalent Production

Input	Output	Units	Material		Labour		Overheads	
			%	Units	%	Units	%	Units
200	Opening Stock	200	-	-	60	120	60	120
1,050	Finished Stock (1100-200) during this period	900	100	900	100	900	100	900
	Closing Stock	150	100	150	70	105	70	105
1250		1,250		1,050		1,125		1,125

Statement of Cost per unit

Particulars	Cost ₹	Equivalent units	Cost per unit ₹
Material	1,050	1,050	1
Labour	2,250	1,125	2
Production Overhead	1,125	1,125	1

Value of Closing Stock

Element	Units	Cost per unit ₹	Total Cost ₹
Material	150	1	150
Labour	105	2	210
Overhead	105	1	105
			<u>465</u>

Dr.		Process Account				Cr.	
Particulars	Units	₹	Particulars	Units	₹		
To, Opening Stock A/c	200	800	By, Closing Stock	150	465		
To, Material A/c	1050	1,050	By, Transfer to Finished Stock A/c @ ₹ 4.327 per unit	1100	4,760		
To, Labour A/c		2,250					
To, Overheads A/c		1,125					
	1,250	5,225		1,250	5,225		

Working Note for checking transfer value to the finished stock:

Element	Units	Cost per unit ₹	Total Cost ₹
Material	-	-	800
Labour	120	2	240
Overhead	120	1	120
			1,160
900 x 4			3,600
			4,760

Illustration 50:

From the following information prepare process account.

OPENING STOCK		DEGREE OF COMPLETION
800 Units @ ₹6 per unit	₹ 4,800	Material I - 100% Material II - 60% Labour & Overheads 40%
Transfer from Process NO - I 12,000 units costing	₹16,350	
Transfer to next process	9,700 units	
Normal process loss	10%	
Closing stock	1,800 units	

Degree of Completion: For units scrapped:- Material 100% Labour and Overheads 50%.

For closing stock: Material 60%; Labour and overheads 50%

Scrap realized Re.1.00 per unit

Other information: Material ₹10,500; Labour ₹20,760; Overheads ₹16,670

Solution:

Statement of Equivalent Production

Input	Output	Units	Material-I		Material - II		Labour		Overheads	
			%	Units	%	Units	%	Units	%	Units
800	Opening Stock	800	-	-	40	320	60	480	60	480
12000	Normal Loss (800+12000-1800) x 10%	1100	-	-	-	-	-	-	-	-
	Finished Units (9700-800)	8900	100	8900	100	8900	100	8900	100	8900
	Closing Stock	1800	100	1800	60	1080	50	900	50	900
		12600		10700		10300		10280		10280
	Add: Abnormal Loss	200		200	100	200	50	100	50	100
12800		12800		10900		10500		10380		10380



Statement of Cost per unit

Particulars	Cost ₹	Equivalent Cost ₹	Cost per unit ₹
Material-I	16350	10900	1.5
Material-II	10500	10500	1.0
Labour	20760	10380	2.0
Overhead (16,670-1,100)	15570	10380	1.5

Value of Abnormal Loss

Element	Units	Cost per unit ₹	Total Cost ₹
Material-I	200	1.5	300
Material-II	200	1.0	200
Labour	100	2.0	200
Overhead	100	1.5	150
			850

Value of Closing Stock

Element	Units	Cost per unit ₹	Total Cost ₹
Material-I	1800	1.5	2,700
Material-II	1080	1.0	1,080
Labour	900	2.0	1,800
Overhead	900	1.5	1,350
			6,930

Dr.		Process Account		Cr.	
Particulars	Units	₹	Particulars	Units	₹
To, Opening Stock A/c	800	4,800	By, Normal Loss A/c	1100	1,100
To, Transfer from Process-I A/c	12000	16,350	By, Closing Stock A/c	1800	6,930
To, Material A/c		10,500	By, Abnormal Loss A/c	200	850
To, Labour A/c		20,760	By, Transfer to Net Process A/c	9700	60,200
To, Overheads A/c		16,670	@ ₹ 6.206 per unit		
	12800	69,080		12800	69,080

Illustration 51:

SM Ltd., furnished you the following information relating to process B for the month of October, 2012.

- Opening work-in-progress- NIL
- Units introduced - 10,000 units @ ₹3 per unit
- Expenses debited to the process; Direct materials ₹14,650; Labour ₹21,148; Overheads ₹ 42,000
- Finished output - 9,500 units
- Closing work-in-progress 350 units; Degree of completion : Material 100%; Labour and overheads 50%
- Normal loss in process- one percent of input
- Degree of completion of abnormal loss: Material 100% ; Labour and Overheads 80%
- Units scrapped as normal loss were sold at ₹1 per unit
- All the units of abnormal loss were sold at ₹2.50 per unit.

Prepare:

- (a) Statement of Equivalent Production
- (b) Statement of Cost
- (c) Process - B Account
- (d) Abnormal Loss Account

Solution:

Statement of Equivalent Production

Input	Output	Units	Material		Labour		Overheads	
			%	Units	%	Units	%	Units
10000	Normal Loss	100	-	-	-	-	-	-
	Finished Units	9500	100	9500	100	9500	100	9500
	Closing Stock	350	100	350	50	175	50	175
	Abnormal Loss	50	100	50	80	40	80	40
10000		10000		9900		9715		9715

Statement of Cost

Particulars	Cost ₹	Equivalent units	Cost per unit ₹
Material (30000+14650)-100	44,550	9,900	4.5000
Labour	21,148	9,715	2.1768
Overhead	42,000	9,715	4.3232

Value of Closing Stock

Element	Units	Cost per unit	Total Cost
Material	350	4.5	1575.00
Labour	175	2.1768	380.94
Overhead	175	4.3232	756.56
			2712.50

Say, ₹ 2713

Value of Abnormal Loss

Element	Units	Cost per unit	Total Cost
Material	50	4.5	225.000
Labour	40	2.1768	87.072
Overhead	40	4.3232	172.928
			485

Dr.

Process Account

Cr.

Particulars	Units	₹	Particulars	Units	₹
To, Material Introduced	10000	30000	By, Normal Loss A/c	100	100
To, Material A/c		14650	By, Abnormal Loss A/c	50	485
To, Labour A/c		21148	By, Closing Stock A/c	350	2,713
To, Overheads A/c		42000	By, Transfer to Next Process @ ₹ 11 per unit	9500	1,04,500
	10000	107798		10000	1,07,798



Abnormal Loss Account

Dr.			Cr.		
Particulars	Units	₹	Particulars	Units	₹
To, Process A/c	50	485	By, Debtors / Cash	50	125
			By, costing P & L A/c	-	360
	50	485		50	485

Illustration 52:

AB Ltd. is engaged in process Engineering Industry. During the month of April, 2012, 2,000 units were introduced in Process 'X'. The normal loss was estimated at 5% of input. At the end of the month 1,400 units had been produced and transferred to process Y. 460 units incomplete and 140 units after passing through fully the entire process had to be scrapped. The incomplete units had reached the following stage of completion.

Material	75% completed
Labour	50% completed
Overhead	50% completed

Following are the further information on the Process 'X'

	₹
Cost of the 2,000 units	58,000
Additional Direct Material	14,400
Direct Labour	33,400
Direct Overheads	16,700

Units scrapped raised ₹ 10 each. Prepare Statement of Equivalent Production, Statement of Cost, Statement of Evaluation and the Process X Account.

Solution:

Statement of Equivalent Production

Input	Output	Units	Material		Labour		Overheads	
			%	Units	%	Units	%	Units
2000	Normal Loss	100	-	-	-	-	-	-
	Closing Stock	460	75	345	50	230	50	230
	Finished Units	1,400	100	1,400	100	1,400	100	1,400
	Abnormal Loss	40	100	40	100	40	100	40
2000		2,000		1,785		1,670		1,670

Statement of Cost

Particulars	Cost	Equivalent	Cost per unit
	₹	Units	₹
Material (58000+14400)-1000	71,400	1,785	40
Direct Labour	33,400	1,670	20
Overhead	16,700	1,670	10

Value of Closing Stock

Element	Units	Cost per unit ₹	Total Cost ₹
Material	345	40	13800
Labour	230	20	4600
Overhead	230	10	2300
			20700

Value of Abnormal Loss

Element	Units	Cost per unit	Total Cost ₹
Material	40	40	1600
Labour	40	20	800
Overhead	40	10	400
			2800

Dr.

Process - 'X' Account

Cr.

Particulars	Units	₹	Particulars	Units	₹
To, Material introduced	2000	58,000	By, Normal Loss	100	1,000
To, Additional Material		14,400	By, Abnormal Loss	40	2,800
To, Labour		33,400	By, Closing Stock	460	20,700
To, Overheads		16,700	By, Transfer to Next Process @ ₹ 70 per unit.	1400	98,000
	2000	1,22,500		2000	1,22,500

Illustration 53:

The product of a manufacturing unit passes through two distinct processes. From the past experience the incidence of wastage is ascertained as under:

PROCESS 'A' 2%

PROCESS 'B' 10%

In each case the percentage of wastage is computed on the number of units entering the process concerned. The sales realisation of wastage in Process A and B are ₹ 25 per 100 units and ₹50 per 100 units respectively.

The following information is obtained for the month of April, 2012; 40,000 units of crude material were introduced in Process A at a cost of ₹ 16,000.

Particulars	PROCESS A ₹	PROCESS B ₹
Other Materials	16,000	5,000
Direct Labour	9,000	8,000
Direct Expenses	8,200	1,500
	Units	Units
Output	39,000	36,500
Finished Product Stock:		
April 1	6,000	5,000
April 30	5,000	8,000
Value of stock per unit on April 1st	1.20	1.60

Stocks are valued and transferred to subsequent process at weighted average costs. Prepare respective Process Accounts and Stock Accounts.



Solution:

Dr.		Process A- Account		Cr.	
Particular	Units	₹	Particular	Units	₹
To, Material Introduced	40000	16,000	By, Normal Loss A/c (40,000 x 2%) x 25/100	800	200
To, Additional Materials		16,000	By, Abnormal Loss A/c $\frac{49,200-200}{40,000-800} \times 200$	200	250
To, Direct Labour A/c		9,000	By, Transfer to Process-A Finished Stock A/c	39,000	48,750
To, Direct Expenses A/c		8,200			
	40,000	49,200		40,000	49,200

Dr.		Process – A Finished Stock Account		Cr.	
Particular	Units	₹	Particular	Units	₹
To, Opening Stock A/c	6,000	7,200	By, Closing Stock A/c	5,000	6,217
To, Transfer from Process –A-A/c	39,000	48,750	$\frac{55,950}{45,000} \times 5000$		
			By, Transfer to Process B A/c @ ₹ 1.243 per unit	40,000	49,733
	45,000	55,950		45,000	55,950

Dr.		Process-B- Account		Cr.	
Particulars	Units	₹	Particulars	Units	₹
To, Transfer from process – A Finished Stock A/c	40000	49,733	By, Normal Loss A/c (40000x 10%) x 50/100	4000	2,000
To, Other Materials		5,000	By, Transfer to Process-B Finished Stock A/c	36500	63,097
To, Direct Labour A/c		8,000			
To, Direct Expenses A/c		1,500			
To, Abnormal Gain A/c $\frac{64,233-2,000}{40,000-4,000} \times 500$	500	864			
	40,500	65,097		40,500	65,097

Dr.		Process – B Finished Stock Account		Cr.	
Particulars		₹	Particulars		₹
To, Opening Stock A/c	5000	8,000	By, Closing Stock A/c	8000	13,705
To, Transfer from Process –B A/c	36500	63,097	$\frac{71,097}{41,500} \times 8,000$		
			By, Transfer to Next Process A/c @ ₹ 1.7132 per unit	33500	57,392
	41500	71,097		41500	71,097

Illustration: 54

The following information is obtained in respect of process 3 of the month of August:

Opening Stock	1,000 units
Value	Direct Material (I) ₹ 390; Direct material (II) ₹ 75; Direct Labour - ₹ 112; Production overhead - ₹ 118.
Process 2 transfer	6,000 units at ₹ 2,360
Process 4 transfer	4,700 units.
Direct material added in process	₹ 520
Direct labour employed	₹ 1,036
Production Over Heads	₹ 1,541
Units scrapped	300
Degree of completion	Direct material 100% Direct labour 80% Production overhead 60%
Closing stock	2,000 units
Degree of completion:	Direct material 60% Direct labour 50% Production overhead 40%

Normal loss: 5% of production units scrap realised 0.20 each.

Prepare Process Account on weighted Average method.

Solution:w

Statement of Equivalent Production

Input	Particulars	Output		Material-II		Labour		Overheads	
		Units		Units	%	Units	%	Units	%
1000	Opening stock	--	--	--	--	--	--	--	--
6000	Normal loss	250	--	--	--	--	--	--	--
	Finished units	4700	4700	100	4700	100	4700	100	4700
	Closing stock	2000	2000	60	1200	50	1000	40	800
	Abnormal Loss *	50	50	100	50	80	40	60	30
7000		7000	6750		5950		5740		5530

Statement of Cost

	Material-I		Material-II		Labour		Overheads	
Opening stock	390		75		112		118	
Add: during the period	2360		520		1036		1541	
	2750							
Less: Scrap value of								
Normal Loss (250 x 0.2)	50	2700	595		1148		1659	
Cost per unit (₹)		0.40	0.10		0.20		0.30	



Calculation of closing stock:

		₹
Material I	2000 x 0.40	= 800
Material II	1200 x 0.10	= 120
Labour	1000 x 0.20	= 200
Overheads	800 x 0.30	= 240
		= 1360

Value of abnormal loss:

		₹
Material I	50 x 0.40	= 20
Material II	50 x 0.10	= 5
Labour	40 x 0.20	= 8
Overheads	30 x 0.30	= 9
		= 42

Dr.		Process – 3 Account		Cr.	
Particulars	Units	Amount ₹	Particulars	Units	Amount ₹
To, Opening Stock A/c	1000	695	By, Normal loss A/c	250	50
To, Transfer from Process 2 A/c	6000	2,360	By, Abnormal loss A/c	50	42
To, Material A/c		520	By, Closing stock A/c	2000	1,360
To, Labour A/c		1,036	By, Transfer to process 4 A/c	4700	4,700
To, Overheads A/c		1,541	@ ₹ 1 per unit		
	7000	6,152		7000	6,152

1.3.6 Joint and By-Products

1.3.6.1 Meaning of Joint Products:

In several industries more than one product emerge from the manufacturing process. These products are sometimes produced intentionally while in some cases they emerge out of the main manufacturing process. Such products are termed as either joint products or by-products. Though sometimes these terms are used interchangeably, there is a major difference between the two and therefore it is necessary to understand clearly the difference between them. Similarly there is a difference between the accounting of the two and hence it is essential to define clearly the concepts of joint products and by-products.

In CIMA Terminology defines joint products as "two or more products separated in the course of processing each having a sufficiently high value to merit recognition as a main product". Joint products imply that they are produced from the same basic raw material, are comparatively of equal importance, are produced simultaneously by a common process and may require further processing after the point of separation.

1.3.6.2 Difference Between Joint products and Co-products:

Joint products are frequently confused with co-products. However, there is significant difference between the two, the former being indivisible and the latter divisible. Common costs are allocable among products or services performed because each of the products or services could have been obtained separately. Therefore, any shared cost of obtaining them can be meaningfully allocated on the basis of relative

usage of the common facilities. For example, the cost of fuel or power may be allocated to products based on production volumes and metered usage. Co-products do not always arise from the same operation or raw materials and the quantity of co-products is within the control of manufacturer. Thus different quantities of car, jeep and trucks can be produced in car manufacturing industry according to the need of the concern.

1.3.6.3 Features of Joint Products:

- (a) Joint products are the result of utilization of the same raw material and same processing operations. The processing of a particular raw material may result into the output of two or more products.
- (b) All the products emerging from the manufacturing process are of the same economic importance. In other words, the sales value of those products may be more or less same and none of them can be termed as the major product.
- (c) The products are produced intentionally which implies that the management of the concerned organization has intention to produce all the products.
- (d) Some of joint products may require further processing or may be sold directly after the split off point.
- (e) The manufacturing process and raw material requirement is common up to a certain stage of manufacturing. After the stage is crossed, further processing becomes different for each product. This stage is known as 'split off' point. The expenditure incurred up to the split off point is called as joint cost and the apportionment of the same to different products is the main objective of the joint product accounting.
- (f) The management has little or no control over the relative quantities of the various products that will result.
- (g) Joint products are commonly produced in industries like, chemicals, oil refining, mining, meatpacking, automobile etc. In oil refining, fuel, oil, petrol, diesel, kerosene, lubricating oil are few examples of the joint products.

1.3.6.4 Accounting for Joint Product Cost:

Before we proceed to discuss the methods of accounting in case of joint products and by-products, it will be necessary to understand certain terms clearly. These terms are explained below:

- (i) **Split Off Point:** This is a point up to which, input factors are commonly used for production of multiple products, which can be either joint products or by-products. After this point, the joint products or byproducts gain individual identity. In other words, up to a certain stage, the manufacturing process is the same for all the products and a stage comes after which, the individual processing becomes different and distinct. For example, in a dairy, several products like, milk, ghee, butter, milk powder, ice-cream etc. may be produced. The common material is milk. The pasteurization of milk is a common process for all the products and after this process; each product has to be processed separately. This point is of special significance in the accounting of joint product and by-products because the joint cost incurred before this point is to be apportioned appropriately in the joint products.
- (ii) **Joint Costs:** Joint cost is the pre separation cost of commonly used input factors for the production of multiple products. In other words, all costs incurred before or up to the split off point are termed as joint costs or pre separation costs and the apportionment of these costs is the main objective of joint product accounting. Costs incurred after the split off point are post separation costs and can be easily identified with the products.



1.3.4.5 Accounting Treatment:

In case of joint products, the main objective of accounting of the cost is to apportion the joint costs incurred up to the split off point. As discussed earlier, the manufacturing process is same up to a certain stage and after crossing that stage; each product has distinct manufacturing process. Therefore the main problem is apportionment of the joint cost or the cost incurred up to the split off point. The total cost of production of the joint product will be cost incurred up to the split off point duly apportioned plus the cost incurred after the split off point. There is no problem of charging the cost incurred after the split off point as the cost can be identified easily. The main problem therefore is that of apportionment of the joint cost and the following methods are used for apportioning the same.

- (i) **Physical Quantity Method:** Under this method, cost apportionment is made in proportion to the volume of production. These physical measures may be units, pounds, liters, kilos, tones, gallons etc.
- (ii) **Average Unit Cost Method:** Under this method, the joint cost is apportioned to the joint products by computing the average unit cost of the product units. The average unit cost is computed by dividing the total manufacturing cost by the total number of units produced of all products. This method is useful where all the products produced are uniform with each other in all the respects. This method will not be useful if the production units are not similar with each other.
- (iii) **Weighted Average Method:** Under this method, weights are assigned to each unit based upon size of the units, difference in type of labor employed, material consumption, market share, efforts of labour required and so on. The joint cost is apportioned on the basis of the weights assigned to each product. This method is highly useful if the weights assigned are on objective basis. If subjective element creeps in, the method may not give accurate results.
- (iv) **Selling Price Method:** Under this method, the joint cost is apportioned on the basis of sales value at the split off point. The logic is that a product should bear the share of the joint cost according to its sale price. If sales price is higher than that of the other products, more share of joint cost should be charged to that product and if it is comparatively less than that of other products, less share of joint cost should be charged to the same. Though logically this method seems to be sound, in practice, charging higher share of joint cost to the product with higher sales value may not be justified due to the fact that lesser efforts are required for manufacturing of the same.

1.3.6.6 Meaning of By-Products:

The term 'by-products' is sometimes used synonymously with the term 'minor products'. The by-product is a secondary product, which incidentally results from the manufacture of a main product. By-products are also produced from the same raw material and same process operations but they are secondary results of operation. The main difference between the joint product and byproduct is that there is no intention to produce the by-product while the joint products are produced intentionally. The relationship between the by-product and the main product changes with changes in economic or industrial conditions or with advancement of science. The by-product of an industry may become a main product and main product may become a by-product subsequently.

For example, (a) in sugar industry, sugar is a main product and molasses is a by-product (b) in coke ovens, gas and tar are incidentally produced in addition to the main product coke. Gas and tar are, therefore, treated as by-products. These minor secondary products have saleable or usable value and are incidentally produced in addition to the main product.

In CIMA Terminology, By-product is "a product which is recovered incidentally from the material used in the manufacture of recognized main products such as having either a net realizable value or a usable value which is relatively low in comparison with the saleable value of the main products. By products may further be processed to increase their realizable value".

Thus the term 'by-product' is generally used by businessmen and accountants to denote one or more products of relatively small value that are produced simultaneously with a product of greater value.

1.3.6.7 Classification of By-Products:

By-products can be classified into two groups according to marketable conditions at the split off point:

- (a) Those sold in the same form as originally produced, and
- (b) Those which may undergo further processing before sale.

1.3.6.8 Accounting treatment:

By-products are jointly produced products of minor importance and do not have separate costs until the split off point. They are not produced intentionally but are emerging out of the manufacturing process of the main products. The following methods are used for accounting of by-products. The methods are broadly divided into Non-Cost Methods and Cost Methods.

(A) Non-Cost Methods: The following methods are included in this category.

- (i) **Other income or miscellaneous income method:** Under this method, sales value of by-products is credited to the Profit and Loss Account and no credit is given in the Cost Accounts. The credit to the Profit and Loss Account is treated as other income or miscellaneous income. No effort is made for ascertaining the cost of the product. No valuation of inventory is made and all costs and expenses are charged to the main product. This is the least scientific method and is used where the sales value of the by-product is negligible.
- (ii) **Total sales less total cost:** Under this method, sales value of by-product is added to the sales value of the main product. Further the total cost of the main product including the cost of the by-product is deducted from the sales revenue of the main product and by-product. All costs and expenses are charged to the main product.
- (iii) **Total cost less sales value of by-product:** In this method, the total cost of production is reduced by the sales value of the by-product. This method seems to be more acceptable because like waste and scrap, by-product revenue reduces the cost of major products.
- (iv) **Total cost less sales value of by-products after setting off selling and distribution overheads of by-products:** Sales value of the by-product minus the selling and distribution overheads of byproduct is deducted from the total cost. Selling and distribution overheads are charged against by-products actually sold.
- (v) **Reverse cost method:** This method is based on the view that the sales value of the by-product contains an element of profit. It is agreed that this element of profit should not be credited to the Profit and Loss Account. The cost of by-product is arrived at by working backwards. Selling price of the by-product is deflated by an assumed gross profit margin. Thus under this method, sales value of the by-product is first reduced by, an estimated profit margin, selling and distribution expenses and then the post split off costs and then the cost of the main product is thus reduced by this net figure.

(B) Cost Methods: The following methods are included in this category.

- (i) **Replacement or opportunity cost method:** If the by-products are consumed captively, they are valued at the opportunity cost method or replacement cost method. This means the cost which would have been incurred had the by-product been purchased from outside. For example, bagasse, which is one of the main by-product of sugar industry and which is used for the factory as a fuel in the boiler is valued at the market value, i.e. the price that would have been paid if it would have been purchased from outside.
- (ii) **Standard cost method:** Under this method, the by-product is valued at the standard cost determined for each product. The standard cost may be based on technical assessment. Standard cost of the by-product is credited to the process account of the main product. Accordingly, the cost control of main product can be exercised effectively.



- (iii) **Joint cost proration:** Where the by-product is of some significance, it is appropriate that the joint costs should be apportioned between the main products and by-products on a most suitable and acceptable method. Thus in this method, no distinction is made between the joint product and byproduct. Industries, where the by-products are quite important, use this method. For example, in a petroleum refinery, gas was earlier considered as a by-product. Now it has assumed the importance like petrol, diesel etc. and is being treated as joint product. Accordingly, the joint cost is prorated between the joint product and the by-product.

1.3.6.9 Difference between Main product & Joint and By-Products:

It is very difficult to make distinction between the joint products, main products and by-products. There are, however, two checks which may be applied to determine if a product is a by-product or a joint product or a main product:

- (i) **Value:** If one of the products is of considerably large value than the others it will usually be considered the main product. Conversely any product which is of considerably less value is likely to be classified as a by-product. If both or some or all the products are more or less of equal value, they are likely to be classified as joint products.
- (ii) **Manufacturing objective:** If the company's objective is to produce A, then B, C and D produced simultaneously will be classified as by-products. This is independent of the comparative values of the various products. If the objective is to produce A and B, they become joint products and C and D become by-products. For example, in coke oven, the objective being production of coke, this is considered as the main product, and gas and tar as by-products.

There are instances when a by-product attains so much importance in terms of sales value and/or the company objective, then it is regarded as a main product. There are also instances when a by-product is more important than the main product, so that they by-product becomes the main product and the main product becomes the by-product.

Illustration 55:

X, Y Ltd. manufactures product A which yields two by-products B and C. The actual joint expenses of manufacturing for a period were ₹ 8,200.

The profits on each product as a percentage of sales are 33-1/3%, 25% and 15% respectively. Subsequent expenses are as follows:

Products (₹)

Particulars	'A'	'B'	'C'
Material	100	75	25
Direct	200	125	50
Overheads	<u>150</u>	<u>125</u>	<u>75</u>
Sales	<u>450</u>	<u>325</u>	<u>150</u>
Apportion the joint expenses	6,000	4,000	2,500



Labour:

$$\begin{aligned}
 A : B : C &= 6 \times 600 : 2 \times 150 : 1 \times 200 \\
 &= 3600 : 300 : 200 \\
 &= 36 : 3 : 2
 \end{aligned}$$

Illustration 57:

The following data have been extracted from the books of M/s. Southern Coke Co. Ltd.

JOINT PRODUCTS	YIELD IN LB OF RECOVERED PRODUCTS PER TONNE OF COAL
Coke	1,420
Coal tar	120
Benzol	22
Sulphate of Ammonia	26
Gas	<u>412</u>
	<u>2,000</u>

The price of coal is ₹80 per tonne. The direct labour and overhead costs to the point of split-off are ₹40 and ₹60 respectively per tonne of coal. Calculate the material, labour and total cost of each product on the basis of weight.

Solution:

Statement Showing Calculation of Material, Labour and Total Cost of Each Product :

Element	Total	(1420) Coke	(120) Coal tar	(22) Benzol	(26) Sulphate	(412) Gas
	₹	₹	₹	₹	₹	₹
Material	80.00	56.80	4.80	0.88	1.04	16.48
Labour	40.00	28.40	2.40	0.44	0.52	8.24
Overheads	60.00	42.60	3.60	0.66	0.78	12.36
	180.00	127.80	10.80	1.98	2.34	37.08

Illustration 58:

A factory engaged in the production of Chemical X and in the course of manufacture in a by-product-Y is produced which after a separate process has a commercial value. Following are the information for the month of March.

	JOINT EXPENSES	SEPARATE EXPENSES	
		X	Y
Materials (₹)	10,000	2,000	2,800
Labour (₹)	4,000	2,500	2,500
Overheads (₹)	2,500	1,400	1,000

The output for the month was 150 quintals of X and 50 quintals of Y. The selling price of product Y is ₹ 200 per quintal. The profit on product Y is $33\frac{1}{3}\%$ on cost price. Prepare an Account to show the cost of X per quintal.

Solution:

Joint Expenses Account

Dr.		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹
To, Material	10,000	By, Y A/c	1,200
To, Labour	4,000	By, X's A/c	15,300
To, Overheads	2,500		
	16,500		16,500

X's Account

Dr.		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹
To, Material	2,000	By, Cost of production A/c	
To, Labour	2,500	@ 141.33 per quintal.	21,200
To, Overheads	1,400		
To, Joint expenses A/c *	15,300		
	21,200		21,200

Y's Account

Dr.		Cr.	
Particulars	Amount ₹	Particulars	Amount ₹
To, Material	2,800	By, Cost of production A/c.	
To, Labour	2,500	(150 x 50)	7,500
To, Overheads	1,000		
To, Joint expenses A/c	1,200		
	7,500		7,500

Illustration 59:

In manufacturing the main product 'A' a company processes the resulting waste material into two by products B and C. Using reversal cost method of by products, prepare a comparative profit and loss statement of the three products from the following data:

- (i) Total cost upto separation point was ₹ 68,000

	A (₹)	B (₹)	C (₹)
(ii) Sales (all production)	1,64,000	16,000	24,000
(iii) Estimated net profit % to sale value	—	20%	30%
(iv) Estimated Selling expenses as % of sales value	20%	20%	20%
(v) Costs after separation	—	4,800	7,200



Solution:

Apportionment of Joint expenses for the products

Particulars	B (₹)	C (₹)
Sales	16,000	24,000
(-) Profit	3,200	7,200
Total Cost	12,800	16,800
(-) Selling expenses	3,200	4,800
Manufacturing cost	9,600	12,000
(-) Separate expenses	4,800	7,200
Joint Expenses	4,800	4,800

Joint expenses of A = 68,000 – (4,800 + 4,800) = 58,400.

Profit and Loss Statement:

	Particulars	A ₹	B ₹	C ₹	Total ₹
(i)	Joint cost	58,400	4,800	4,800	68,000
(ii)	Separate cost	--	4,800	7,200	12,000
(iii)	Manufacturing cost (I + II)	58,400	9,600	12,000	80,000
(iv)	Selling expenses	32,800	3,200	4,800	40,800
(v)	Total cost (III + IV)	91,200	12,800	16,800	1,20,800
(vi)	Profit *	72,800	3,200	7,200	83,200
(vii)	Sales	1,64,000	16,000	24,000	2,04,000

Illustration 60:

The progressive manufacturing company manufactures one main product and two by-products. Data for month are shown below:

Particulars	Main Product	By-Product A	By Product B
Sales	1,50,000	12,000	7,000
MANUFACTURING COST:			
(a) Before separation	75,000	—	—
(b) After separation	23,000	2,200	1,800
Administration cost	12,000	1,500	1,000
Ratio of Distribution of			
Selling cost	85%	10%	5%
Net profit in sales	20%	15%	10%

Assuming no beginning and ending inventories, apportion the joint cost among main product and the byproducts.

Solution:

Calculation of Selling Expenses:

Particulars	Amount ₹
Sales of 3 products	1,69,000
(-) Profit (30,000 + 1,800 + 700)	(32,500)
Total Cost	1,36,500
(-) Joint & Separate cost (75,000 + 27,000)	(1,02,000)
	34,500
(-) Administration cost	14,500
Selling Expenses	20,000

Statement showing apportionment of Joint Expenditure:

	Particulars	Main Product	By Product A	By Product B	Total
(i)	Sales	1,50,000	12,000	7,000	1,69,000
(ii)	Profit	30,000	1,800	700	32,500
(iii)	Total cost (i – ii)	1,20,000	10,200	6,300	1,36,500
(iv)	Selling expenses	17,000 (85%)	2,000 (10%)	1,000 (5%)	20,000
(v)	Cost of production	1,03,000	8,200	5,300	1,16,500
(vi)	Administration cost	12,000	1,500	1,000	14,500
(vii)	Manufacturing cost (V-VI)	91,000	6,700	4,300	1,02,000
(viii)	Separate expenses	23,000	2,200	1,800	27,000
(ix)	Share of joint expenses (VII – VIII)	6,800	4,500	2,500	75,000

Illustration 61:

In a factory producing joint products of two varieties, the following data are extracted from the books:

	TOTAL (₹)
Sales of products X and Y	7,50,000
Direct Material	2,25,000
Direct Labour	1,10,000
Variable Overhead (150% on Labour)	1,65,000
Fixed Overhead	2,00,000

The analysis of sales reveals that the percentage of sale of product X is $66\frac{2}{3}\%$.

Management contemplates to process further joint products so that they could be sold at higher rates. Facilities for this are available. The additional expenditure for the further process and total sales anticipated at higher selling prices are given below. Make recommendations presenting the affect of the proposal.

	PRODUCT X	PRODUCT Y	TOTAL
Sales after further processing	6,00,000	3,00,000	9,00,000
Additional material	50,000	20,000	70,000
Additional direct labour	20,000	8,000	28,000

**Solution:**

	Particulars	X ₹	Y ₹	Total ₹
(i)	Sales after further processing	6,00,000	3,00,000	9,00,000
(ii)	Sales at split off	5,00,000	2,50,000	7,50,000
(iii)	Incremental sales	1,00,000	50,000	1,50,000
(iv)	Incremental/Additional/further processing / Separate cost:			
	Material	50,000	20,000	70,000
	Labour	20,000	8,000	28,000
	Variable Overheads	30,000	12,000	42,000
(v)	Incremental Profit/Loss	--	10,000	10,000

It is recommended to further process Product Y because there is an incremental / additional profit ₹ 10,000 where as product X need not be further processed because there is no additional profit.

Illustration 62:

A vegetable oil refining company obtains four products whose cost details are:

Joint costs of the four products: ₹ 8,29,600

Outputs : A - 5,00,000 litres; B -10,000 litres,C- 5,000 litres and D- 9,000 kgs.

Further processing costs: A ₹ 2,40,000; B ₹ 48,000, C-Nil and D-₹ 8,030.

The products can be sold as intermediates i.e., at split-off point without further processing. The sale prices are:

	As finished Product	As Intermediate
A ₹ Per litre	1.84	1.20
B ₹ Per litre	8.00	4.00
C ₹ per litre	6.40	6.40
D ₹ Per Kg.	26.67	24.00

(a) Calculate the product-wise profit allocating joint costs on net realisable values.

(b) Compare the profitability in selling the products with and without further processing.

Solution:**(a) Statement showing computation of profit after further processing:**

	Particulars	A ₹	B ₹	C ₹	D ₹	Total ₹
(i)	Sales after further processing	9,20,000	80,000	32,000	2,40,030	12,72,030
(ii)	Separate / further costs	2,40,000	48,000	--	8,030	2,96,030
(iii)	Sales at split off (being NRV) (I-II)	6,80,000	32,000	32,000	2,32,000	9,76,000
(iv)	Joint costs (NRV basis)	5,78,000	27,200	27,200	1,97,200	8,29,600
(v)	Profit	1,02,000	4,800	4,800	34,800	1,46,400

Statement Showing Computation of Profit Before Further Processing:

	Particulars	A	B	C	D	Total
		₹	₹	₹	₹	₹
(I)	Sales at split off	6,00,000	40,000	32,000	2,16,000	8,88,000
(II)	Joint costs as apportioned above	5,78,000	27,200	27,200	1,97,200	8,29,600
(III)	Profit (I – II)	22,000	12,800	4,800	18,800	58,400

(b) Statement Showing Computation of Incremental or Additional Profit by Further Process:

	Particulars	A	B	C	D	Total
		₹	₹	₹	₹	₹
(I)	Sales after further processing	9,20,000	80,000	32,000	2,40,030	12,72,030
(II)	Sales before further processing	6,00,000	40,000	32,000	2,16,000	8,88,000
(III)	Incremental or additional sales (I-II)	3,20,000	40,000	-	24,030	3,84,030
(IV)	Incremental cost	2,40,000	48,000	-	8,030	2,96,030
(III)	Additional Profit or Loss (III-IV)	80,000	(8,000)	-	16,000	88,000

Products A&B Should Be Further Process, Because There Is Incremental Profit And Where As Products B And C Need Not Be Further Process.

Alternative Method:

Statement Showing Computation of Profit Before Further Processing (on the basis of sales):

	Particulars	A	B	C	D	Total
		₹	₹	₹	₹	₹
(I)	Sales before further processing / split off	6,00,000	40,000	32,000	2,16,000	8,88,000
(II)	Joint costs 8,29,000 x (6,00,000/8,88,000)	5,60,540	37,369	29,895	2,01,796	8,29,600
(III)	Profit	39,460	2,631	2,105	14,204	58,400

Statement Showing Computation Of Profit After Further Processing (on basis of sales)

	Particulars	A	B	C	D	Total
		₹	₹	₹	₹	₹
(I)	Sales at split off	6,80,000	32,000	32,000	2,32,000	9,76,000
(II)	Joint costs as apportioned above.	5,60,540	37,369	29,895	2,01,796	8,29,600
(III)	Profit or Loss	1,19,460	(5,369)	2,105	30,204	1,46,400

Illustration:63

T Ltd., in the course of refining crude oil obtains four joint products A, B, C and D. The total cost till the split off point was ₹ 97,600. The output and sales in the year 2011 were as follows:

Product	Output (Balance)	Sales (₹)	Separate Costs (₹)
A	5,00,000	1,15,000	30,000
B	10,000	10,000	6,000
C	5,000	4,000	—
D	9,000	30,000	1,000



You are required:

- Calculate the net income for each of the products if the joint costs are apportioned on the basis of sales value of the different products.
- What would be the net income of the company from each product if it decides to sell the products at the split off point itself A@ 15 paise, B 50 paise C 80 paise and D ₹, 3 per gallon.
- In case the company expects to operate at the same level of production and sales in the year 2012 could the company increase the net income by altering its processing decisions? If so, what would be the expected overall net income? Which product should be sold at split off? Assume that all costs incurred after the split -off are variable.

Solution:

Statement Showing Computation of Profit After Further Processing:

	Particulars	A	B	C	D	Total
		₹	₹	₹	₹	₹
(I)	Sales at further processing	1,15,000	10,000	4,000	30,000	1,59,000
(II)	Separate cost	30,000	6,000	--	1,000	37,000
(III)	Sales at Split off	85,000	4,000	4,000	29,000	1,22,000
(IV)	Joint Costs (On basis of NRV)	68,000	3,200	3,200	23,200	97,600
(V)	Profit	17,000	800	800	5,800	24,400

Statement Showing Computation of Profit Before Further Processing:

	Particulars	A	B	C	D	Total
		₹	₹	₹	₹	₹
(I)	Sales at split off	75,000	5,000	4,000	27,000	1,11,000
(II)	Joint Cost (as apportioned above)	68,000	3,200	3,200	23,200	97,600
(III)	Profit	7,000	1,800	800	3,800	13,400

Statement Showing Computation Of Incremental Profit By Further Processing :

	Particulars	A	B	C	D	Total
		₹	₹	₹	₹	₹
(I)	Sales after further process	1,15,000	10,000	4,000	30,000	1,59,000
(II)	Sales at split off	75,000	5,000	4,000	27,000	1,11,000
(III)	Incremental sales	40,000	5,000	--	3,000	48,000
(IV)	Incremental/Separate costs	30,000	6,000	--	1,000	37,000
(V)	Incremental Profit (loss)	10,000	(1,000)	--	2,000	11,000

Product 'A' and 'D' should be further processed because there is additional profit where as product 'B' and 'C' need not be further processed because there is no additional profit.

Computation of Profit by implementing decision:

	₹
Profit from A	= 17,000
Profit from B	= 1,800
Profit from C	= 800
Profit from D	= <u>5,800</u>
	= <u>25,400</u>

Illustration: 64

Beauty soap, company manufactures four different brands of soaps namely Komal, Lovely, Makeup and Nice. The data on production and sale of these brands during 2012 is reproduced below.

Brand Name	Komal	Lovely	Makeup	Nice
Production & Sales (units)	3,00,000	5,00,000	70,000	40,000
Sale value ₹ Lakhs	15	31	2.8	1.2

All the above soaps are manufactured jointly up to a particular process. At split off point they are formed into cake-sand packed. The annual cost data were as under.

Direct Material Cost	₹ 30 lakhs
Value added	₹ 20 lakhs
(includes profit at 25% on total cost)	

Out of the above brands, Make up is sold in unpacked condition without further processing while other 3 brands further processed at an additional cost:

Komal	₹1,20,000	
Lovely	₹1,30,000	and
Nice	₹ 50,000	

You are required to:-

- Work out the profit and cost of each brand of soap after allocating joint cost on the basis of Net Realisable value at split up point. (per unit cost not required).
- Find out revised cost and profit on each brand if the company decides to sell all soaps at split up point at following prices; Komal ₹ 4.50; Lovely ₹6.00; Make up ₹ 4.00 and Nice ₹ 1.50 per unit.
Assume that for allocation of joint cost net Realisable value method is used.
- With the working results in (a) and (b) above advise Beauty Soap Company about the processing decision as to which soap to ;be sold at split of point and which to be processed further so as to maximise profit. Substantiate your decision with suitable costing to technique.

Solution:

Computation of Joint Cost

Particulars	Amount (₹)
Direct material	30,00,000
(+) value added	20,00,000
Total Sales	50,00,000
(-) Profit @ 25% on cost (i.e. 20% on sales)	10,00,000
Total Cost	40,00,000
(-) Separate Cost (120 + 130 + 50)	3,00,000
Joint Cost	37,00,000



Statement Showing Computation of Profit After Further Processing:

	Particulars	K	L	M	N	Total
		₹	₹	₹	₹	₹
(I)	Sales after further processing	15,00,000	31,00,000	2,80,000	1,20,000	50,00,000
(II)	Separate cost	1,20,000	1,30,000	-	50,000	3,00,000
(III)	Sales before further processing NRV= (I-II)	13,80,000	29,70,000	2,80,000	70,000	47,00,000
(IV)	Joint Costs	10,86,383	23,38,085	2,20,426	55,106	37,00,000
(V)	Profit or Loss (III-IV)	2,93,617	6,31,915	59,574	14,894	10,00,000

Statement Showing Computation of Profit Before Further Processing:

	Particulars	K	L	M	N	Total
		₹	₹	₹	₹	₹
(I)	Sales at split off	13,50,000	30,00,000	2,80,000	60,000	46,90,000
(II)	Joint Cost (as apportioned above)	10,86,383	23,38,085	2,20,426	55,106	37,00,000
(III)	Profit or Loss	2,63,617	6,61,915	59,574	4,894	9,90,000

Statement Showing Computation of Incremental Profit By Further Processing

	Particulars	K	L	M	N	Total
		₹	₹	₹	₹	₹
(I)	Sales after further process	15,00,000	31,00,000	2,80,000	1,20,000	50,00,000
(II)	Sales before further process	13,50,000	30,00,000	2,80,000	60,000	46,90,000
(III)	Incremental sales (I-II)	1,50,000	1,00,000	-	60,000	3,10,000
(IV)	Separate costs	1,20,000	1,30,000	-	50,000	3,00,000
(V)	Incremental Profit (loss) (III-IV)	30,000	(30,000)	-	10,000	10,000

Products K and N are to be further Process and whereas Products L and M need not to be further process

Illustration: 65

In the course of manufacture of the main product 'P' by products 'A' and 'B' also emerge. The joint expenses of manufacture amount to ₹ 1,19,550. All the three products are processed further after separation and sold as per details given below:

	Main product	By products	
	P	A	B
Sales	90,000	60,000	40,000
Cost incurred after separation	6,000	5,000	4,000
Profit as percentage on sales	25	20	15

Total fixed selling expenses are 10% of total cost of sales which are apportioned to the three products in the ratio of 20 : 40 : 40.

- Prepare a statement showing the apportionment of joint costs to the main product and the two by products.
- If the by-product A is not subjected to further processing and is sold the point of separation for which there is a market, at ₹58,500 without incurring any selling expenses. Would you advise its disposal at this stage. Show the workings.

Solution:

(a) **Statement showing computation of share of joint expenses:**

	Particulars	Main Product P	By Product A	By Product B	Total
		₹	₹	₹	₹
(i)	Sales	90,000	60,000	40,000	1,90,000
(ii)	Profit	22,500	12,000	6,000	40,500
(iii)	Cost of sales	67,500	48,000	34,000	1,49,500
(iv)	Selling expenses	2,990	5,980	5,980	14,950
(v)	Manufacturing cost	64,510	42,020	28,020	1,34,550
(vi)	Separate costs	6,000	5,000	4,000	15,000
(vii)	Share of joint expenses (V – VI)	58,510	37,020	24,020	1,19,550

₹

Sales at split off (A)	=	58,500
(-) Joint Cost	=	<u>37,020</u>
	=	<u>21,480</u>

(b) It is better to sell By-Product 'A' at split off point because it gives more profit ₹ 21,480 against profit after processing ₹ 12,000.

Illustration 66 :

"If the products are truly joint products the cost of the process can be applied to these products".

- (i) On the basis of the weight or other physical quantity of each product.
- (ii) In respect of the marginal cost of the process on the basis of physical quantities and in respect of fixed costs of the process on the basis of the contribution made by the various products.
- (iii) On the basis of selling values of the different products

Illustrate the above statement by using the following figures in respect of joint production of A and B for a month.

TOTAL COST:	Direct Material	5,000
	Direct labour	3,000
	Variable Overheads	2,000
	Fixed Overheads	2,000
	Sales ——— A 100 Qtls.	₹ 80 per qtl
	Sales ——— B 150 Qtls.	₹ 40 per qtl

Solution:

Computation of Profit By Distributing Joint Costs on The Basis of Weight.

	Particulars	A	B	Total
		₹	₹	₹
(i)	Sales	8,000	6,000	14,000
(ii)	Costs (100 : 150)	4,800	7,200	12,000
(iii)	Profit / (Loss)	3,200	(1,200)	2,000



Computation of Profit By Distributing Variable Cost On The Basis of Weight & Fixed Cost On Basis of Contribution:

	Particulars	A	B	Total
		₹	₹	₹
(i)	Sales	8,000	6,000	14,000
(ii)	Variable costs (100 : 150)	4,000	6,000	10,000
(iii)	Contribution	4,000	--	4,000
(iv)	Fixed cost	2,000	--	2,000
(v)	Profit	2,000	--	2,000

Computation of Profit By Distribution On The Basis of Sales :

	Particulars	A	B	Total
		₹	₹	₹
(i)	Sales	8,000	6,000	14,000
(ii)	Total cost	6,857	5,143	12,000
(iii)	Profit	1,143	857	2,000

1.3.7 Operating or Service Costing

Cost Accounting has been traditionally associated with manufacturing companies. However in the modern competitive market, cost accounting has been increasingly applied in service industries like banks, insurance companies, transportation organizations, electricity generating companies, hospitals, passenger transport and railways, hotels, road maintenance, educational institutions, road lighting, canteens, port trusts and several other service organizations. The costing method applied in these industries is known as 'Operating Costing'.

According to CIMA [London] operating costing is, 'that form of operating costing which applies where standardized services are provided either by an undertaking or by a service cost center within an undertaking'.

1.3.7.1 Nature of Operating Costing:

The main objective of operating costing is to compute the cost of the services offered by the organization. For doing this, it is necessary to decide the unit of cost in such cases. The cost units vary from industry to industry. For example, in goods transport industry, cost per ton kilometer is to be ascertained while in case of passenger transport, cost per passenger kilometer is to be computed. Cost units used in different service units are explained in detail later in chapter. The next step is to collect and identify various costs under different headings.

The headings used are,

- Fixed or standing charges
- Semi-fixed or maintenance charges
- Variable or running charges.

One of the important features of operating costing is that mostly such costs are fixed in nature. For example, in case of passenger transport organization, most of the costs are fixed while few costs like diesel and oil are variable and dependent on the kilometers run.

Because of the diverse nature of activities carried out in service undertakings, the cost system used is obviously different from that of manufacturing concern. Let us discuss the method of computing costs in various service organisations .

1.3.7.3 Transport Organisation: Costing in a transport industry consists of determining the operating cost of each vehicle and applying this cost to find out the cost per unit of service rendered by a vehicle. The cost unit is selected with proper care keeping in view the needs of each concern, the weight, bulk, volume and type of goods carried and distance covered in each trip. Transport undertakings include goods transport organizations as well as passenger transport organizations. The cost unit is either ton kilometer or passenger kilometer. The meaning is cost of carrying one ton over a distance of one kilometer or cost of carrying one passenger for a distance of one kilometer.

1.3.7.4 Collection of Costs: A log book is maintained for each vehicle to record details of trips made by the vehicle during a specified period of time. Log book is maintained usually on a daily basis. The details shown in the log book enables the management to make suitable allocation of vehicles, to avoid the duplicate trips, or to avoid idle running capacity. The log book also provides the information relating to the fuel consumed, distance travelled, no of hours travelled, chargeable kilo meters. The log book provide the data for proper allocation of cost and in this respect these may be compared with the production details available in a manufacturing concern

1.3.7.5 Classification of Costs:

The costs of a transport organisation can be classified and accumulated under the following heads:-

- (a) *Fixed or stand-by costs:* These costs which include garage charges, insurance, taxes, license, depreciation, wages of drivers, cleaner's salary, establishment cost of workshop and office. Out of the above some of the costs are directly identifiable for each vehicle such as license fee and some are apportioned such as office expenses
- (b) *Maintenance Charges:* These costs are in the nature of semi-variable nature includes expenditure on maintenance, repairs, tyres, tubes and other charges.
- (c) *Operating and Running costs:* These costs are variable in nature, includes fuel, lubricating oil, wages of drivers / cleaners (if paid on per trip / kilometer). These costs can be easily identifiable with each of the vehicle.

1.3.7.6 Significance of Operating or Running Costs:

- (i) Control of operating and running cost and avoidance of waste of fuel and other consumable material.
- (ii) Cost of running own vehicles may compared with the hired or other forms of transport.
- (iii) Facilitates quotation of hiring rates to outside parties who ask for the transport service.
- (iv) If transport service is treated as a separate department or service cost center, the costs to be charged to the requesting department may be easily determined.
- (v) Suitable information is obtained for efficient routing of vehicles.
- (vi) Cost of idle vehicles and lost running time is easily obtained.



Cost sheet for a transport organisation can be prepared in the following manner

	Particulars	Amount ₹	Amount ₹
A	Standing charges/Fixed Charges <ul style="list-style-type: none"> • Insurance • License/Permit fees • Salaries of drivers, cleaners etc. • Depreciation • Interest • Total 		
B	Running charges / Variable Expenses <ul style="list-style-type: none"> • Petrol/Diesel • Oil • Grease • Total 		
C	Maintenance charges <ul style="list-style-type: none"> • Repairs • Tyres • Spares • Garage Charges • Total 		
D	Total Cost (A + B + C)		
E	Total ton kilometers/passenger kilometers		
F	Cost per ton kilometer/passenger kilometers (D/E)		

Cost sheet for electricity generating company can be prepared in the following manner

	Particulars	Amount ₹	Amount ₹
A	Fixed Charges <ul style="list-style-type: none"> • Rent, Rates, Taxes • Insurance • Depreciation • Salaries • Total 		
B	Fuel charges		
C	Maintenance charges <ul style="list-style-type: none"> • Meters • Furnaces • Service materials • Tools • Total 		
D	Waters charges		
E	Wages/Labour charges		
F	Supervision and other Administrative charges		
G	Total charges		

Operating costing can be used effectively in hotels and canteens. While hotels are run purely on commercial principles, canteen facilities are provided by several organizations by providing subsidies. However it is necessary to compute the cost in both the cases to find out the profit or loss at the end of a particular period. In this case, the costs associated with different products offered should be identified and cost per unit should be worked out. The cost unit may be number of meals served or any other dish offered to the customers. A typical format of the cost sheet is given below. It should be noted that this format is not a standardized one and can be modified to suit the requirements of an organization.

Cost sheet for Hotels and Canteens can be prepared in the following manner

	Particulars	Amount ₹	Amount ₹
A	Fixed Charges <ul style="list-style-type: none"> • Salaries • Insurance • Taxes • Interest • Depreciation • Any other • Total 		
B	Operating expenses <ul style="list-style-type: none"> • Raw material consumed • Electricity • Gas (or) fuel etc. • Total 		
C	Maintenance charges <ul style="list-style-type: none"> • Crockery • Glassware • Towels • Consumable stores • Other maintenance charges • Total 		
D	Supervision charges		
E	Total charges		
F	Number of meals served		
G	Cost per meal		

Illustration 67 :

There are two warehouses for storing finished goods produced in a factory. Warehouse 'A' is at a distance of 10 kms. and Warehouse 'B' is at a distance of 15 kms from the factory. A fleet of 5 tonne lorries is engaged in transporting the finished goods from the factory. The records show that the lorries average a speed of 30 kms. per hour when running and regularly take 40 minutes to load at the factory. At warehouse 'A' unloading takes 30 minutes per load while at warehouse 'B' it takes 20 minutes per load.

Drivers' Wages, depreciation, insurance and taxes amount to ₹18 per hour operated. Fuel oil, tyres, repairs and maintenance cost ₹ 2.40 per kilometer. You are required to draw up a statement showing



the cost per tonne kilometer of carrying the finished goods to the two warehouses.

Solution:

Statement showing computation of total cost and cost per tonne kilometer of carrying finished goods to warehouses:

Particulars	A	B
Time for travelling	40 Min	60 Min
Time for loading	40 Min	40 Min
Time for unloading	30 Min	20 Min
	110 Min	120 Min
Cost of Insurance, wages, tax, etc.	[(110/60) x 18]	33.00
	[(120/60) x 18] ₹	36.00
Fuel & oil etc.	(20 x 2.4) (30 x 2.4) ₹	48.00 72.00
Total Cost	₹	81.00 108.00
Tonne Kilometers (5 x 10) (5 x 15)	₹	50.00 75.00
Cost per tonne KM	₹	1.62 1.44

Illustration 68 :

A transport service company is running 4 buses between two towns which are 50 miles apart. Seating capacity of each bus is 40 passengers. The following particulars were obtained from their books for April, 2012.

	₹
Wages of Drivers, Conductors and Cleaners	2,400
Salaries of Office and Supervisory Staff	1,000
Diesel and oil and other oil	4,000
Repairs and Maintenance	800
Taxation, Insurance, etc.	1,600
Depreciation	2,600
Interest and Other Charges	2,000
	<u>14,400</u>

Actual passengers carried were 75% of the seating capacity. All the four buses ran on all days of the month. Each bus made one round trip per day. Find out the cost per passenger mile

Solution:

Computation of Cost per Passenger Mile:

$$\begin{aligned}\text{Passenger miles} &= \text{No. of buses} \times \text{Distance} \times \text{Round trip} \times \text{No. of Passengers} \times \text{No. of days in} \\ &\quad \text{month} \times \text{Capacity.} \\ &= 4 \times 50 \times 2 \times 40 \times 30 \times 75\% \\ &= 3,60,000 \text{ miles} \\ \text{Cost per passenger mile} &= 14,400 / 3,60,000 \\ &= ₹ 0.04\end{aligned}$$

Illustration 69:

Mr. Sohan Singh has started transport business with a fleet of 10 taxies. The various expenses incurred by him are given below:

- (i) Cost of each taxi ₹ 75,000
- (ii) Salary of office Staff ₹ 1,500 p.m.
- (iii) Salary of Garage's Supervisor ₹ 2,000 p.m.
- (iv) Rent of Garage ₹ 1,000 p.m
- (v) Drivers Salary (per taxi) ₹ 400 pm.
- (vi) Road Tax and Repairs per taxi ₹ 2,160 p.a.
- (vii) Insurance premium @ 4% of cost p.a.

The life of a taxi is 3,00,000 km. and at the end of which it is estimated to be sold at ₹ 15,000. A taxi runs on an average 4,000 Km. per month of which 20% it runs empty, petrol consumption 9 Km. per litre of petrol costing ₹ 6.30 per litre. Oil and other sundry expenses amount to ₹ 10 per 100 Km.

Calculate the effective cost of running a taxi per kilometre. If the hire charge is ₹ 1.80 per Kilometre, find out the profit that Mr. Shoan may expect to make in the first year of operation.

Solution:

Statement Showing Computation Of Effective Cost And Profit For The Year

Particulars	Amount ₹	Amount ₹
Fixed expenses:		
Salary of staff	1,500	
Salary of garage supervisor	2,000	
Rent of garage	1,000	
Driver Salary (10 x 400)	4,000	
Road tax and repairs (2,160 x 10/12)	1,800	
Insurance premium (75,000 x 4 % x 10/12)	2,500	12,800
Fixed cost of 10 taxi's per month		
Cost per taxi = ₹ 12,800/10 = ₹ 1,280		
Cost per km = 1280/4,000 = 0.32		0.32
Running Costs:		
Depreciation [(75,000-15,000) / 3,00,000]		0.20
Petrol (6.3/9)		0.70
Oil & sundry expenses (10/100)		0.10
		1.32
Effective cost per Km = 1.32 x (100/80)		1.65

$$\begin{aligned} \text{Profit for year} &= (1.80 - 1.65) \times 10 \times 3,200 \times 12 \\ &= ₹ 57,600 \end{aligned}$$

Illustration 70:

Janata Transport Co. has been given a route 20 km. long for running buses. The company has a fleet of 10 buses each costing ₹ 50,000 and having a life of 5 years without any scrap value.



From the following estimated expenditure and other details calculate the bus fare to be charged from each passenger.

(i) Insurance charges	3 %	p.a.
(ii) Annual tax for each bus	₹ 1,000	
(iii) Total garage charges	₹1,000	
(iv) Drivers' salary for each bus	₹150	p.m
(v) conductor's salary for each bus	₹100	p.m
(vi) Annual repairs to each bus	₹1,000	
(vii) Commission to be shared by the driver and conductor equally: 10% of the takings		
(viii) Cost of stationary	₹500	p.m.
(ix) Manager's salary	₹2,000	p.m.
(x) Accountant's salary	₹1,500	p.m.
(xii) Petrol and oil	₹25	per 100 km

Each bus will make 3 round trips carrying on an average 40 passengers on each trip. The bus will run on an average for 25 days in a month. Assuming 15% profit on takings, calculate, the bus fare to be charged from each passenger.

Solution:

Particulars	Amount (₹)
Insurance (50,000 x 3% x 10/12)	1,250
Tax (1,000 x 10/12)	833.33
Garage charges	1,000
Drivers salary (150 x 10)	1,500
Conductor salary (100 x 10)	1,000
Repairs (1,000 x 10/12)	833.33
Cost of stationary	500
Managers salary	2,000
Accountant salary	1,500
Depreciation (50,000 x 10/5 x 1/12)	833.33
Petrol * (30,000/100) x 25	7,500
Commission of conductor & driver 35,000 x (10/100)	3,500
	29,750
(+) Profit @ 15% on takings (35,000 x 15/100)	5,250
	35,000

$$* 10 \times 20 \times 3 \times 2 \times 25 = 30,000$$

Let 'X' be the takings

$$X = 26,250 + (10/100 X) + (15/100 X)$$

$$100 X = 26,25,000 + 25 X$$

$$\Rightarrow X = 35,000$$

$$\begin{aligned} \text{Fare per passenger Km} &= 35,000 / (30,000 \times 40) \\ &= 0.0292 = ₹ 0.03 \end{aligned}$$

Illustration 71 :

Union Transport Company supplies the following details in respect of a truck of 5 tonne capacity

Cost of truck	₹ 90,000
Estimated life	10 years
Diesel, oil, grease	₹ 15 per trip each way
Repairs and maintenance	₹500 p.m.
Driver's wages	₹ 500 p.m.
Cleaner's wages	₹ 250 p.m.
Insurance	₹ 4,800 per year
Tax	₹2,400 per year
General supervision charges	₹4,800 per year

The truck carries goods to and from the city covering a distance of 50 kms. each way.

On outward trip freight is available to the extent of full capacity and on return 20% of capacity.

Assuming that the truck runs on an average 25 days a month, work out:

- (a) Operating cost tonne-km.
- (b) Rate for tonne per trip that the company should charge if a profit of 50% on freight is to be earned.

Solution:

Particulars	Amount ₹
Repairs & Maintenance	500
Drivers wages	500
Cleaners wages	250
Insurance	400
Tax	200
Supervision charge	400
Depreciation [(90,000/10) x (1/12)]	750
Diesel, oil, grease (15 x 2 x 25)	750
	3,750
(+) 50% profit on freight (100% on cost)	3,750
	7,500

$$\begin{aligned} \text{Tonne Kms} &= 25 [(50 \times 5) + (20/100 \times 50 \times 5)] \\ &= 7,500 \end{aligned}$$

$$\begin{aligned} \text{Cost per tonne km} &= 3,750 / 7,500 = 0.50 \\ (+) \text{ Profit @ 50\% on freight} &= 0.50 \\ &= \underline{1.00} \end{aligned}$$

Illustration 72 :

Manar lodging home is being run in a small hill station with 50 single rooms. The home offers concessional rates during six off- season months in a year. During this period, half of the full room rent is charged. The management's profit margin is targeted at 20% of the room rent. The following are the cost estimates and other details for the year ending on 31st March 2012. [Assume a month to be of 30 days].



- (i) Occupancy during the season is 80% while in the off- season it is 40% only.
- (ii) Expenses:
- Staff salary [Excluding room attendants] ₹2,75,000
 - Repairs to building ₹ 1,30,500
 - Laundry and linen ₹ 40,000
 - Interior and tapestry ₹ 87,500
 - Sundry expenses ₹ 95,400
- (iii) Annual depreciation is to be provided for buildings @ 5% and on furniture and equipments @ 15% on straight-line basis.
- (iv) Room attendants are paid ₹ 5 per room day on the basis of occupancy of the rooms in a month.
- (v) Monthly lighting charges are ₹ 120 per room, except in four months in winter when it is ₹ 30 per room and this cost is on the basis of full occupancy for a month.
- (vi) Total investment in the home is ₹ 100 lakhs of which ₹ 80 lakhs relate to buildings and balance for furniture and equipments.

You are required to work out the room rent chargeable per day both during the season and the off-season months on the basis of the foregoing information.

Solution:

- (i) **Computation of Estimated Cost for the year ending 31st March, 2012**

Particulars	Amount ₹
Salary	2,75,000
Repairs	1,30,500
Laundry and linen	40,000
Interior decoration	87,500
Depreciation:	
5% on ₹ 80 lakhs: ₹ 4,00,000	
15% on ₹ 20 lakhs: ₹ 3,00,00	7,00,000
Sundry expenses	95,400
Total costs	13,28,400

- (ii) Number of room days in a year:

Occupancy during season for 6 months @ 80% $(50 \times 0.80 \times 6 \times 30) = 7,200$

Off-season occupancy for 6 months @ 40% $(50 \times 0.40 \times 6 \times 30) = 3,600$

Total number of room days during a year = 10,800

- (iii) Attendant's salary

For 10,800 room days @ ₹ 5 per day = ₹ 54,000

- (iv) Light charges for 8 months @ ₹ 120 per month i.e. ₹ 120/30 = ₹ 4 per room day.

Light charges for 4 months @ ₹ 30 per month, i.e. ₹ 30/30 = ₹ 1 per room day

Total lighting charges:

During season @ ₹ 4 for 7200 days = ₹ 28,800

During off season 2 months @ ₹ 4 for 1200 days $(2/6 \times 3600) = ₹ 4,800$

During 4 months of winter @ Re. 1 for 2,400 days $(4/6 \times 3600) = ₹ 2,400$

Note: It is given in the example that during four months of winter, the lighting is ₹ 30 per room, which is 1/4th of the lighting charges during the remaining period of the year. Hence the rate of room day which is ₹ 4 will also be 1/4th for winter period and so it is taken as Re. 1 per room day.

Statement of Total Estimated Cost

Particulars	Amount ₹
Expenses as shown in I above	13,28,000
Attendant's salary as shown in III above	54,000
Lighting charges as shown in IV above	36,000
Total cost	14,18,400

Computation of total Full Room Days

During season : 7,200
 Off-season : 1,800 (Equivalent to 50% rate of 3,600 days)
 Total Full Room Days : 9,000

Computation of Room Rent

Cost per room day : ₹ 14,18,400 / 9,000 = ₹ 157.60
 Add: Profit margin at 20% of rent or 25%
 Of cost = ₹ 39.40
 Room Rent = ₹ 197.00

Therefore, during season, room rent of ₹ 197 is to be charged while in the off-season room rent of ₹ 98.50 is to be charged.

1.3.8 Unit (Or Single Or Output) Costing

1.3.8.1 Meaning:

Unit costing is a form of process costing under which costs are accumulated and analyzed under various elements of costs and the cost per unit is ascertained by dividing the total cost by the number of units produced.

Unit Costing is a method of costing by units of production and is adopted where production is uniform and a continuous affair, units of output are identical and the cost units are physical and natural. The cost per unit is determined by dividing the total cost during a given period by the number of units produced during that period. This method of costing is generally adopted where an undertaking is engaged in producing only one type of product or two or more products of the same kind but of varying grades or quality. The industries where this method of costing is used are collieries, sugar mills, cement works, brick works, paper mills etc. In all these cases, work is a natural unit of cost e.g., a tonne of coal, a quintal of sugar, a tonne of cement, 1000 bricks, 1 ream of paper and so on.

Some examples of Cost Unit for different products are as follows:

Product	Cost Unit
Petrol/Diesel	Per litre
Printing	Per thousand impressions
Pencil	Per dozen
Paper	Per ream
Gold	Per 10 gram/ per gram
Silver	Per kg
Iron/coal	Per tonne
Cement	Per bag



1.3.8.2 Tenders or Quotations:

Very often a producer in response to an advertisement in the press is required to submit a tender or to quote prices for the supply of the commodities he produces or for completing a job. A tender has to be prepared very carefully as the receipts of orders depend upon the acceptance of quotations or tenders supplied by the manufacturers. The preparation of tenders requires information regarding Prime Cost, Works, Administration and Selling overheads and profit of the preceding period. The manufacturer has to ascertain and find out the possible changes in prices of material, rates of wages and other costs. He has to ascertain the amount of variable, semi-variable and fixed overheads on the basis of past experience. He must also have a reasonable amount of profit by taking into consideration the market condition. In preparation of estimates or tenders, overheads are generally not given. They are estimated as a percentage i.e., works overhead on wages and administration, selling and distribution on works cost basis.

1.3.8.3 Production Account:

Where the statement of cost is extended to include sales, stock of finished goods and profit, the statement usually assumes the form of manufacturing or a production account, or output account. A manufacturing account, therefore, may be described as the statement prepared under the unit costing which shows the output during the given period, the total cost and per unit cost incurred during the same period, their components as also the profit or loss.

However, the real production account is one which combines in itself the ingredients of cost sheet and a trading and profit and loss account with result that it consists of four distinct parts, first part gives prime cost, the second part gives the cost of goods manufactured, third part shows the gross profit and fourth part shows the net profit.

1.3.9 Multiple (or) Composite costing:

When the output comprises many assembled parts or components such as in ship building, television, motor Car or electronic gadgets, costs have to be ascertained or each component as well as the finished product. Such costing may involve different methods of costing for different components. In all the above types of industries, the product produced by them involves so many parts and components. Therefore this type of costing is known as composite costing or multiple costing.

Illustration 73 :

Following extract of costing information relates to commodity for the half year ended 30th June, 2012.

Particulars	₹	Particulars	₹
Stock on 1 st January, 2012		Stock on 30 th June, 2012	
Raw Materials	22,000	Raw materials	24,464
Finished product (1,600 tonnes)	17,600	Finished product (3,200 tonnes)	35,200
Purchase of raw materials	1,32,000	Work in progress 1 st Jan. 2012	5,280
Direct Wages	1,10,000	Work-in-progress 30 th June, 2012	17,600
Rent, rates, insurance and works on cost	44,000	Cost of factory Supervision	8,800
Carriage inward	1,584	Sales-Finished products	3,30,000

Advertising, discount allowed and selling cost 75 paise per tone sold 25,600 tonnes of commodity was produced during the period.

You are required to ascertain: (a) Value of Raw Materials Used (b) Cost of Output for the Period; (c) Cost of Turnover for the Period; (d) Net Profit for the Period; and (e) Net Profit per tone of the commodity.

Solution:

Statement of Cost and Profit

Particulars	Qty.	₹
Opening stock of Raw Materials		22,000
Add: Purchase of Raw Materials		1,32,000
		1,54,000
Less: Closing Stock of Raw Materials		24,464
Materials consumed		1,29,536
Direct Wages		1,10,000
Carriage inward		1,584
Prime Cost		2,41,120
Add: Factory Expenses – Rent Rates Insurance and Works expenses		44,000
Add: Cost of Supervision		8,800
Add: Opening Stock of WIP		5,280
		2,99,200
Less: Closing Stock of WIP		17,600
Factory Cost	25,600	2,81,600
Add: Opening Stock of Finished Goods	1,600	17,600
	27,200	2,99,200
Less: Closing Stock of Finished Goods	3,200	35,200
Cost of Goods Sold	24,000	2,64,000
Add: Advertising Discount Allowed and Selling Cost(24000 x 0.75)		18,000
Cost of Sales		2,82,000
Profit (₹ 2 per unit sold)		48,000
Sales		3,30,000

Illustration 74 :

The accounts of a machine manufacturing company disclose the following information for the six months ending 31st December, 2012.

Materials used ₹ 1,50,000; Direct Wages ₹ 1,20,000; Factory Overheads ₹ 30,000 and Administrative Expenses ₹ 15,000.

Prepare the Cost Sheet of the machines and calculate the price which the company should quote for the manufacture of a machine requiring materials valued ₹ 1,250 and expenditure in productive wages ₹ 750 so that the price might yield a profit of 20% on the selling price.

Solution:

Statement of Cost for the year 2012

	₹
Materials used	1,50,000
Direct Wages	1,20,000
Prime Cost	2,70,000
Factory overheads	30,000
Works Cost	3,00,000
Administration expenses	15,000
Cost of Production	3,15,000



Percentage of Factory Overheads to Direct wages = $\frac{30,000}{1,20,000} \times 100 = 25\%$

Percentage of Administration Expenses to Works Cost = $\frac{15,000}{3,00,000} \times 100 = 5\%$

Statement showing the price at which company should sell its machines

Particulars	₹
Materials	1,250.00
Productive Wages	750.00
Prime Cost	2,000.00
Factory overheads (25% of wages)	187.50
Works Cost	2,187.50
Administration expenses (5% of works cost)	109.38
Cost of Production	2,296.88
Profit (1/4 of cost of production)	574.22
Selling price	2,871.10

Illustration 75 :

From the following particulars you are required to prepare a statement showing (a) The Cost of Materials Consumed, (b) Prime Cost, (c) Works Cost, (d) Total Cost, (e) The Percentage of Works Overheads to Productive Wages, and (f) The Percentage of General Overheads to Works Cost:

Particulars	₹	Particulars	₹
Stock of finished goods on 1-1-2012	72,800	Stock of Finished Goods on 31-12-2012	78,000
Stock of Raw Materials on 1-1-2012	33,280	Stock of Raw materials on 31-12-2012	35,360
Purchases of Raw materials	7,59,200	Works Overhead Charges	1,29,220
Productive Wages	5,16,880	Office and General Expenses	70,161
Sales of Finished Goods	15,39,200		

The company is about to send a tender for a large plant. The Costing Department estimated that the materials required would cost ₹ 52,000 and the wages to workmen for making the plant would cost ₹ 31,200. The tender is to be made at a net profit of 20% on the selling price. Show what the amount of tender would be if based on the above percentages.

Solution:

Statement of Cost

Particulars	₹
Raw Materials (Opening Stock)	33,280
Add: Purchase of Raw Materials	7,59,200
	7,92,480
Less: Closing Stock of Raw materials	35,360
(a) Materials Consumed	7,57,120
Productive Wages	5,16,880
(b) Prime Cost	12,74,000
Works Overhead Charges	1,29,220
(c) Works Cost	14,03,220
Office and General Expenses	70,161
(d) Cost of Production or Total Cost	14,73,381

(e) Percentage of Works Overheads to Productive wages = $\frac{1,29,220}{5,16,880} \times 100 = 25\%$

(f) Percentage of office and General Expenses to Works Cost = $\frac{70,161}{14,03,220} \times 100 = 5\%$

Tender for a Large Plant

Particulars	₹
Raw Materials	52,000
Wages	31,200
Prime Cost	83,200
Works overhead (25% of wages)	7,800
Works Cost	91,000
Office and General Expenses (5% of works cost)	4,550
Cost of Production	95,550
Profit (1/4 of cost of production)	23,888
Tender Price	1,19,438

Illustration 76 :

A factory's normal capacity is 1,20,000 units per annum. The estimated costs of production for the year 2011 are as under:

Direct Materials ₹ 3 per unit. Direct Labour ₹ 2 per unit (subject to a minimum of ₹ 12,000 p.m.)

Overhead – Fixed ₹ 1,60,000 p.a.; Variable ₹ 2 per unit; Semi Variable ₹ 60,000 p.a. upto 50% capacity and an additional ₹ 20,000 for every 20% increase in capacity or part thereof.

Each unit of raw material yields scrap which is sold at the rate of 20 paise.

In the year 2012 the factory worked at 50% capacity for the first three months but it was expected that it would work @ 80% capacity for the remaining 9 months.

During the first three months, the selling price per unit was ₹ 12. What should be the price in the remaining nine months to produce a total profit of ₹ 2,18,000.

Solution:

Cost Sheet for the year 2012

Particulars	First three months output = 15,000 units		Remaining nine months output = 72,000 units	
	Per unit ₹	Total ₹	Per unit ₹	Total ₹
Direct Materials	3.00	45,000	3.00	2,16,000
Less: Sale of scrap	0.20	3,000	0.20	14,400
	2.80	42,000	2.80	2,01,600
Direct Labour (Minimum charge p.m. in cost of first three months)	2.40	36,000	2.00	1,44,000
Prime Cost	5.20	78,000	4.80	3,45,600
Overhead:				
Variable	2.00	30,000	2.00	1,44,000
Semi Variable:	1.00	15,000	1.04	75,000



Particulars	First three months output = 15,000 units		Remaining nine months output = 72,000 units	
	Per unit ₹	Total ₹	Per unit ₹	Total ₹
Fixed ₹ 1,60,000 to be apportioned on the basis of time (1:3)	2.67	40,000	1.67	1,20,000
Total Cost	10.87	1,63,000	9.51	6,84,600
Profit	1.13	17,000	2.79	2,01,000
Sales	12.00	1,80,000	12.30	8,85,600

Note: Profit for remaining 9 months shall be (₹ 2,18,000 – ₹ 17,000) = ₹ 2,01,000. Thus, sales could be ₹ 8,85,600 and the sale price per unit will be

$$= \frac{\text{₹ } 8,85,600}{72,000 \text{ units}} = \text{₹ } 12.30.$$

Illustration 77 :

From the following particulars of Shiva Ram Ltd. for three months ending 31st March, 2012 prepare:

- Cost sheet for the period giving various costs, and
- Profit and Loss Account for the quarter showing profit per barrel.

Wages ₹ 12,000, Coal and Oil ₹ 11,200, Cooperage, Corks and Shives ₹ 4,000, Malt ₹ 40,000. Hops 10,800, Beer Duty ₹ 2,80,000, Water ₹ 1,000, Rent and Taxes ₹, 6,000, By product ₹ 3,600, Sugar ₹ 14,000. Preservatives ₹ 1,600, Other Materials ₹ 1,200, Repairs ₹ 1,800, Depreciation ₹ 1,200, Administration Expenses ₹ 24,000, Selling and Distribution Expenses ₹ 30,000

Opening Stock of beer ₹ 40,500 (300 barrels), Closing stock of beer ₹ 67,500 (500 barrels) Beer Sales ₹ 4,98,000 (2,800 barrels). Beer brewed during the period 3,000 barrels.

Solution:

Cost Sheet for the Quarter ending 31st March, 2012 (Output: Beer Brewed 3,000 Barrels)

Particulars	Total Cost	Cost per Barrel
	₹	₹
Materials Consumed:		
Malts	40,000	13.33
Hops	10,800	3.60
Sugar	14,000	4.67
Preservatives	1,600	0.53
Other Materials	1,200	0.40
Water	1,000	0.33
	68,600	22.86
Beer Duty	2,80,000	93.33
	3,48,600	116.19
Less: Proceeds from Sale of By-product	3,600	1.19
	3,45,000	115.00
Wages	12,000	4.00
Prime Cost	3,57,000	119.00

Particulars	Total Cost	Cost per Barrel
	₹	₹
Factory Overheads:		
Coal and Oil	11,200	3.73
Cooperage, Corks and Shives	4,000	1.33
Rent and Taxes	6,000	2.00
Repairs	1,800	0.60
Depreciation	1,200	0.40
Factory Cost	3,81,200	127.06
Administration Expenses	24,000	8.00
Cost of production	4,05,200	135.06

Profit and Loss Account for the quarter ending 31st March, 2012

Dr.				Cr.			
Particulars	Barrel	Total ₹	Per Barrel ₹	Particulars	Barrel	Total ₹	Per Barrel ₹
To Opening Stock	300	40,500		By Sales	2,800	4,98,000	177.85
To Cost of production	3,000	4,05,200	135.06	By Stock (at cost)	500	67,500	
To Selling and Distribution Expenses		30,000	10.72				
To Net Profit		89,800	32.07				
	3,300	5,65,500	177.85		3,300	5,65,500	177.85

Illustration 78 :

From the following particulars prepare a Production Account showing all details of cost and their break up and also calculate gross profit and net profit.

	1-9-2012	30-9-2012
	₹	₹
Stock of Raw Materials	75,000	91,500
Stock of Work-in-progress	28,000	35,000
Stock of Finished Goods	54,000	31,000

Particulars	₹	Particulars	₹
Raw Materials Purchased	66,000	Salesmen Salaries and Commission	6,500
Direct Wages	54,000	Office Rent, Rates etc.	2,500
Indirect Wages	2,750	Sundry Office Expenses	6,500
Factory Expenses	25,000	Advertising	3,500
Depreciation on Plant and Machinery	3,500	Carriage Outwards	2,500
Sales	2,11,000		



Solution:

Production Account for September, 2012

Dr.

Cr.

Particulars	₹	₹	Particulars	₹
To Materials Consumed:			By Prime Cost c/d	1,03,500
Opening Stock of Raw Material	75,000			
Add: Material Purchased	66,000			
	1,41,000			
Less: Closing Stock of Raw materials	(91,500)	49,500		
To Direct Wages		54,000		
		1,03,500		1,03,500
To Prime Cost b/d		1,03,500	By Cost of Goods Manufactured	1,27,750
To Factory Overheads:				
Indirect Wages	2,750			
Factory Expenses	25,000			
Depreciation of Plant and Machinery	3,500	31,250		
To Work-in-Progress (opening)		28,000		
		1,62,750		
Less: Work-in-Progress (closing)		(35,000)		
		1,27,750		1,27,750
To Cost of Goods Manufactured b/d		1,27,750	By Sales	2,11,000
To Opening Stock of Finished Goods		54,000	By Stock of Finished goods	31,000
To Gross Profit c/d		60,250		
		2,42,000		2,42,000
To Office Expenses:			By Gross Profit b/d	60,250
Rent, Rates etc.	2,500			
Sundry Office Expenses	6,500	9,000		
To Selling Expenses:				
Salesmen's Salaries and Commission	6,500			
Advertising	3,500			
Carriage Outwards	2,500	12,500		
To Net Profit		38,750		
		60,250		60,250

Illustration 79 :

The cost structure of an article the selling price of which is ₹ 45,000 is as follows:

Direct Materials	50%
Direct Labour	20%
Overheads	30%

An increase of 15% in the cost of materials and of 25% in the cost of labour is anticipated. These increased costs in relation to the present selling price would cause a 25% decrease in the amount of present profit

per article.

You are required:

- (a) To prepare a Statement of Profit Per Article at Present, and
- (b) The Revised Selling Price to produce the same percentage of profit to sales as before.

Solution:

Present Statement of Profit Per Article

Particulars		₹
Direct Materials	0.5x	15,000
Direct Labour	0.2x	6,000
Overheads	0.3x	9,000
Total Cost		30,000
Profit (50% on Cost)		15,000
Selling Price		45,000

Statement Of Revised Selling Price Per Article

Particulars		₹
Direct Materials	0.575x	17,250
Direct Labour	0.250x	7,500
Overheads	0.300x	9,000
Total Anticipated Cost		33,750
Profit (50% on Cost)		16,875
Selling Price		50,625

Working Notes:

Suppose,
 x = Total Cost
 y = Profit per article
 Hence $x + y = ₹ 45,000$

Statement Showing The Present & Anticipated Cost Per Article

Items	Present Cost	Increase % ₹	Anticipated Cost
Direct Materials	0.5x	15.00	0.575x
Direct Labour	0.2x	25.00	0.250x
Overheads	0.3x		0.300x
	x		1.125x

$$1.125x + 0.75y = ₹ 45,000 - I$$

$$x + y = 45,000 - II$$

$$1.5x + y = 60,000 \text{ (Multiply both sides of first equation by } \frac{4}{3} \text{) - III}$$

$$\text{(Deducting (III) equation)} \quad 0.5x = 15,000$$

$$\text{From equation (II), we get} \quad \therefore x = ₹ 30,000$$

$$\text{and } y = ₹ 15,000$$

Study Note - 2

DECISION MAKING TOOLS



This Study Note Includes

- 2.1 Marginal Costing
- 2.2 Throughput Accounting
- 2.3 Activity Based Costing
- 2.4 Transfer Pricing
- 2.5 Treatment of Special Expenses in Cost Accounts
- 2.6 Integration of Standard Costing with Marginal Cost Accounting, Absorption Cost Accounting and Throughput Accounting

2.1 MARGINAL COSTING

The cost of a product or process can be ascertained using different elements of cost using any of the following two techniques viz.,

1. Absorption Costing
2. Marginal Costing

2.1.1 Absorption Costing:

Under this method, the cost of the product is determined after considering the total cost i.e., both fixed and variable costs. Thus this technique is also called traditional or total costing. The variable costs are directly charged to the products where as the fixed costs are apportioned over different products on a suitable basis, manufactured during a period. Thus under absorption costing, all costs are identified with the manufactured products. However, this technique suffers from the following limitations:

2.1.1.1 Limitations of Absorption Costing:

1. Being dependent on levels of output which vary from period to period, costs are vitiated due to the existence of fixed overhead. This renders them useless for purposes of comparison and control. (If, however, overhead recovery rate is based on normal capacity, this situation will not arise).
2. Carryover of a portion of fixed costs, i.e., period costs to subsequent accounting periods as part of the cost of inventory is a unsound practice because costs pertaining to a period should not be allowed to be vitiated by the inclusion of costs pertaining to the previous period.
3. Profits and losses in the accounts are related not only to sales but also to production, including the production which is unsold. This is contrary to the principle that profits are made not at the stage when products are manufactured but only when they are sold.
4. There is no uniformity in the methods of application of overhead in absorption costing. These problems have, no doubt, to be faced in the case of marginal costing also but to a less extent because of the exclusion of fixed costs, as different assumptions made in the matter of application of fixed overhead will not arise in the case of marginal costing.
5. Absorption costing is not always suitable for decision making solutions to various types of problems of management decision making, where the absorption cost method would be practically ineffective, such as selection of production volume and optimum capacity utilisation, selection of production mix, whether to buy or manufacture, choice of alternatives and evaluation of performance can be had with the help of marginal cost analysis. Sometimes, the conclusion drawn from absorption cost data in this regard may be misleading and lead to losses.

2.1.2 Marginal Costing:

Marginal costing is "the ascertainment of marginal costs and of the effect on profit of changes in volume or type of output by differentiating between fixed costs and variable costs." Several other terms in use

like direct costing, contributory costing, variable costing, comparative costing, differential costing and incremental costing are used more or less synonymously with marginal costing.

It is a process whereby costs are classified into fixed and variable and with such a division so many managerial decisions are taken. The essential feature of marginal costing is division of total costs into fixed and variable, without which this could not have existed. Variable costs vary with volume of production or output, whereas fixed costs remains unchanged irrespective of changes in the volume of output. It is to be understood that unit variable cost remains same at different levels of output and total variable cost changes in direct proportion with the number of units. On the other hand, total fixed cost remains same disregard of changes in units, while there is inverse relationship between the fixed cost per unit and the number of units.

2.1.2.1 Features of Marginal Costing:

The main features of Marginal Costing may be summed up as follows:

1. Appropriate and accurate division of total cost into fixed and variable by picking out variable portion of semi variable costs also.
2. Valuation of stocks such as finished goods, work-in-progress is valued at variable cost only.
3. The fixed costs are written off soon after they are incurred and do not find place in product cost or inventories.
4. Prices are based on Marginal Cost and Marginal Contribution.
5. It combines the techniques of cost recording and cost reporting.

2.1.2.2 Advantages or Merits or Applications of Marginal Costing:

1. Marginal costing system is simple to operate than absorption costing because they do not involve the problems of overhead apportionment and recovery.
2. Marginal costing avoids, the difficulties of having to explain the purpose and basis of overhead absorption to management that accompany absorption costing. Fluctuations in profit are easier to explain because they result from cost volume interactions and not from changes in inventory valuation.
3. It is easier to make decisions on the basis of marginal cost presentations, e.g., marginal costing shows which products are making a contribution and which are failing to cover their avoidable (i.e., variable) costs. Under absorption costing the relevant information is difficult to gather, and there is the added danger that management may be misled by reliance on unit costs that contain an element of fixed cost.
4. Marginal costing is essentially useful to management as a technique in cost analysis and cost presentation. It enables the presentation of data in a manner useful to different levels of management for the purpose of controlling costs. Therefore, it is an important technique in cost control.
5. Future profit planning of the business enterprises can well be carried out by marginal costing. The contribution ratio and marginal cost ratios are very useful to ascertain the changes in selling price, variable cost etc. Thus, marginal costing is greatly helpful in profit planning.
6. When a business concern consists of several units and produces several products and evaluation of performance of such components can well be made with the help of marginal costing.
7. It is helpful in forecasting.
8. When there are different products, the determination of number of units of each product, called Optimum Product Mix, is made with the help of marginal costing.
9. Similarly, optimum sales mix i.e., sales of each and every product to get maximum profit can also be determined with the help of marginal costing.
10. Apart from the above, numerous managerial decisions can be taken with the help of marginal costing, some of which, may be as follows:-

> 2.2 | COST AND MANAGEMENT ACCOUNTANCY



- a) Make or buy decisions,
- b) Exploring foreign markets,
- c) Accept an order or not,
- d) Determination of selling price in different conditions,
- e) Replace one product with some other product,
- f) Optimum utilisation of labour or machine hours,
- g) Evaluation of alternative choices,
- h) Subcontract some of the production processes or not,
- i) Expand the business or not,
- j) Diversification,
- k) Shutdown or continue,

2.1.2.3 Limitations of Marginal Costing:

- a. The separation of costs into fixed and variable present's technical difficulties and no variable cost is completely variable nor is a fixed cost completely fixed.
- b. Under the marginal cost system, stock of finished goods and work-in-progress are understated. After all, fixed costs are incurred in order to manufacture products and as such, these should form a part of the cost of the products. It is, therefore, not correct to eliminate fixed costs from finished stock and work-in-progress.
- c. The exclusion of fixed overhead from the inventories affects the Profit and Loss Account and produces an unrealistic and conservative Balance Sheet, unless adjustments are made in the financial accounts at the end of the period.
- d. In marginal costing system, marginal contribution and profits increase or decrease with changes in sales volume. Where sales are seasonal, profits fluctuate from period to period. Monthly operating statements under the marginal costing system will not, therefore, be as realistic or useful as in absorption costing.
- e. During the earlier stages of a period of recession, the low profits or increase in losses, as revealed in a magnified way in the marginal costs statements, may unduly create panic and compel the management to take action that may lead to further depression of the market.
- f. Marginal costing does not give full information. For example, increased production and sales may be due to extensive use of existing equipments (by working overtime or in shifts), or by an expansion of the resources, or by the replacement of labour force by machines. The marginal contribution fails to reveal these.
- g. Though for short-term assessment of profitability marginal costs may be useful, long term profit is correctly determined on full costs basis only.
- h. Although marginal costing eliminates the difficulties involved in the apportionment and under and over-absorption of fixed overhead, the problem still remains so far as the variable overhead is concerned.
- i. With increased automation and technological developments, the impact on fixed costs on products is much more than that of variable costs. A system which ignores fixed costs is therefore, less effective because a major portion of the cost, such as not taken care of.
- j. Marginal costing does not provide any standard for the evaluation of performance. A system of budgetary control and standard costing provides more effective control than that obtained by marginal costing.

2.1.3 Differences between Absorption Costing and Marginal Costing:

	Absorption Costing	Marginal Costing
1.	Both fixed and variable costs are considered for product costing and inventory valuation.	Only variable costs are considered for product costing and inventory valuation.
2.	Fixed costs are charged to the cost of production. Each product bears a reasonable share of fixed cost and thus the profitability of a product is influenced by the apportionment of fixed costs.	Fixed costs are regarded as period costs. The profitability of different products is judged by their P/V ratio.
3.	Cost data are presented in conventional pattern. Net profit of each product is determined after subtracting fixed cost along with their variable cost.	Cost data are presented to highlight the total contribution of each product.
4.	The difference in the magnitude of opening stock and closing stock affects the unit cost of production due to the impact of related fixed cost.	The difference in the magnitude of opening stock and closing stock does not affect the unit cost of production.
5.	In case of absorption costing the cost per unit reduces, as the production increases as it is fixed cost which reduces, whereas, the variable cost remains the same per unit.	In case of marginal costing the cost per unit remains the same, irrespective of the production as it is valued at variable cost.

2.1.4 Difference in profit under Marginal and Absorption Costing:

- No opening and closing stock: In this case, profit/loss under absorption and marginal costing will be equal.
- When opening stock is equal to closing stock: In this case, profit/loss under two approaches will be equal provided the fixed cost element in both the stocks is same amount.
- When closing stock is more than opening stock: In other words, when production during a period is more than sales, then profit as per absorption approach will be more than that by marginal approach. The reason behind this difference is that a part of fixed overhead included in closing stock value is carried forward to next accounting period.
- When opening stock is more than the closing stock: In other words when production is less than the sales, profit shown by marginal costing will be more than that shown by absorption costing. This is because a part of fixed cost from the preceding period is added to the current year's cost of goods sold in the form of opening stock.

2.1.5 MARGINAL COST:

Marginal Cost is defined as "the amount at any given volume of output by which aggregate costs are changed if the volume of output is increased or decreased by one unit." Marginal Cost also means *Prime Cost plus Variable Overheads*. Marginal Cost is a constant ratio which may be expressed in terms of an amount per unit of output. On the other hand, fixed cost which is not normally traceable to particular unit denotes a fixed amount of expenditure incurred during an accounting period. Fixed cost is, therefore, also called time cost, period cost, standby cost, capacity cost, or constant cost. Variable cost or marginal cost is also termed as direct cost, activity cost, volume cost or out-of-pocket cost.

From the above definition and analysis of marginal cost, we can understand that is the cost which varies according to the variations in the volumes of output. However, by definition marginal cost is the change in the total cost for addition of one unit. *It is to be noted that for an economist marginal cost and variable cost would be different. But for an accountant both marginal cost and variable cost are same and are interchangeably used.* Therefore, for our study, we use marginal cost and variable cost synonymously.

> 2.4 | COST AND MANAGEMENT ACCOUNTANCY



2.1.6 Differential Cost Analysis

Differential Cost is the change in the costs which results from the adoption of an alternative course of action. The alternative actions may arise due to change in sales volume, price, product mix (by increasing, reducing or stopping the production of certain items), or methods of production, sales, or sales promotion, or they may be due to 'make or buy' or 'take or refuse' decisions. When the change in costs occurs due to change in the activity from one level to another, differential cost is referred to as incremental cost or decremental cost, if a decrease in output is being considered, i.e. total increase in cost divided by the total increase in output. However, accountants generally do not distinguish between differential cost and incremental cost and the two terms are used to mean one and the same thing.

The computation of differential cost provides an useful method of analysis for the management for anticipating the results of any contemplated changes in the level or nature of activity. When policy decisions have to be taken, differential costs worked out on the basis of alternative proposals are of great assistance.

The determination of differential cost is simple. Differential cost represents the algebraic difference between the relevant costs for the alternatives being considered. Thus, when two levels of activities are being considered, the differential cost is obtained by subtracting the cost at one level from the cost of another level.

2.1.6.1 The essential features of differential costs are as follows:-

1. The basis data used for differential cost analysis are costs, revenue and the investment factors which are relevant in the problem for which the analysis is undertaken.
2. Total differential costs rather than the costs per unit are considered.
3. Differential cost analysis is made outside the accounting records.
4. As the differences in the costs at two levels are considered, absolute costs at each level are not as relevant as the difference between the two. Thus, items of costs which do not change but are identical for the alternatives under consideration, are ignored.
5. The differentials are measured from a common base point or position.
6. The stage at which the difference between the revenue and the cost is the highest, measured from the common base point, determines the choice from amongst a number of alternative actions.
7. In computing differential costs, historical or standard costs may be used but they should be adjusted to the requirements of future conditions.
8. The elements and items of cost to be considered in differential cost analysis will depend upon the nature of the problem and the alternatives being considered.

2.1.7 Differential Costs Analysis and Marginal Costing:

Although the techniques of differential costs analysis are similar to those of marginal costing, the two should not be confused. The points of similarity and difference between differential costs analysis and marginal costing are summarized below:

Similarity:

- a. Both the techniques of cost analysis and cost presentation.
- b. Both are made use of by the management in decision making and in formulating policies.
- c. The concepts of differential costs and marginal costs mainly arise out of the difference in the behaviour of fixed and variable costs.
- d. Differential costs compare favourably with the economist's definition of marginal cost, viz. that marginal cost is the amount which at any given volume of output is changed if output is increased or decreased by one unit.

Difference:

- a. Differential cost analysis can be made in the case of both absorption costing as well as marginal costing.
- b. While marginal costing excludes the entire fixed costs, some of the fixed costs may be taken into account as being relevant for the purpose of differential cost analysis.
- c. Marginal costs may be embodied in the accounting system whereas differential costs are worked out separately as analysis statements.
- d. In marginal costing, margin of contribution and contribution ratio are the main yardsticks for performance evaluation and for decision making. In differential cost analysis, differential costs are compared with the incremental or decremental revenues, as the case may be.

2.1.8 Practical Application of Differential Costs:

They are useful in managerial decisions, which are enumerated below:

- i. Determination of most profitable levels of production and price.
- ii. Acceptance of offer at a lower price or offering a quotation at lower selling price in order to increase capacity.
- iii. It is used to decide whether it will be more profitable to sell a product as it is or to process it further into a different product to be sold at an increased price.
- iv. Determining the suitable price at which raw material may be purchased.
- v. Decision of adding a new product or business segment.
- vi. Discontinuing a product or business segment in order to avoid or reduce the present loss or increase profit.
- vii. Changing the product mix.
- viii. Make or buy decisions.
- ix. Decision regarding alternative capital investment and plant replacement.
- x. Decision regarding change in method of production.

2.1.9 Tools and Techniques of Marginal Costing:

1. Contribution:~

In common parlance, contribution is the reward for the efforts of the entrepreneur or owner of a business concern. From this, one can get in his mind that contribution means profit. But it is not so. Technically or in Costing terminology, contribution means not only profit but also fixed cost. That is why; it is defined as the amount recovered towards fixed cost and profit.

Contribution can be computed by subtracting variable cost from sales or by adding fixed costs and profit.

Symbolically, $C = S - V \rightarrow (1)$

Where C = Contribution
S = Selling Price
V = Variable Cost

Also $C = F + P \rightarrow (2)$

Where F = Fixed Cost
P = Profit



From (1) and (2) above, we may deduce the following equation called Fundamental Equation of Marginal Costing i.e.

$$S - V = F + P \rightarrow (3)$$

Contribution is helpful in determination of profitability of the products and/or priorities for profitabilities of the products. When there are two or more products, the product having more contribution is more profitable.

For example: The following are the three products with selling price and cost details:

Particulars	A	B	C
Selling price (₹)	100	150	200
Variable cost (₹)	50	70	100
Contribution (₹)	50	80	100

In the above example, one can say that the product 'C' is more profitable because, it has more contribution. This proposition of product having more contribution is more profitable is valid, as long as, there are no limitations on any factor of production. In this context, factors of production means, the factors that are responsible for producing the products such as material, labour, machine hours, demand for sales etc.,

Limiting Factor (or) Key Factor:

In the above example, we find that product having more contribution is more profitable. However, when there is a limitation on any input factor, the profitability of the product cannot simply be determined by finding out the contribution of the unit, but it can be found out by ascertaining the contribution per unit of that factor of production which is limited in the given situation. Such factor of production which is limited in the question is called key factor or limiting factor.

Continuing the above example, it may be explained as follows:

The three products take same raw material. A takes 1 kg, B requires 2 kgs, C requires 5 kgs and the raw material is not abundant.

Then profitability of the above products is determined as follows:

$$\text{Profitability} = \frac{\text{Contribution}}{\text{Key Factor}}$$

A	B	C
$50 / 1 = ₹ 50$	$80 / 2 = ₹ 40$	$100 / 5 = ₹ 20$

Now, product A is more profitable because it has more contribution per kg of material.

The key factor can also be called as scarce factor or Governing factor or Limiting factor or Constraining factor etc., whatever may be the name, it indicates the limitation on the particular factor of production.

From the above, it is essentially understandable that contribution is helpful in determination of profitability of the products, priorities for profitability of the products and in particular, profitabilities when there are limitation on any factor.

2. Profit Volume Ratio (P/V Ratio) or Contribution Ratio:

First of all, a ratio is a statistical or mathematical tool with the help of which a relationship can be established between the variables of the same kind. Further, it may be expressed in different forms such as fractional form, quotient, percentage, decimal form, and proportional form.

For example:

Gross profit ratio: It may be expressed as follows:

- Gross profit is ¼th of sales
- Sales is 4 times that of gross profit
- Gross profit ratio is 25%
- Gross profit is 0.25 of sales and lastly
- Gross profit and sales are in the ratio of 1:4

So, P/V ratio or contribution ratio is association of two variables. From this, one may assume that it is the ratio of profit and sales. But it is not so. It is the ratio of Contribution to Sales.

Symbolically, $P/V \text{ ratio} = \left(\frac{\text{Contribution}}{\text{Sales}} \right) \times 100 \rightarrow (1)$

$$\Rightarrow P/V \text{ ratio} = \left(\frac{C}{S} \times 100 \right)$$

$$\Rightarrow \text{Contribution} = \text{Sales} \times P/V \text{ ratio} \rightarrow (2)$$

$$\Rightarrow \text{Sales} = \left(\frac{\text{Contribution}}{P/V \text{ Ratio}} \right) \rightarrow (3)$$

When cost accounting data is given for two periods, then:

$$P/V \text{ ratio} = \left(\frac{\text{Change in Contribution}}{\text{Change in Sales}} \times 100 \right) \text{ or}$$

$$P/V \text{ ratio} = \left(\frac{\text{Change in Profit}}{\text{Change in Sales}} \times 100 \right)$$

It is to be noted that the above two formulas are valid as long as there are no changes in prices, means input prices and selling prices.

Usually, $\text{Sales} = \text{Cost} + \text{Profit}$

i.e. it can also be written as $\text{Sales} = \text{Variable Cost} + \text{Fixed Cost} + \text{Profit}$ and this is called general sales equation.

Since Sales consists of variable costs and contribution, given the variable cost ratio, P/V ratio can be found out. Similarly, given the P/V ratio, variable cost ratio can be found out.

For example, P/V ratio is 40%, then variable cost ratio is 60%, given variable cost ratio is 70%, then P/V ratio is 30%. Such a relationship is called complementary relationship. Thus P/V ratio and variable cost ratios are said to be complements of each other.

P/V ratio is also useful like contribution for determination of profitabilities of the products as well as the priorities for profitabilities of the products. In particular, it is useful in determination of profitabilities of the products in the following two situations:

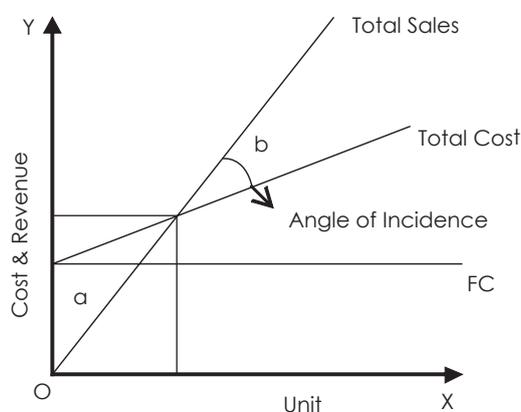
- i. When sales potential in value is limited.

ii. When there is a greater demand for the products.

3. Break Even Point:

When someone asks a layman about his business he may reply that it is alright. But a technical man may reply that it is break even. So, Break Even means the volume of production or sales where there is no profit or loss. In other words, Break Even Point is the volume of production or sales where total costs are equal to revenue. It helps in finding out the relationship of costs and revenues to output. In understanding the breakeven point, cost, volume and profit are always used. The break even analysis is used to answer many questions of the management in day to day business.

The formal break even chart is as follows:



a = Losses

b = Profits

When no. of units are expressed on X-axis and costs and revenues are expressed on Y-axis, three lines are drawn i.e., fixed cost line, total cost line and total sales line. In the above graph we find there is an intersection point of the total sales line and total cost line and from that intersection point if a perpendicular is drawn to X-axis, we find break even units. Similarly, from the same intersection point a parallel line is drawn to X-axis so that it cuts Y-axis, where we find Break Even point in terms of value. This is how, the formal pictorial representation of the Break Even chart.

At the intersection point of the total cost line and total sales line, an angle is formed called *Angle of Incidence*, which is explained as follows:

Angle of Incidence:

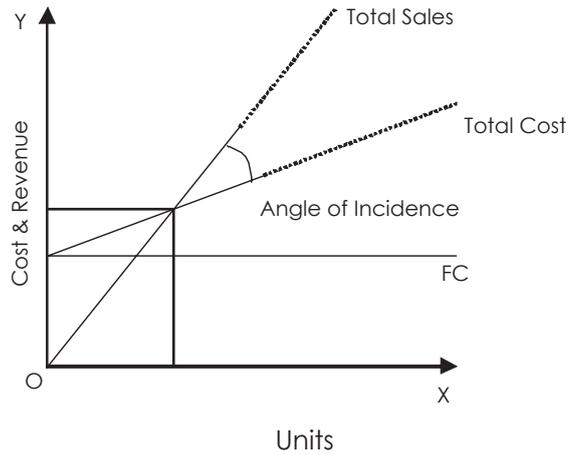
Angle of Incidence is an angle formed at the intersection point of total sales line and total cost line in a formal break even chart. If the angle is larger, the rate of growth of profit is higher and if the angle is lower, the rate of growth of profit is lower. So, growth of profit or profitability rate is depicted by Angle of Incidence.

Break Even Analysis (or) Cost-Volume-Profit Analysis (CVP analysis):

From the breakeven charts breakeven point and profits at a glance can be found out. Besides, management makes profit planning with the help of breakeven charts. It can clearly be understood by way of charts to know the changes in profit due to changes in costs and output. Such profit planning is made with the variables mainly cost, profit and volume, such an analysis is called breakeven analysis. Throughout the charts relationship is established among the cost, volume and profit, it is also called *Cost-Volume-Profit Analysis (CVP analysis)*. That is why it is popularly said by S.C.Kuchal in his book "*Financial Management - An Analytical and Conceptual Approach*", that **Cost-volume-profit analysis, break even analysis and profit graphs are interchangeable words**. The analysis is further explained as follows:

The change in profit can be studied through Break even charts in different situations in the following manner:

i) Increase in No. of Units

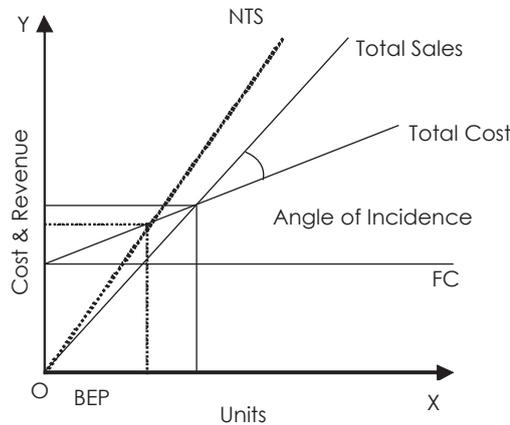


'.....' line indicates increase in total cost and total sales.

In the above chart, if we clearly observe we find that there is no change in BEP even if there is increase or decrease in No. of units.

ii) Increase in Sales due to increase in selling price.

NTS = New Total Sales line

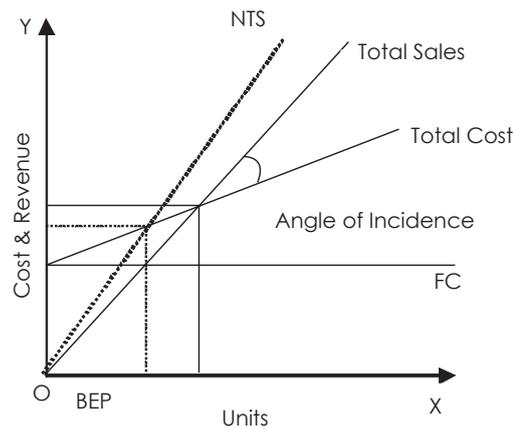


'.....' line indicates changes in break even point and changes in sales.

From the above chart, we observe that profit is increased by increasing the selling price and also, if there is change in selling price, BEP also changes. If selling price is increased then BEP decreases.

If selling price is decreased then BEP increases. Thus, we say that there is an inverse relationship between selling price and BEP.

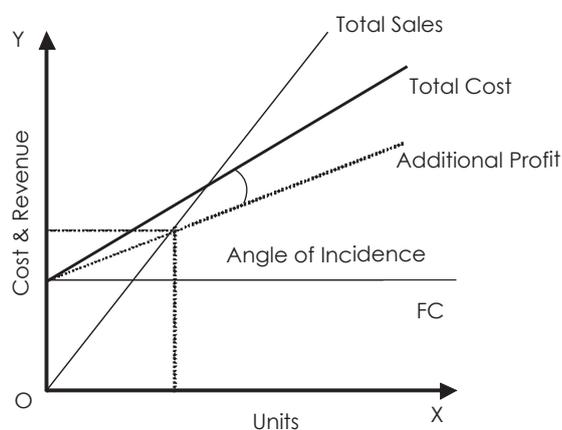
iii) Decrease in variable cost:



'.....' line indicates decrease in total cost and decrease in B.E.P

From the above chart, we observe that when variable costs are decreased, no doubt, profit is increased. If there is change in variable cost then BEP also changes. If variable cost is decreased then BEP also decreases. If variable cost is increased then BEP also increases. Thus there is direct relationship between variable cost and BEP.

iv) Change in fixed cost:

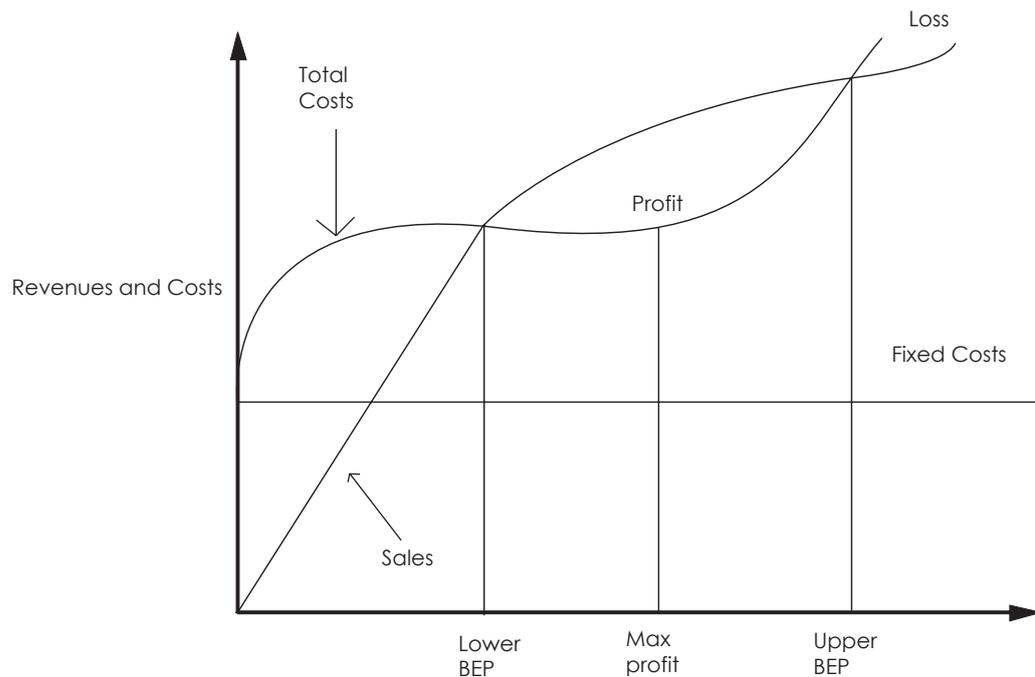


'.....' line indicates decrease in fixed cost and total cost and also decrease in BEP.

NTC = New Total Cost Line

NFC = New Fixed Cost Line

From the above chart also we find that there is increase in profit due to decrease in fixed cost. If fixed cost is increased then BEP also increases. If fixed cost is decreased then BEP also decreases. Thus there is a direct relationship between fixed cost and BEP.

Non linear Break Even Chart:

In some cases on account of non-linear behaviour of cost and sales there may be two or more break even points. In such a case the optimum profit is earned where the difference between the sales and the total costs is the largest. It is obvious that the business should produce only upto this level. This is being illustrated in the above chart.

Cash Break-Even Point:

When break-even point is calculated only with those fixed costs which are payable in cash, such a break-even point is known as cash break-even point. This means that depreciation and other non-cash fixed costs are excluded from the fixed costs in computing cash break-even point. Its formula is-

Cash break even point = Cash fixed costs / Contribution per unit.

Profit Volume Chart:

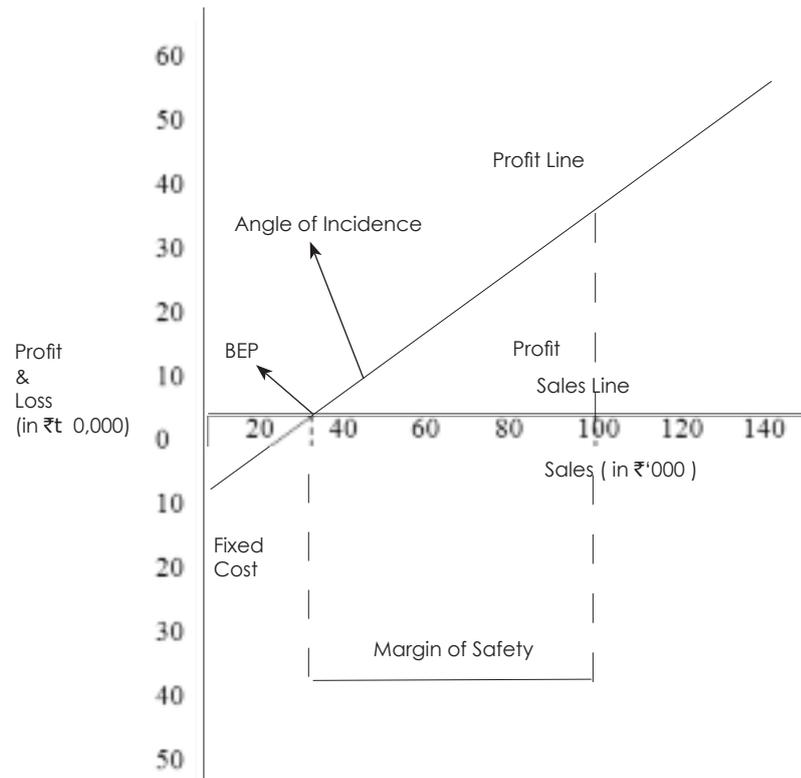
Profit-volume chart prominently exhibits the relationship between profit and sales volume. The normal break-even charts suffer from one limitation. Profit cannot be read directly from the chart. It is essential to deduct total cost from sale to know the profit figure. The profit graph overcomes the difficulty by plotting profit directly against an activity. These charts are easy to understand and their preparation involves drawing sales curve and profit curve. The point at which profit line cuts the sales line is called break-even point. Taking the methods and objects under consideration, the profit-volume chart can be further divided into following categories i.e.,

a. *Simple Profit-Volume Chart:*

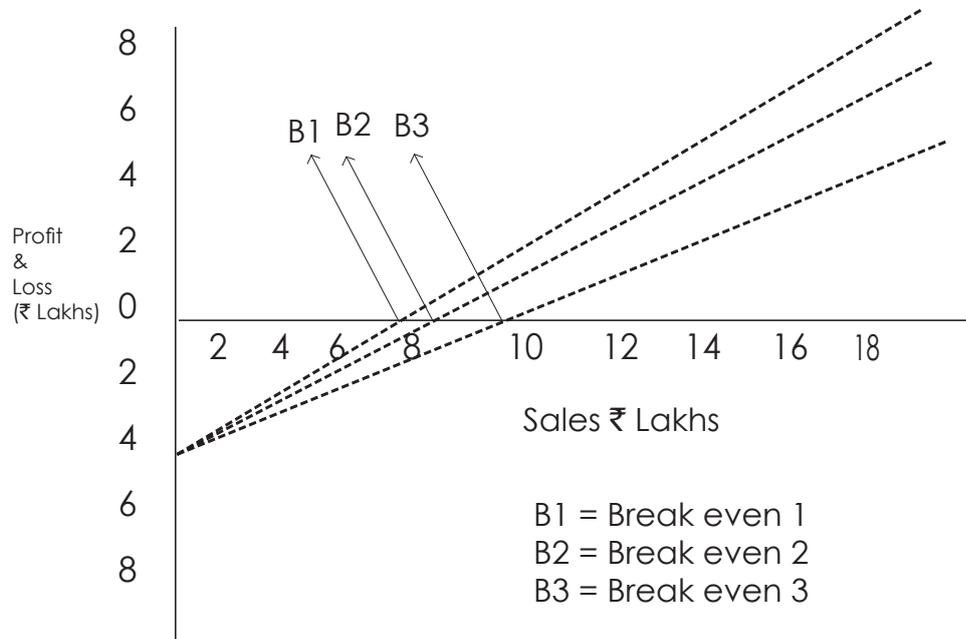
Its preparation involves the following steps:

- Finding out profit at any two levels of activity.
- Drawing sales line.
- Drawing profit line.

Simple Profit-Volume chart is shown below:



b. Profit volume chart showing different breakeven point at different price levels is shown below:



Sequential Profit Graph:

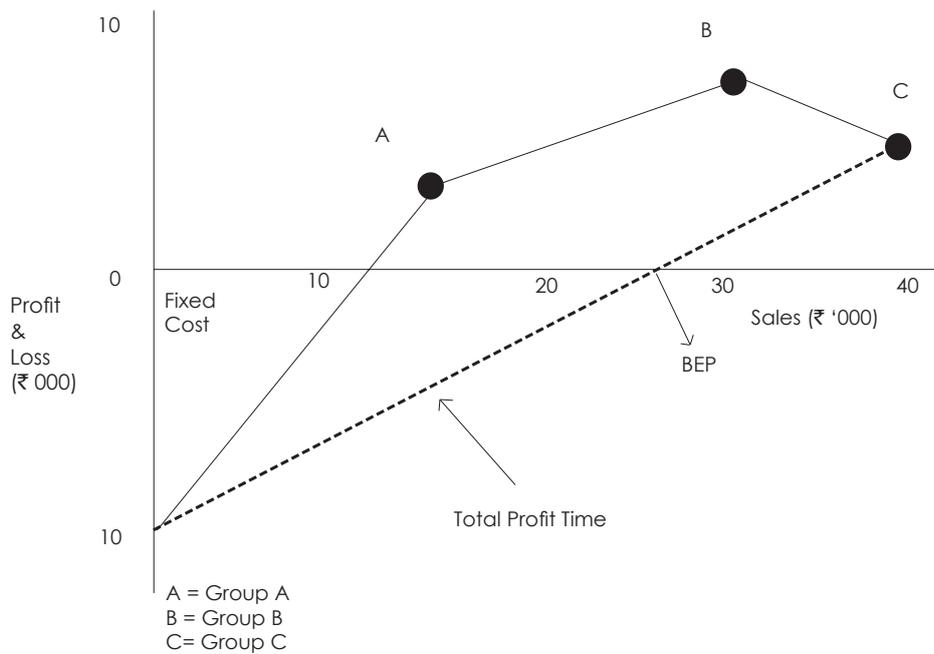
Sometimes, a company manufactures more than one product of varying profitability. A change in the profitability of one product will lead to a change in the profitability as a whole. Profit-volume chart can be prepared for a group also. This chart shows relative profitability of different products. It is also called profit-volume graph for a group of products, sequential profit graph or profit path chart. Its main advantage is that it exhibits the relative profitability of different products at a glance. This graph is also useful to show average slope and marginal slope.

Methods of drawing 'Profit Path':

In sequential profit graph or profit graph for a group of products, a line "profit plan" is drawn in order to draw total profit line. For drawing profit path, a statement is prepared showing cumulative sale and cumulative profit. The line 'Profit path' is drawn with the aid of columns for cumulative same and cumulative profit.

Steps in drawing Profit volume graph (or) sequential profit graph:

- First prepare a marginal cost statement to know the P/V ratios.
- Prepare a statement to find out cumulative sale and cumulative profit.
- Draw a profit path with the help of columns, cumulative sale and cumulative profit.
- Draw total profit line for group of products.





COMPUTATION OF BREAK EVEN POINT:

$$\text{Break Even Point in value} = \frac{F \times S}{S - V} \quad \dots (1)$$

$$= \frac{F \times S}{C} \quad \dots (2)$$

$$= \frac{F \times S}{F + P} \quad \dots (3)$$

$$= \frac{F}{\text{P.V. Ratio}} \quad \dots (4)$$

$$\text{or} = \frac{F}{\frac{C}{S}}$$

$$\text{or} = \frac{F}{\frac{S - V}{S}}$$

$$= \frac{F}{1 - \frac{V}{S}} \quad \dots (5)$$

Break Even Point (in units) = Fixed Cost / Contribution per unit

Proof for basic breakeven:

Let, V be the variable cost per unit

U be the volume of output i.e., No. of units

P be the Profit

F be the Fixed Cost

S be the Selling Price

By substituting the notations in general sales equation:

Sales = Fixed cost + Variable cost + Profit

$$SU = F + VU + P$$

At Break Even, $SU = F + VU$ (Since $P = 0$)

$$\rightarrow SU - VU = F$$

$$\rightarrow U(S - V) = F$$

$$\rightarrow U = \frac{F}{S - V}$$

OR

$$\text{No. of Units} = \frac{\text{Fixed Cost}}{\text{Contribution per Unit}}$$

Break even sales

$$SU (\text{Sales}) = \frac{F \times S}{S - V}$$

Where,

F = Fixed cost

V = Variable cost

S = Sales

P = Profit

C = Contribution

Uses and applications of Break even Analysis (Or) Profit Charts (Or) Cost Volume Profit Analysis:

The important uses to which cost-volume profit analysis or break-even analysis or profit charts may be put to use are:

- a. Forecasting costs and profits as a result of change in Volume determination of costs, revenue and variable cost per unit at various levels of output.
- b. Fixation of sales Volume level to earn or cover given revenue, return on capital employed, or rate of dividend.
- c. Determination of effect of change in Volume due to plant expansion or acceptance of order, with or without increase in costs or in other words, determination of the quantum of profit to be obtained with increased or decreased volume of sales.
- d. Determination of comparative profitability of each product line, project or profit plan.
- e. Suggestion for shift in sales mix.
- f. Determination of optimum sales volume.
- g. Evaluating the effect of reduction or increase in price, or price differentiation in different markets.
- h. Highlighting the impact of increase or decrease in fixed and variable costs on profit.
- i. Studying the effect of costs having a high proportion of fixed costs and low variable costs and vice-versa.
- j. Inter-firm comparison of profitability.
- k. Determination of sale price which would give a desired profit for break-even.
- l. Determination of the cash requirements as a desired volume of output, with the help of cash break-even charts.
- m. Break-even analysis emphasizes the importance of capacity utilization for achieving economy.
- n. During severe recession, the comparative effects of a shutdown or continued operation at a loss are indicated.
- o. The effect on total cost of a change in the fixed overhead is more clearly demonstrated through break-even charts.

Limitations of Break-even Analysis:

- a. That Costs are either fixed or variable and all costs are clearly segregated into their fixed and variable elements. This cannot possibly be done accurately and the difficulties and complications involved in such segregation make the break-even point inaccurate.
- b. That the behavior of both costs and revenue is not entirely related to changes in volume.
- c. That costs and revenue patterns are linear over levels of output being considered. In practice, this is not always so and the linear relationship is true only within a short run relevant range.
- d. That fixed costs remain constant and variable costs vary in proportion to the volume. Fixed costs are constant only within a limited range and are liable to change at varying levels of activity and also over a long period, particularly when additional plants and equipments are introduced.
- e. That sales mix is constant or only one product is manufactured. A combined analysis taking all the products of the mix does not reflect the correct position regarding individual products.
- f. That production and sales figures are identical or the change in opening and closing stocks of the finished product is not significant.
- g. That the units of production on the various product range are identical. Otherwise, it is difficult to find a homogeneous factor to represent volume.



- h. That the activities and productivity of the concern remain unchanged during the period of study.
- i. As output is continuously varied within a limited range, the contribution margin remains relatively constant. This is possible mainly where the output is more or less homogeneous as in the case of process industries.

4. Margin of Safety:

It is the sales point beyond the breakeven point. Margin of safety can be obtained by subtracting break even sales from Total sales. It is useful to determine financial soundness of business enterprise. If margin of safety is high, then the financial position of the enterprise is sound.

Margin of Safety = Total Sales – Break Even Sales → (1)

Total Sales = Break Even Sales + Margin of Safety Sales → (2)

→ Margin of safety can also be computed as follows:

Margin of Safety = Profit / P/V ratio → (3)

A relative measure to the margin of safety is its ratio to total sales.

→ Margin of safety ratio is the ratio of Margin of safety sales to Total sales.

Margin of safety ratio = [Margin of safety / Total sales] x 100 → (4)

→ Margin of safety ratio and Break even sales ratios are complements of each other.

→ If the sales amount, P/V ratio and M/S ratio are given, then profit can be computed as follows:

Profit = Total sales x P/V ratio x M/S ratio → (5)

Apart from the above formulae, various formulae that are used in the chapter to find out different results are as follows:

Profit = (Sales x P/V ratio) – Fixed Cost

Sales value to earn desired profit = $\left(\frac{\text{Fixed Cost} + \text{desired profit}}{\text{P/V ratio}} \right)$ and

Required units to earn desired profit = $\left(\frac{\text{Fixed Cost} + \text{desired profit}}{\text{Contribution per unit}} \right)$

Fixed cost = (Sales x P/V ratio) – Profit

Total sales = Break even sales + Margin of safety sales

Break even sales = Total sales – Margin of safety sales

Margin of safety sales = Total sales – Break even sales

Fixed cost = Break even sales x P/V ratio

Shut down sales = $\left(\frac{\text{Fixed Cost} - \text{Shut down costs}}{\text{P/V ratio}} \right)$

Shut down Units = $\left(\frac{\text{Fixed Cost} - \text{Shut down costs}}{\text{Contribution per unit}} \right)$

The level at which profits are same or the level at which costs are same for two methods or two alternatives

$$\text{i.e., Indifference Point} = \left(\frac{\text{Difference in fixed costs}}{\text{Difference in variable costs per unit}} \right)$$

Illustration 1:

The sports material manufacturing company budgeted the following data for the coming year.

	₹
Sales (1,00,000 units)	1,00,000
Variable cost	40,000
Fixed cost	50,000

Find out

- (a) P/V Ratio, B.E.P and Margin of Safety
- (b) Evaluate the effect of
 - (i) 20% increase in physical sales volume
 - (ii) 20% decrease in physical sales volume
 - (iii) 5% increase in variable costs
 - (iv) 5% decrease in variable costs
 - (v) 10% increase in fixed costs
 - (vi) 10% decrease in fixed costs
 - (vii) 10% decreases in selling price and 10% increase in sales volume
 - (viii) 10% increase in selling price and 10% decrease in sales volume
 - (ix) ₹ 5,000 variable cost decrease accompanied by ₹ 15,000 increase in fixed costs.

Solution:

- (a) P/V ratio, B.E.P and Margin of Safety

$$\begin{aligned} \text{Contribution} &= \text{Sales} - \text{Variable cost} \\ &= 1,00,000 - 40,000 \\ &= ₹ 60,000 \end{aligned}$$

$$\begin{aligned} \text{P/V Ratio} &= (\text{Contribution} / \text{Sales}) \times 100 \\ &= (60,000 / 1,00,000) \times 100 \\ &= 60\% \end{aligned}$$

$$\begin{aligned} \text{B.E.P sales} &= \text{Fixed cost} / \text{PV ratio} \\ &= 50,000 / 60\% \\ &= ₹ 83,333 \end{aligned}$$

$$\begin{aligned} \text{Margin of Safety} &= \text{Total sales} - \text{B.E.P sales} \\ &= 1,00,000 - 83,333 \\ &= ₹ 16,667 \end{aligned}$$



(b)

	Contribution ₹	P/V ratio	BE Sales ₹	Margin of safety ₹
(i) Increase in volume by 20%	1,20,000 – 48,000 = 72,000	$(72,000 / 1,20,000) \times 100$ = 60%	$(50,000 / 60\%)$ = 83,333	1,20,000 – 83,333 = 36,667
(ii) Decrease in volume by 20%	80,000 – 32,000 = 48,000	$(48,000 / 80,000) \times 100$ = 60%	$(50,000 / 60\%)$ = 83,333	80,000 – 83,333 = (3,333)
(iii) 5% increase in variable cost	1,00,000 – 42,000 = 58,000	$(58,000 / 1,00,000) \times 100$ = 58%	$(50,000 / 58\%)$ = 86,207	1,00,000 – 86,207 = 13,793
(iv) 5% decrease in variable cost	1,00,000 – 38,000 = 62,000	$(62,000 / 1,00,000) \times 100$ = 62%	$(50,000 / 62\%)$ = 80,645	1,00,000 – 80,645 = 19,355
(v) 10% increase in fixed cost	1,00,000 – 40,000 = 60,000	$(60,000 / 1,00,000) \times 100$ = 60%	$(55,000 / 60\%)$ = 91,667	1,00,000 – 91,667 = 8,333
(vi) 10% decrease in fixed costs	1,00,000 – 40,000 = 60,000	$(60,000 / 1,00,000) \times 100$ = 60%	$(45,000 / 60\%)$ = 75,000	1,00,000 – 75,000 = 25,000
(vii) 10% decreases in selling price and 10% increase in sales volume	99,000 – 44,000 = 55,000	$(55,000 / 99,000) \times 100$ = 55.55%	$(50,000 / 55.55\%)$ = 90,009	99,000 – 90,009 = 8,991
(viii) 10% increase in selling price and 10% decrease in sales volume	99,000 – 36,000 = 63,000	$(63,000 / 99,000) \times 100$ = 63.63%	$(50,000 / 63.63\%)$ = 78,579	99,000 – 78,579 = 20,421
(ix) ₹ 5,000 variable cost decrease accompanied by ₹ 15,000 increase in fixed costs.	1,00,000 – 35,000 = 65,000	$(65,000 / 1,00,000) \times 100$ = 65%	$(65,000 / 65\%)$ = 1,00,000	1,00,000 – 1,00,000 = 0

Illustration 2:

Two businesses AB Ltd and CD Ltd sell the same type of product in the same market. Their budgeted profits and loss accounts for the year ending 30th June, 2012 are as follows:

	AB Ltd (₹)		CD Ltd (₹)	
Sales		1,50,000		1,50,000
Less: Variable costs	1,20,000		1,00,000	
Fixed Cost	15,000	1,35,000	35,000	1,35,000
Profit		15,000		15,000

You are required to calculate the B.E.P of each business and state which business is likely to earn greater profits in conditions.

- Heavy demand for the product
- Low demand for the product.

Solution:**Statement Showing Computation of P/V ratio, BEP and Determination of Profitability in Different conditions:**

	Particulars	AB Ltd ₹	CD Ltd ₹
I.	Sales	1,50,000	1,50,000
II.	Variable cost	1,20,000	1,00,000
III.	Contribution	30,000	50,000
IV.	P/V ratio $\left[\frac{(30,000/1,50,000) \times 100}{(50,000/1,50,000) \times 100} \right]$	20%	33 1/3%
V.	Fixed cost	15,000	35,000
VI.	Profit	15,000	15,000
VII.	Breakeven sales (V/IV)	75,000	1,05,000

From the above computation, it was found that the product produced by CD Ltd is more profitable in conditions of heavy demand because its P/V ratio is higher. On the other hand, in the condition of low demand, the product produced by AB Ltd is more profitable because its BEP is low.

Illustration 3 :

A factory is currently working to 40% capacity and produces 10,000 units. At 50% the selling price falls by 3%. At 90% capacity the selling price falls by 5% accompanied by similar fall in prices of raw material. Estimate the profit of the company at 50% and 90% capacity production.

The cost at present per unit is:

Material	₹ 10
Labour	₹ 3
Overheads	₹ 5(60% fixed)

The selling price per unit is ₹ 20/- per unit.

Solution:**Statement Showing Computation of Profit at 50% and 90% Capacity as well as at Current Capacity:**

	Particulars	40%		50%		90%	
		₹		₹		₹	
		Unit	Total	Unit	Total	Unit	Total
I.	Selling price	20.00	2,00,000	19.40	2,42,500	19.00	4,27,500
II.	Variable cost						
	Material	10.00	1,00,000	10.00	1,25,000	9.50	2,13,750
	Labour	3.00	30,000	3.00	37,500	3.00	67,500
	Variable OH	2.00	20,000	2.00	25,000	2.00	45,000
		15.00	1,50,000	15.00	1,87,500	14.50	3,26,250
III.	Contribution	5.00	50,000	4.40	55,000	4.50	1,01,250
IV.	Fixed cost	3.00	30,000		30,000		30,000
V.	Profit		20,000		25,000		71,250
VI.	B.E. sales $\left(\frac{F \times S}{C} \right)$		1,20,000		1,32,273		1,26,667

**Illustration 4 :**

The sales turnover and profit during two periods were as follows:

Period	Sales (₹)	Profit (₹)
1	2,00,000	20,000
2	3,00,000	40,000

What would be probable trading results with sales of ₹1,80,000? What amount of sales will yield a profit of ₹ 50,000?

Solution:

$$\begin{aligned} \text{P/V ratio} &= (\text{Change in profit} / \text{Change in sales}) \times 100 \\ &= (20,000 / 1,00,000) \times 100 = 20\% \end{aligned}$$

$$\begin{aligned} \text{Fixed cost} &= (\text{Sales} \times \text{P/V ratio}) - \text{Profit} \\ &= (2,00,000 \times 0.2) - 20,000 = ₹ 20,000 \end{aligned}$$

$$\begin{aligned} \text{Sales required to earn desired profit} &= \frac{\text{Fixed cost} + \text{desired profit}}{\text{P/V ratio}} \\ &= (20,000 + 50,000) / 20\% = ₹ 3,50,000 \end{aligned}$$

Illustration 5 :

The following figures for profit and sales obtained from the accounts of X Co. Ltd.

Year	Sales (₹)	Profit (₹)
2011	20,000	2,000
2012	30,000	4,000

Calculate:

(a) P/V Ratio (c) B.E. Sales (e) Sales to earn a profit of ₹5,000.

(b) Fixed cost (d) Profit at sales ₹ 40,000 and

Solution:

$$\begin{aligned} \text{(a) P/V ratio} &= (\text{Change in profit} / \text{Change in sales}) \times 100 \\ &= (2,000 / 10,000) \times 100 = 20\% \end{aligned}$$

$$\begin{aligned} \text{(b) Fixed cost} &= (\text{Sales} \times \text{P/V ratio}) - \text{Profit} \\ &= (20,000 \times 0.2) - 2,000 = ₹ 2,000 \end{aligned}$$

$$\begin{aligned} \text{(c) Break even sales} &= \text{Fixed cost} / \text{PV ratio} \\ &= 2,000 / 20\% = ₹ 10,000 \end{aligned}$$

$$\begin{aligned} \text{(d) Profit at sales ₹ 40,000} &= (\text{Sales} \times \text{P/V ratio}) - \text{Fixed cost} \\ &= (40,000 \times 20\%) - 2,000 = ₹ 6,000 \end{aligned}$$

$$\begin{aligned} \text{(e) Sales required to earn desired profit} &= \frac{\text{Fixed cost} + \text{desired profit}}{\text{P/V ratio}} \\ \text{of ₹ 5,000} &= (2,000 + 5,000) / 20\% = ₹ 35,000 \end{aligned}$$

Illustration 6 :

The following results of a company for the last two years are as follows:

Year	Sales (₹)	Profit (₹)
2011	1,50,000	20,000
2012	1,70,000	25,000

You are required to calculate:

- (i) P/V Ratio
- (ii) B.E.P
- (iii) The sales required to earn a profit of ₹ 40,000
- (iv) Profit when sales are ₹ 2,50,000
- (v) Margin of safety at a profit of ₹ 50,000 and
- (vi) Variable costs of the two periods.

Solution:

- (i) P/V ratio = (Change in profit / Change in sales) x 100
 = (5,000 / 20,000) x 100 = 25%
 Fixed cost = (Sales x P/V ratio) – Profit
 = (1,50,000 x 25%) – 20,000 = ₹ 17,500
- (ii) Break even sales = Fixed cost / PV ratio
 = 17,500 / 25% = ₹ 70,000
- (iii) Sales required to earn a profit of ₹ 40,000 = $\frac{\text{Fixed cost} + \text{desired profit}}{\text{P/V ratio}}$
 = (17,500 + 40,000) / 25% = ₹ 2,30,000
- (iv) Profit at sales ₹ 2,50,000 = (Sales x P/V ratio) – Fixed cost
 = (2,50,000 x 25%) – 17,500 = ₹ 45,000
- (v) Margin of safety at profit of ₹ 50,000 = Profit / PV ratio
 = 50,000 / 25% = ₹ 2,00,000
- (vi) Variable cost for 2011 = 1,50,000 x 75% = ₹ 1,12,500
 Variable cost for 2012 = 1,70,000 x 75% = ₹ 1,27,500

Illustration 7:

The Reliable Battery Co. furnishes you the following income information:

	Year 2012	
	First Half (₹)	Second Half (₹)
Sales	8,10,000	10,26,000
Profit earned	21,600	64,800

From the above you are required to compute the following assuming that the fixed cost remains the same in both periods.



1. P/V Ratio
2. Fixed cost
3. The amount of profit or loss where sales are ₹ 6,48,000
4. The amount of sales required to earn a profit of ₹ 1,08,000

Solution:

1. P/V ratio = $[(64,800 - 21,600) / (10,26,000 - 8,10,000)] \times 100$
= 20%
2. Fixed cost = (Sales x P/V ratio) – Profit
= $(8,10,000 \times 20\%) - 21,600 = ₹ 1,40,400$
3. Profit/Loss when sales are ₹ 6,48,000
= (Sales x P/V ratio) – 1,40,400
= $(6,48,000 \times 20\%) - 1,40,400 = 1,29,600 - 1,40,400$
= ₹ 10,800 (loss)
4. Amount of sales to earn profit of ₹ 1,08,000
= $(1,40,400 + 1,08,000) / 20\%$
= $2,48,400 / 20\% = ₹ 12,42,000$

Illustration 8 :

The following figures relate to a company manufacturing a varied range of products:

	Total Sales (₹)	Total Cost(₹)
Year ended 31-12-2011	22,23,000	19,83,600
Year ended 31-12-2012	24,51,000	21,43,200

Assuming stability in prices, with variable cost carefully controlled to reflect pre-determined relation.

- (a) The profit volume ratio to reflect the rates of growth for profit and sales and
- (b) Any other cost figures to be deduced from the data.

Solution:

	31-12-2011 (₹)	31-12-2012 (₹)
Sales	22,23,000	24,51,000
(-) cost	19,83,600	21,43,200
Profit	2,39,400	3,07,800

$$\text{Change in profit} = 3,07,800 - 2,39,400 = ₹ 68,400$$

$$\text{Change in sales} = 24,51,000 - 22,23,000 = ₹ 2,28,000$$

- (a) P/V ratio = $(68,400 / 2,28,000) \times 100 = 30\%$
- (b) Fixed cost = $(22,23,000 \times 30\%) - 2,39,400$
= ₹ 4,27,500
- (c) Break even sales = $4,27,500 / 30\% = ₹ 14,25,000$
- (d) M/S for 2011 = $22,23,000 - 14,25,000 = ₹ 7,98,000$

- M/S for 2012 = 24,51,000 – 14,25,000 = ₹ 10,26,000
- (e) Variable cost for 2011 = 22,23,000 x 70% = ₹ 15,56,100
 Variable cost for 2012 = 24,51,000 x 70% = ₹ 17,15,700
- (f) % of fixed cost in 2011 = (4,27,500 / 22,23,000) x 100 = 19.23%
 % of fixed cost in 2012 = (4,27,500 / 24,51,000) x 100 = 17.44%

Illustration 9:

SV Ltd a multi product company furnishes you the following data relating to the year 2012:

	First Half of the year (₹)	Second Half of the year (₹)
Sales	45,000	50,000
Total cost	40,000	43,000

Assuming that there is no change in prices and variable cost and that the fixed expenses are incurred equally in the two half year period, calculate for the year, 2012

- (i) The P/V Ratio, (iii) Break-even sales
 (ii) Fixed Expenses (iv) Percentage of Margin of safety.

Solution:

- (i) P/V ratio = [(7,000 – 5,000) / (50,000 – 45,000)] x 100
 = 40%
- (ii) Fixed expenses for first half year : = (Sales x PV ratio) – Profit
 = (45,000 x 0.4) – 5,000 = ₹ 13,000
 Fixed expenses for the year = 13,000 + 13,000 = ₹ 26,000
- (iii) Break even sales = 26,000 / 40% = ₹ 65,000
- (iv) Margin of safety = (50,000 + 45,000) – 65,000
 = ₹ 30,000
 Margin of safety ratio = [30,000 / (50,000 + 45,000)] x 100
 = 31.58%

Illustration 10 :

S Ltd. furnishes you the following information relating to the half year ended 30th June, 2012.

Fixed expenses	₹ 45,000
Sales value	₹1,50,000
Profit	₹ 30,000

During the second half the year the company has projected a loss of ₹10,000.

Calculate:

- (1) The B.E.P and M/S for six months ending 30th June, 2012.
- (2) Expected sales volume for the second half of the year assuming that the P/V Ratio and Fixed expenses remain constant in the second half year also.
- (3) The B.E.P and M/S for the whole year for 2012.

**Solution:**

$$(1) \text{ P/V ratio : } = [(45,000 + 30,000) / 1,50,000] \times 100 \\ = 50\%$$

$$\text{BE sales for I half year} = 45,000 / 50\% = ₹ 90,000$$

$$\text{Margin of safety for I half year} = 1,50,000 - 90,000 = ₹ 60,000$$

For II half year:

$$(2) \text{ P/V ratio} = (\text{Fixed cost} + \text{Profit}) / \text{Sales}$$

$$0.5 = [45,000 + (-) 10,000] / \text{Sales}$$

$$0.5 \text{ sales} = 35,000$$

$$\Rightarrow \text{Sales} = ₹ 70,000$$

$$(3) \text{ BE sales for 2012} \quad = (45,000 + 45,000) \times 50\% \\ = 1,80,000$$

$$\text{Margin of safety for 2012} \quad = (1,50,000 + 70,000) - 1,80,000 \\ = ₹ 40,000$$

Illustration 11:

The following is the statement of a Radical Co. for the month of June.

	Products		Total (₹)
	L (₹)	M (₹)	
Sales	60,000	60,000	1,20,000
Variable costs	42,000	30,000	72,000
Contribution	18,000	30,000	48,000
Fixed cost			36,000
Net Income			12,000

You are required to compute the P/V ratio for each product and then compute the P/V Ratio, Break-even Point and net profit for the following assumption.

(i) Sales revenue divided 60% to Product L & 40% to Product M.

(ii) Sales revenue divided 40% to Product L & 60% to Product M.

Also calculate the profit estimated on sales upto ₹ 1,80,000/- p.m. for each of the sales mix provided above.

Solution:**Computation of P/V ratio**

Particulars	L	M	Total
P/V ratio (C/S) x 100	30%	50%	40%

(i) For Assumption I:

Statement showing computation of P/V ratio, Break even point and profit:

Sr. No.	Particulars	L (₹)	M (₹)	Total (₹)
I.	Sales	72,000	48,000	1,20,000
II.	Variable cost (L - 70%); (M - 50%)	50,400	24,000	74,400
III.	Contribution (L - 30%); (M - 50%)	21,600	24,000	45,600
IV.	Fixed cost			36,000
V.	Profit			9,600
	P/V ratio $(45,600 \times 1,20,000) / 100 = 38\%$	30%	50%	38%
	Break even sales = $36,000 / 38\% = ₹94,737$			

(ii) For Assumption II:

Statement showing computation of P/V ratio, Break even point and profit:

Sr. No.	Particulars	L (₹)	M (₹)	Total (₹)
I.	Sales	48,000	72,000	1,20,000
II.	Variable cost (L - 70%); (M - 50%)	33,600	36,000	69,600
III.	Contribution (L - 30%); (M - 50%)	14,400	36,000	50,400
IV.	Fixed cost			36,000
V.	Profit			14,400
	P/V ratio $(50,400 \times 1,20,000) / 100 = 42\%$	30%	50%	42%
	Break even sales = $36,000 / 42\% = ₹85,714$			

Illustration 12 :

Accelerate Co. Ltd., manufactures and sells four types of products under the brand names of A, B, C and D. The sales Mix in value comprises $33\frac{1}{3}\%$, $41\frac{2}{3}\%$, $16\frac{2}{3}\%$ and $8\frac{1}{3}\%$ of products A, B, C & D respectively.

The total budgeted sales (100% are ₹60,000 p.m). Operating costs are:

Variable Costs:

Product A 60% of selling price

Product B 68% of selling price

Product C 80% of selling price

Product D 40% of selling price

Fixed Costs: ₹ 14,700 p.m.

- (a) Calculate the break - even - point for the products on overall basis and
 (b) Also calculate break-even-point, if the sales mix is changed as follows the total sales per month remaining the same. Mix: A - 25% : B - 40% : C - 30% : D - 5%.

Solution:

Particulars	A(₹)	B(₹)	C(₹)	D(₹)	Total(₹)
I. Sales	20,000	25,000	10,000	5,000	60,000
II. Variable cost	12,000	17,000	8,000	2,000	39,000
III. Contribution	8,000	8,000	2,000	3,000	21,000
IV. Fixed cost					14,700
V. Profit					6,300
P/V ratio (C/S) x 100	40%	32%	20%	60%	35%

- (a) Break even sales

$$\text{Break even sales} = 14,700 / 35\% = ₹ 42,000$$



(b)

	Particulars	A (₹)	B (₹)	C (₹)	D (₹)	Total (₹)
I.	Sales	15,000	24,000	18,000	3,000	60,000
II.	Variable cost	9,000	16,320	14,400	1,200	40,920
III.	Contribution	6,000	7,680	3,600	1,800	19,080
IV.	Fixed cost					14,700
V.	Profit					4,380
	P/V ratio (C/S) x 100	40%	32%	20%	60%	31.8 %

Break even sales = $14,700 / 31.8\%$ = ₹ 46,226

Illustration 13 :

Present the following information to show to management:

- The marginal product cost and the contribution p.u.
- The total contribution and profits resulting from each of the following sales mix results.

Particulars	Product	Per unit ₹
Direct Materials	A	10
Direct Materials	B	9
Direct wages	A	3
Direct wages	B	2

Fixed Expenses – ₹ 800

(Variable expenses are allotted to products at 100% Direct Wages)

Sales Price ---- A ₹ 20

Sales Price ---- B ₹ 15

- Sales Mixtures:
- 100 units of Product A and 200 of B.
 - 150 units of Product A and 150 of B.
 - 200 units of Product A and 100 of B.

Solution:

(i) Statement of Marginal Product cost

Sr. No.	Particulars	A (₹)	B (₹)
I.	Selling price	20.00	15.00
II.	Variable cost		
	Direct material	10.00	9.00
	Direct wages	3.00	2.00
	Variable OHs (100% of direct wages)	3.00	2.00
		16.00	13.00
III.	Contribution (i – ii)	4.00	2.00

(ii) **Profit at Mix (a):**

Sr. No.	Particulars	A (₹)	B (₹)	Total (₹)
I.	No. of units	100	200	
II.	'C' per unit	4	2	
III.	Total contribution (ii x i)	400	400	800
IV.	Fixed cost			800
V.	Profit (iii - iv)			Nil

Profit at Mix (b):

Sr. No.	Particulars	A (₹)	B (₹)	Total (₹)
I.	No. of units	150	150	
II.	'C' per unit	4	2	
III.	Total contribution (ii x i)	600	300	900
IV.	Fixed cost			800
V.	Profit (iii - iv)			100

Profit at Mix (c):

Sr. No.	Particulars	A (₹)	B (₹)	Total (₹)
I.	No. of units	200	100	
II.	'C' per unit	4	2	
III.	Total contribution (i x ii)	800	200	1000
IV.	Fixed cost			800
V.	Profit (iii - iv)			200

here 'C' means 'Contribution'.

Illustration 14:

The following particulars are extracted from the records of a company:

		PER UNIT	
		PRODUCT A	PRODUCT B
Sales	(₹)	100	120
Consumption of material		2 Kg	3 Kg
Material cost	(₹)	10	15
Direct wages cost	(₹)	15	10
Direct expenses	(₹)	5	6
Machine hours used		3 Hrs	2 Hrs
Overhead expenses:			
Fixed	(₹)	5	10
Variable	(₹)	15	20

Direct wages per hour is ₹ 5

- (a) Comment on profitability of each product (both use the same raw material) when :
- 1) Total sales potential in units is limited;
 - 2) Total sales potential in value is limited;
 - 3) Raw material is in short supply;
 - 4) Production capacity (in terms of machine hours) is the limiting factor.
- (b) Assuming raw material as the key factor, availability of which is 10,000 Kgs. and each product cannot be sold more than 3,500 units find out the product mix which will yield the maximum profit.

Illustration 15 :

A company has a capacity of producing 1 lakh units of a certain product in a month. The sales department reports that the following schedule of sales prices is possible.

VOLUME OF PRODUCTION		SELLING PRICE PER UNIT
	%	₹
	60	0.90
	70	0.80
	80	0.75
	90	0.67
	100	0.61

The variable cost of manufacture between these levels is 15 paise per unit and fixed cost ₹ 40,000. Prepare a statement showing incremental revenue and differential cost at each stage. At which volume of production will the profit be maximum?

Solution:

Statement showing computation of differential cost, incremental revenue and determination of capacity at which profit is maximum:

Capacity %	Units	Sales (₹)	V. Cost @ (₹) 0.15	Fixed cost (₹)	Total Cost (₹)	Differential Cost (₹)	Incremental Revenue (₹)
60%	60,000	54,000	9,000	40,000	49,000	--	--
70%	70,000	56,000	10,500	40,000	50,500	1,500	2,000
80%	80,000	60,000	12,000	40,000	52,000	1,500	4,000
90%	90,000	60,300	13,500	40,000	53,500	1,500	300
100%	1,00,000	61,000	15,000	40,000	55,000	1,500	700

From the above computation, it was found that the incremental revenue is more than the differential cost up to 80% capacity, the profit is maximum at that capacity.

Illustration 16:

A company is at present working at 90 per cent of its capacity and producing 13,500 units per annum. It operates a flexible budgetary control system. The following figures are obtained from its budget.

	90%	100%
	₹	₹
Sales	15,00,000	16,00,000
Fixed expenses	3,00,500	3,00,600
Semi-fixed expenses	97,500	1,00,500
Variable expenses	1,45,000	1,49,500
Units made	13,500	15,000

Labour and material costs per unit are constant under present conditions. Profit margin is 10 per cent.

- (a) You are required to determine the differential cost of producing 1,500 units by increasing capacity to 100%



- (b) What would you recommend for an export price for these 1,500 units taking into account that overseas prices are much lower than indigenous prices?

Solution:

Computation of material and labour cost:

Particulars	₹	₹
Sales at present		15,00,000
(-) Profit @ 10%		1,50,000
Total cost		13,50,000
(-) All costs other than material & labour		
Fixed expenses	3,00,500	5,43,000
Semi fixed expenses	97,500	
Variable expenses	1,45,000	
Material & Labour cost		8,07,000

(a) Statement showing differential cost of 1500 units:

Particulars	₹
Material & Labour (8,07,000 x 1500/13500)	89,667
Fixed expenses (3,00,600 – 3,00,500)	100
Semi fixed expenses (1,00,500 – 97,500)	3,000
Variable expenses (1,49,500 – 1,45,000)	4,500
Differential cost	97,267

- (b) Differential cost per unit = $97,267 / 1,500 = ₹ 64.84$

The minimum price for these 1,500 units should not be less than ₹ 64.84

Illustration 17 :

The operating statement of a company is as follows:

	(₹)	(₹)
Sales (80,000 @ ₹15 each)		12,00,000
Costs:		
Variable:	(₹)	
Material	2,40,000	
Labour	3,20,000	
Overheads	<u>1,60,000</u>	
	7,20,000	
Fixed Cost	<u>3,20,000</u>	<u>10,40,000</u>
PROFIT		<u><u>1,60,000</u></u>

The capacity of the plant is 1 lakh units. A customer from U.S.A. is desirous of buying 20,000 units at a net price of ₹10 per unit. Advice the producer whether or not offer should be accepted. Will your advice be different, if the customer is local one.

Solution:**Statement showing computation of profit before and after accepting the order:**

Sr. No.	Particulars	Present Position (Before accepting) 80,000	Order Value (20,000)	Total (After accepting) 1,00,000
		₹	₹	₹
I.	Sales	12,00,000	2,00,000	14,00,000
II.	Variable Cost			
	Material	2,40,000	60,000	3,00,000
	Labour	3,20,000	80,000	4,00,000
	Variable OH	1,60,000	40,000	2,00,000
		7,20,000	1,80,000	9,00,000
III.	Contribution (i - ii)	4,80,000	20,000	5,00,000
IV.	Fixed cost	3,20,000	--	3,20,000
V.	Profit (iii -	1,60,000	20,000	1,80,000

As the profit is increased by ₹ 20,000 by accepting the order, it is advised to accept the same. If the order is from local one, it should not be accepted because it will adversely affect the present market.

Illustration 18 :

A company manufactures scooters and sells it at ₹3,000 each. An increase of 17% in cost of materials and of 20% of labour cost is anticipated. The increased cost in relation to the present sales price would cause at 25% decrease in the amount of the present gross profit per unit.

At present, material cost is 50%, wages 20% and overhead is 30% of cost of sales.

You are required to :

- Prepare a statement of profit and loss per unit at present and;
- Compute the new selling price to produce the same percentage of profit to cost of sales as before.

Solution:

Let X and Y be the cost and profit respectively.

$$X + Y = 3,000 \quad \rightarrow (1)$$

$$\text{Material} = X \times 50/100 = 0.5X$$

$$\text{Labour} = X \times 20/100 = 0.2X$$

$$\text{Overheads} = X \times 30/100 = 0.3X$$

After increase of cost:

$$\text{Material} = 0.5 X \times 117/100 = 0.585 X$$

$$\text{Labour} = 0.2X \times 120/100 = 0.240 X$$

$$\text{Overheads} = 0.300 X$$

$$= \underline{1.125 X}$$

$$\text{Profit} = Y \times 75/100 = 0.75Y$$

$$\therefore \text{New Equation } 1.125X + 0.75Y = 3,000 \quad \rightarrow (2)$$

$$\text{Multiplying Eq. (1) by 0.75} \quad 0.75X + 0.75Y = 2,250$$

$$0.375X = 750$$

$$X = 750/0.375 = ₹ 2,000$$

$$Y = 3,000 - 2,000 = ₹ 1,000$$



Statement of cost & profit per unit at present:

	₹
Material = 2,000 x 50%	= 1,000
Labour = 2,000 x 20%	= 400
Overheads = 2,000 x 30%	= <u>600</u>
	= 2,000
(+) profit @ 50% of cost	= <u>1,000</u>
	= <u>3,000</u>

Computation of new selling price to get same percentage of profit:

	₹
Material = 1,000 x 117/100	= 1,170
Labour = 400 x 120/100	= 480
Overheads	= <u>600</u>
Cost	= 2,250
(+) Profit @ 50%	= <u>1,125</u>
New selling price	= <u>3,375</u>

Illustration 19 :

An umbrella manufacturer marks an average net profit of ₹ 2.50 per piece on a selling price of ₹14.30 by producing and selling 6,000 pieces or 60% of the capacity. His cost of sales is

	₹
Direct material	3.50
Direct wages	1.25
Works overheads (50% fixed)	6.25
Sales overheads (25% variable)	0.80

During the current year, he intends to produce the same number but anticipates that fixed charges will go up by 10% which direct labour rate and material will increase by 8% and 6% respectively but he has no option of increasing the selling price. Under this situation, he obtains an offer for further 20% of the capacity. What minimum price you will recommend for acceptance to ensure the manufacturer an overall profit of ₹16,730.

Solution:**Computation of profit at present after increase in cost:**

	Particulars	₹
I.	Selling price	14.30
II.	Variable cost	
	Material (3.5 x 106/100)	3.710
	Labour (1.25 x 108/100)	1.350
	Works overhead	3.125
	Sales overhead	0.200
	Total	8.385
III.	Contribution per unit (I-II)	5.915
IV.	Total contribution (6,000 x 5.915)	35,490
V.	Fixed cost	
	Works OH 3.125	24,585
	Sales OH 0.600	
	3.725 x 6,000 = 22,350 x 110/100	
VI.	Profit (iv - v)	10,905

Computation of selling price of the order: (₹)

Variable cost of order (2,000 x 8.385) = 16,770

(+) required profit (16,730 – 10,905) = 5,825

Sales required = 22,595

Selling price of order = 22,595/2,000 = 11.2975 (or) ₹ 11.30

Illustration 20 :

The Dynamic company has three divisions. Each of which makes a different product. The budgeted data for the coming year are as follows:

	A (₹)	B (₹)	C (₹)
Sales	1,12,000	56,000	84,000
Direct Material	14,000	7,000	14,000
Direct Labour	5,600	7,000	22,400
Direct Expenses	14,000	7,000	28,000
Fixed Cost	28,000	14,000	28,000
	61,600	35,000	93,400

The Management is considering to close down the division C'. There is no possibility of reducing fixed cost. Advise whether or not division C' should be closed down.



Solution:

Statement showing computation of profit before closing down of division C:

Sr. No.	Particulars	A (₹)	B (₹)	C (₹)	Total (₹)
I.	Sales	1,12,000	56,000	84,000	2,52,000
II.	Variable cost				
	Direct Material	14,000	7,000	14,000	35,000
	Direct Labour	5,600	7,000	22,400	35,000
	Direct expenses	14,000	7,000	28,000	49,000
III.	Total Variable Cost	33,600	21,000	64,400	1,19,000
IV.	Contribution (i - iii)	78,400	35,000	19,600	1,33,000
V.	Fixed cost				70,000
VI.	Profit (iv - v)				63,000

Statement showing computation of profit after closing 'C':

Sr. No.	Particulars	A (₹)	B (₹)	Total (₹)
I.	Sales	1,12,000	56,000	1,68,000
II.	Variable cost			
	Direct Material	14,000	7,000	21,000
	Direct Labour	5,600	7,000	12,600
	Direct expenses	14,000	7,000	21,000
III.	Total Variable Cost	33,600	21,000	54,600
IV.	Contribution (i - iii)	78,400	35,000	1,13,400
V.	Fixed cost			70,000
VI.	Profit (iv - v)			43,400

From the above computations, it was found that profit is decreased by ₹ 19,600 by closing down division 'C', it should not be closed down. In other words, as long as if there is a contribution of ₹ 1, from division 'C', it should not be closed down.

Illustration 21 :

Mr. Young has ₹ 1,50,000 investment in a business. He wants a 15% profit on his money. From an analysis of recent cost figures he finds that his variable cost of operating is 60% of sales; his fixed costs are ₹75,000 per year. Show supporting computations for each answer.

- What sales volume must be obtained to break-even?
- What sales volume must be obtained to his 15% return on investment?
- Mr. Young estimates that even if he closed the doors of his business he would incur ₹25,000 expenses per year. At what sales would be better off by locking his sales up?

Solution:

- P/V ratio (V. cost ratio 60%) = 40%
- a) Break even sales = $75,000 / 40\% = ₹ 1,87,500$
- b) Required sales to get desired income = $(75,000 + 22,500) / 40\% = ₹ 2,43,750$
= ₹ 2,43,750
- c) Shut down sales = $\frac{\text{Fixed cost} - \text{shut down cost}}{\text{P/V Ratio}}$
= $(75,000 - 25,000) / 40\%$
= ₹ 1,25,000

Illustration 22 :

The manager of a Co. provides you with the following information:

	₹	
Sales	:	4,00,000
Costs: Variable (60% of sales)		
Fixed cost	:	80,000
Profit before tax	:	80,000
Income-tax (60%)		
Net profit	:	32,000

The company is thinking of expanding the plant. The increased fixed cost with plant expansion will be ₹40,000. It is estimated that the maximum production in new plant will be worth ₹2,40,000. The company also wants to earn additional income ₹3,200 on investment. On the basis of computations give your opinion on plant expansion.

Solution:**Statement showing computation of profit before and after plant expansion:**

Sr. No.	Particulars	Present (Before expansion) (₹)	Expansion value (₹)	Total (After expansion) (₹)
I.	Sales	4,00,000	2,40,000	6,40,000
II.	Variable cost (60%)	2,40,000	1,44,000	3,84,000
III.	Contribution (i - ii)	1,60,000	96,000	2,56,000
IV.	Fixed cost	80,000	40,000	1,20,000
V.	Profit before tax (iii - iv)	80,000	56,000	1,36,000
VI.	Profit after tax (V x 0.40)	32,000	22,400	54,400

From the above computations, it was found that the profit is increased by ₹ 22,400 by expanding the plant, which is much higher than the expected income of ₹ 3,200, one's opinion should be in favour of plant expansion.



Illustration 23 :

A manufacturer with overall (interchangeable among the products) capacity of 1,00,000 machine hours has been so far producing a standard mix of 15,000 units of product A, 10,000 units of product B and C each. On experience, the total expenditure exclusive of his fixed charges is found to be ₹ 2.09 lakhs and the cost ratio among the product approximately 1, 1.5, 1.75 respectively per unit.

The fixed charges comes to ₹ 2 per unit. When the unit selling prices are ₹ 6.25 for A, ₹ 7.5 for B and ₹ 10.5 for C. He incurs a loss.

	Mix-I	Mix-II	Mix-III
A	18,000	15,000	22,000
B	12,000	6,000	8,000
C	7,000	13,000	8,000

As a management accountant what mix will you recommend?

Solution:

Let variable cost per unit of A, B, C be ₹ X, ₹ 1.5X and ₹ 1.75X respectively.

$$A = 15,000 \times X = 15,000 X$$

$$B = 10,000 \times 1.5X = 15,000 X$$

$$C = 10,000 \times 1.75X = 17,500 X$$

$$\text{Total variable cost} = 47,500 X$$

So, we can say,

$$47,500 X = 2,09,000$$

or, $X = 4.4$

Variable cost per unit of A = X = ₹ 4.4

Variable cost per unit of B = 1.5 (4.4) = ₹ 6.6

Variable cost per unit of C = 1.75 (4.4) = ₹ 7.7

Statement showing computation of loss at present mix

	Particulars	A (₹)	B (₹)	C (₹)	Total (₹)
I.	Selling price	6.25	7.50	10.50	
II.	Variable cost	4.40	6.60	7.70	
III.	Contribution	1.85	0.90	2.80	
IV.	No. of units at present mix	15,000	10,000	10,000	
V.	Total contribution	27,750	9,000	28,000	64,750
VI.	Fixed cost				70,000
VII.	Loss				5,250

Computation of Profit/(loss) at Mix I:

	Particulars	A (₹)	B (₹)	C (₹)	Total (₹)
I.	No. of units	18,000	12,000	7,000	
II.	Contribution per unit	1.85	0.90	2.80	
III.	Total contribution	33,300	10,800	19,600	63,700
IV.	Fixed cost				70,000
V.	Loss				6,300

Computation of Profit/(loss) at Mix II:

	Particulars	A (₹)	B (₹)	C (₹)	Total (₹)
I.	No. of units	15,000	6,000	13,000	
II.	Contribution per unit	1.85	0.90	2.80	
III.	Total contribution	27,750	5,400	36,400	69,550
IV.	Fixed cost				70,000
V.	Loss				450

Computation of Profit/(loss) at Mix III:

	Particulars	A (₹)	B (₹)	C (₹)	Total (₹)
I.	No. of units	22,000	8,000	8,000	
II.	Contribution per unit	1.85	0.90	2.80	
III.	Total contribution	40,700	7,200	22,400	70,300
IV.	Fixed cost				70,000
V.	Profit				300

As management accountant, one should recommend Mix III because there is profit of ₹ 300 against loss at other mixes including present mix.

Illustration 24 :

Details about the single product marketed by a company are as under:

Per Unit	₹
Selling Price	100
Direct Material	60
Direct Labour	10
Variable Overheads	10

Number of units sold in the year 2012 is 5035. Pursuant to an agreement with the employees union, there would be next year a 10% increase in wages. Work out:-

- 1) How many more units have to be sold next year to maintain the same quantum of profit.
- 2) Or else, by what percentage the selling price has to be raised to maintain the same P/V Ratio.

Solution:

	Particulars	₹
I.	Selling price	100
II.	Variable cost	
	Direct Material	60
	Direct Labour	10
	Variable OH	10
		80
III.	Contribution	20
IV.	Total contribution (5035 x 20)	1,00,700
V.	P/V ratio	20%



New Variable cost:

Direct material	= 60
Direct wages (10 x 110/100)	= 11
Variable OH	= <u>10</u>
	= <u>81</u>

Contribution per unit = 100 – 81 = 19

- (i) No. of units to get some quantum of profit.

$$\begin{aligned} &= \frac{\text{Desired Contribution}}{\text{Contribution per unit}} \\ &= 1,00,700 / 19 \\ &= 5,300 \text{ units} \end{aligned}$$

Extra units = 5,300 – 5,035 = 265 units

- (ii) $0.2 = (S - 81) / S$

$$0.2S = S - 81$$

$$0.8S = 81$$

$$S = 101.25$$

In order to maintain the same P/V ratio, the selling price has to be raised by 1.25%.

Illustration 25 :

A Co. has annual fixed costs of ₹ 1,40,000. In 2012 sales amounted to ₹6,00,000, as compared with ₹ 4,50,000 in 2011, and profit in 2012 was ₹ 42,000 higher than that in 2011.

- (i) At what level of sales does the company break-even?
(ii) Determine profit or loss on a forecast sales volume of ₹ 8,00,000
(iii) If there is a reduction in selling price by 10% in 2013 and the company desires to earn the same amount of profit as in 2012, what would be the required sales volume?

Solution:

$$\begin{aligned} \text{P/V ratio} &= (\text{Change in profit} / \text{Change in sales}) \times 100 \\ &= (42,000 / 1,50,000) \times 100 \\ &= 28\% \end{aligned}$$

- (i) Break even sales = Fixed cost / PV ratio
= 1,40,000 / 28%
= ₹ 5,00,000

- (ii) Profit = (8,00,000 x 0.28) – 1,40,000
= 2,24,000 – 1,40,000
= ₹ 84,000

$$\begin{aligned}
 (3) \text{ Profit in 2012 being desired profit} &= (6,00,000 \times 0.28) - 1,40,000 \\
 &= 1,68,000 - 1,40,000 \\
 &= ₹ 28,000
 \end{aligned}$$

Assuming same quantity of sales as in 2012 is also made in 2013, then sales would be ₹ 6,00,000 x 90/100 = ₹ 5,40,000

Consequently contribution is ₹ 1,08,000 (1,68,000 – 60,000)

$$\begin{aligned}
 \text{New P/V ratio} &= (1,08,000 / 5,40,000) \times 100 \\
 &= 20\%
 \end{aligned}$$

$$\begin{aligned}
 \text{Required sales to get the same profit as in 2012} &= (1,40,000 + 28,000) / 20\% \\
 &= 8,40,000
 \end{aligned}$$

(or)

	2012		2013
SP	100	SP	90
C	28	V	72
V	72	C	18

$$\text{P/V ratio} = (18/90) \times 100 = 20\%.$$

Illustration 26 :

A Co. currently operating at 80% capacity has the following; profitability particulars:

	₹	₹
Sales		12,80,000
Costs:		
Direct Materials	4,00,000	
Direct labour	1,60,000	
Variable Overheads	80,000	
Fixed Overheads	5,20,000	11,60,000
Profit:		1,20,000

An export order has been received that would utilise half the capacity of the factory. The order has either to be taken in full and executed at 10% below the normal domestic prices, or rejected totally.

The alternatives available to the management are given below:

- Reject order and Continue with the domestic sales only, as at present;
- Accept order, split capacity equally between overseas and domestic sales and turn away excess domestic demand;
- Increase capacity so as to accept the export order and maintain the present domestic sales by:
 - buying an equipment that will increase capacity by 10% and fixed cost by ₹40,000 and
 - Work overtime a time and a half to meet balance of required capacity.

Prepare comparative statements of profitability and suggest the best alternative.



Solution:

Statement showing computation of profit at present and at proposed two alternatives;

Sr. No.	Particulars	Present 80%	Foreign 50% Domestic 50% = 100%	50% Foreign + 80% Domestic = 130 %
I.	Sales	12,80,000	15,20,000	20,00,000
II.	Variable Cost			
	Direct material	4,00,000	5,00,000	6,50,000
	Direct wages	1,60,000	2,00,000	2,60,000
	Variable OH	80,000	1,00,000	1,30,000
	Addl. OT cost	--	--	* 20,000
III.	Total Variable Cost	6,40,000	8,00,000	10,60,000
IV.	Contribution (i - iii)	6,40,000	7,20,000	9,40,000
V.	Fixed cost	5,20,000	5,20,000	5,60,000
VI.	Profit (iv - v)	1,20,000	2,00,000	3,80,000

As the profit is more at the Alternative III, i.e. accepting foreign order fully and maintaining present domestic sales fully, it is the best alternative to be suggested.

$$\text{Overtime cost} = \left(80,000 \times \frac{20\%}{80\%} \right) = ₹ 20,000.$$

Illustration 27 :

Y Company has just been incorporated and plan to produce a product that will sell for ₹ 10 per unit. Preliminary market surveys show that demand will be around 10,000 units per year.

The company has the choice of buying one of the two machines 'A' would have fixed costs of ₹ 30,000 per year and would yield a profit of ₹ 30,000 per year on the sale of 10,000 units. Machine 'B' would have fixed costs ₹18,000 per year and would yield a profit of ₹ 22,000 per year on the sale of 10,000 units. Variable costs behave linearly for both machines.

Required to:

- Break-even sales for each machine
- Sales level where both machines are equally profitable
- Range of sales where one machine is more profitable than the other.

Solution:

Statement showing computation of Break Even sales for each machine and other required information:

Sr. No.	Particulars	A	B
I.	Selling price (₹)	10	10
II.	No. of units (₹)	10,000	10,000
III.	Sales (₹)	1,00,000	1,00,000
IV.	Fixed cost (₹)	30,000	18,000
V.	Profit (₹)	30,000	22,000
VI.	Contribution (₹)	60,000	40,000
VII.	Variable cost (S - C) (₹)	40,000	60,000
VIII.	Variable cost per unit (₹)	4	6
IX.	Contribution per unit (₹)	6	4

- Break even sales:
 $A = 30,000 / 6 = 5,000$ units (or) ₹ 50,000
 $B = 18,000 / 4 = 4,500$ units (or) ₹ 45,000
- Sales level where both machines are equally profitable (or) Breakeven level (or) indifference level = difference in Fixed cost / difference in VC per unit.
 $= (30,000 - 18,000) / (6 - 4)$
 $= 12,000 / 2$
 $= 6,000$ units
- For sales level of 6,000 and above units, Machine A would be more profitable because its variable cost per unit is less. For sales level below 6,000 units, Machine B would be more profitable because its fixed cost is less than the fixed cost of Machine A

Illustration 28 :

A practicing Cost Accountant now spends ₹ 0.90 per k.m on taxi fares for his client's work. He is considering to other alternatives the purchase of a new small car or an old bigger car.

Item	New Small Car	Old bigger Car
Purchase price (₹)	35,000	20,000
Sale price after 5 years (₹)	19,000	12,000
Repairs and servicing per annum (₹)	1,000	1,200
Taxes and insurance p.a (₹)	1,700	700
Petrol consumption per liter (K.m.)	10	7
Petrol price per liter (₹)	3.5	3.5

He estimates that he does 10,000 K.m annually. Which of the three alternatives will be cheaper? If his practice expands he has to do 19,000 Km p.a which is cheaper? Will cost of the two cars break even and why? Ignore interest and Income-tax.

Solution:**Statement showing computation of comparative cost of three alternatives**

	Taxi (₹)	New Small Car (₹)	Old Bigger Car (₹)
Fixed Costs:			
Depreciation	---	3,200	1,600
Repairs & Servicing	---	1,000	1,200
Taxes & Insurance	---	1,700	700
	---	5,900	3,500
Variable cost:			
Petrol per k.m.	0.90	0.35	0.5
Cost at 10,000 kms	9,000 (10,000 x 0.9)	9,400 [5,900 + (10,000 x 0.35)]	8,500 [3,500 + (10,000 x 0.5)]
Cost at 19,000 kms	17,100 (19,000 x 0.9)	12,550 [5,900 + (19,000 x 0.35)]	13,000 [3,500 + (19,000 x 0.5)]



- (i) At 10,000 kms, old bigger car is cheaper.
(ii) At 19,000 kms, new smaller car is cheaper.

$$\begin{aligned} \text{The distance at which cost of two cars is equal is} &= (5,900 - 3,500) / (0.5 - 0.35) \\ &= 16,000 \text{ Kms} \end{aligned}$$

Indifference point for firm's old bigger car and taxi = $3500 / 0.4 = 8,750$ kms

Indifference point for firm's new small car and taxi = $5,900 / 0.55 = 10,727$ kms

Illustration 29 :

There are two plants manufacturing the same products under one corporate management which decides to merge them.

	PLANT - I	PLANT - II
Capacity operation	100%	60%
Sales (₹)	6,00,00,000	2,40,00,000
Variable costs (₹)	4,40,00,000	1,80,00,000
Fixed Costs (₹)	80,00,000	40,00,000

You are required to calculate for the consideration of the Board of Directors

- a) What would be the capacity of the merged plant to be operated for the purpose of break-even ?
b) What would be the profitability on working at 75% of the merged capacity.

Solution:

Statement showing computation of Breakeven of merged plant and other required information:

(₹ in lakhs)

Sr. No.	Particulars	Plant I		Plant II		Merged Plant (100%)
		Before (100%)	After (100%)	Before (60%)	After (100%)	
I.	Sales	600	600	240	400	1000
II.	Variable cost	440	440	180	300	740
III.	Contribution (i - ii)	160	160	60	100	260
IV.	Fixed cost	80	80	40	40	120
V.	Profit (iii - iv)	80	80	20	60	140

$$\begin{aligned} \text{(a) Breakeven sales of merged plant} &= (120 \times 1,000) / 260 \\ &= 461.5384615 \text{ lakhs} \end{aligned}$$

$$\begin{aligned} \text{For 1,000} &- 100\% \\ \text{For 461.5384615} &- ? \\ &= (100 / 1000) \times 461.5384615 \\ &= 46.15384615\% \end{aligned}$$

$$\begin{aligned} \text{(b) Sales at 75\% capacity} &= 1,000 \times (75/100) \\ &= 750 \text{ lakhs} \end{aligned}$$

$$\begin{aligned} \text{Profit} &= (750 \times 0.26) - 120 \\ &= 75 \text{ Lakhs} \end{aligned}$$

Illustration 30 :

The particulars of two plants producing an identical product with the same selling price are as under:

	PLANT - A	PLANT - B
Capacity utilisation	70%	60%
	(₹ in lakhs)	(₹ in lakhs)
Sales	150	90
Variable Costs	105	75
Fixed costs	30	20

It has been decided to merge plant B with Plant A. The additional fixed expenses involved in the merger amount to is ₹ 2 lakhs.

Required:

- 1) Find the break-even-point of plant A and plant B before merger and the break-even point of the merged plant.
- 2) Find the capacity utilisation of the integrated plant required to earn a profit of ₹ 18 lakhs.

Solution:

Statement showing computation of profit before and after merger and other required information:

(₹ in lakhs)

	Particulars	Plant A		Plant B		Merged
		Before (70%)	After (100%)	Before (60%)	After (100%)	(100%)
I.	Sales	150	214.2857	90	150	364.2857
II.	Variable cost	105	150.0000	75	125	275.0000
III.	Contribution	45	64.2857	15	25	89.2857
IV.	Fixed cost	30	30.0000	20	20	52.0000
V.	Profit / (Loss)	15	34.2857	(5)	5	37.2857
	Break even before merger	(30 x 150) / 45 = 100 lakhs		(20 x 90) / 15 = 120 lakhs		52 x 364.2857/89.2857 = 212.16 lakhs

$$\begin{aligned} \text{P/V Ratio} &= (89.2857 / 364.2857) \times 100 \\ &= 24.5098 \% \end{aligned}$$

$$\text{Required sales} = (52 + 18) / 0.245098 = 285.6$$

$$\text{For } 364.2857 \quad - 100$$

$$\text{For } 285.6 \quad - ?$$

$$\text{Capacity} = (100 / 364.2857) \times 285.6 = 78.4\%$$

Illustration 31 :

A company engaged in plantation activities has 200 hectares of virgin land which can be used for growing jointly or individually tea, coffee and cardamom, the yield per hectare of the different crops and their selling prices per Kg. are as under:



	Yield in Kgs.	Selling price per Kg.(₹)
Tea	2,000	20
Coffee	500	40
Cardamom	100	250

The relevant data are given below:

	TEA	COFFEE	CARDAMOM
Labour charges ₹	8	10	120
Packing materials ₹	2	2	10
Other costs ₹	<u>4</u>	<u>1</u>	<u>20</u>
	14	13	150

b) Fixed costs per annum:	₹
Cultivation and growing cost	10,00,000
Administrative cost	2,00,000
Land Revenue	50,000
Repairs and maintenance	2,50,000
Other costs	<u>3,00,000</u>
Total Cost	<u>18,00,000</u>

The policy of the company is to produce and sell all three kinds of products and the maximum and minimum area to be cultivated per product is as follows:

	Hectors	
	Maximum	Minimum
Tea	160	120
Coffee	50	30
Cardamom	30	10

Calculate the most profitable product mix and the maximum profit which can be achieved.

Solution:

Statement showing computation of contribution per hectare and determination of priority for profitability:

	Particulars	Tea (₹)	Coffee (₹)	Cardamom (₹)
I.	Sales realisation per hectare	40,000	20,000	25,000
II.	Variable cost	28,000	6,500	15,000
III.	Contribution	12,000	13,500	10,000
IV.	Priority	II	I	III

Statement showing optimum mix under given conditions and computation of profit at that mix:

	Particulars	Tea (₹)	Coffee (₹)	Cardamom (₹)	Total (₹)
	Minimum area to be produced (hectars)	120	30	10	160
	Remaining land (hectars)	20 (II)	20 (I)		40
I.	No. of hectares	140	50	10	200
II.	Contribution per hectares (₹)	12,000	13,500	10,000	

III.	Total contribution	(₹)	16,80,000	6,75,000	1,00,000	24,55,000
IV.	Fixed cost	(₹)				18,00,000
V.	Profit	(₹)				6,55,000

Illustration 32 :

A Co. running an adequate supply of labour presents the following data requests your advice about the area to be allotted for the cultivation of various types of fruits which would result in the maximization of profits. The company contemplates growing Apples Lemons Oranges and Peaches.

	APPLES	LEMONS	ORANGES	PEACHES
Selling price per box ₹	15	15	30	45
Seasons yield box per acre	500	150	100	200
Cost in Rupees:				
Material per acre	270	105	90	150
Growing per acre labour	300	225	150	195
Picking & Packing per box	1.5	1.5	3	4.5
Transport per box	3.00	3.00	1.5	4.5

The fixed costs in each season would be:

Cultivation & Growing ₹56,000: Picking ₹42,000

Transport - ₹10,000: Administration-₹84,000

Land Revenue - ₹18,000

The following limitations are also placed before you:

- The area available is 450 acres, but out of this 300 acres are suitable for growing only Oranges and Lemons .The balance of 150 acres is suitable for growing for any of the four fruits viz., Apples, Lemons, Oranges and Peaches.
- As the products may be hypothecated to banks ,area allotted for any fruit should be demarcated in complete acres and not in fractions of an acre.
- The marketing strategy of the company requires the compulsory production of all the four types of fruits in a season and the minimum quantity of any type to be 18,000 boxes.

Calculate the total profits that would accrue if your advice is accepted.

Solution:**Statement showing computation of contribution per acre and determination of priority for profitability :**

Sr. No.	Particulars	Apples (₹)	Lemons (₹)	Oranges (₹)	Peaches (₹)
I.	Sales value per acre (₹)	7,500	2,250	3,000	9,000
II.	Variable cost				
	Material (₹)	270	105	90	150
	Growing labour (₹)	300	225	150	195
	Pickings & Packing labour (₹)	750	225	300	900
	Transport (₹)t	1,500	450	150	900
		2,820	1,005	690	2,145
III.	Contribution	4,680	1,245	2,310	6,855
	Priority	II	IV	III	I



Statement showing optimum mix under given conditions and computation of profit at that mix:

	Particulars	Apples (₹)	Lemons (₹)	Oranges (₹)	Peaches (₹)	Total (₹)
	Minimum production in boxes	18,000	18,000	18,000	18,000	
	Area utilized for these minimum	36	120	180	90	426
	Remaining area				24	24
I.	No. of acres	36	120	180	114	450
II.	Contribution per acre	4,680	1,245	2,310	6,855	
III.	Total contribution	1,68,480	1,49,400	4,15,800	7,81,470	15,15,150
IV.	Fixed cost					2,10,000
V.	Profit					13,05,150

Illustration 33 :

A market gardener is planning his production for next season and he asked you, as a cost consultant, to recommend the optimum mix of vegetable production for the coming year. He has given you the following data relating to the current year:

	POTATOES	TOMATOES	PEAS	CARROTS
Area occupied in acres	25	20	30	25
Yield per acre in tons	10	8	9	12
Selling Price per ton ₹	1,000	1,250	1,500	1,350

Variable Cost per acre:

Fertilizer	300	250	450	400
Seeds	150	200	300	250
Pesticides	250	150	200	250
Direct Wages	4,000	4,500	5,000	5,700

Fixed Overhead per annum: ₹5,40,000

The land which is being used for the production of carrots and peas can be used for either crop but not for potatoes and tomatoes. The land being used for potatoes and tomatoes can be used for either crops but not carrots and peas. In order to provide an adequate market service, the gardener must produce each year at least 40 tons of each of potatoes and tomatoes and 36 tons of each peas and carrots. You are required to present a statement to show :

- (a) (1) The profit for the current year:
- (2) The profit for the production mix you would recommend;
- (b) Assuming that the land could be cultivated in such a way that any of the above crops could be produced and there was no market commitment. You are required to:
 - (1) Advise the market gardener on which crop he should concentrate his production.
 - (2) Calculate the profit if he were to do so, and
 - (3) Calculate in rupees the breakeven - point of sales.

Solution:

Statement showing computation of contribution and determination of priority for profitability:

	Particulars	Potatoes	Tomatoes	Peas	Carrots
I.	Sales per acre (₹)	10,000	10,000	13,500	16,200
II.	Variable cost (₹)	4,700	5,100	5,950	6,600
III.	Contribution (₹)	5,300	4,900	7,550	9,600
IV.	Priority	III	IV	II	I

a)

(1) Statement showing computation of profit for current year:

Sr. No.	Particulars	Potatoes	Tomatoes	Peas	Carrots	Total
I.	No. of acres	25	20	30	25	100
II.	Contribution per acre (₹)	5,300	4,900	7,550	9,600	
III.	Total contribution (₹)	1,32,500	98,000	2,26,500	2,40,000	6,97,000
IV.	Fixed cost (₹)					5,40,000
V.	Profit (₹)					1,57,000

(2) Statement showing optimum mix under given conditions and computation of profit at that mix:

Sr. No.	Particulars	Potatoes	Tomatoes	Peas	Carrots	Total
	Minimum production in tons	40	40	36	36	100
	Area required for this (acre)	4	5	4	3	16
	Remaining area (acre)	36	--	--	48	84
I.	No. of acres	40	5	4	51	
II.	Contribution per acre (₹)	5,300	4,900	7,550	9,600	
III.	Total contribution (₹)	2,12,000	24,500	30,200	4,89,600	7,56,300
IV.	Fixed cost (₹)					5,40,000
V.	Profit (₹)					2,16,300

(b)

- (1) If the land is suitable for growing any of the crops and there is no market commitment, the gardener is advised to concentrate his production on carrots.

(2) & (3):

Sr. No.	Particulars	₹
I.	Sales (16,200 x 100)	16,20,000
II.	Contribution (9,600 x 100)	9,60,000
III.	Fixed cost	5,40,000
IV.	Profit	4,20,000

$$\begin{aligned} \text{Break even sales} &= (5,40,000 \times 16,20,000) / 9,60,000 \\ &= ₹ 9,11,250 \end{aligned}$$

Illustration 34 :

Small Tools Factory has a plant capacity adequate to provide 19,800 hours of machine use. The plant can produce all A type tools or all B type tools or a mixture of these two type. The following information is relevant

	A	B
Selling price ₹	10	15
Variable cost ₹	8	12
Hours required to produce	3	4

Market conditions are such that not more than 4,000 A type tools and 3,000 B type tools can be sold in a year. Annual fixed costs are ₹ 9,900.

Compute the product mix that will maximise the net income to the company and find that maximum net income.



Solution:

Statement showing computation of contribution per machine hour and determination of priority for profitability:

Sr. No.	Particulars		A	B
I.	Selling price (₹)		10	15
II.	Variable cost (₹)		8	12
III.	Contribution (₹)		2	3
IV.	Contribution per machine hour (₹)		$\frac{2}{3}$ = 0.67	$\frac{3}{4}$ = 0.75
	Priority		II	I

Statement showing optimum mix under given conditions and computation of profit at that mix:

Sr. No.	Particulars		A	B	Total
I	No. of units		2,600	3,000	
II.	Contribution per unit (₹)		2	3	
III.	Total contribution (₹)		5,200	9,000	14,200
IV.	Fixed cost (₹)				9,900
V.	Profit				4,300

Available hours 19,800

(-) Hours for B (3,000 x 4) 12,000

7,800

Units of A = $7,800 / 3 = 2,600$

Illustration 35 :

Taurus Ltd. produces three products A, B and C from the same manufacturing facilities. The cost and other details of the three products are as follows:

	A	B	C
Selling price per unit (₹)	200	160	100
Variable cost per unit (₹)	120	120	40
Fixed expenses/month (₹)			2,76,000
Maximum production per month (units)	5,000	8,000	6,000
Total hours available for the month			200
Maximum demand per month (units)	2,000	4,000	2,400

The processing hour cannot be increased beyond 200 hrs per month.

You are required to:

- Compute the most profitable product-mix.
- Compute the overall break-even sales of the co., for the month based in the mix calculated in (a) above.

**Solution:**

	(₹)
Variable cost	= 14
Fixed cost	= 2
Total cost	= 16
(+) Profit @ 15%	= <u>2.4</u>
Selling price	= <u>18.40</u>

Sr. No.	Particulars	₹
I.	Selling price	18.40
II.	Variable cost	14.00
III.	Contribution	4.40
IV.	Total contribution (1,50,000 x 4.4)	6,60,000
V.	Fixed cost (1,50,000 x 2)	3,00,000
VI.	Profit	3,60,000

(a) $BEP = 3,00,000 / 4.4 = 68,182$ units

(b) $P/V \text{ ratio} = (4.4 / 18.4) \times 100 = 23.91\%$

(c)

Sr. No.	Particulars	₹
I.	Selling price (18.4 x 95%)	17.48
II.	Variable cost	14.00
III.	Contribution	3.48
IV.	P/V ratio (3.48 / 17.48) x 100	19.908%
V.	Breakeven point = 3,00,000 / 3.48	86,207 units

(d) Desired profit = 3,60,000 x (110/100) = ₹ 3,96,000

Sales required = $(3,00,000 + 3,96,000) / 3.48 \times 17.48$
= ₹ 34,96,000

Illustration 37 :

VINAYAK LTD. which produces three products furnishes you the following information for 2011-12:-

	PRODUCTS		
	A	B	C
Selling price per unit (₹)	100	75	50
Profit volume ratio %	10	20	40
Maximum sales potential units	40,000	25,000	10,000
Raw Material content as % of variable costs	50	50	50

The expenses - fixed are estimated at ₹ 6,80,000. The company uses a single raw material in all the three products. Raw material is in short supply and the company has a quota for the supply of raw materials of the value of ₹ 18,00,000 for the year 2011-12 for the manufacture of its products to meet its sales demand.

You are required to:-

- Set a product mix which will give a maximum overall profit keeping the short supply of raw material in view.
- Compute that maximum profit.

Solution:

Statement showing computation of contribution per rupee of material and determination of priority for profitability:

Sr. No.	Particulars	A	B	C
I.	Selling price (₹)	100	75	50
II.	Contribution (₹)	10	15	20
III.	Variable cost (₹)	90	60	30
IV.	Raw material cost (₹)	45	30	15
V.	Contribution per rupee of material. (₹)	(10/45) = 0.22	(15/30) = 0.50	(20/15) = 1.33
	Priority	III	II	I

Statement showing optimum mix under given conditions and computation of profit at that mix:

Sr. No.	Particulars	A	B	C	Total
I.	No. of units	20,000	25,000	10,000	
II.	Contribution per unit (₹)	10	15	20	
III.	Total contribution (₹)	2,00,000	3,75,000	2,00,000	7,75,000
IV.	Fixed cost (₹)				6,80,000
V.	Profit (₹)				95,000

Available material = 18,00,000

(-) Material for C (10,000 x 15) = 1,50,000

= 16,50,000

(-) Material for B (25,000 x 30) = 7,50,000

= 9,00,000

No. of units of A = 9,00,000 / 45 = 20,000 units.

Illustration 38 :

A review, made by the top management of Sweet and Struggle Ltd. which makes only one product, of the result of two first quarters of the year revealed the following:-

Sales in units	10,000
Loss	₹10,000
Fixed Cost (for the year ₹1,20,000)	30,000 Quarter
Variable cost per unit	₹ 8

The finance Manager who feels perturbed suggests that the company should at least break-even in the second quarter with a drive for increased sales. Towards this the company should introduce a better packing which will increase the cost by ₹ 0.50 per unit.

The Sales Manager has an alternate proposal. For the second quarter additional sales promotion expenses can be increased to the extent of ₹ 5,000 and a profit ;of ₹5,000 can be aimed at the for the period with increased sales.



The production manager feels otherwise. To improve the; demand the selling price per unit has to be reduced by 3%. As a result the sales volume can be increased to attain a profit level of ₹ 4,000 for the quarter.

The Managing Director asks for as a Cost Accountant to evaluate these three proposals and calculate the additional units required to reach their respective targets help him to make a decision.

Solution:

Computation of selling price:

Particulars	₹
Variable cost (10,000 x 8)	80,000
Fixed cost	30,000
Total cost	1,10,000
(+) Profit / (loss)	(10,000)
Sales	1,00,000

Selling price = $1,00,000 / 10,000 = ₹10/-$

Statement showing computation of additional units required to attain the target of respective managers:

	Particulars	FM	SM	PM
I.	Selling price	10.00	10.00	9.70
II.	Variable cost	8.50	8.00	8.00
III.	Contribution	1.50	2.00	1.70
IV.	Fixed cost	30,000	35,000	30,000
V.	Target	BE sales	Profit of ₹ 5,000	Profit of ₹ 4,000
VI.	No. of units	$(30,000/1.5)$ = 20,000	$(35,000+5,000)/2$ = 20,000	$(30,000+4,000)/1.70$ = 20,000
VII.	Additional units	10,000	10,000	10,000

Illustration 39 :

A limited company manufactures three different products and the following information has been collected from the books of accounts.

	PRODUCTS		
	S	T	Y
Sales Mix	35%	35%	30%
Selling price (₹)	30	40	20
Variable Cost (₹)	15	20	12
Total fixed cost (₹)	1,80,000		
Total Sales (₹)	6,00,000		

The company has currently under discussion, a proposal to discontinue the manufacture of product Y and replace it with product M, when the following results are anticipated.

	PRODUCTS		
	S	T	M
Sales Mix	50%	25%	25%
Selling price (₹)	30	40	30
Variable Cost (₹)	15	20	15
Total fixed cost (₹)	1,80,000		
Total Sales (₹)	6,40,000		

Will you advise the company to changeover to production of M? Give reasons for your answer.

Solution:

Statement showing computation of profit before replacing product Y with M

Sr. No.	Particulars	S (35%)	T (35%)	Y (30%)	Total
I.	Sales (₹)	2,10,000	2,10,000	1,80,000	6,00,000
II.	Variable cost (₹)	1,05,000	1,05,000	1,08,000	3,18,000
III.	Contribution (₹)	1,05,000	1,05,000	72,000	2,82,000
IV.	Fixed cost (₹)				1,80,000
V.	Profit (₹)				1,02,000

Statement showing computation of profit after replacing product Y with M:

Sr. No.	Particulars	S (50%)	T (25%)	M (25%)	Total
I.	Sales (₹)	3,20,000	1,60,000	1,60,000	6,40,000
II.	Variable cost (₹)	1,60,000	80,000	80,000	3,20,000
III.	Contribution (₹)	1,60,000	80,000	80,000	3,20,000
IV.	Fixed cost (₹)				1,80,000
V.	Profit (₹)				1,40,000

As the profit is increased by ₹ 38,000 by replacing Product 'Y' with 'M', it is advisable to changeover to the production of M.

Illustration 40 :

The following figures have been extracted from the accounts of manufacturing undertaking, which produces a single product for the previous (base) year.

Units produced and sold	10,000
Fixed overhead	(₹) 20,000

Variable overhead cost per unit:

Labour	₹ 4
Material	₹ 2
Overheads	₹ 0.8
Selling Price	₹10 per unit

In preparing the budget for the current (budget) year the undernoted changes have been envisaged:

Units to be produced and sold	15,000
Fixed overheads increased by	₹ 5,000
Fall in labour efficiency	20%
Special additional discount for Bulk purchased of material	$2\frac{1}{2}\%$
Variable overheads percentage reduced by	$1\frac{1}{4}\%$
Fall in selling price per unit	10%



Calculate:

- (i) the no. of units which must be sold to break even in each of the two years
- (ii) the no. of units which would have to be sold to double the profit of the base year under base year conditions
- (iii) the no. of units which will have to be sold in the budget year to maintain the profit level of preceding year.

Solution:

(i) Statement showing computation of break even units in two years and other required information:

(Amount in ₹)

		Base/Previous Year	Current/Budget Year
I.	Selling price	10.00	9.00
II.	Variable cost		
	Material	2.00	(2 x 97.5 / 100) 1.95
	Labour	4.00	(4/0.8) 5.00
	Variable Overhead	0.80	(0.8 x 98.75%) 0.79
		6.80	7.74
III.	Contribution	3.20	1.26
IV.	Total contribution	(10,000 x 3.2)	(15,000 x 1.26)
		32,000	18,900
V.	Fixed cost	20,000	25,000
VI.	Profit	12,000	(6,100)
VII.	Break Even units	(20,000/3.2)	(25,000/1.26)
		= 6,250 units	= 19,841 units

(ii) No. of units required to double the profit of base year under

$$\begin{aligned} \text{base year conditions} &= 20,000 + 24,000 / 3.2 \\ &= 13,750 \text{ units} \end{aligned}$$

(iii) No. of units required in current year to get base year

$$\begin{aligned} \text{Profit} &= (25,000 + 12,000) / 1.26 \\ &= 29,365 \text{ units} \end{aligned}$$

Illustration 41 :

VINAK Ltd. operating at 75% level of activity produces and sells two products A and B. The cost sheets of these two products are as under:-

	Product A	Product B
Units produced and sold	600	400
Direct materials (₹)	2.00	4.00
Direct labour (₹)	4.00	4.00
Factory overheads (40% fixed) (₹)	5.00	3.00
Selling and administration overheads (60% fixed) (₹)	8.00	5.00
Total cost (₹)	<u>19.00</u>	<u>16.00</u>
Selling price per unit (₹)	23.00	19.00

Factory overheads are absorbed on the basis of machine hour which is the limiting factor. The machine hour rate is ₹ 2 per hour. The company receives an offer from Canada for the purchase of Product A at a price of ₹17.50 per unit.

Alternatively the company has another offer from the Middle East for the purchase of Product B at a price of ₹15.50 p.u.

In both cases, a special packing charge of fifty paise per unit has to be borne by the company.

The company can accept either of the two export orders and in the either case the company can supply such quantities as may be possible to produce by utilising the balance of 25% of its capacity.

You are required to prepare:

- (1) A statement showing the economics of the two export proposals giving your recommendation as to which the proposal should be accepted, and
- (2) A statement showing the overall profitability of the company after incorporating the export proposal recommended by you.

Solution:**(1) Statement showing economics of two products :****(Amount in ₹)**

Sr. No.	Particulars	A	B
I.	Selling price	17.5	15.5
II.	Variable cost		
	Direct Materials	2.00	4.00
	Direct Labour	4.00	4.00
	Factory OH	3.00	1.80
	Selling & Distribution OH	3.20	2.00
	Packing cost	0.50	0.50
		<u>12.70</u>	<u>12.30</u>
III.	Contribution	4.80	3.20
IV.	Contribution per hour	(4.8/2.5) = 1.92	(3.2/1.5) = 2.13



The order from middle east for product B is to be accepted because it has more contribution per machine hour.

$$\begin{aligned} \text{Machine hours at present capacity (75\%)} &= (600 \times 2.5) + (400 \times 1.5) \\ &= 2,100 \text{ hrs} \end{aligned}$$

$$\begin{aligned} \text{Machine hours at 100\% capacity} &= 2,100 \times 100/75 \\ &= 2,800 \text{ hrs} \end{aligned}$$

$$\text{Hours of balance capacity (25\%)} = 2,800 - 2,100 = 700 \text{ hours}$$

$$\text{No. of units of B that can be manufactured in those 700 hrs} = 700/1.5 = 467 \text{ units.}$$

(2) Statement showing computation of profit after incorporating the export order:

	Particulars	B				
		A	Home	Export	Total	Total
I.	No. of units	600	400	467	867	
II.	Contribution per unit (₹)	23 – 12.2 = 10.80	19 – 11.8 = 7.2	= 3.2		
III.	Total contribution (₹)	6,480	2,880	1,494.4	4,374.4	10,854.4
IV.	Fixed cost (₹)	(2+4.8) x 600 = 4,080	4.2x400 = 1,680	--	1,680	5,760.0
V.	Profit (₹)	2,400	1,200	1,494.4	2,694.4	5,094.4

Illustration 42 :

Your company has a production capacity of 2,00,000 units per year. Normal capacity utilisation is reckoned at 90%. Standard Variable Production costs are ₹ 11p.u. The fixed costs are ₹ 3,60,000 per year. Variable selling costs are ₹ 3p.u. and fixed selling costs are ₹2,70,000 per year. The unit selling price is ₹ 20. In the year just ended on 30th June, 2012, the production was 1,60,000 units and sales were 1,50,000 units. The closing inventory on 30-6-2012 was 20,000 units. The actual variable production costs for the year was ₹ 35,000 higher than the standard.

Calculate:

- (1) The profit for the year
 - (a) by absorption costing method
 - (b) by the marginal cost method.
- (2) Explain the difference in profits.

Solution:

(1) (a) Statement showing computation of profit under absorption costing

Particulars	Amount (₹)
Standard variable production = 1,60,000 x 11	17,60,000
(+) Variance	35,000
Actual variable production costs	17,95,000
Fixed production cost recovered (1,60,000 x ₹ 2*)	3,20,000
	21,15,000
(+) Under recovery of fixed production overheads (3,60,000 – 3,20,000)	40,000

Production cost of goods manufactured	21,55,000
(+) Opening Stock (10,000 x 13) *	1,30,000
(-) Closing stock (21,55,000/1,60,000 x 20,000)	2,69,375
(+) Selling expenses	
Variable 1,50,000 x 3 = 4,50,000	
Fixed = 2,70,000	7,20,000
	27,35,625
Profit	2,64,375
Sales (1,50,000 x 20)	30,00,000

Variable cost = 11.00

(+) Fixed production cost per unit

(3,60,000/2,00,000 x 90%) = *2.00

= 13.00

(b) Statement showing computation of profit under marginal costing

	Particulars		₹
I.	Sales		30,00,000
II.	Variable cost		
	Production (17,60,000 + 35,000)	17,95,000	
	(+) Opening (10,000 x 11)	1,10,000	
		19,05,000	
	(-) Closing stock (17,95,000/1,60,000 x 20,000)	2,24,375	16,80,625
	Selling expenses (1,50,000 x 3)		4,50,000
			21,30,625
III.	Contribution (I-II)		8,69,375
IV.	Fixed cost (3,60,000 + 2,70,000)		6,30,000
V.	Profit (III-IV)		2,39,375

(2) The difference in profit shown by absorption costing and marginal costing is due to valuation of costs i.e., stocks are valued at total production cost in absorption costing and at variable production cost in marginal costing.

The difference in profits can be explained as follows:

	Absorption Costing	Marginal Costing	Profit is (less)/more in absorption costing
Opening stock	1,30,000	1,10,000	(-) 20,000
Closing stock	2,69,375	2,24,375	(+) 45,000
			25,000

**Illustration 43 :**

From the following data calculate:

- (1) B.E.P expressed in amount of sales in rupees.
- (2) Number of units that must be sold to earn a profit of ₹60,000 per year
- (3) How many units must be sold to earn a net income of 10% of sales.

Sales price ₹ 20 per unit; variable manufacturing costs ₹ 11 p.u; fixed factory overheads ₹ 5,40,000 p.a; variable selling costs ₹ 3 p.u. Fixed selling costs ₹ 2,52,000 per year.

Solution:

Sr. No.	Particulars	₹
I.	Selling price	20.00
II.	Variable cost (11+3)	14.00
III.	Contribution per unit (i - ii)	6.00

$$\text{BEP in units} = (2,52,000 + 5,40,000) / 6 = 1,32,000$$

- a) BEP sales = 1,32,000 x 20 = 26,40,000
- b) No. of units = (7,92,000 + 60,000) / 6 = 1,42,000
- c) Let 'S' be the no. of units required

$$\text{Sales} = S \times 20 = 20S$$

$$\text{Desired profit} = 20S \times 10\% = 2S$$

$$\text{Required units} = \frac{\text{F. C} + \text{Desired Profit}}{\text{Contribution per unit}}$$

$$S = (7,92,000 + 2S) / 6$$

$$4S = 7,92,000$$

$$S = 1,98,000$$

Illustration 44 :

The Board of Directors of KE Ltd. manufacturers of three products A, B and C have asked for advice on the production mixture of the company.

- (a) You are required to present a statement to advise the directors of the most profitable mixture of the products to be made and sold.

The statement should show:

- i) The profit expected on the current budgeted production, and
- ii) The profit which could be expected if the most profitable mixture was produced.

- (b) You are also required to direct the director's attention to any problem which is likely to arise if the mixture in (a) (ii) above were to be produced.

The following information is given:-

Data for standard Costs, per unit:

	Product A	Product B	Product C
Direct material (₹)	10	30	20
Variable overhead (₹)	3	2	5

Direct Labour :-

Department	Rate per hour	Hours	Hours	Hours
1	0.5	28	16	30
2	1.0	5	6	10
3	0.5	16	8	30

Data from current budget production

in thousands of units per year :	10	5	6
Selling price per unit: (₹)	50	68	90

Fixed cost per year ₹ 2,00,000

Maximum sales forecast by the Sales

director for the year 2013 in

thousands of units	12	7	9
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However the type of labour required by Dept 2 is in short supply and it is not possible to increase the manpower of this dept. beyond its present level.

Solution:

(a) Statement showing computation of contribution per hour in Dept. 2 and determination of priority for profitability

Sr. No.	Particulars	A (₹)	B (₹)	C (₹)
I.	Selling price	50	68	90
II.	Variable cost			
	Direct Material	10	30	20
	Variable OH	3	2	5
	Direct labour in			
	Dept 1	14	8	15
	Dept 2	5	6	10
	Dept 3	8	4	15
III.	Total Variable Cost	40	50	65
IV.	Contribution (i - iii)	10	18	25
V.	Contribution per hour in Dept. 2	10/5	18/6	25/10
		= 2	= 3	= 2.5
	Priority	III	I	II



Statement showing computation of profit at current budgeted production

Sr. No.	Particulars	A	B	C	Total
I.	No. of units	10,000	5,000	6,000	
II.	Contribution per unit (₹)	10	18	25	
III.	Total contribution (₹)	1,00,000	90,000	1,50,000	3,40,000
IV.	Fixed cost (₹)				2,00,000
V.	Profit (₹)				1,40,000

$$\begin{aligned}\text{No. of hours in Dept. 2} &= (10,000 \times 5) + (5,000 \times 6) + (6,000 \times 10) \\ &= 1,40,000 \text{ hours}\end{aligned}$$

Statement showing optimum mix under given conditions and computation of profit at that mix

Sr. No.	Particulars	A	B	C	Total
I.	No. of units	1,600	7,000	9,000	
II.	Contribution per unit	10	18	25	
III.	Total contribution	16,000	1,26,000	2,25,000	3,67,000
IV.	Fixed cost				2,00,000
V.	Profit				1,67,000

$$\begin{aligned}\text{Available hours} &= 1,40,000 \\ \text{(-) hours used for B (7,000 x 6)} &= \underline{42,000} \\ &= 98,000 \\ \text{(-) hours for C (9,000 x 10)} &= \underline{90,000} \\ &= \underline{8,000}\end{aligned}$$

$$\text{Units of A} = 8,000/5 = 1,600 \text{ units}$$

- (b) The directors are to pay attention on the point that the sales of less no. of units of 'A' will adversely affect the sales of product 'B' and 'C' (or) not.

Illustration 45 :

An engineering company receives in enquiry for the manufacture of certain products, where costs estimated as follows per product. Direct materials ₹ 3.10; Direct labour (5 hours) ₹ 2.05; Direct expenses ₹ 0.05 Variable overheads 20 paise per hour.

The manufacture of these products will necessitate the provision of special tooling costing approximately ₹ 4,500. The price per unit is ₹ 8.00. For an order to be considered profitable it is necessary for it to yield a target contribution at the rate of ₹ 0.30 per Labour Hour (after tooling cost).

Find out:

- The sales level at which contribution to profit commences.
- The sales at which the contribution exceeds the target.

Solution:**Statement Showing Computation of Contribution**

Sr. No.	Particulars	Amount (₹)
I.	Selling price	8.00
II.	Variable cost	
	Direct material	3.10
	Direct Labour	2.05
	Direct expenses	0.05
	Variable OH (5 x 0.2)	1.00
III.	Total Variable Cost	6.20
	Contribution (i - iii)	1.80

Break even units = $4,500 / 1.8 = 2,500$ units.

Break even sales = $2,500 \times 8 = ₹ 20,000$

Target profit = ₹ 0.3 per hour i.e. ₹ 1.5 per unit (5×0.3)

Let 'S' be the required units.

Desired profit = $1.5 \times S = 1.5S$

Required units = $4,500 + 1.5S / 1.8$

$\Rightarrow S = 4,500 + 1.5S / 1.8$

$\Rightarrow S = 15,000$ units

Required sales = $15,000 \times 8 = ₹ 1,20,000$.

Illustration 46 :

The present output details of a manufacturing department are as follows:

Average output per week - 48,000 units from 160 employees.

	₹
Saleable value of the output	1,50,000
Contribution made by output towards fixed expenses and profit	60,000

The board of directors plan to introduce more mechanisation into the department at a capital cost of ₹ 40,000. The effect of this will be to reduce the number of employees to 120, but to increase the output per individual employees by 40%. To provide the necessary incentive to achieve the increased output, the board intends to offer a 1% increase on the piece of work price of 25 paise per article for every 2% increase in average individual output achieved. To sell the increased output, it will be necessary to decrease the selling price by 4%. Calculate the extra weekly contribution resulting from the proposed change and evaluate for the board's consideration, the worth of the project.

Solution:**Statement Showing the Computation of Selling Price Per Unit**

Sr. No.	Particulars	Amount (₹)
I.	Sales	1,50,000
II.	Contribution	60,000
III.	Variable cost	90,000
IV.	Direct Labour (48,000 x 0.25)	12,000
V.	Variable cost other than labour	78,000
VI.	Variable cost other than labour per unit (78,000/48,000)	1.625



VII.	Output per employee (48,000/160)(units)	300
VIII.	Selling price (1,50,000 / 48,000)	3.125

Statement showing computation of contribution after introduction of mechanization:

	Particulars	Amount (₹)
I.	No. of employees	120
II.	Output per employee (300 x 140/100)	420
III.	Total output	50,400
IV.	Selling Price (3.125 x 96/100)	3
V.	Sales	1,51,200
VI.	Variable cost	
	V.C other than labour (50,400 x 1.625)	81,900
	Labour cost (50,400 x 0.25 x 120/100)	15,120
VII.	Contribution	54,180

From the above computation, it was found that there is no extra contribution due to increase of mechanization and infact contribution decreased by ₹ 5,820. There is no worth of project.

2.2 THROUGHPUT ACCOUNTING

Throughput Accounting is a management accounting technique used as a performance measure in the theory of constraints. It is the business intelligence used for maximizing profits. It focuses importance on generating more throughput. It seeks to increase the velocity or speed of production of products and services keeping in view of constraints. It is based on the concept that a company must determine its overriding goal and then it should create a system that clearly defines the main capacity constraint that allows it to maximize that goal. The changes that this concept causes are startling.

Throughput accounting is a system of performance measurement and costing which traces costs to throughput time. It is claimed that it complements JIT principles and forces attention to the true determinants of profitability. Throughput accounting is defined as follows:

“A management accounting system which focuses on ways by which the maximum return per unit of bottleneck activity can be achieved” – CIMA Terminology.

2.2.1 Throughput Concepts:

A few new terms are used in throughput accounting. They are explained as below:

Throughput:

Throughput is the excess of sales value over the totally variable cost. That is nothing but contribution margin left after a product's price is reduced by the amount of its totally variable cost.

Totally Variable Cost:

This cost is incurred only if a product is produced. In many cases only direct materials are considered as totally variable cost. Direct labour is not totally variable, unless piece rate wages are paid.

Capacity Constraints:

It is a resource within a company, that limits its total output. For example, it can be a machine that can produce only a specified amount of a key component in a given time period, thereby keeping overall sales from expanding beyond the maximum capacity of that machine. There may be more than one capacity constraint in a company, but rarely more than one for a specified product or product line.

Throughput (or Cycle) Time:

Throughput (or cycle) time is the average time required to convert raw materials into finished goods ready to be shipped to customer. It includes the time required for activities such as material handling, production processing, inspecting and packaging.

Throughput Efficiency:

Throughput efficiency is the relation of throughput achieved to resources used.

$$\text{Throughput efficiency} = \frac{(\text{Throughput cost})}{(\text{Actual factory cost})}$$

Throughput Time Ratio:

It is the ratio of time spent adding customer value to products and services divided by total cycle time. It is also known as the 'ratio of work content to lead time'.

Operating Expenses:

This is sum total of all company expenses including totally variable expenses. It should be noted that throughput accounting does not care, if a cost is semi-variable, fixed or allocated – all costs that are not totally variable is lumped together for throughput accounting purpose. This group of expenses is considered the price that a company pays to ensure that it maintains its current level of capacity.

Investment:

This term is used here also, as it is used in common parlance, i.e. any application of funds, which is intended to provide a return by way of interest, dividend or capital appreciation. However, there is a particular emphasis on company's investment in working capital. This is discussed subsequently in discussion about throughput model.

Total Factory Cost:

With the exception of material costs, in the short run, most factory costs (including direct labour) are fixed. These fixed costs can be grouped together and called total factory costs (TFC).

Manufacturing Response Time:

With JIT, products should not be made, unless there is a customer waiting for them, because the ideal inventory level is zero. The effect of this will be that there will be idle capacity in some operations except the operation, which is bottleneck of the moment. Working on output just to increase WIP or Finished Goods stocks creates no profit and so would not be encouraged. This means that profit is inversely proportional to the level of inventory in the system. It can be expressed as follows:

$$\text{Profit} = f = \frac{1}{\text{MRT}}$$

where, MRT = Manufacturing Response Time

Profitability:

This concept emphasis that profitability is determined by how quickly goods can be produced to satisfy customer's order. Production for stock does not create profits. Improving the throughput of bottleneck operations will increase the rate at which customer demand can be met and this will improve profitability. Contribution in its traditional form (sales – variable costs) is not good guide or profitability because it ignores capacity factors and rate of production.

$$\text{Return per factory hour} = \frac{\text{Sales Prices} - \text{material Cost}}{\text{Time on key resource i.e., the bottleneck}}$$



Product costs are measured thus:

$$\text{Cost per factory hour} = \frac{\text{Total factory costs (TFC)}}{\text{Total time available on the key resource}}$$

The return and cost per factory hour are combined into the throughput accounting ratio as follows:

$$\text{TA} = \frac{\text{Return per factory hour (or minute)}}{\text{Cost per factory hour (or minute)}}$$

The TA ratio should be greater than 1. If it is less than 1 the product will lose money for the company and the company should consider withdrawing it from the market.

Using TA, value is not created until products are sold. Thus items made for stock produce no return and depress the TA ratio. This should prompt managers to use their limited bottleneck resource to produce products for which customer demand exists. The TA ratio can be considered in total terms and compares the total return from the throughput to TFC, i.e.,

$$\text{Primary TA Ratio} = \frac{\text{Return from total throughput (i.e., Sales-Material Costs)}}{\text{(TFC (i.e., all costs other than materials))}}$$

2.2.2 Throughput Accounting and Contribution Approach:

Throughput accounting has certain similarities with the traditional approach of maximizing contribution per unit of scarce resource. However, there are certain differences. In throughput accounting, return is defined as sales less material costs in contrast to contribution, which is sales less all variable costs, i.e., material, labour, overheads. The assumption (i.e., emphasis) in throughput accounting is that all costs except material are fixed in relation to throughput in short run. Eminent management accountants like Kaplan and Shank have criticized TA for its short-term emphasis. Besides, TA does not appear to be useful in JIT environment. Throughput helps to direct attention to bottlenecks and forces management to concentrate on the key elements in making profits and approach adopted to gain this objective is reduction in inventory and reducing response time to customer demand.

2.2.3 Basic logic of throughput costing and comparison with absorption costing:

Throughput costing assigns only unit level spending for direct costs as the cost of products or services. Advocates of throughput costing argue that adding any other indirect cost, past or committed cost, to product cost creates improper incentives to drive down the average cost per unit by making more products than can be used or sold. Since these are committed costs, making more units with the same level of spending arithmetically reduces the average cost per unit and makes the production process appear to be more efficient. Throughput accounting (costing) avoids this incentive because the cost per unit depends only on the unit level spending (i.e., cost of materials) not how many units are made. Using throughput accounting (costing) means that cost management analyst must distinguish between

- (a) Spending for resources caused by the decision to produce different levels of products and services, and
- (b) The use of resources that organisation has committed to supply regardless of level of products and services provided.

2.2.4 Steps to be followed to increase the throughput:

The theory of constraints is applied within an organisation by following what are called 'the five focusing steps.' These are a tool that Goldratt developed to help organisations deal with constraints, otherwise known as bottlenecks, within the system as a whole (rather than any discrete unit within the organisation.) The steps are as follows:

- a. Identify the bottle neck in the system i.e., identification of the limiting factor of the production (or) process such as installing capacity or hours etc.
- b. Decide how to exploit the systems bottleneck that means bottleneck resource should be actively and effectively used as much as possible to produce as many goods as possible.
- c. Subordinate everything else to the decision made in step (b). The production capacity of the bottleneck resource should determined production schedule.
- d. Augment the capacity of the bottleneck resource with the minimum capital input.
- e. Identify the new bottlenecks in the process and repeat the same above steps to address the bottlenecks.

2.2.5 Problems with throughput accounting:

1. When throughput accounting is the driving force behind all production scheduling, a customer that has already placed an order for a product, which will result in a sub-optimal profit level for the manufacturing, may find that its order is never filled.
2. The company's ability to create the highest level of profitability is now dependent on the production scheduling staff, who decides, what products are to be manufactured and in what order.
3. Another issue is that all costs are totally variable in the long-run since the management then, has the time to adjust them to long-range production volumes.

2.2.6 Reporting under throughput accounting:

When the throughput model is used for financial reporting purposes, the format appears slightly different. The income statement includes only direct materials in the cost of goods sold, which results in a 'throughput contribution instead of gross margin. All other costs are jumped into an 'Operating Expenses' category below the throughput contribution margin, yielding a net income figure at the bottom. All other financial reports stay the same. Though this single change appears relatively minor, it has significant impact. *The primary change is that throughput accounting does not charge any operating expenses to inventory so that they can be expressed in future period. Instead, all operating expenses are realized during the current period.* As a result, any incentive for managers to over produce is completely eliminated because they cannot use the excess amount to shift expenses out of current period, thereby making their financial results look better than they would otherwise. Though this is a desirable result, such a report can be used only for internal reporting because of the requirement of generally accepted accounting principles that some overheads should be charged to excess production.

2.2.7 Systematic changes required for acceptance of the throughput accounting:

Throughput accounting does not have a logical linkage with the more traditional form of cost accounting. This makes it difficult for it to gain acceptance. The main problem is that this method does not use cost as the basis for the most optimal production decisions. This is entirely contrary to the teachings of any other type of accounting, which holds that the highest margin products should always be produced first. Now question is whether the enterprise should either use throughput or traditional costing exclusively or is there any way to merge the two. Following discussion relates to this issue:

a) Inventory Valuation:

Generally accepted accounting principles clearly state that cost of overhead must be apportioned to inventory. Throughput accounting states that none of the overhead cost should be so assigned. In this case, since the rules are so clear, it is apparent that throughput accounting loses. The existing system must continue to assign costs irrespective of how throughput principles are used for other decision making (short-range) activities.

b) Inventory Investment Analysis:

There are fundamental differences between the two methodologies. Both hold that the objective



is always to keep one's investment at a minimum. In the case of traditional cost accounting, this is because the return on investment is higher when the total amount of investment is forced to the lowest possible level. Throughput accounting, however, wants to shrink the amount of investment because it includes work-in-progress inventory in this category. It tries to keep WIP levels down so that waste is reduced in the production system. In short, first system advocates a small investment for financial reasons, while later system favours it because it makes more operational sense. Despite the differences in reasoning, the same conclusion is reached by both methodologies. However, throughput approach is still better, for it forces one to analyse all inventory reduction projects in light of how they together will impact the capacity constraint rather than individually.

c) Capital Investment Analysis:

Traditional cost accounting only analyses each investment proposal on its own rather than considering its impact on the production processes as a whole. It tends to recommend investments that will result in an incremental investment but no overall change in the level of corporate capacity, which is driven by capacity constraint. Throughput accounting, however, has a tight focus on investment only in areas that impact capacity constraint – to other investment proposals are rejected. In this instance, it is best to reject the traditional system and conduct analysis based on throughput principles.

d) Product Costing:

Under throughput accounting, a product has only a totally variable cost, which may be far lower than the fully absorbed cost, that would be assigned to it under more traditional costing system. This totally variable cost is almost always direct materials, which is an easily calculated figure. Full absorption costing, however, requires a large amount of calculation effort, before a detailed cost can be compiled for a product. For companies selling to Government under cost-plus contracts, there are lengthy detailed requirement as to what variable and overhead costs should be assigned to each product manufactured. These rules virtually require the use of absorption costing – throughput costing is not a viable solution. For companies, that do not require detailed costing justifications while selling their products, it may be possible to use the much simpler throughput accounting approach.

e) Production Scheduling:

Traditional systems do not include any kind of throughput accounting, that tells production planners which orders should be produced first. These days with throughput accounting, it is possible to customize existing systems or to upgrade packaged software so that this option is available to planner. This would allow them to produce the items that result in the highest throughput per minute of the capacity constraint. Here it is difficult to fully support the throughput approach. Any company that has already received a customer has an obligation to fill it, even if the resulting sale will reduce its overall level of profit from the theoretical maximum that can be calculated with throughput accounting. Maximising short-term profit by ignoring orders is tantamount to long-term suicide since customers will leave in droves. Consequently, production planners should be left alone to schedule production in the traditional manner rather than basing their decisions on short-term profit maximisation.

f) Long-term planning:

This is the main application area of throughput accounting. The enterprise should estimate the approximate sales levels for each product for a long-time frame enter into a throughput model and determine what mix of prospective sales will result in the highest level of profitability. This method is much superior to use of throughput costing for short-term production decisions, since long-term planning sidesteps problems by avoiding existing customer orders that will result in low profits. Long-

term planning does not involve existing customer orders so that decisions to produce various types of products at different price points can be made before the sales force goes out to obtain orders.

g) Price Setting:

Throughput accounting is favoured by the sales and marketing staff favours throughput accounting because the margin on products is simple to obtain—just subtract totally variable costs from the price. This beats the incomprehensible image of allocations accompanying activity based costing. Price setting in throughput environment focuses more on what products can be inserted into the existing production mix at a price that will incrementally increase overall profitability, rather than the painful accumulation and allocation of costs to specific products. Throughput accounting is the clear choice here based on ease of understandability and the speed with which information can be accumulated.

Illustration: 47

Modern Co produces 3 products, A, B and C, details of which are shown below:

Particulars	A	B	C
Selling price per unit (₹)	120	110	130
Direct material cost per unit (₹)	60	70	85
Variable overhead (₹)	30	20	15
Maximum demand (units)	30,000	25,000	40,000
Time required on the bottleneck resource (hours per unit)	5	4	3

There are 3,20,000 bottleneck hours available each month.

Required:

Calculate the optimum product mix based on the throughput concept.

Solution:

Particulars	A	B	C
Selling price per unit (₹)	120	110	130
Direct material cost per unit (₹)	60	70	85
Throughput per unit (₹)	60	40	45
Time required on the bottleneck resource (hours per unit)	5	4	3
Return per factory hour (₹)	12	10	15
Ranking	2	3	1
Total Available hours		= 3,20,000	



(-) Hours used for C (40,000 x 3) = 1,20,000
 (-) Hours used for A (30,000 x 5) = 1,50,000 = 2,70,000
 Balance hours available for B = 50,000
 No. of units that can be made in balance hours = 50,000 / 4 = 12,500 units.

Statement showing optimum mix:

	A	B	C
No. of units	30,000	12,500	40,000

Illustration 48:

Cat Co makes a product using three machines – X, Y and Z. The capacity of each machine is as follows:

	X	Y	Z
Machine capacity per week (in units)	800	600	500

The demand for the product is 1,000 units per week. For every additional unit sold per week, profit increases by ₹ 50,000. Cat Co is considering the following possible purchases (they are *not* mutually exclusive):

Purchase 1 Replace machine X with a newer model. This will increase capacity to 1,100 units per week and costs ₹ 60 Lakhs.

Purchase 2 Invest in a second machine Y, increasing capacity by 550 units per week. The cost of this machine would be ₹ 68 Lakhs.

Purchase 3 Upgrade machine Z at a cost of ₹ 75 Lakhs, thereby increasing capacity to 1,050 units.

Required:

Which is Cat Co's best course of action under throughput accounting?

Solution:

Bottleneck resource in order of preference is firstly machine 'Z', secondly machine 'Y' and lastly machine 'X' because the no. of units are in that order in the existing capacity.

Particulars	X	Y	Z	Demand
Current capacity per week	800	600	500*	1,000
Buy Z	800	600*	1,050	1,000
Buy Z & Y	800*	1,150	1,050	1,000
Buy Z, Y & X	1,100	1,150	1,050	1,000*

* = bottleneck resource

All the three machines to be purchased in the above order to meet the existing demand.

Illustration 49:

A factory has a key resource (bottleneck) of Facility A which is available for 31,300 minutes per week. Budgeted factory costs and data on two products, X and Y, are shown below:

Product	Selling Price/Unit	Material Cost/Unit	Time in Facility A
X	₹ 35	₹ 20.00	5 minute
Y	₹ 35	₹ 17.50	10 minutes

Budgeted factory costs per week:

	₹
Direct labour	25,000
Indirect labour	12,500
Power	1,750
Depreciation	22,500
Space costs	8,000
Engineering	3,500
Administration	5,000

Actual production during the last week is 4,750 units of product X and 650 units of product Y. Actual factory cost was ₹ 78,250.

Calculate:

- (i) Total factory costs (TFC)
- (ii) Cost per Factory Minute
- (iii) Return per Factory Minute for both products
- (iv) TA ratios for both products.
- (v) Throughput cost per the week.
- (vi) Efficiency ratio

Solution:

- (i) Total Factory Costs = Total of all costs except materials.
 $= ₹ 25,000 + ₹ 12,500 + ₹ 1,750 + ₹ 22,500 + ₹ 8,000 + ₹ 3,500 + ₹ 5,000.$
 $= ₹ 78,250$
- (ii) Cost per Factory Minute = Total Factory Cost ÷ Minutes available
 $= ₹ 78,250 ÷ 31,300 = ₹ 2.50$
- (iii)
 - (a) Return per bottleneck minute for Product X = $\frac{\text{Selling Price} - \text{Material Cost}}{\text{Minutes in bottleneck}}$
 $= (35 - 20) / 5 = ₹ 3$
 - (b) Return per bottleneck minute for Product Y = $\frac{\text{Selling Price} - \text{Material Cost}}{\text{Minutes in bottleneck}}$
 $= (35 - 17.5) / 10 = ₹ 1.75$
- (iv) Throughput Accounting (TA) Ratio for Product X = $\frac{\text{Return per Minute}}{\text{Cost per Minute}}$
 $= (3 / 2.5) = ₹ 1.2$
 Throughput Accounting (TA) Ratio for Product Y = $\frac{\text{Return per Minute}}{\text{Cost per Minute}}$
 $= (1.75 / 2.5) = ₹ 0.7$



Based on the review of the TA ratios relating to two products, it is apparent that if we only made Product Y, the enterprise would suffer a loss, as its TA ratio is less than 1. Advantage will be achieved, when product X is made.

(v) Standard minutes of throughput for the week:
 $= [4,750 \times 5] + [650 \times 10] = 23,750 + 6,500 = 30,250$ minutes
 Throughput cost per week:
 $= 30,250 \times ₹ 2.5$ per minutes
 $= ₹ 75,625$

(vi) Efficiency % = (Throughput cost / Actual TFC) %
 $= (₹ 75,625 / ₹ 78,250) \times 100$
 $= 96.6\%$

The bottleneck resource of Facility A is available for 31,300 minutes per week but produced only 30,250 standard minutes. This could be due to:

- (a) the process of a 'wandering' bottleneck causing facility A to be underutilized.
- (b) inefficiency in facility A.

Illustration: 50

Given below is the basic data relating to New India Company for three years:

	Year1	Year 2	Year 3
Production and Inventory data			
Planned production (in units)	2,500	2,500	2,500
Finished goods inventory (in units), Jan 1	0	0	750
Actual production (in units)	2,500	2,500	2,500
Sales (in units)	2,500	1,750	3,250
Finished goods inventory (in units), Dec 31	0	750	0
Revenue and cost data, all three-years			
Sales price per unit			₹ 48
Manufacturing costs per unit			
Direct material			12
Direct labour			8
Variable manufacturing overhead			4
Total variable cost per unit			24
Used only under absorption costing:			
Fixed manufacturing overhead = Annual fixed OH / Annual Production = ₹ 30,000 / ₹ 2,500			12
Total absorption cost per unit			₹ 36
Variable selling and administrative cost per unit			
Fixed selling and administrative cost per year			₹ 4
			₹ 5,000

You are required to Prepare:

- (a) Absorption Costing Income Statement
- (b) Variable Costing Income Statement.
- (c) Reconciliation of Income under Absorption and Variable Costing.
- (d) Throughput Costing Income Statement and Comment how it is relatively more useful.

Draw your conclusion.

Solution:**(a) Absorption Costing Income Statement**

New India Company
Income Statement as per Absorption Costing

Particulars	₹ Year1	₹ Year 2	₹ Year 3
Sales revenue (at ₹ 48 per unit)	1,20,000	84,000	1,56,000
Less: Cost of goods sold (at absorption cost of ₹ 36 per unit)	90,000	63,000	1,17,000
Gross margin	30,000	21,000	39,000
Less: Selling and administrative expenses:			
Variable (at ₹ 4 per unit)	10,000	7,000	13,000
Fixed	5,000	5,000	5,000
Operating Income	15,000	9,000	21,000

(b) Variable Costing Income Statement

New India Company
Income Statement as per Variable Costing

Particulars	Year1 (₹)	Year 2 (₹)	Year 3 (₹)
Sales revenue (at ₹ 48 per unit)	1,20,000	84,000	1,56,000
Less: Variable expenses:			
Variable manufacturing costs (at variable cost of ₹ 24 per unit)	60,000	42,000	78,000
Variable selling & admn. Costs (at ₹ 4 per unit)	10,000	7,000	13,000
Contribution margin	50,000	35,000	65,000
Less: Fixed expenses :			
Fixed manufacturing overhead	30,000	30,000	30,000
Fixed selling & admn. Expenses	5,000	5,000	5,000
Operating Income	15,000	0	30,000



(c) Reconciliation of Income under Absorption and Variable Costing

New India Company

Reconciliation of Income under Absorption and Variable Costing

Particulars	Year1 (₹)	Year 2 (₹)	Year 3 (₹)
Cost of goods sold under absorption costing	90,000	63,000	1,17,000
Variable manufacturing costs under variable costing	60,000	42,000	78,000
Difference	30,000	21,000	39,000
Fixed manufacturing overhead as a period expense under variable costing.	30,000	30,000	30,000
Balance	0	(9,000)	9,000
Operating Income under variable costing	15,000	0	30,000
Operating income under absorption costing	15,000	9,000	21,000
Difference in operating income	0	(9,000)	9,000

The following table shows, this difference in the amount of fixed overhead expenses explains the difference in reported income under absorption and variable costing:

Year	Change in Inventory (in units)	Fixed Overhead Rate	Difference in Fixed Overhead Expenses	Absorption Costing Income Minus Variable Costing Income
Year 1	0	x ₹ 12 =	= 0	= 0
Year 2	750 increase	x ₹ 12 =	= ₹ 9,000	= ₹9,000
Year 3	750 decrease	x ₹ 12 =	= (9,000)	= (9,000)

(d) Throughput Costing Income Statement

New India Company

Income Statement as per Throughput Costing

Particulars	Year1 (₹)	Year 2 (₹)	Year 3 (₹)
Sales revenue (at ₹ 48 per unit)	1,20,000	84,000	1,56,000
Less: Cost of goods sold (at throughput cost: Direct – material cost) ¹	30,000	21,000	39,000
Throughput	90,000	63,000	1,17,000
Less: Operating costs:	20,000	20,000	20,000
Direct labour	10,000	10,000	10,000
Variable manufacturing overhead	30,000	30,000	30,000
Fixed manufacturing overhead	10,000	7,000	13,000
Variable Selling & Admn. Costs	5,000	5,000	5,000
Fixed selling & Admn. Costs			
Total Operating costs	75,000	72,000	78,000
Operating Income	15,000	(9,000)	39,000

Notes:

1. Standard direct-material cost per unit of ₹ 12 multiplied by sales volume in units.
2. Assume that management has committed to direct labour sufficient to produce the planned annual production volume of 2500 units; direct labour cost is used at a rate of ₹ 8 per unit produced.
3. Assumes management has committed to support resources sufficient to produce the planned annual production volume of ₹ 2500 units; variable overhead cost is used at a rate of ₹ 4 per unit produced. Fixed overhead is ₹ 30,000 per year.
4. Variable selling and administrative costs used amount to ₹ 1 per unit sold. Fixed selling and administrative costs are ₹ 5,000 per year.

2.3 ACTIVITY BASED COSTING (ABC COSTING)

Limitations of Traditional Costing System:

1. In a traditional costing system, overheads i.e. indirect costs are allocated, apportioned and finally absorbed in the cost units. There can be distortion in computing costs due to the basis selected for absorption. The following example will clarify the situation.

A manufacturing company is producing two products, X and Y. The direct material cost for the products is ₹5,00,000 and ₹ 10,00,000 respectively. The total overheads are ₹7,50,000 and the company adopts direct material cost as the basis for absorption. The absorption percentage of overheads will be 50% of the direct material for X. Thus the overheads absorbed on the product X will be ₹ 2,50,000 and for Y, they will be ₹5,00,000 Product Y has a larger share of the overhead costs as the material costs are higher than that of X. However, actually product Y may be requiring lesser efforts in the indirect activities than X, but only because it has a higher material costs, it will be charged with larger amount of overheads. Thus there is a distortion in the total cost. This distortion in costs may lead to wrong decisions in several areas like make or buy, pricing decisions, acceptance of export offer etc.

2. Another limitation of traditional costing system is the division between fixed and variable may not be realistic as there are many complications due to the complexity of the modern business.
3. There should be linkage between the activities and the costs. Similarly the information should be available simultaneously which means that information should be made available while the activities are going on. Information available after the activity is over will not be of much use.

To overcome the above limitations, the Activity Based Costing system has emerged.

Activity Based Costing:

2.3.1 Definition:- CIMA defines Activity Based Costing as, '*cost attribution to cost units on the basis of benefit received from indirect activities e.g. ordering, setting up, assuring quality.*'

Another definition of Activity Based Costing is, '*the collection of financial and operational performance information tracing the significant activities of the establishment to product costs.*'

2.3.2 Objectives of Activity Based Costing

1. To remove the distortions in computation of total costs as seen in the traditional costing system and bring more accuracy in the computation of costs of products and services.
2. To help in decision making by accurately computing the costs of products and services.
3. To identify various activities in the production process and further identify the value adding activities.



4. To distribute overheads on the basis of activities.
5. To focus on high cost activities.
6. To identify the opportunities for improvement and reduction of costs.
7. To eliminate non value adding activities.

2.3.3 Steps in Activity Based Costing

The steps in Activity Based Costing are explained below.

1. Understanding and analyzing manufacturing process:-

For installation of any costing system, study of manufacturing process is essential. For Activity Based Costing system also, it is necessary to study the manufacturing process and ascertain various stages involved in the product or service so that 'activities' involved in that can be identified.

2. Study of the Activities involved:-

The next step is to study the activities involved in the manufacturing process. In this step, the activities involved in a process are identified. For example, in a bank, opening of an account is one of the services offered to customers. In this service, activities involved are studied. It may be revealed that opening of a new account involves activities like issuing the application form, verification of the same and accepting the initial amount required for opening of an account. Similarly in case of a manufacturing company, purchase procedure may involve activities like receiving of purchase requisition for concerned department or the stores department, inviting quotations from various suppliers, placing of an order, follow up of the same and finally receiving and inspection of the goods. In case of an educational institute, activities in a library may include activities like issue of books, receipt of books, ordering new books, stock taking, removing obsolete and outdated books, identification of slow moving and fast moving items etc. In this manner, whether in manufacturing or in service sector, activities are identified and the next step is to divide the activities into value adding and non value adding. The objective behind this is that attention can be focused on the value adding activities while non value adding activities can be eliminated in the future.

3. Activity Cost Pool:-

Cost pool is defined by CIMA as, '*the point of focus for the costs relating to a particular activity in an activity based costing system.*' For example, in case of a manufacturing organisation, as regards to stores, cost of classification, cost of issue of stores requisitions, inspection costs etc. can be pooled under the heading 'stores'. Thus cost pool concept is similar to the concept of cost center. The cost pool is the point of focus or in other words, it is the total cost assigned to an activity. It is the sum of all the cost elements assigned to an activity.

4. Cost Drivers:-

According to CIMA, '*cost driver is any factor which causes a change in the cost of an activity, e.g. the quality of parts received by an activity is a determining factor in the work required by that activity and therefore affects the resources required. An activity may have multiple cost drivers associated with it.*' In other words, cost driver means the factors which determine the cost of an activity. For example, in stores, no. of stores requisitions will be cost drivers, in customer order processing the no. of customers as well as no. of orders will be cost drivers. Thus a cost driver is an activity which generates cost. Activity Based Costing is based on the belief that activities cause costs and therefore a link should be established between activities and product. The cost drivers thus are the link between the activities and the cost.

5. Identification of costs with the products:-

The final step in Activity Based Costing is to identify the cost with the final products which can also be called as cost objects. Cost objects include, products, services, customers, projects and contracts.

As mentioned earlier, direct costs can be identified easily with the products but the indirect costs can be linked with the products by identifying activities and cost drivers. Thus Activity Based Costing is the process of tracing costs first from resources to activities and then from activities to specific products.

To conclude that, the Activity Based Costing is a costing system, that tries to charge the indirect costs to the products and services fairly and accurately. However for effective implementation there is a need of involvement of the staff and their training on continuous basis. Similarly there is a need to review the working of the system at periodic intervals and keep a follow up of the feedback received. These actions will ensure effective implementation of the system. Support of top management is also required for effective implementation of this system. Activity Based Costing system is definitely a better system but much depends on the implementation of the same.

2.3.4 Limitations of Activity Based Costing:

1. Activity Based Costing is a complex system and requires lot of records and tedious calculations.
2. For small organisations, traditional cost accounting system may be more beneficial than Activity Based Costing due to the simplicity of operation of the former.
3. Sometimes it is difficult to attribute costs to single activities as some costs support several activities.
4. There is a need of trained professionals who are limited in number.
5. This system will be successful if there is a total support from the top management.
6. Substantial investment of time and money is required for the implementation of this system.

2.3.5 Activity Based Budgeting:

The traditional budgeting is based on traditional cost accounting i.e. on the basis of allocation, apportionment and absorption of overheads in the products. However, the Activity Based Budgeting is different from the traditional budgeting in the sense that it provides a strong link between the objectives of organisation and objectives of a particular activity. In other words, it involves identification of activities and dividing them in value adding and non value adding activities. The non value adding activities are eliminated in due course of time. Activity Based Budgeting thus requires identification of activities of the organisation, establishing the factors which cause costs, the cost drivers and then collecting the costs of the activities in cost pools. The following are the features of Activity Based Budgeting.

1. It uses the activity analysis to relate costs to activities.
2. It identifies cost improvement opportunities.
3. There is a clear link between strategic objectives and planning and the strategic planning of the ABC process.

2.3.6 Activity Based Accounting:

Activity Based Accounting is a broader term which involves in, '*collection, recording, analysis, controlling and reporting of activity related costs rather than departmental or cost centers related costs.*' It involves several activities like Activity Based Budgeting, Cost management based on activities, performance measurement of activity, reducing the costs through elimination of non value adding activities and also initiating innovative measure for reduction of costs.

2.3.7 Activity Based Management:

The Activity Based Management is a tool of management that involves analysing and costing activities with the goal of improving efficiency and effectiveness. Though it is closely related to the Activity Based Costing, still it differs from the same in its primary goal. The Activity Based Costing focuses on activities with the object of measuring the cost of products/services. It tries to compute the cost as accurately as possible. On the other hand Activity Based Management focuses on managing the activities themselves.



In Activity Based Costing resources are traced to the activities for the purpose of computing the costs while in Activity Based Management, resources are traced to activities for evaluation of the activities themselves. In other words, efforts are made to improve the activities further. Thus Activity Based Management is a set of actions that management can take, based on information from an Activity Based Costing system, to increase/improve profitability.

For continuous improvement, Activity Based Management attempts the following analysis.

- **Cost Driver Analysis:-** The factors that cause activities to be performed need to be identified in order to manage activity costs. Cost driver analysis identifies these casual factors For example, in a stores department, it may be observed that slow moving and obsolete stock is not disposed of in time, the reason being the staff in the stores is not trained properly in this area. Managers have to address this cost driver to correct the root cause of this problem and take proper action.
- **Activity Analysis:-** Activity Analysis identifies value added and non value added activities. This analysis identifies the activities in the organisation and the activity centers that should be used in Activity Based Costing system. In Activity Based Management, as said above, identification of activities into value adding and non value adding is made and efforts are made to eliminate the non value adding activities.
- **Performance Analysis:-** Performance analysis involves the identification of appropriate measures to report the performance of activity centers or other organisational units consistent with each units goals and objectives. Performance Analysis aims to identify the best ways to measure the performance of factors that are important to organisations in order to stimulate continuous improvement.

2.3.8 Difference Between Activity Based Costing And Activity Based Management:

Activity Based Costing is logical distribution of overheads, i.e. overheads are distributed on the basis of the consumption of resources. It helps to avoid distortion of costs of products/services. On the other hand, Activity Based Management, on the other hand, is a discipline that focuses on efficient management so as to value of services rendered to customers This focus on activities is being used effectively for cost reduction, business process re-engineering, and benchmarking and performance measurement. Activity Based Management brings about a change in viewing at the objective by incorporation of financial perspective, internal business perspective, innovation and learning perspective.

Illustration: 51

The budgeted overheads and cost driver volumes of XYZ Ltd are as follows.

Cost Pool	Budgeted Overheads (₹)	Cost Driver	Budgeted Volume
Material procurement	5,80,000	No. of orders	1,100
Material handling	2,50,000	No. of movements	680
Set-up	4,15,000	No. of set ups	520
Maintenance	9,70,000	Maintenance hours	8,400
Quality control	1,76,000	No. of inspection	900
Machinery	7,20,000	No. of machine hours	24,000

The company has produced a batch of 2,600 components of AX-15, its material cost was ₹ 1,30,000 and labor cost ₹ 2,45,000. The usage activities of the said batch are as follows.

Material orders – 26, maintenance hours – 690, material movements – 18, inspection – 28, set ups – 25, machine hours – 1,800

Calculate – cost driver rates that are used for tracing appropriate amount of overheads to the said batch and ascertain the cost of batch of components using Activity Based Costing.

Solution:

Computation of Cost Driver Rates

	Particulars		Amount (₹)
1.	Material procurement	580000/1100	527
2.	Material handling	250000/680	368
3.	Set-up	415000/520	798
4.	Maintenance	970000/8400	115
5.	Quality control	1,76,000/900	196
6.	Machinery	720000/24000	30

Computation of Batch Cost of 2600 units of AX-15

Particulars		₹
Material cost		1,30,000
Labour Cost		2,45,000
Prime Cost		3,75,000
Add: Overheads		
Material orders	26 x 527	13,702
Material handling	18 x 368	6,624
Set-up	25 x 798	19,950
Maintenance	690 x 115	79,350
Quality Control	28 x 196	5,488
Machinery	1800 x 30	54,000
Total Cost		5,54,114

Illustration 52 :

A company produces four products, viz. P, Q, R and S. The data relating to production activity are as under:

Product	Quantity of production	Material cost/unit ₹	Direct labour hours/unit	Machine hours/unit	Direct Labour cost/unit ₹
P	1,000	10	1	0.50	6
Q	10,000	10	1	0.50	6
R	1,200	32	4	2.00	24
S	14,000	34	3	3.00	18

Production overheads are as under:

	₹
(i) Overheads applicable to machine oriented activity:	1,49,700
(ii) Overheads relating to ordering materials	7,680
(iii) Set up costs	17,400
(iv) Administration overheads for spare parts	34,380
(v) Material handling costs	30,294

The following further information have been compiled:



Product	No. of set up	No. of materials orders	No. of times materials handled	No. of spare parts
P	3	3	6	6
Q	18	12	30	15
R	5	3	9	3
S	24	12	36	12

Required:

- Select a suitable cost driver for each item of overhead expense and calculate the cost per unit of cost driver.
- Using the concept of activity based costing, compute the factory cost per unit of each product.

Solution:

(i) **Computation of Cost Driver Rates**

- Overheads relating to Machinery oriented activity
 Cost Driver → Machine Hour Rate
 $(1000 \times 0.5) + (1000 \times 0.5) + (1200 \times 2) + (14000 \times 3)$
 $1,49,700/49,900 = ₹ 3$ per hour
- Overheads relating to ordering materials
 Cost driver → No. of Material orders
 $7,680/30 = ₹ 256$ per order
- Set up costs
 Cost driver → No. of set ups
 $1,7400/50 = ₹ 348$ per set up
- Administrative overheads for spare parts
 Cost driver → No. of spare parts
 $34380/36 = ₹ 955$ per spare part.
- Material handling costs
 Cost driver → No. of times materials handled
 $30,294/81 = ₹ 374$ per material handling

Computation of factory cost for each product per unit (Amount in ₹)

	P (₹)		Q (₹)		R (₹)		S (₹)	
Materials		10.00		10.00		32.00		34.00
Labour		6.00		6.00		24.00		18.00
Overheads								
Machine oriented activity	1.500		1.50		6.00		9.00	
Ordering of Materials	0.768		0.31		0.64		0.22	
Set up costs	1.044		0.63		1.45		0.60	
Administrative Spare Parts	5.730		1.43		2.39		0.82	
Material handling	2.244	11.29	1.12	4.99	2.81	13.29	0.96	11.60
Factory Cost ₹		27.29		20.99		69.29		63.60

Illustration: 53

Relevant data relating to a company are:

	Products			
	P	Q	R	Total
Production and sales (units)	60,000	40,000	16,000	
Raw material usage in units	10	10	22	
Raw material costs (₹)	50	40	22	24,76,000
Direct labour hours	2.5	4	2	3,42,000
Machine hours	2.5	2	4	2,94,000
Direct labour costs (₹)	16	24	12	
No. of production runs	6	14	40	60
No. of deliveries	18	6	40	64
No. of receipts	60	140	880	1,080
No. of production orders	30	20	50	100

Overheads:	₹
Setup	60,000
Machines	15,20,000
Receiving	8,70,000
Packing	5,00,000
Engineering	7,46,000

The company operates a JIT inventory policy and receives each component once per production run.
Required:

- Compute the product cost based on direct labour-hour recovery rate of overheads.
- Compute the product cost using activity based costing.

Solution:

(i) Traditional Method of absorption of overhead i.e. on the basis of Direct Labour Hours

$$\begin{aligned} \text{Total overheads} &= \frac{36,96,000}{(\text{Hours } (60000 \times 2.5) + (40000 \times 4) + (16000 \times 2))} \\ &= \frac{36,96,000}{3,42,000} = ₹10.81 \text{ per labour hour} \end{aligned}$$

Calculation of Factory cost of the products under Traditional Method of apportioning overheads:

	P	Q	R
	₹	₹	₹
Raw Material	50.000	40.00	22.00
Direct Labour	16.000	24.00	12.00
Overheads (2.5 x 10.81)	27.025	43.24	21.62
Factory cost (Total)	93.025	107.24	55.62



(ii) Under Activity Based Costing System

Computation of Cost Drivers Rates.

Set up cost : Cost driver → No. of Production run

$60000/60 = ₹ 1000/\text{per run}$

Machines : Cost driver → Machine hour rate

$15,20,000/2,94,000 = ₹ 5.17 \text{ per Machine hour rate}$

Receiving cost: Cost driver → No. of Receipts

$8,70,000/1080 = ₹ 805.56$

Packing : Cost driver → No. of deliveries

$5,00,000/64 = ₹ 7812.5 \text{ per delivery}$

Engineering: Cost driver → No. of Production order

$7,46,000/100 = ₹ 7,460 \text{ per order}$

Calculation of Factory Cost Per Unit of Production

	P		Q		R	
	₹	₹	₹	₹	₹	₹
Materials		50.00		40.00		22.00
Direct Labour		16.00		24.00		12.00
Overheads						
Setup cost	0.10		0.35		2.50	
Machines	12.93		10.34		20.68	
Receiving cost	0.81		2.82		44.31	
Packing	2.34		1.17		19.53	
Engineering	3.73	19.91	3.73	18.41	23.31	110.33
Factory Cost (Total)		85.91		82.41		144.33

Illustration: 54

Trimake Limited makes three main products, using broadly the same production methods and equipment for each. A conventional product costing system is used at present, although an Activity Based Costing (ABC) system is being considered. Details of the three products, for typical period are:

	Labour Hours per unit	Machine Hours per unit	Material Per unit	Volumes Units
Product X	½	1 ½	₹ 20	750
Product Y	1 ½	1	₹ 12	1,250
Product Z	1	3	₹ 25	7,000

Direct labour costs ₹ 6 per hour and production overheads are absorbed on a machine hour basis. The rate for the period is ₹ 28 per machine hour.

You are required:

(a) to calculate the cost per unit for each product using conventional methods.

Further analysis shows that the total of production overheads can be divided as follows

	%
Costs relating to set-ups	35
Costs relating to machinery	20
Costs relating to materials handling	15
Costs relating to inspection	<u>30</u>
Total production overhead	<u>100%</u>

The following activity volumes are associated with the product line for the period as a whole.

Total activities for the period

	Number of Set-ups	Number of movements of materials	Number of Inspections
Product X	75	12	150
Product Y	115	21	180
Product Z	480	87	670
	670	120	1,000

You are required:

b) To calculate the cost per unit for each product using ABC principles;

Solution:

(a) Computation of cost per unit using Conventional Methods:

	Total overheads	₹
X	= 750 x 1.5 x 28	= 31,500
Y	= 1250 x 1 x 28	= 35,000
Z	= 7000 x 3 x 28	= <u>5,88,000</u>
		<u>6,54,500</u>

Computation of Cost

Particulars	X	Y	Z
	₹	₹	₹
Materials	20	12	25
Labour	3	9	6
Overheads	42	28	84
Factory Cost	65	49	115

(b) Under ABC Costing

	Setup Cost	Machine Cost	Machine Handling Cost	Inspection Expenses	Total
Costs (₹)	2,29,075	1,30,900	98,175	1,96,350	6,54,500
Cost Driver	No. of setups	Machine hours	No. of movement of materials	No. of Inspections	
Cost driver rates (₹)	341.90 (229075/670)	5.6 (130900/23375)	818.125 (98,175/120)	196.35 (196350/1000)	



Cost per unit under ABC costing

Particulars	X		Y		Z	
	₹	₹	₹	₹	₹	₹
Materials		20.00		12.00		25.00
Labour		3.00		9.00		6.00
Overheads						
Setup Cost	34.19		31.45		23.44	
Machine cost	8.40		5.60		16.80	
Machine Handling Cost	13.09		13.74		10.17	
Inspection Cost	39.27	94.95	28.27	79.06	18.79	69.20
Total Cost		117.95		100.06		100.20

2.4 TRANSFER PRICING

2.4.1 Introduction and Meaning:

In the modern days, production is on the mass scale due to technological advancement and upgradation. Organisations grow in course of time and for such growing organisations, decentralization becomes absolutely necessary. It becomes inevitable for such organisations to establish separate divisions and departments to ensure smooth working. Transfer pricing has become necessary in highly decentralized companies where number of divisions/departments are created as a part and parcel of the decentralized organisation. Transfer pricing is one of the tools in the hands of management for measuring the performance of divisions or departments.

A 'Transfer Price' is that notional value at which goods and services are transferred between divisions in a decentralized organisation. Transfer prices are normally set for intermediate products, which are goods, and services that are supplied by the selling division to the buying division. In large organisations, each division is treated as a 'profit center' as a part and parcel of decentralization. Their profitability is measured by fixation of 'transfer price' for inter divisional transfers.

The transfer price can have impact on the division's performance and hence lot of care is to be taken in fixation of the same. The following factors should be taken into consideration before fixing the transfer prices.

1. Transfer price should help in the accurate measurement of divisional performance.
2. It should motivate the divisional managers to maximize the profitability of their divisions.
3. Autonomy and authority of a division should be ensured.
4. Transfer Price should allow 'Goal Congruence' which means that the objectives of divisional managers match with those of the organisation.

2.4.2 Objectives of Inter Company Transfer Pricing:

The following are the main objectives of intercompany transfer pricing scheme:

1. **To evaluate the current performance and profitability of each individual unit :** This is necessary in order to determine whether a particular unit is competitive and can stand on its working. When the goods are transferred from one department to another, the revenue of one department becomes the cost of another and such inter transfer price affects the reported profits.
2. **To improve the profit position :** Intercompany transfer price will make the unit competitive so that it may maximize its profits and contribute to the overall profits of the organisation.
3. **To assist in decision making :** Correct intercompany transfer price will make the costs of both the units realistic in order to take decisions relating to such problems as make or buy, sell or process

further, choice between alternative methods of production.

4. **For accurate estimation of earnings on proposed investment decisions :** When finance is scarce and it is required to determine the allocation of scarce resources between various divisions of the concern taking into consideration their competing claims, then this technique is useful.

2.4.3 Methods of Transfer Pricing:

It is the notional value of goods and services transferred from one division to other division. In other words, when internal exchange of goods and services take place between the different divisions of a firm, they have to be expressed in monetary terms. The monetary amount for those inter divisional exchanges is called as 'transfer price'. The determination of transfer prices is an extremely difficult and delicate task as lot of complicated issues are involved in the same. Inter division conflicts are also possible. There are several methods of fixation of 'Transfer Price'. They are discussed below.

1. Pricing based on cost.
 - a) Actual cost
 - b) Cost plus
 - c) Standard cost
 - d) Marginal cost
 2. Market price as transfer price.
 3. Negotiated pricing.
 4. Pricing based on Opportunity cost.
1. **Pricing based on cost:** - In these methods, 'cost' is the base and the following methods fall under this category.
 - (a) **Actual Cost:** - Under this method the actual cost of production is taken as transfer price for inter divisional transfers. Such actual cost may consist of variable cost or sometimes total costs including fixed costs.
 - (b) **Cost Plus:** - Under this method, transfer price is fixed by adding a reasonable return on capital employed to the total cost. Thereby the measurement of profit becomes easy.
 - (c) **Standard Cost:** - Under this method, transfer price is fixed on the basis of standard cost. The difference between the standard cost and the actual cost being variance is absorbed by transferring division. This method is simple and easy to follow, but the constant revision of standards is necessary at regular intervals.
 - (d) **Marginal Cost:** - Under this method, the transfer price is determined on the basis of marginal cost. The reason being fixed cost is in any case unavoidable and hence should not be charged to the buying division. That is why only marginal cost will be taken as transfer price
 2. **Market price as transfer price:** - Under this method, the transfer price will be determined according to the market price prevailing in the market. It acts as a good incentive for efficient production to the selling division and any inefficiency in production and abnormal costs will not be borne by the buying division. The logic used in this method is that if the buying division would have purchased the goods/services from the open market, they would have paid the market price and hence the same price should be paid to the selling division. One of the variation of this method is that from the market price, selling and distribution overheads should be deducted and price thus arrived should be charged as transfer price. The reason behind this is that no selling efforts are required to sale the goods/services to the buying division and therefore these costs should not be charged to the buying division. Market price based transfer price has the following advantages :



- 1 Actual costs are fluctuating and hence difficult to ascertain. On the other hand market prices can be easily ascertained.
- 2 Profits resulting from market price based transfer prices are good parameters for performance evaluation of selling and buying divisions.
- 3 It avoids extensive arbitration system in fixing the transfer prices between the divisions.

However, the market price based transfer pricing has the following limitations :

1. There may be resistance from the buying division. They may question buying from the selling division if in any way they have to pay the market prices.
 2. Like cost based prices, market prices may also be fluctuating and hence there may be difficulties in fixation of these prices.
 3. Market price is a rather vague term as such prices may be ex-factory price, wholesale price, retail price etc.
 4. Market prices may not be available for intermediate products, as these products may not have any market.
 5. This method may be difficult to operate if the intermediate product is for captive consumption.
 6. Market price may change frequently.
 7. Market prices may not be ascertained easily.
- 3. Negotiated Pricing:** - Under this method, the transfer prices may be fixed through negotiations between the selling and the buying division. Sometimes it may happen that the concerned product may be available in the market at a cheaper price than charged by the selling division. In this situation the buying division may be tempted to purchase the product from outside sellers rather than the selling division. Alternatively the selling division may notice that in the outside market, the product is sold at a higher price but the buying division is not ready to pay the market price. Here, the selling division may be reluctant to sell the product to the buying division at a price, which is less than the market price. In all these conflicts, the overall profitability of the firm may be affected adversely. Therefore it becomes beneficial for both the divisions to negotiate the prices and arrive at a price, which is mutually beneficial to both the divisions. Such prices are called as 'Negotiated Prices'. In order to make these prices effective care should be taken that both, the buyers and sellers should have access to the available data including about the alternatives available if any. Similarly buyers and sellers should be free to deal outside the company, but care should be taken that the overall interest of the organisation is not affected.
- The main limitation of this method is that lot of time is spent by both the negotiating parties in fixation of the negotiated prices.
 - Negotiating skills are required for the managers for arriving at a mutually acceptable price, otherwise there is a possibility of conflicts between the divisions.
- 4. Pricing based on opportunity cost:** - This pricing recognizes the minimum price that the selling division is ready to accept and the maximum price that the buying division is ready to pay. The final transfer price may be based on these minimum expectations of both the divisions. The most ideal situation will be when the minimum price expected by the selling division is less than the maximum price accepted by the buying division. However in practice, it may happen very rarely and there is possibility of conflicts over the opportunity cost.

It is very clear that fixation of transfer prices is a very delicate decision. There might be clash of interests between the selling and buying division and hence while fixing the transfer price, overall interests of the organisation should be taken into consideration and overall 'Goal Congruence' should be given utmost importance rather than interests of the selling or buying division.

Illustration 55 :

The following information relates to budgeted operations of Division X of a manufacturing company.

Particulars	Amount in ₹
Sales – 50,000 units @ ₹ 8	4,00,000
Less: Variable Costs @ ₹ 6 per unit	3,00,000
Contribution margin	1,00,000
Less: Fixed Costs	75,000
Divisional Profits	25,000

The amount of divisional investment is ₹ 1,50,000 and the minimum desired rate of return on the investment is the cost of capital of 20%

Calculate

- i) Divisional expected ROI and
- ii) Divisional expected RI

Solution:

- (i) $ROI = ₹ 25,000 / 1,50,000 \times 100 = 16.7\%$
- (ii) $RI = \text{Divisional Profits} - \text{Minimum desired rate of return} = 25,000 - 20\% \text{ of } 1,50,000$
 $= (₹ 5,000)$

Illustration: 56

A company has two divisions, A and B. Division A manufactures a component which is used by Division B to produce a finished product. For the next period, output and costs have been budgeted as follows.

Particulars	Division A	Division B
Component units	50,000	-
Finished units	-	50,000
Total variable costs – Rupees	2,50,000	6,00,000
Fixed Costs Rupees	1,50,000	2,00,000

The fixed costs are separable for each division. You are required to advise on the transfer price to be fixed for Division A's component under the following circumstances.

- A. Division A can sell the component in a competitive market for ₹ 10 per unit. Division B can also purchase the component from the open market at that price.
- B. As per the situation mentioned in (A) above, and further assume that Division B currently buys the component from an external supplier at the market price of ₹ 10 and there is reciprocal agreement between the external supplier and another Division C, within the same group. Under this agreement, the external supplier agrees to buy one product unit from Division C at a profit of ₹ 4 per unit to that division, for every component which Division B buys from the sup.

**Solution:**

Transfer price decisions can be taken on the following basis.

- A. Transfer Price : - Marginal Cost + Opportunity Cost i.e. ₹ (5 + 5) = ₹ 10

Note : Marginal Cost = ₹ 2,50,000 / 50,000 units = ₹ 5

Opportunity cost ₹ 5 is computed on the basis that the Division A will sacrifice ₹ 5 if they sell the product to Division B.

- B. In this situation, the transfer price will be worked out as under:

Transfer price = Marginal Cost + Contribution + Profit foregone by Division C

= ₹ (5 + 5 + 4) = ₹ 14

In situation (B), if Division B purchases from Division A, it will not purchase from external supplier. Hence, the supplier will stop purchasing from Division C, which will result in a loss of profit to Division C @ ₹ 4 per unit, and therefore this amount will be recovered from the transfer price.

Illustration 57:

A company fixes the inter-divisional transfer prices for its products on the basis of cost plus an estimated return on investment in its divisions. The relevant portion of the budget for the Division A for the year 2012 -13 is given below.

Particulars	Amount in (₹)
Fixed Assets	5,00,000
Current Assets (other than debtors)	3,00,000
Debtors	2,00,000
Annual fixed cost for the division	8,00,000
Variable cost per unit of product	10
Budgeted volume of production per year (units)	4,00,000
Desired Return on Investment	28%

You are required to determine the transfer price for Division A.

Solution:**Computation of Transfer Price per unit**

Particulars	Amount
	₹
Variable cost	10.00
Fixed cost (8,00,000 / 4,00,000)	2.00
Total Cost	12.00
Add: Desired return (10,00,000 x 28%) ÷ 4,00,000	0.70
Transfer Price	12.70

Illustration 58:

XYZ Ltd which has a system of assessment of Divisional Performance on the basis of residual income has two Divisions, Alfa and Beta. Alfa has annual capacity to manufacture 15,00,000 numbers of a special component that it sells to outside customers, but has idle capacity. The budgeted residual income of Beta is ₹ 1,20,00,000 while that of Alfa is ₹ 1,00,00,000. Other relevant details extracted from the budget of Alfa for the current years were as follows.

Particulars

Sale (outside customers)	12,00,000 units @ ₹ 180 per unit
Variable cost per unit	₹ 160
Divisional fixed cost	₹ 80,00,000
Capital employed	₹ 7,50,00,000
Cost of Capital	12%

Beta has just received a special order for which it requires components similar to the ones made by Alfa. Fully aware of the idle capacity of Alfa, beta has asked Alfa to quote for manufacture and supply of 3,00,000 numbers of the components with a slight modification during final processing. Alfa and Beta agree that this will involve an extra variable cost of ₹ 5 per unit.

You are required to calculate,

- Calculate the transfer price which Alfa should quote to Beta to achieve its budgeted residual income.
- Also indicate the circumstances in which the proposed transfer price may result in a sub optimal decision for the Company as a whole.

Solution:**I. Contribution required at Budgeted Residual Income ₹**

Fixed cost	80,00,000
Profit on 7,50,00,000 x 12 %	90,00,000
Residual Income	<u>1,00,00,000</u>
Total Contribution required.	<u>2,70,00,000</u>

Contribution derived from existing units = 12,00,000 x 20 = ₹ 2,40,00,000

Contribution required on 3,00,000 units = 2,70,00,000 – 2,40,00,000 = ₹ 30,00,000

Contribution per unit = 30,00,000 / 3,00,000 = ₹ 10

Increase in Variable cost = ₹ 5

$$\begin{aligned} \therefore \text{Transfer price} &= \text{V.C} + \text{Desired Residual Income} + \text{Increase in VC} \\ &= 160 + 10 + 5 \\ &= ₹ 175 \end{aligned}$$

- If Beta can buy from outside at less than the Variable cost of manufacture, i.e. ₹ 165, then only the decision to transfer price of ₹ 175, will be sub-optimal for the group as whole.

Illustration 59:

Transferor Ltd. has two processes – Preparing and Finishing. The normal output per week is 7,500 units (completed) at a capacity of 75%.

Transferee Ltd. had production problems in preparing and require 2,000 units per week of prepared material for their finishing process.



The existing cost structure of one prepared unit of Transferor Ltd. at the existing capacity is as follows.

Material: ₹ 2.00 (variable 100%)

Labor: ₹ 2.00 (variable 50%)

Overheads: ₹ 4.00 (variable 25%)

The sale price of a completed unit of Transferor Ltd. is ₹ 16 with a profit of ₹ 4 per unit.

Contrast the effect on the profits of Transferor Ltd. for 6 months (25 weeks) of supplying units to Transferor Ltd. with the following alternative transfer prices per unit.

- i) Marginal Cost
- ii) Marginal Cost + 25%
- iii) Marginal cost + 15% return on capital employed. (Assume capital employed ₹ 20 lakhs)
- iv) Existing Cost
- v) Existing Cost + a portion of profit on the basis of preparing cost / total cost X unit profit
- vi) At an agreed market price of ₹ 8.50.

Assume no increase in the fixed costs.

Solution:

$$\text{Transferred units (25 x 2,000)} = 50,000$$

$$\text{Existing profit (7500 x 25 x 4)} = ₹ 7,50,000$$

Effect on profit if transfer price is :

- (i) Marginal cost

	₹
Material	2.00
Labour	1.00
OHS	1.00
	<u>4.00</u>

At this transfer price there is no effect on profit of transferor Ltd.

- (ii) Increase of Profit ₹ 50,000

(iii) Profit per unit = $4 + \{(2000000 \times 15\% \times 0.5) / 50000\}$ = ₹ 7

Under this price profit of transferor Ltd is increases by ₹ 1,50,000 i.e., 50,000 x (7-4)

- (iv) Profit increases by 50,000 x (8-4) = ₹ 2,00,000

- (v) Transfer price: ₹

$$\{8 + (8/12)4\} = 10.67$$

$$(-) \text{ profit} = \underline{4.00}$$

$$\underline{6.67}$$

Profit increases by 50000 x 6.67 = ₹ 3,33,500/-

- (vi) Transfer price = 8.50

$$\text{Profit increase by } 4.5 \times 50000 = ₹ 2,25,000$$

Illustration 60:

Division A is a profit centre that produces three products X, Y and Z and each product has an external market.

The relevant data is as:

	X	Y	Z
External market price per unit (₹)	48	46	40
Variable cost of production (division A) (₹)	33	24	28
Labour hours per unit (division A)	3	4	2
Maximum external sales units	800	500	300

Up to 300 units of Y can be transferred to an internal division B.

Division B has also the option of purchasing externally at a price of ₹ 45 per unit.

Determine the transfer price for Y the total labour hours available in division A is:

- (a) 3800 hours
(b) 5600 hours

Solution:

Computation of contribution per labour hour from external sales:

	X	Y	Z
Market price (₹)	48	46	40
Variable cost (₹)	33	24	28
Contribution (₹)	15	22	12
Labour hours required	3	4	2
Contribution per labour hour (₹)	5	5.50	6
Priority	III	II	I

Computation of transfer price when

(a) The capacity is 3800 hours:

Hours required for	Z = 300 x 2	=	600
	Y = 500 x 4	=	2000
	X = 800 x 3	=	<u>2400</u>
			<u>5000</u>

The existing capacity is not sufficient to produce the units to meet the external sales. In order to transfer 300 units of Y, 1200 hours are required in which division A will give up the production of X to this extent.

	₹
Variable cost of Y	24
(+) contribution lost by giving up production of X to the extent of 1200 hours	
= 1200 x 5 = ₹ 6,000	
∴ Opportunity cost per unit = (6000/300)	<u>20</u>
Required transfer price	<u>44</u>



(b) If the capacity is 5600 hours:

Variable cost		24
Contribution lost by giving up X to the extent of 600 hours = 600 x 5 (being opportunity cost)	= 3000	
Opportunity Cost Per unit	= (3000/300)	<u>10</u>
Required transfer price		<u>34</u>

Illustration 61:

Rana manufactures a product by a series of mixing of ingredients. The product is packed in company's made bottles and put into an attractive carton. One division of company manufactures the bottles while another division prepares the mix that does the packing.

The user division obtained the bottle from the bottle manufacturing division. The bottle manufacturing division has obtained the following quotations from an external source for supply of empty bottles.

Volume no of bottles	For 8,00,000 bottles	For 12,00,000 bottles
Total price offer (₹)	14,00,000	20,00,000

The estimated cost is:

Volume no of bottles	For 8,00,000 bottles	For 12,00,000 bottles
Total Cost (₹)	10,40,000	14,40,000

The sales value and the end cost in the mixing/packing division are:

Volume no of bottles	For 8,00,000 bottles	For 12,00,000 bottles
Total sales value (₹)	91,20,000	1,27,80,000
Total Cost ** (₹)	64,80,000	96,80,000

** Excluding cost of bottles

There is a considerable discussion as to the proper transfer price from the bottle division to the marketing division.

The divisional managers salary is an incentive bonus based on profits of the centres.

You are required to show for the given two levels of activity the profitability of the two divisions and the total organisation based on appropriate transfer price determined on the basis of:

- Shared profit related to the cost
- Market price

Solution:

Statement showing Computation of transfer price on the basis of profit shared on cost basis:

Particulars	Output (8,00,000)	Output (12,00,000)
	(₹)	(₹)
Sales	91,20,000	1,27,80,000
Costs:		
Product manufacturing division	64,80,000	96,80,000
Bottle manufacturing division	10,40,000	14,40,000
	75,20,000	1,11,20,000
Profit	16,00,000	16,60,000
Share of bottle manufacturing division	2,21,276	2,14,964
Product manufacturing division	13,78,724	14,45,036
Transfer price	12,61,276	16,54,964
Transfer price per bottle	1.5777	1.379

Profitability on the basis of market price:

Particulars	Output (8,00,000)		Output (12,00,000)	
	(₹)	(₹)	(₹)	(₹)
Bottle manufacturing division				
Sale value		14,00,000		20,00,000
(-)cost		10,40,000		14,40,000
Profit		3,60,000		5,60,000
Product manufacturing division				
Sale value		91,20,000		1,27,80,000
(-)cost of product	64,80,000		96,80,000	
Cost of bottle	14,00,000		20,00,000	
		78,80,000		1,16,80,000
Profit		12,40,000		11,00,000
Total profit		16,00,000		16,60,000
Transfer price		1.75		1.67

Illustration: 62

PH Ltd. manufactures and sells two products, namely BXE and DXE. The company's investment in fixed assets is ₹ 2 lakh. The working capital investment is equivalent to three months' cost of sales of both the products. The fixed capital has been financed by term loan lending institutions at an interest of 11% p.a. Half of the working capital is financed through bank borrowing carrying interest at the rate of 19.4%, the other half of the working capital being generated through internal resources.

The operating data anticipated for 2013-14 is as under:

	Product BXE	Product DXE
Production per annum (in units)	5,000	10,000
Direct Material/unit:		
Material A (Price ₹ 4 per kg)	1 Kg	0.75 Kg
Material B (Price ₹ 2 per kg)	1 Kg	1 Kg
Direct labour hours	5	3



Direct wage rate ₹2 per hour. Factory overheads are recovered at 50% of direct wages. Administrative overheads are recovered at 40% of factory cost. Selling and distribution expenses are ₹2 and ₹3 per unit respectively of BXE and DXE. The company expects to earn an after tax profit of 12% on capital employed. The income tax rate is 50%.

Required:

- (i) Prepare a cost sheet showing the element wise cost, total cost profit and selling price per unit of both the products.
- (ii) Prepare a statement showing the net profit of the company after taxes for the 2013-14.

Solution:

(a) Cost sheet

	BXE		DXE		TOTAL
	UNIT	TOTALS	UNIT	TOTAL	
	₹	₹	₹	₹	₹
Direct material	6	30,000	5	50,000	80,000
Direct wages	10	50,000	6	60,000	1,10,000
Prime cost	16	80,000	11	1,10,000	1,90,000
Factory OHs	5	25,000	3	30,000	55,000
Factory cost	21	1,05,000	14	1,40,000	2,45,000
Office OHs	8.40	42,000	5.60	56,000	98,000
Cost of production	29.40	1,47,000	19.60	1,96,000	3,43,000
Selling & dist. OHs	2.00	10,000	3.00	30,000	40,000
Cost of sales	31.40	1,57,000	22.60	2,26,000	3,83,000
Profit as % on					
Fixed capital		21,818		26,182	48,000
Working capital		9,420		13,560	22,980
Sales/S.P	37.6476	1,88,238	26.5742	2,65,742	4,53,980

Working notes

Return after tax	{[383000 × 0.25] + 2,00,000} 12%	35,490
∴ Sales	3,83,000 + 35,490 × (1/50%)	4,53,980

(b) Statement showing net profit:

Sales		453980
(-) Cost of Sales		(383000)
Gross Profit		70980
(-) Interest	{22000 + (95750/2) 19.4%}	(31288)
Profit Before Tax		39692
(-) Tax @ 50%		(19846)
Profit After Tax		19846

2.5 TREATMENT OF SPECIAL EXPENSES IN COST ACCOUNTS

1. Research and Development Expenses:-

Research cost is defined as the cost of searching for new or improved products, new applications of material, or new or improved methods, process, systems or services. In the modern days, firms spend heavily on research and development. Expenses incurred on research and development is known as Research and Development expenses. Research may be of the following types:

- a) Pure or basic research to gain general know-how regarding the production or market, not directed towards any particular product
- b) Applied research which applies the basic knowledge in practice. i.e improvement of existing products, new process, exploring of new products, improved measures of safety, etc

Development Cost is the cost of the process which begins with the implementation of the decision to use scientific or technical knowledge to produce a new or improved product or to employ a new or improved method, process, system, etc and ends with the commencement of formal production of that product by that method. Development starts where the research ends. Development cost is the expenditure incurred for putting the results of research on a practical commercial basis.

Special features of Research & Development Costs:

- a) Expenditure is incurred ahead of the actual production and may not be charged to current production
- b) The amount of expenditure may often substantial
- c) The expenditure made at times be entirely in fruituous, yielding no tangible results
- d) Benefit of the expenditure may be realized over a number of years
- e) Difficulty in fixation of standards for control

Collection of R&D Expenses:

Accumulation of research and development expenses is essential for the following reasons

- a) For review cost to date
- b) For planning the activities subsequent to research
- c) For evaluation of performance with relation to past performance or for inter-firm comparison

The collection of R&D expenses is made through the following documents. Material requisitions, labour time cards, invoices, vouchers (royalty, patent, license. etc). Research & Development expenditure may be identified by its nature i.e basic or applied research or development by the elements of cost, by business sector, by project. Each Research & Development project is allotted a project work order number. Separate series of work orders or codes should be used to distinguish from regular work orders

- a) All expenditure under the direct elements (direct material, labour and expenses) must be charged to the work orders
- b) Expenses like supervisor salary, material handling charges, maintenance of equipments can be directly allocated to particular research work order
- c) Items of general overheads like depreciation of building, depreciation of maintenance equipment, share of purchase department expenses may be suitable apportioned to the research work order

Accounting of R&D Expenses:

Accounting of research & development cost arise due to the following cause :

- 1) The expenditure is in the nature of pre-production costs and there is a considerable time lag between the incidence and expenditure and realization of benefit.



- 2) There is no immediate production, or the production is so small that it becomes difficult to charge such costs to products

It is because of these difficulties that the accounting of research and development costs has been a subject of some controversy. There methods are available for charging research and development costs

- a) Charging off to the current year profit & loss account.
- b) Capitalization so that cost may be amortized on a long term basis
- c) Deferment and charge-off to costs of the next two or three years a short / medium term amortization

Research and development may be regarded as a function of production and the research & development costs may be charged to costs to be recovered through the general overhead rates. There are many arguments for and against charging the research & development costs in current revenue. The arguments in support of this method are as follows

- a) All research & development expenses may not result in new processes or saleable products.
- b) Some of the research & development projects may result in failures .
- c) These expenses may be incurred simply to maintain the present competitive position of the concern .
- d) It is difficult to assess the period over which the know-how or knowledge acquired may be spread over .
- e) It may be more advantageous to recover a substantial portion of the cost immediately, as the life of the new products is uncertain .
- f) In certain cases, the effect of these research costs on future revenues may be doubtful.

2. Preliminary Expenses:

A new entity may have incurred some expense on bringing the firm into existence, in pilot production or trail run and also in test marketing. These are preliminary expenses. Preliminary expenses on formation also comprise the legal fees, expenses on preparation of documents and other such legalities. The expenses should be treated as deferred revenue expense and should be amortized as administrative overheads over a period of time. One may even consider not treating an expense as cost, because it may make the product less competitive in the market. Initial cost of product is any way higher due to heavy depreciation charge and low capacity utilisation. However, if a firm is promoted as an ancillary unit, it may have legitimate right to treat preliminary expenses as an administrative cost and thereby to charge the expenses to product produced.

Setting up of a plant may also see some expenses. Expenses incurred during the trial runs are one of them. These expenses can be treated as deferred revenue expenses and can be written off as factory overheads over a period. The cost of test marketing can be treated similarly.

3. Rectification Cost: In the course of manufacturing/process, there is likely to be some defective which can be rectified or brought upto the standard by incurring some extra material, labour and overheads. The cost is booked under 'Cost on rectification of defectives or re-processing cost'. The defectives should be classified under (i) normal (ii) abnormal for the purpose of control and treated as :

- (i) Normal defectives - Rectification cost may be treated as part of the product cost if this is identifiable with any specific product or process, otherwise this may be treated as manufacturing overhead.
- (ii) Abnormal defectives - Such defectives should not normally have arisen and therefore, rectification cost is not to be charged in cost accounts but debit to profit and loss account.

4. **Obsolescence:**

- (a) Obsolescence of Fixed Assets.
- (b) Obsolescence of Inventory.

(a) Obsolescence of Fixed Assets:

Obsolescence represents the loss arising as a result of having to discard an asset due to its supersession in favor of a more productive asset at an earlier date than planned/contemplated. It is sometimes called "external depreciation" because the existing asset is replaced by a new asset on account of invention/innovation.

The loss due to obsolescence to fixed assets may be dealt with in the following manner:

- In industries which are vulnerable to the risks of obsolescence, e.g., electronics, it is somewhat predictable that obsolescence will take place with certain frequency. In such case, higher rates of depreciation may be charged to take care of such obsolescence.
- For industries which are not vulnerable to frequent obsolescence it is prudent to create a reserve fund to take care of such eventualities.
- For other industries bearing a remote possibility of obsolescence in the event of obsolescence taking place, loss is to be written off to profit and loss account.

(b) Obsolescence of Inventory:

Obsolete inventory may consist of raw materials, stores of finished goods. In either case, the write off is made direct to profit and loss account or no charge is made to cost of production.

5. **Waste:**

Definition : This is the residue such as smoke, dust, gases, slag, etc., which arises in course of manufacturing process and practically has no measurable sale or utility value. In certain types of processes and operations, some material physically disappears on account of shrinkage, evaporation etc., with the result that the quantity of the output is less than the input. Such wastage is termed invisible waste where the residue instead of fetching any value, creates a problem for its disposal which entails further costs. Special arrangements have to be made for disposal and refuse, effluent, obnoxious gases, etc.

Accounting: As waste has practically no value, its accounting is relatively simple. The effect of the waste is to reduce the quantity of output; in order to arrive at the unit cost of the process, operation, or job, the total cost of the process, etc., is distributed over the reduced output, i.e., the units of good production only. The cost of abnormal waste, should, however, be excluded from the total cost and charged to the profit and loss account.

The actual waste is observed against standards and periodically reported to the management.

6. **Scrap:**

This is also in the form of incidental material residue coming out of certain types of manufacturing processes but it is usually in small amounts and has low measurable utility or market value, recoverable without further processing. Numerous examples of scrap may be given; scrap may arise in the form of turnings, borings, trimmings, filings, shavings etc., from metals on which machine operations are carried out; saw dust and trimmings in the timber industry; dead heads and bottom ends in foundries; and cuttings, pieces, and split in leather industries. Scrap should always be physically available unlike waste which may or may not be present in the form of a residue.

Accounting treatment of scrap is as follows:



a. Sales Credited to Revenue:

In this method, the scrap is not cost and its value does not, therefore, appear separately in the cost accounts. Only a quantitative record of the scrap returned to storeroom from the shops is maintained and the sale value realised from time to time is credited to the profit and loss account as miscellaneous revenue.

b. Credit to Overhead:

In this method and in the following method the scrap is assigned a cost. The cost is usually the sale value of the scrap less selling and distribution costs. If the scrap has no ready market but has only utility or use value, and is taken as a credit to manufacturing overhead. The effect of this credit is to reduce the overhead recovery rate. When predetermined overhead rates are in use, it is more expedient to credit an estimated allowance for the scrap instead of the amount of actual scrap.

c. Credit to Jobs:

The scrap is assigned a cost and is traced to the job which yielded the scrap. This affords a reasonable amount of credit to the jobs and widely different.

d. Transfer to Other Jobs:

Scrap arising in one job may be issued for utilisation in another job. Such transfers of scrap from one job to another should be affected through material transfer notes. Alternatively, scrap may be returned to store room and subsequently issued to another job for utilisation. The latter method is more appropriate when some further processing is required on the scrap before it can be utilised for other jobs.

Control of Scrap:

Scrap is also an unavoidable residue material arising in the process of manufacture. The basic difference between scrap and waste is that while waste may not have any value, scrap must necessarily have a value, though a comparatively small one. Scrap may be sold or re-used in some process. In some industries, arising of scraps of various types in significant quantities is a regular feature and in such cases, it would be worth while having a proper administrative set-up for control of scrap. A Scrap survey Committee may be constituted which would be responsible for such matters as (1) classifying the various types of scrap. (2) Assessing the quantum of each and (3) Deciding upon the manner of their use or disposal.

Control of scrap should start from the designing stage of the products. At the designing stage, the type, shape and form of materials which all result in the minimum of waste or the least quantity of scrap in manufacturing process are decided. The quantity of scrap resulting from a process also depends upon the manufacturing equipment used and the efficiency of the operative who performs the work. In order to minimise scrap, production should be planned that the best possible equipment is used and properly trained personnel are employed on the job

7. Spoilage:

Definition:

When production does not come up to the standard specifications or quality it has to be rejected outright. The components or materials are so damaged in the manufacturing process that they cannot be brought back to the normal specifications by repairs or reconditioning. Some spoiled work may be sold as seconds but in most cases, the entire production is sold for small value in the form of scrap or treated as waste if it has no market value. Spoilage involves not only loss of

materials but also of labour and manufacturing overhead incurred up to the stage when the spoilage incurred.

Accounting and Control of Spoilage:

Spoilage arises when the production output is damaged in such a manner and to such an extent that it cannot be used for the original purpose for which it was designed but is to be disposed off in some suitable manner without further processing. The distinction between scrap and spoiled work is that while normal scrap arises mostly as a result of the processing of materials, spoilage occurs due to some defect in operations or materials which may or may not be inherent in the manufacturing process or operation. Further, scrap has always a relatively low but some definite value, but the value of spoilage may range from nought, if it is a waste, to comparatively high values if the spoilage is to be sold as seconds. Spoilage involves not only the loss of material but also labour and manufacturing overheads.

Spoilage may create two types of situations; the entire production output in a batch may be rejected as spoiled or only a part may be rejected and the rest passed as good production. The former situation may sometimes arise in certain process types of industries and the latter mainly in job types where one production order or a batch of production may consist of a number of units of a product. The manner of disposal of spoiled production depends upon the nature and extent of spoilage; while some of the spoiled work may be sold at a reduced price as seconds, the rest may have either a scrap value or may be treated only as waste.

The accounting of spoilage involves three steps:

- a. Ascertainment of the cost of spoilage;
- b. Apportionment of the cost to normal and abnormal spoilage, and
- c. Treatment of the two types of spoilage costs in accounts.

When spoilage is total, i.e. all the units of output are lost, the cost of spoilage is equal to the total cost of material, labour and overhead incurred upto the spoilage stage less the salvage value. In case of partial spoilage, the total costs should be prorated to good and rejected units of production.

Normal and Abnormal Spoilage:

The normal spoilage is treated as normal loss. The scrap value if any realized from this is credited to the product or job and the remaining loss of cost is recovered on good units. The cost of abnormal spoilage is transferred to the abnormal loss account and after crediting any scrap value in that account, the remaining balance is transferred to the Costing Profit and Loss A/c.

The following table shows the conceptual difference of waste, scrap and spoilage.

Waste	Scrap	Spoilage
It represents that portion of basic raw material which is lost in processing. It can be visible or invisible. It does not normally have a recoverable value.	Scrap is incidental residue to certain type of manufacturing activities. It usually has low value, which is recoverable without further processing. Scrap also represents loss of basic raw material, which is consequential residue of some type of manufacturing activities. It is always visible and it always fetches some value.	It represents loss of defective production, which cannot be finished. Spoilage can be made to realize some value after application of some more material, labour or overhead. This spoilage represents loss of material, labour and overhead on production, which cannot be brought to finished stage. By application of more material, labour and overhead, it can be made to fetch some value.



8. Accounting and control of Defectives:

Like spoilage, defective work arises when manufacture is not up to the required specification and quality. The main difference between the two is that spoilage cannot be retrieved and is to be sold as it is, but defective work can be reworked and transformed, either back into standard production or as seconds. The problem of accounting of defective work is thus a problem of rework or rectification costs.

Rectification of defective work may be undertaken by the shop in which the work was originally done. In big concerns where the number of such rectifications is large, a separate Salvage Department may be set up for the reworking of all types of defective work. It is assumed that rectification costs would not be heavy and only some minor rectifications should set right the defective work. Before rectification work is taken up, it should be seen whether the estimated cost of rectification would be commensurate with the value obtained and whether the rectification would be more profitable than any other choice available.

When it is decided to rectify the defective work, the rectification is undertaken on Salvage or Rectification Work Order and all costs of re-work under material, labour and overhead are collected against this work order. If the defective production is inherent in the process of manufacture, arising as a normal consequence of productive activity and if it can be identified with specific jobs, the rectification cost is charged to the jobs as cost of manufacturing good units of products. This will have the effect of adding to the cost of the jobs. If the expenditure on rectification is considered abnormal, it is excluded from product costs and charged to the Profit and Loss Account or the Costing Profit and Loss Account, as the case may be.

For the purpose of control of defective work, performance standard is set as in the case of spoilage. The manufacturing operations are examined carefully and the abnormal quantity, i.e., the minimum possible quantity of defective work likely to arise in each process, operation, or job is estimated. The actual quantity of defective work is compared with the predetermined normal and any excess, i.e. the abnormal defective work is highlighted through suitable reports and charts. Reports on defective works should show the reasons for the excess defective work and should be prepared for each department for proper fixation of responsibility. The reports may also be made out separately for each individual job or production order in which case the details of material, labour and overhead costs up to the point or stage of rejection, may also be shown.

In many manufacturing processes, inefficient and bad workmanship are the main reasons for high percentage of defective work. Control of such cases of defective work may be more effectively exercised by providing suitable incentives to the workers for minimizing defective work. Incentives which may be either financial or non-financial are based on the quantity or percentage of reduction in defective work.

2.6 INTEGRATION OF STANDARD COSTING WITH MARGINAL COST ACCOUNTING, ABSORPTION COST ACCOUNTING AND THROUGHPUT ACCOUNTING

The following table provides a cursory glance related to classification and treatment of elements of cost under different methods of costing.

Particulars	Standard Costing	Marginal Costing	Absorption Costing	Throughput Costing
Treatment of Variable Cost				
Variable material cost – whether considered in inventory valuation	Yes	Yes	Yes	Yes
Variable labour cost – whether considered in inventory valuation	Yes	Yes	Yes	No
Variable overhead cost – whether considered in inventory valuation	Yes	Yes	Yes	No
Treatment of Fixed Cost				
Fixed material cost – whether considered in inventory valuation	Yes	No	Yes	No
Fixed labour cost – whether considered in inventory valuation	Yes	No	Yes	No
Fixed overhead cost – whether considered in inventory valuation	Yes	No	Yes	No
Fixed manufacturing cost – whether considered in inventory valuation	Yes	No	Yes	No
Effect on Total Income				
Production variance is found	Yes	No	Yes	No
Income is driven by	Unit level of production as well as sales	Unit level of sales	Unit level of production as well as sales	Unit level of sales
Classification of variable and fixed cost is made	No	Yes	Infrequently	Yes
Other factors				
Format used	No specific format	Contribution margin format	Gross-margin format	Contribution margin format

However, there may be a Reconciliation statement between:

- (1) Throughput Costing – Marginal Costing - Absorption Costing
- (2) Throughput Costing to Marginal Costing
- (3) Absorption Costing to Marginal Costing
- (4) Standard Costing to Absorption Costing



An analysis of the process is stated hereunder:

(1) Throughput Costing – Marginal Costing - Absorption Costing

Particulars	Amount(Rs.)
Sales	XX
Less: Direct Material	XX
Throughput Contribution	XX
Less: Direct and Other Manufacturing Expenses	XX
Contribution (as per Marginal Costing)	XX
Less: Fixed Cost	XX
Profit (as per Absorption Costing)	XX

(2) Issues for consideration -

(a) Comparison of Alternative Inventory Costing Systems - Variable Direct Manufacturing Cost

Actual Costing	Normal Costing	Standard Costing
Actual prices X Actual quantity of inputs used	Actual prices X Actual quantity of inputs used	Standard prices X Standard quantity of inputs allowed for actual output achieved

(b) Variable Indirect Manufacturing Cost

Actual Costing	Normal Costing	Standard Costing
Actual variable indirect rates X Actual quantity of cost- allocation bases used	Budgeted variable indirect rates X Actual quantity of cost- allocation bases used	Standard variable indirect rates X Standard quantity of cost- allocation bases allowed for actual output achieved

(c) Fixed Direct Manufacturing Cost

Actual Costing	Normal Costing	Standard Costing
Actual prices X Actual quantity of inputs used	Actual prices X Actual quantity of inputs used	Standard prices X Standard quantity of inputs allowed for actual output achieved

(d) Fixed Indirect Manufacturing Cost

Actual Costing	Normal Costing	Standard Costing
Actual fixed indirect rates X Actual quantity of cost-allocation bases used	Budgeted fixed indirect rates X Actual quantity of cost-allocation bases used	Standard fixed indirect rates X Standard quantity of cost-allocation bases allowed for actual output achieved

(e) Costing Systems Compared

		Actual Costing	Normal Costing	Standard Costing	
Absorption Costing	Variable Costing	Variable Direct Manufacturing Cost	Actual prices × Actual quantity of inputs used	Actual prices × Actual quantity of inputs used	Standard prices × Standard quantity of inputs allowed for actual output achieved
		Variable Manufacturing Overhead Costs	Actual variable overhead rates × Actual quantity of cost-allocation bases used	Budgeted variable overhead rates × Actual quantity of cost-allocation bases used	Standard variable overhead rates × Standard quantity of cost-allocation bases allowed for actual output achieved
	Fixed Direct Manufacturing Costs	Actual prices × Actual quantity of inputs used	Actual prices × Actual quantity of inputs used	Standard prices × Standard quantity of inputs allowed for actual output achieved	
	Fixed Manufacturing Overhead Costs	Actual fixed overhead rates × Actual quantity of cost-allocation bases used	Budgeted fixed overhead rates × Actual quantity of cost-allocation bases used	Standard fixed overhead rates × Standard quantity of cost-allocation bases allowed for actual output achieved	

Study Note - 3

BUDGETING AND BUDGETARY CONTROL



This Study Note Includes

3.1 Budgeting

3.2 Budgetary Control

3.1 BUDGETING

The literary meaning of the word Budget is a statement of income and expenditure of a certain period. In principle, the meaning is same in the context of business also. An individual will have his own budget, a family, a local authority, state and country etc. All will have their respective budgets. So also the business concern must have its budget so as to attain their objectives.

CIMA defines a budget as, "A budget is a financial and/or quantitative statement, prepared prior to a defined period of time, of the policy to be pursued during that period for the purpose of attaining a given objective."

3.1.1 Features of Budget

An analysis of the above definition reveals the following as features of the budget.

- (i) A Budget must be expressed either in quantitative form i.e., the number of units of different products or it may be expressed in rupees of each product or it may be quantitative and financial form i.e., the number of units and rupees of each product etc.,
- (ii) It must be prepared before the time for which it is required, for example, if budget is required for the year 2013-14, it must be prepared in the year 2012-13.
- (iii) Budget must be prepared for a definite period.
- (iv) Budget must be prepared in accordance with the policies of the business enterprise.
- (v) Budgets are prepared normally for attaining organisational objectives, because policies are formulated to achieve the objectives and those are translated into quantitative and financial form.

3.1.2 Objectives of the Budget:

- (i) A budget is a blue print for the desired plan of action. Since budgets are prepared in accordance with the policies of various functions of the organisation such as purchase, production sales etc., these will be helpful as plan of action to discharge the above functions.
- (ii) Budgets are useful for forecasting the operating activities and financial position of a business enterprise.
- (iii) Budgets are helpful in establishing divisional and departmental responsibilities.
- (iv) Budgets provide a means of coordination for the business as a whole. When the budgets are established various factors such as production capacity, sales responsibilities, procurement of material, deployment of labour etc., are balanced and synchronised so that all the activities are processed according to the objective. Thereby Budgets are very much useful in coordination of factors and functions.
- (v) Budget ensures good business practice because they plan for future.
- (vi) Budgets are means of communication. The complex plans that are laid down by the top management are to be passed on to the operative personnel, those who actually put the plans into action. Budgets are very much helpful in processing such information to the lowest personnel in the organisation.
- (vii) Budgets are devised to obtain more economical use of capital and all other inputs.
- (viii) Budgets are more definite assurance of earning of the proper return on capital invested.

- (ix) Budgets facilitate centralised control with delegated responsibilities and authorities. Budgets are instruments of managerial control by means of which the management can measure the performances in every part of the business concerns and corrective action can be taken soon after deviations are found out.

3.1.3 Limitations of Budgets:

(i) Budgets fail if estimates are not accurate:

Budgets mainly depend upon the accuracy of the estimates. So estimates should be made on the basis of all the information available. Though forecasting is not an exact science, accurate estimates can be made by using advanced statistical techniques. Thus preparation of budgets involves certain amount of judgment and proper interpretation of reports.

(ii) Risk of Rigidity:

Budgeting process creates a sense of rigidity in the minds of people who are working in the organisation. But in the modern business world, which is more dynamic in nature, such rigidity will create problems. Therefore budgeting process should also be dynamic in nature, so that it can be updated according to the situation.

(iii) Budgeting is an expensive process:

The installation and implementation of the budgeting process involves too much time and costs. Therefore small organisations can not afford to it. Even for large organisations cost benefit analysis should be conducted before installing such a system. It can be adopted only if the benefits exceed the costs.

(iv) Budgeting is not a substitute for management:

Budgeting is only a tool for management. Installation of Budgeting system does not relieve the managers from their duties. It involves only in effective management of the resources of the organisation. It is only a misconception to think that the introduction of budgeting is alone sufficient to ensure success and to guarantee future profits. It is only a means for achieving the end.

(v) Continuous monitoring is required:

Installation of budgeting system does not imply that it is effectively implemented. Management must continuously monitor the operating system (whether the goals intended) how far the plans and budgets are helpful in achieving the goals of the organisation.

3.1.4 Classification of Budgets:

(A) On the basis of time:

- (i) **Long term budget:** Though there is no exact definition of long term budget, yet we can say that a budget prepared covering a period of more than a year can be taken as long term budget. Of course, it may be for 3 years, 5 years, 10 years and even 20 years etc.,
- (ii) **Short term budget:** It is a budget prepared for a period covering a year or less than a year.

(B) On the basis nature of expenditure and receipts:

- (i) **Capital Budget:** It is a budget prepared for capital receipts and expenditure such as obtaining loans, issue of shares, purchase of assets, etc.,
- (ii) **Revenue Budget:** A Budget covering revenue receipts and expenses for a certain period is called Revenue Budget. Examples: Sales, other incomes, purchases, administrative expenses etc.,

(C) On the basis of functions:

Functional Budget: If budgets are prepared of a business concern for a certain period taking each and every function separately such budgets are called functional budgets. Example: Production, Sales, purchases, cost of production, cash, materials etc.



The following are the various functional budgets, some of which are briefly explained here under:

- (i) Sales Budget:** The sales budget is a forecast of total sales, expressed in terms of money or quantity or both. The first step in the preparation of the sales budget is to forecast as accurately as possible, the sales anticipated during the budget period. Sales forecasts are usually prepared by the sales manager assisted by the market research personnel.

Factors to be considered in preparing Sales Budget:-

As business existence depends upon the sales it is going to make and therefore it is an important one to be prepared meticulously. It is the forecast of what it can reasonably sell to its customers during the period for which budget is prepared. The company's profit mostly depends upon the ability to sell its products to customers. In the present era it is indispensable to establish the demand for the product even before it is produced. It is the sales order book that the company's continuity depends upon. Also, a reasonable degree of accuracy must be there in preparing a sales budget unless its sales are accurately forecast, production estimates will also become erroneous. A good amount of experience must be necessary to prepare the sales budget. Yet the following factors must be considered in preparing the sales budget:

- (a) The locality of the market i.e., domestic or export
- (b) The target customers i.e., industry or trade or a section or group of general public etc.,
- (c) The product portfolio i.e., the number of products offered and their popularity among the target customers.
- (d) The market share of each product and its influence on the product portfolio and the total market
- (e) The effectiveness of existing marketing policy on the current sales volume and value.
- (f) The market share of competitor's products and their effect on the company's sales.
- (g) Seasonal fluctuation in sales.
- (h) Expenditure on advertisement and its impact on sales.

- (ii) Production Budget:** The production budget is a forecast of the production for the budget period. Production budget is prepared in two parts, viz. production volume budget for the physical units of the products to be manufactured and the cost of production or manufacturing budget detailing the budgeted cost under material, labour, and factory overhead in respect of the products.

Factors to be considered in Production Budget:

Next to the sales budget, the main function of a business concern is the production and for this, a budget is prepared simultaneously with the sales budget. It is the forecast of production during the period for which the budget is prepared. It can also be prepared in two parts viz., production volume budget for the physical units i.e., the number of units, the tonnes of production etc., and the cost of production or manufacture showing details of all elements of the manufacture. While preparing the production budget, the following factors must be taken into consideration:-

(a) Production plan:-

Production planning is an important part of the preparation of the production budget. Optimum utilisation of plant capacity is taken by eliminating or reducing the limiting factors and thereby effective production planning is made.

(b) The capacity of the business concern:-

It is to be ensured that the capacity of the organisation will coincide the budgeted production or not. For this purpose, plant utilisation budget will also be necessary. The production budget must be based on normal capacity likely to be achieved and it should not be too high or too low.

(c) Inventory Policy:-

While preparing the production budget it is also necessary to see to what extent materials are available for producing the budgeted production. For that purpose, a purchase budget or a purchase plan must also be studied. Similarly, on the other hand, it is also necessary to verify the extent to which the inventory of finished goods is to be carried.

- (d)** Sales budgets must also be considered before preparing production budget because it may so happen that the entire production of the concern may not be sold. In such a case the production budget must be in line with the sales budget.
- (e)** A plan of the sequence of operations of production for effective preparation of a production budget should always be there.
- (f)** Last, but not the least, the policy of the management should also be considered before preparing the production budget.

Objectives and Advantages of Production budget:

- Optimum utilisation of the productive resources of the organisation;
 - Maintaining low inventory which results in risk of deterioration and fall in prices;
 - Focus on the factors that are necessary to frame policies and plan sequence of operations;
 - Projection of policies framed, on the basis of past performance, into the future to get the desired results;
 - To see that right materials are provided at right place and at right time;
 - Helps in scheduling of production so that delivery dates are met and customer satisfaction is gained;
 - Helpful in preparation of projected profit and loss statement, which is useful in evaluation of performance and profitability.
- (iii) Materials Budget:** The material budget includes quantities of direct materials; the quantities of each raw material needed for each finished product in the budget period is specified. The input data for this budget is obtained by applying standard material usage rates by each type of material to the volume of output budgeted.
- (iv) Purchase Budget:** The purchase budget establishes the quantity and value of the various items of materials to be purchased for delivery at specified points of time during the budget period taking into account the production schedule of the concern and the inventory requirements. It takes into account the requirements for the entire budget plan as per the sales, materials, maintenance, research and development, and capital budgets. Purchases may be required to be made in respect of direct and indirect materials, finished goods for resale, components and parts, and purchased services. Before incorporation in the purchase budget, these purchase requirements should be suitably ascertained. Purchase budget also includes material procurement budget.
- (v) Cash Budget:** Cash Budget is estimated receipts and expenses for a definite period, which usually are cash sales, collection from debtors and other receipts and expenses and payment to suppliers, payment of wages, payment of other expenses etc.
- (vi)** Direct Labour Budget.
- (vii)** Human Resources Budget.
- (viii)** Selling and Distribution cost budget.
- (ix)** Administration Cost Budget.
- (x)** Research and Development Cost Budget etc.



Master Budget: Master budget is the budget prepared to cover all the functions of the business organisation. It can be taken as the integrated budget of business concern, that means, it shows the profit or loss and financial position of the business concern such as Budgeted Profit and Loss Account, Budgeted Balance Sheet etc. Master budget, also known as summary budget or finalized profit plan, combines all the budgets for a period into one harmonious unit and thus, it shows the overall budget plan. The master budget incorporates all the subsidiary functional budgets and the budgeted Profit and Loss Account and Balance Sheet. Before the budget plan is put into operation, the master budget is considered by the top management and revised if the position of profit disclosed therein is not found to be satisfactory. After suitable revision is made, the master budget is finally approved and put into action. Another view regards the budgeted Profit and Loss Account and the Balance Sheet as the master budget.

(D) On the basis of capacity:

(i) Fixed or Rigid budget: When budgets are prepared for a fixed or standard volume of activity, they are called static or rigid or fixed budgets. They do not change with the changes in the volume of the output. These are prepared normally 3 months in advance of the year. However these will not be much helpful in comparing the actual activity, as these are prepared at a fixed volume of output. It, however, does not mean that the fixed budget is a rigid one, not to be changed at all. Though not adjusted to the actual volume attained, a fixed budget is liable to revision if due to business conditions undergoing a basic change or due to other reasons, actual operations differ widely from those planned in the fixed budget.

Fixed budgets are most suited for fixed expenses. In case of discretionary costs situations where the expenditure is optional and has no relation with the output, e.g. expenditure on research and development, advertising, and new projects. A fixed budget has only a limited application and is ineffective as a tool for cost control. Fixed budgets are useful where the plan permits maximum stabilization of production, as for example, for concerns which manufacture to build up inventories of finished products and components.

(ii) Flexible Budget: A flexible budget is a budget that is prepared for different levels of activity or capacity utilization or volume of output. If the budgets are prepared in such a way so as to change in accordance with the volume of output, they are called flexible budgets. These can be prepared from fixed budget which are also called revised budgets. These are much helpful in comparison with actual because the exact deviations are found for which timely corrective action can be taken. The basic idea of a flexible budget is that there shall be some standard of cost and expenditures. Thus, a budget prepared in a manner to give budgeted costs for any level of activity is known as flexible budget. Such budget is prepared after considering the variable and fixed elements of costs and the changes, which may be expected for each item at various levels of operations. Thus a flexible budget recognises the difference in behaviour between fixed and variable costs in relation to fluctuations in production or sales and is designed to change appropriately with such fluctuations. In flexible budget, data relating to costs, expenditures may progressively be changed in any month in accordance with actual output achieved. While preparing flexible budgets, estimates of costs and expenditures on the basis of standards determined are made from minimum to maximum level of operations.

Difference between Fixed and Flexible Budgets:

	Fixed Budget	Flexible Budget
(i)	It does not change with actual volume of activity achieved. Thus it is known as rigid or inflexible budget.	It can be recasted on the basis of activity level to be achieved. Thus it is not rigid.
(ii)	It operates on one level of activity and under one set of conditions. It assumes that there will be no change in the prevailing conditions, which is unrealistic.	It consists of various budgets for different levels of activity.

(iii)	Here as all costs like – fixed, variable and semi-variable are related to only one level of activity so variance analysis does not give useful information.	Here analysis of variance provides useful information as each cost is analysed according to its behaviour.
(iv)	If the budgeted and actual activity levels differ significantly, then the aspects like cost ascertainment and price fixation do not give a correct picture.	Flexible budgeting at different levels of activity facilitates the ascertainment of cost, fixation of selling price and tendering of quotations.
(v)	Comparison of actual performance with budgeted targets will be meaningless specially when there is a difference between the two activity levels.	It provides a meaningful basis of comparison of the actual performance with the budgeted targets.

3.1.5 Principal Budget Factor:

Budgets cover all the functional areas of the organisation. For the effective implementation of the budgetary system, all the functional areas are to be considered which are interlinked. Because of these interlinks, certain factors have the ability to affect all other budgets. Such factor is known as principle budget factor.

Principal Budget factor is the factor the extent of influence of which must first be assessed in order to ensure that the functional budgets are reasonably capable of fulfillment. A principal budget factor may be lack of demand, scarcity of raw material, non-availability of skilled labour, inadequate working capital etc. If for example, the organisation has the capacity to produce 2500 units per annum. But the production department is able to produce only 1800 units due to non-availability of raw materials. In this case, non-availability of raw materials is the principal budget factor (limiting factor). If the sales manger estimates that he can sell only 1500 units due to lack of demand. Then lack of demand is the principal budget factor. This concept is also known as key factor, or governing factor. This factor highlights the constraints with in which the organisation functions.

3.1.6 Responsibility Accounting:

One of the recent developments in the field of management accounting is the responsibility accounting, which is helpful in exercising cost control. 'Responsibility Accounting is a system of accounting that recognizes various responsibility centers throughout the organization and reflects the plans and actions of each of these centers by assigning particular revenues and costs to the one having the pertinent responsibility. It is also called profitability accounting and activity accounting.

It is a system in which the person holding the supervisory posts as president, function head, foreman, etc are given a report showing the performance of the company or department or section as the case may be. The report will show the data relating to operational results of the area and the items of which he is responsible for control. Responsibility accounting follows the basic principles of any system of cost control like budgetary control and standard costing. It differs only in the sense that it lays emphasis on human beings and fixes responsibilities for individuals. It is based on the belief that control can be exercised by human beings, so responsibilities should be fixed for individuals.

Principles of responsibility accounting are as follows:

- (a) A target is fixed for each department or responsibility center.
- (b) Actual performance is compared with the target.
- (c) The variances from plan are analysed so as to fix the responsibility.
- (d) Corrective action is taken by higher management and is communicated.

3.1.7 Performance Budgeting:

Performance Budgeting is synonymous with Responsibility Accounting which means thus the responsibility of various levels of management is predetermined in terms of output or result keeping in view the authority vested with them. The main concepts of such a system are enumerated below:



- (a) It is based on a classification of managerial level for the purpose of establishing a budget for each level. The individual in charge of that level should be made responsible and held accountable for its performance over a given period of time.
- (b) The starting point of the performance budgeting system rests with the organisation chart in which the spheres of jurisdiction have been determined. Authority leads to the responsibility for certain costs and expenses which are forecast or present in the budget with the knowledge of the manager concerned.
- (c) The costs in each individual's or department's budget should be limited to the cost controllable by him.
- (d) The person concerned should have the authority to bear the responsibility.

3.1.8 Zero Based Budgeting (ZBB) : It differs from the conventional system of budgeting mainly it starts from scratch or zero and not on the basis of trends or historical levels of expenditure. In the customary budgeting system, the last year's figures are accepted as they are, or cut back or increases are granted. Zero based budgeting on the other hand, starts with the premise that the budget for next period is zero so long the demand for a function, process, project or activity is not justified for each rupee from the first rupee spent. The assumptions are that without such a justification no spending will be allowed. The burden of proof thus shifts to each manager to justify why the money should be spent at all and to indicate what would happen if the proposed activity is not carried out and no money is spent.

The first step in the process of zero base budgeting is to develop an operational plan or decision package. A decision package identifies and describes a particular activity with a view to:

- (i) evaluate and allotte ranking the activity against other activities competing for the same scarce resources, and
- (ii) decide whether to accept or reject or amend the activity.

For this purpose, each package should give details of costs, returns, purpose, expected results, the alternatives available and a statement of the consequences if the activity is reduced or not performed at all.

The advantages of Zero based budgeting are:

- (a) Out of date and inefficient operations are identified.
- (b) Allows managers to promptly respond to changes in the business environment.
- (c) Instead of accepting the current practice, it creates a challenging and questioning attitude.
- (d) Allocation of resources is made according to needs and the benefits derived.
- (e) It has a psychological impact on all levels of management which makes each manager to 'pay his way'.

3.2 BUDGETARY CONTROL

Budgetary control is defined as "the establishment of budgets relating the responsibilities of executives to the requirements of a policy and the continuous comparison of actual with budgeted results, either to secure by individual action the objective of that policy or to provide a basis for its revision."

From the above definition, the steps for Budgetary Control can be drawn as follows: -

(i) Establishment of Budgets:

Budgetary control primarily aims at preparation of various budgets such as sales Budget, production budget, overhead expenses budget, cash budget etc.,

(ii) Responsibilities of executives:

The budgetary control system is designed to fix responsibilities on executives through preparation of budgets.

(iii) Policy making:

The established policies of the organisation are designed as budgets so as to fix responsibility on executives.

(iv) Comparison of actuals with budgets:

After establishing the budgets, the actuals are compared with them and any deviations, if any are called variances.

(v) Achieving the desired result:

The desired result of the budgetary control system is comparison of actuals with the budgeted results and the causes of variances, if any, are analysed.

(vi) Reporting to Top Management:

After the causes of Variances are analysed, the variances and their causes are reported to top management so that the remedial action can be taken.

3.2.1 Advantages of Budgetary Control:

- (i) Budgetary control aims at maximisation of profits through optimum utilisation of resources.
- (ii) It is a technique for continuous monitoring of policies and objectives of the organisation.
- (iii) It helps in reducing the costs, thereby helps in better utilisation of funds of the organisation.
- (iv) All the departments of the organisation are closely coordinated through establishment of plans resulting in smooth functioning of the organisation.
- (v) Since budgets fix the responsibilities of the executives, they act as a plan of action for them there by reducing some of their work.
- (vi) It facilitates analysis of variances, thereby identifying the areas where deficiencies occur and proper remedial action can be taken.
- (vii) It facilitates the management by exception.
- (viii) Budgets act as a motivating force to achieve the desired objective of the organisation.
- (ix) It assists delegation of authority and is a powerful tool of responsibility accounting.
- (x) It helps in stabilizing the conditions in industries which face seasonal fluctuations.
- (xi) It helps as a basis for internal audit.
- (xii) It provides a suitable basis for introducing the payment by results system.
- (xiii) It ensures adequacy of working capital to the organisation.
- (xiv) It aids in performance analysis and performance reporting system.
- (xv) It aids in obtaining bank credit.
- (xvi) Budgets are forerunners of standard costs in the sense that they create necessary conditions to suit setting up of standard costs.

3.2.2 Preliminaries for the Adoption of a System of Budgetary Control:

For the successful implementation of a system of budgetary control certain pre-requisites are to be fulfilled. These are enumerated below:

- (i) There should be an organization chart laying out in clear terms the responsibilities and duties of each level of executives, and the delegation of authority to the various levels. For complete success, a solid foundation in this regard should be laid at the outset.



- (ii) The objectives, plans and policies of the business should be defined in clear cut and unambiguous terms.
- (iii) The output level for which budgets are fixed, i.e., the budgeted output, should be stated.
- (iv) The particular budget factor which will be the starting point of the preparation of the various budgets should be indicated.
- (v) There should be an efficient system of accounting to record and provide data in line with the budgetary control system.
- (vi) For the establishment and efficient execution of the plan, a Budget Committee should be set up.
- (vii) There should be a proper system of communication and reporting between the various levels of management.
- (viii) There should be a charter of programme. This is usually in the form of a budget manual.
- (ix) The budgets should primarily be prepared by those who are responsible for performance.
- (x) The budgets should be complete, continuous and realistic.
- (xi) There should be an assurance from the top management executives of co-operation and acceptance of the budgetary system.

Illustration 1:

Prepare a Production Budget for three months ending March 31, 2013 for a factory producing four products, on the basis of the following information.

Type of Product	Estimated Stock on Jan. 1, 2013	Estimated Sales during Jan. To Mar. 2013	Desired closing stock on 31.3.2013
A	2,000	10,000	3,000
B	3,000	15,000	5,000
C	4,000	13,000	3,000
D	3,000	12,000	2,000

Solution:

Production Budget for the 3 Months Ending 31st March 2013

Particulars	Product A	Product B	Product C	Product D
Sales	10,000	15,000	13,000	12,000
Add: Closing Stock	3,000	5,000	3,000	2,000
	13,000	20,000	16,000	14,000
Less: Opening Stock	2,000	3,000	4,000	3,000
Production (Units)	11,000	17,000	12,000	11,000

Illustration 2:

Budgeted production and production costs for the year ending 31st December are as follows:

	PRODUCT- X	PRODUCT -Y
Production (units)	2,20,000	2,40,000
Direct material/unit	₹ 12.5	₹19.0
Direct wages/unit	₹ 4.5	₹7.0
Total factory overheads for each type of product (variable)	₹ 6,60,000	₹9,60,000

A company is manufacturing two products X and Y. A forecast about the number of units to be sold in the first seven months is given below:

MONTH	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY
Product – X	10,000	12,000	16,000	20,000	24,000	24,000	20,000
Y	28,000	28,000	24,000	20,000	16,000	16,000	18,000

It is anticipated that:

- (a) There will be no work-in-progress at the end of any month.
- (b) Finished units equal to half the sales for the next month will be in stock at the end of each month (including December of previous year).

Prepare for 6 months ending 30th June a Production Budget and a summarised cost of production budget.

Solution:

Production Budget for 6 Months ending 30th June (Product X)

Particulars	Jan	Feb	Mar	Apr	May	Jun
Sales	10,000	12,000	16,000	20,000	24,000	24,000
Add: Closing Stock	6,000	8,000	10,000	12,000	12,000	10,000
	16,000	20,000	26,000	32,000	36,000	34,000
Less: Opening Stock	5,000	6,000	8,000	10,000	12,000	12,000
Production (units)	11,000	14,000	18,000	22,000	24,000	22,000

Total Production of X for 6 months = 11,000 + 14,000 + 18,000 + 22,000 + 24,000 + 22,000 = 1,11,000 units.

Production Budget for 6 Months ending 30th June (Product Y)

Particulars	Jan	Feb	Mar	Apr	May	Jun
Sales	28,000	28,000	24,000	20,000	16,000	16,000
Add: Closing Stock	14,000	12,000	10,000	8,000	8,000	9,000
	42,000	40,000	34,000	28,000	24,000	25,000
Less: Opening Stock	14,000	14,000	12,000	10,000	8,000	8,000
Production (units)	28,000	26,000	22,000	18,000	16,000	17,000

Total production of Y for 6 months = 28,000 + 26,000 + 22,000 + 18,000 + 16,000 + 17,000 = 1,27,000 units.

Summarised Cost of Production Budget for 6 Months Ending 30th June

Particulars	Product X	Product Y	Total ₹
	(1,11,000 units) ₹	(1,27,000 units) ₹	
Materials	13,87,500	24,13,000	38,00,500
Direct Wages	4,99,500	8,89,000	13,88,500
Variable Factory Overhead (wn)	3,33,000	5,08,000	8,41,000
Summarised cost of Production	22,20,000	38,10,000	60,30,000



Working Notes:

1. Computation of Variable Factory Overhead

$$\text{For Product X} = \left(\frac{6,60,000}{2,20,000} \times 1,11,000 \right) = 3,33,000$$

$$\text{For product Y} = \left(\frac{9,60,000}{2,24,000} \times 1,27,000 \right) = 5,08,000$$

Illustration 3 :

Draw a Material Procurement Budget (Quantitative) from the following information:

Estimated sales of a product 40,000 units. Each unit of the product requires 3 units of material A and 5 units of material B.

Estimated opening balances at the commencement of the next year:

Finished product = 5,000 units
Material A = 12,000 units
B = 20,000 units

Material on order:

Material A = 7,000 units
Material B = 11,000 units

The desirable closing balance at the end of the next year:

Finished product = 7,000 units
Material A = 15,000 units
B = 25,000 units

Material on order:

Material A = 8,000 units
B = 10,000 units

Solution:

$$\begin{aligned} \text{Production} &= \text{Sales} + \text{Closing Stock} - \text{Opening Stock} \\ &= 40,000 + 7,000 - 5,000 \\ &= 42,000 \text{ units} \end{aligned}$$

Raw Materials Purchase Budget

Particulars	Product A	Product B
Material Required	1,26,000 (42,000 x 3)	2,10,000 (42,000 x 5)
Add: Closing Stock	15,000	25,000
Add: Closing Stock on order	8,000	10,000
	1,49,000	2,45,000
Less: Opening Stock	12,000	20,000
Less: Opening Stock on order	7,000	11,000
Raw Material Purchase	1,30,000	2,14,000

Illustration 4:

From the following figures prepare the raw material purchase budget for January, 2013:

	Materials					
	A	B	C	D	E	F
Estimated Stock on Jan 1	16,000	6,000	24,000	2,000	14,000	28,000
Estimated Stock on Jan 31	20,000	8,000	28,000	4,000	16,000	32,000
Estimated Consumption	1,20,000	44,000	1,32,000	36,000	88,000	1,72,000
Standard Price per Unit	25 p.	5 p.	15 p.	10 p.	20 p.	30 p.

Solution:

Raw Materials Purchase Budget For January 2013

Type	A	B	C	D	E	F	Total
Estimated Consumption (units)	1,20,000	44,000	1,32,000	36,000	88,000	1,72,000	
Add: Estimated stock on Jan 31, 2013 (units)	20,000	8,000	28,000	4,000	16,000	32,000	
	1,40,000	52,000	1,60,000	40,000	1,04,000	2,04,000	
Less: Estimated stock on Jan 1, 2013 (units)	16,000	6,000	24,000	2,000	14,000	28,000	
Estimated purchase (units)	1,24,000	46,000	1,36,000	38,000	90,000	1,76,000	6,10,000
Rate per unit (₹)	0.25	0.05	0.15	0.10	0.20	0.30	
Estimated purchases (₹)	31,000	2,300	20,400	3,800	18,000	52,800	1,28,300

Illustration 5 :

A company manufactures product - A and product -B during the year ending 31st December 2013, it is expected to sell 15,000 kg. of product A and 75,000 kg. of product B at ₹30 and ₹16 per kg. respectively. The direct materials P, Q and R are mixed in the proportion of 3: 5: 2 in the manufacture of product A, Materials Q and R are mixed in the proportion of 1:2 in the manufacture of product B. The actual and budget inventories for the year are given below:

	Opening Stock	Expected Closing stock	Anticipated cost per Kg.
	Kg.	Kg.	₹
Material – P	4,000	3,000	₹12
Material –Q	3,000	6,000	10
Material – R	30,000	9,000	8
Product - A	3,000	1,500	—
B	4,000	4,500	—

Prepare the Production Budget and Materials Budget showing the expenditure on purchase of materials for the year ending 31-12-2013.



Solution:

Production Budget for the Products A & B

Particulars	Product A	Product B
Sales	15,000	75,000
Add: Closing Stock	1,500	4,500
	16,500	79,500
Less: Opening Stock	3,000	4,000
Production	13,500	75,500

Material Purchase Budget for the Year ending Dec 31st 2013

Particulars	P	Q	R	Total
Material required for product A in the ratio of 3:5:2	4,050	6,750	2,700	13,500
Material required for product B in the ratio of 1:2	-	25,167	50,333	75,500
Total requirement	4,050	31,917	53,033	
Add: Closing Stock	3,000	6,000	9,000	
	7,050	37,917	62,033	
Less: Opening Stock	4,000	3,000	30,000	
Purchases (in units)	3,050	34,917	32,033	
Cost per Kg.	12	10	8	
Total Purchase cost (₹)	36,600	3,49,170	2,56,264	6,42,034

Illustration 6:

The following details apply to an annual budget for a manufacturing company.

QUARTER	1 st	2 nd	3 rd	4 th
Working Days	65	60	55	60
Production (Units per working day)	100	110	120	105
Raw material purchases (% by weight of annual total)	30%	50%	20%	—
Budgeted purchase price/Kg. (₹)	1	1.05	1.125	—

Quantity of raw material per unit of production 2 kg. Budgeted closing stock of raw material 2,000 kg. Budgeted opening stock of raw material 4,000 kg. (Cost ₹ 4,000)

Issues are priced on FIFO Basis. Calculate the following budgeted figures.

- Quarterly and annual purchase of raw material by weight and value.
- Closing quarterly stocks by weight and value.

Solution:

Material Purchase Budget

Particulars	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Production	6,500	6,600	6,600	6,300	26,000
	(65x100)	(60x110)	(120x55)	(60x105)	
Material Required (Production x 2)	13,000	13,200	13,200	12,600	52,000
Add: Closing Stock					2,000
					54,000
Less: Opening Stock					4,000
Purchases by Weight	15,000	25,000	10,000	-	50,000

Computation of Purchases by Value

Particulars	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Purchases (Weight)	15,000	25,000	10,000	-	
	(50,000 x 30%)	(50,000 x 50%)	(50,000 x 20%)		
Cost per Kg.	1	1.05	1.125	-	
Purchases (₹)	15,000	26,250	11,250	-	52,500

Budget Showing Closing Quarterly Stocks by Weight and Value

Particulars	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Opening Stock	4,000	6,000	17,800	14,600
Purchases	15,000	25,000	10,000	-
	19,000	31,000	27,800	14,600
Material consumed	13,000	13,200	13,200	12,600
Closing Stock by Weight	6,000	17,800	14,600	2,000
Closing Stock by Value (₹)	6,000	18,690	16,080	2,250
	(6,000 x 1)	(17,800 x 1.05)	{(10,000 x 1.125)+ (4,600 x 1.05)}	(2,000 x 1.125)

Illustration 7 :

You are required to prepare a Selling Overhead Budget from the estimates given below:

	₹
Advertisement	1,000
Salaries of the Sales Dept.	1,000
Expenses of the Sales Dept.(Fixed)	750
Salesmen's remuneration	3,000
Salesmen's and Dearness Allowance - Commission @ 1% on sales affected	
Carriage Outwards: Estimated @ 5% on sales	
Agents Commission: 7½% on sales	

The sales during the period were estimated as follows:

- ₹80,000 including Agent's Sales ₹8,000
- ₹90,000 including Agent's Sales ₹10,000
- ₹1,00,000 including Agent's Sales ₹10,500



Solution:

Selling Overhead Budget (₹)

Sales	80,000	90,000	1,00,000
(A) Fixed overhead:			
Advertisement	1,000	1,000	1,000
Salaries of the sales dept.	1,000	1,000	1,000
Expenses of the sales dept.	750	750	750
Salesmen remuneration	3,000	3,000	3,000
Total (A)	5,750	5,750	5,750
(B) Variable overhead:			
Commission	720 (72,000 x 1%)	800 (80,000 x 1%)	895 (89,500 x 1%)
Carriage outwards	4,000	4,500	5,000
Agents Commission	600 (8,000 x 7.5%)	750 (10,000 x 7.5%)	788 (10,500 x 7.5%)
Total (B)	5,320	6,050	6,683
Grand Total (A+B)	11,070	11,800	12,433

Illustration 8:

ABC Ltd. a newly started company wishes to prepare Cash Budget from January. Prepare a cash budget for the first six months from the following estimated revenue and expenses.

Month	Total Sales ₹	Materials ₹	Wages ₹	Overheads	
				Production ₹	Selling & Distribution ₹
January	20,000	20,000	4,000	3,200	800
February	22,000	14,000	4,400	3,300	900
March	28,000	14,000	4,600	3,400	900
April	36,000	22,000	4,600	3,500	1,000
May	30,000	20,000	4,000	3,200	900
June	40,000	25,000	5,000	3,600	1,200

Cash balance on 1st January was ₹10,000. A new machinery is to be installed at ₹20,000 on credit, to be repaid by two equal installments in March and April, sales commission @5% on total sales is to be paid within a month following actual sales.

₹10,000 being the amount of 2nd call may be received in March. Share premium amounting to ₹2,000 is also obtained with the 2nd call. Period of credit allowed by suppliers — 2months; period of credit allowed to customers — 1month, delay in payment of overheads 1 month. Delay in payment of wages ½ month. Assume cash sales to be 50% of total sales.

Solution:

Cash Budget for the First 6 Months

Particulars	Jan	Feb	Mar	Apr	May	Jun
Opening Balance (A)	10,000	18,000	29,800	27,000	24,700	33,100
Add: Receipts (B)						
Cash Sales (50%)	10,000	11,000	14,000	18,000	15,000	20,000
Collection from debtors	-	10,000	11,000	14,000	18,000	15,000
Share call money (including share premium)	-	-	12,000	-	-	-
Total (A+B)	20,000	39,000	66,800	59,000	57,700	68,100
Less: Payments						
Materials	-	-	20,000	14,000	14,000	22,000
Wages	2,000	4,200	4,500	4,600	4,300	4,500
Overheads	-	4,000	4,200	4,300	4,500	4,100
Sales Commission	-	1,000	1,100	1,400	1,800	1,500
Installment of Machinery purchase	-	-	10,000	10,000	-	-
Total Payments(C)	2,000	9,200	39,800	34,300	24,600	32,100
Closing Balance (A+B-C)	18,000	29,800	27,000	24,700	33,100	36,000

Note: According to credit terms wages to be taken at half of the current month plus half of the previous month.

Illustration 9:

Prepare a Cash Budget for the three months ending 30th June, 2012 from the information given below:

(a)

MONTH	SALES (₹)	MATERIALS (₹)	WAGES (₹)	OVERHEADS (₹)
February	14,000	9,600	3,000	1,700
March	15,000	9,000	3,000	1,900
April	16,000	9,200	3,200	2,000
May	17,000	10,000	3,600	2,200
June	18,000	10,400	4,000	2,300

(b) Credit terms are:

Sales / Debtors : 10% sales are on cash, 50% of the credit sales are collected next month and the balance in the following month.

Creditors: Materials 2 months

Wages 1/4 month

Overheads 1/2 month.

(c) Cash and bank balance on 1st April, 2012 is expected to be ₹ 6,000.

(d) Other relevant information are:



- (i) Plant and machinery will be installed in February 2012 at a cost of ₹ 96,000. The monthly installment of ₹2,000 is payable from April onwards.
- (ii) Dividend @ 5% on preference share capital of ₹ 2,00,000 will be paid on 1st June.
- (iii) Advance to be received for sale of vehicles ₹ 9,000 in June.
- (iv) Dividends from investments amounting to ₹ 1,000 are expected to be received in June.

Solution:

Cash Budget for the 3 Months Ending 30th June 2012 (Amount in ₹)

Particulars	April	May	June
Opening Balance	6,000	3,950	3,000
Add: Receipts :			
Cash Sales	1,600	1,700	1,800
Collection from debtors [see note(1)]	13,050	13,950	14,850
Advance for sale of vehicles	-	-	9,000
Dividends from Investments	-	-	1,000
Total (A+B)	20,650	19,600	29,650
Less: Payments			
Materials	9,600	9,000	9,200
Wages (see note2)	3,150	3,500	3,900
Overheads	1,950	2,100	2,250
Installment of Plant & Machinery	2,000	2,000	2,000
Preference Dividend	-	-	10,000
Total (C)	16,700	16,600	27,350
Closing Balance (A+B-C)	3,950	3,000	2,300

Working Notes:

(i) Computation of Collection from Debtors (Amount in ₹)

Month	Total Sales	Credit Sales	Feb	Mar	Apr	May	June
Feb	14,000	12,600	-	6,300	6,300	-	-
Mar	15,000	13,500	-	-	6,750	6,750	-
Apr	16,000	14,400	-	-	-	7,200	7,200
May	17,000	15,300	-	-	-	-	7,650
					13,050	13,950	14,850

- (ii)** Wages payment in each month is to be taken as three-fourths of the current month plus one-fourth of the previous month.

Illustration 10:

For production of 10,000 units the following are budgeted expenses:

	Per Unit ₹
Direct Materials	48
Direct Labour	24
Variable Overheads	20
Fixed Overheads (₹1,20,000)	12
Variable Expenses (Direct)	4
Selling Expenses (10% fixed)	12
Administration Expenses (₹40,000 fixed)	4
Distribution Expenses (20% fixed)	4
	128

Prepare a budget for production of 7,000 units and 9,000 units.

Solution:

Flexible Budget

Particulars	10000 Units		7000 Units		9000 Units	
	CPU	Total	CPU	Total	CPU	Total
A) Marginal Cost:						
Direct Material	48	4,80,000	48	3,36,000	48	4,32,000
Direct Labour	24	2,40,000	24	1,68,000	24	2,16,000
Variable Expenses	4	40,000	4	28,000	4	36,000
Variable overheads	20	2,00,000	20	1,40,000	20	1,80,000
Selling expenses	10.80	1,08,000	10.80	75,600	10.80	97,200
Distribution expenses	3.20	32,000	3.20	22,400	3.20	28,800
Total (A)	110.00	11,00,000	110.00	7,70,000	110.00	9,90,000
B) Fixed Cost:						
Fixed Overheads	12.00	1,20,000		1,20,000		1,20,000
Selling expenses	1.20	12,000		12,000		12,000
Administration overheads	4.00	40,000		40,000		40,000
Distribution expenses	0.80	8,000		8,000		8,000
Total (B)	18.00	1,80,000		1,80,000		1,80,000
Grand Total (A+B)	128.00	12,80,000		9,50,000		11,71,000



Illustration 11 :

Draw up a flexible budget for overhead expenses on the basis of the following data and determine the overhead rates at 70%, 80% and 90%

Plant Capacity	At 80% capacity
	₹
Variable Overheads:	
Indirect labour	12,000
Stores including spares	4,000
Semi Variable:	
Power (30% - Fixed: 70% -Variable)	20,000
Repairs (60%- Fixed: 40% -Variable)	2,000
Fixed Overheads:	
Depreciation	11,000
Insurance	3,000
Salaries	10,000
Total overheads	62,000
Estimated Direct Labour Hours	1,24,000

Solution:

Flexible Budget at Different Capacities and Determination of Overhead Rates

Particulars	70%	80%	90%
	₹	₹	₹
(A) Variable Overheads:			
Indirect labour	10,500	12,000	13,500
Stores including spares	3,500	4,000	4,500
Total (A)	14,000	16,000	18,000
(B) Semi Variable Overheads:			
Power (See Note)	18,250	20,000	21,750
Repairs (See Note)	1,900	2,000	2,100
Total (B)	20,150	22,000	23,850
(C) Fixed Overheads:			
Depreciation	11,000	11,000	11,000
Insurance	3,000	3,000	3,000
Salaries	10,000	10,000	10,000
Total (C)	24,000	24,000	24,000
Grand Total (A+B+C)	58,150	62,000	65,850
Labour Hours	10,8,500	1,24,000	1,39,500
	$\left(1,24,000 \times \frac{7}{8}\right)$		$\left(1,24,000 \times \frac{9}{8}\right)$
Overhead rate per hour (₹)	= 0.536 $\left(\frac{58,150}{1,08,500}\right)$	= 0.50 $\left(\frac{62,000}{1,24,000}\right)$	= 0.472 $\left(\frac{65,850}{1,39,500}\right)$

Working Notes: Semi Variable Overheads:

	70%	90%
Power:		
Variable	$\left(14,000 \times \frac{7}{8}\right) = 12,250$	$\left(14,000 \times \frac{9}{8}\right) = 15,750$
Fixed	<u>6,000</u>	<u>6,000</u>
Total	18,250	21,750
Repairs:		
Variable	$\left(800 \times \frac{7}{8}\right) = 700$	$\left(800 \times \frac{9}{8}\right) = 900$
Fixed	1,200	1,200
Total	1 900	2 100

Illustration 12 :

The profit for the year of Push On Ltd. works out to 12.5% of the capital employed and the relevant figures are as under:-

	₹
Sales	5,00,000
Direct Materials	2,50,000
Direct Labour	1,00,000
Variable Overheads	40,000
Capital Employed	4,00,000

The new sales manager who has joined the company recently estimates for the next year a profit of about 23% on capital employed, provided the volume of sales is increased by 10% and simultaneously there is an increase in selling price of 4% and an overall cost reduction in all the elements of cost by 2%.

Find out by computing in detail the cost and profit for next year, whether the proposal of sales manager can be adopted.

Solution:

Computation of Fixed Expenses

Particulars	₹
Sales	5,00,000
Less: Profit [4,00,000 x (12.5/100)]	50,000
Total Cost	4,50,000
Less: All costs other than Fixed Cost	3,90,000
Fixed Cost	60,000



**Statement Showing Computation of Profit
If Salesman's Proposal is Adopted**

Particulars	₹
(i) Sales [500000 x 110% x 104%]	5,72,000
(ii) Variable Cost:	
Direct Material [250000 x 110% x 98%]	2,69,500
Direct Labour [100000 x 110% x 98%]	1,07,800
Variable Overheads [40000 x 110% x 98%]	43,120
	4,20,420
(iii) Contribution [i - ii]	1,51,580
(iv) Fixed Cost [60000 x 98%]	58,800
(v) Profit [iii - iv]	92,780

$$\% \text{ of profit on Capital Employed} = \left(\frac{92,780}{4,00,000} \times 100 \right) = 23.195\%$$

From the above computation, it was found that the percentage of profit is 23.195% on Capital Employed by adopting the sales manager's proposal which is just more than 23% of expected, therefore the proposal can be adopted.

Illustration 13:

A Glass Manufacturing company requires you to calculate and present the budget for the next year from the following information.

Sales: Toughened glass	₹ 3,00,000
Bent toughened glass	₹ 5,00,000
Direct Material cost	60% of sales
Direct Wages	20 workers @ ₹150 p.m.
Factory Overheads:	
Indirect Labour: Works Manager	₹500 per month
Foreman	₹400 per month
Stores and spares	2½% on sales
Depreciation on machinery	₹12,000
Light and power	5,600
Repairs and maintenance	8,000
Other sundries	10% on direct wages
Administration, selling and distribution expenses	₹14,000 per year.

Solution:

Master Budget Showing Profit for Next Year

	₹	₹
Sales:		
Toughened Glass	3,00,000	
Bent Toughened Glass	5,00,000	
		8,00,000
Less: Cost:		
Material @ 60%	4,80,000	
Direct Wages (20 x 150 x 12)	36,000	5,16,000
Gross Profit		2,84,000
Less: Factory Overheads:		
Indirect Labour: Works Manager's Salary [500 x 12] = 6,000		
Foreman's Salary [400 x 12] = <u>4,800</u>	10,800	
Stores & Spares	20,000	
Depreciation	12,000	
Light & Power	5,600	
Repairs & Maintenance	8,000	
Other Sundries	3,600	
Administration & Selling Expenses	14,000	74,000
Profit		2,10,000

Illustration 14:

From the following information relating to 2012 and conditions expected to prevail in 2013, prepare a budget for 2013.

	₹
2012 Actual:	
Sales (40,000 units)	1,00,000
Raw materials	53,000
Wages	11,000
Variable Overhead	16,000
Fixed Overheads	10,000
2013 Prospects:	
Sales (60,000 units)	1,50,000
Raw Materials	5% increase in prices
Wages	10% increase in wage rate
	5% increase in productivity
Additional plant:	One Lathe ₹ 25,000
	One Drill ₹ 12,000
10% Depreciation to be considered.	



Solution:

Budget Showing Costs and Profits for the Year 2013

I. Sales	1,50,000
II. Costs:	
Raw Materials $\left(53,000 \times \frac{6}{4} \times \frac{105}{100}\right)$	83,475
Wages $\left(11,000 \times \frac{110}{100} \times \frac{6}{4} \times \frac{100}{105}\right)$	17,285
Variable Overheads $\left(16,000 \times \frac{6}{4}\right)$	24,000
Fixed Overheads $\left[10,000 \left(3,70,000 \times \frac{10}{100}\right)\right]$	13,700
	1,38,460
iii. Profit (i – ii)	11,540

Illustration 15:

Production costs of a factory for a year are as follows:

	₹
Direct Wages	80,000
Direct Materials	1,20,000
Production Overheads: Fixed	40,000
Variable	60,000

During the forthcoming year it is anticipated that:

- The average rate for direct labour remuneration will fall from ₹0.80 per hour to ₹0.75 per hour.
- Production efficiency will be reduced by 5%
- Price per unit of direct material and of other materials and services which comprise overheads will remain unchanged, and
- Production in the coming year will increase by $33\frac{1}{3}\%$. Draw up a production cost budget.

Solution:

Production Cost Budget for the Forthcoming Year

Particulars	₹
i. Wages $\left[80,000 \times 133\frac{1}{3}\% \left(\frac{0.75}{0.80}\right) \times \frac{100}{95}\right]$	1,05,263
ii. Materials $\left[1,20,000 \times 133\frac{1}{3}\%\right]$	1,60,000
iii. Variable Overheads $\left[60,000 \times 133\frac{1}{3}\%\right]$	80,000
iv. Fixed Overheads	40,000
Production cost	3,85,263

Illustration 16:

A company manufactures two products, A and B and the budgeted data for the year are as follows:

	Product A (₹)	Product B (₹)
Sales price per unit	100	75
Direct material per unit	20	10
Direct wages per unit	5	4
Total works overhead	10,105	9,009
Total marketing overhead	1,200	1,100

The sales manager forecasts the sales in units as follows:

	Product A (units)	Product B (units)
January	28	10
February	28	12
March	24	16
April	20	20
May	16	24
June	16	24
July to January (next year) Per month	18	20

It is assumed that (i) there will be no work in progress at the end of any month, and (ii) finished units equal to half the sales for the following month will be kept in stock.

Prepare (a) A Production Budget for each month and (b) A Summarized Profit and Loss Statement for the year.

Solution:

(a) Production Budget (in number of units)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Product –A													
Sales	28	28	24	20	16	16	18	18	18	18	18	18	240
Add: Closing Stock	14	12	10	8	8	9	9	9	9	9	9	9	
	42	40	34	28	24	25	27	27	27	27	27	27	
Less: Opening Stock	14	14	12	10	8	8	9	9	9	9	9	9	
Production	28	26	22	18	16	17	18	18	18	18	18	18	235
Product- B													
Sales	10	12	16	20	24	24	20	20	20	20	20	20	226
Add: Closing Stock	6	8	10	12	12	10	10	10	10	10	10	10	
	16	20	26	32	36	34	30	30	30	30	30	30	
Less: Opening Stock	5	6	8	10	12	12	10	10	10	10	10	10	
Production	11	14	18	22	24	22	20	20	20	20	20	20	231



(b) Summarised Product Cost Budget

Output	Particulars	Product A 235 units (₹)	Product B 231 units (₹)	Total (₹)
	Direct Material : A @ ₹ 20 B @ ₹ 10	4,700	2310	7,010
	Direct Labour : A @ ₹ 5 B @ ₹ 4	1,175	924	2,099
	Works overheads	10,105	9009	19,114
	Total production Cost	15,980	12243	28,223
	Cost per unit	68 (15,980/235)	53 (12,243/231)	

Summarised Profit and Loss Statement for the Year

Particulars	Product A (₹)	Product B (₹)	Total (₹)
Sales	24,000	16,950	40,950
Less:	16,320	11,978	
Production Cost of goods sold (240 x 68) (226 x 53)	1,200	1,100	
Marketing Overheads			
Total (ii) Cost (ii)	17,520	13,078	30,598
Profit (i - ii)	6,480	3,872	10,352

Illustration 17 :

Three Articles X, Y and Z are produced in a factory. They pass through two cost centers A and B. From the data furnished compile a statement for budgeted machine utilization in both the centers.

(a) Sales budget for the year

Product	Annual Budgeted Sales (units)	Opening stock of finished products (units)	Closing stock
X	4800	600	Equivalent to 2 months sales
Y	2400	300	--DO--
Z	2400	800	--DO--

(b) Machine hours per unit of product

Product	Cost centers	
	A	B
X	30	70
Y	200	100
Z	30	20

(c) Total number of machines

Cost Centre:	A	284
	B	256
Total		540

(d) Total working hours during the year: Estimated 2500 hours per machine.

Solution:

Calculation of Units of Production of Different Products

Particulars	Product X	Product Y	Product Z
Sales	4800	2400	2400
Add: Closing Stock	800	400	400
	5600	2800	2800
Less: Opening stock	600	300	800
Production	5000	2500	2000

MACHINE UTILISATION BUDGET

Particulars	A				B			
	X	Y	Z	Total	X	Y	Z	Total
(i) Production (Units)	5000	2500	2000		5000	2500	2000	
(ii) Hours per unit	30	200	30		70	100	20	
(iii) Total Machine Hours	1,50,000	5,00,000	60,000	7,10,000	3,50,000	2,50,000	40,000	6,40,000
(iv) Number of Machines Required	60	200	24	284	140	100	16	256

Illustration 18 :

The monthly budgets for manufacturing overhead of a concern for two levels of activity were as follows:

Capacity	60%	100%
Budgeted production (units)	600	1,000
	₹	₹
Wages	1,200	2,000
Consumable stores	900	1,500
Maintenance	1,100	1,500
Power and fuel	1,600	2,000
Depreciation	4,000	4,000
Insurance	1,000	1,000
	9,800	12,000

You are required to:

- (i) Indicate which of the items are fixed, variable and semi-variable;
- (ii) Prepare a budget for 80% capacity and
- (iii) Find the total cost, both fixed and variable per unit of output at 60%, 80% and 100% capacity.



Solution:

- (i) Fixed → Depreciation and insurance.
 Variable → Wages and consumables stores.
 Semi-variable Costs → Maintenance, Power and fuel.

Segregation Of Semi Variable Costs

$$\text{Maintenance} = \left(\frac{1,500 - 1,100}{400} \right) = ₹ 1 \text{ per unit variable and}$$

₹500 fixed (i.e., 1,100-600)

$$\text{Power and fuel} = \left(\frac{2,000 - 1,600}{400} \right) = ₹ 1 \text{ per unit variable and}$$

₹1000 (i.e., 1,600-600) is fixed.

- (ii) Budget for 80% capacity(output 800 units):

	₹
Wages @₹2 per unit	1,600
Consumables stores @ ₹ 1.50 per unit	1,200
Maintenance: ₹ 500+₹. 1.50 per unit	1,300
Power & fuel ₹ 1,000+ ₹.1 per unit	1,800
Depreciation	4,000
Insurance	1,000
Total cost:	10,900

- (iii)

Capacity Units	60%		80%		100%	
	600		800		1000	
	Total (₹)	Per unit	Total (₹)	Per unit	Total (₹)	Per unit
Fixed Costs:						
Depreciation	4,000		4,000		4,000	
Insurance	1,000		1,000		1,000	
Maintenance	500		500		500	
Power and fuel	1,000		1,000		1,000	
	6,500	10.83	6,500	8.125	6,500	6.50
Variable costs:						
Wages @ ₹2perunit	1,200		1,600		2,000	
Consumable stores @ ₹ 1.50 per unit	900		1,200		1,500	
Maintenance @ ₹.1 Per unit	600		800		1,000	
Power and fuel @ ₹.1 per unit	600		800		1,000	
	3,300	5.50	4,400	5.500	5,500	5.50
		16.33		13.625		12.00

Illustration 19:

X Chemical Ltd. manufacture two products AB and CD by making the raw material in the proportion shown:

Raw Material	Product AB	Product CD
A	80%	
B	20%	
C		50%
D		50%

The finished weight of products AB and CD are equal in the weight of in gradients. During the month of June, it is expected that 60 tons of AB and 200 tons of CD will be sold.

Actual and budgeted inventories for the month of June as follows:

	Actual Inventory (1st June) Quantity (Tons)	Budgeted Inventory (30th June) Quantity (Tons)
A	15	20
B	10	40
C	200	300
D	250	200
Product AB	10	5
Product CD	50	60

The purchase price of materials for June is expected to be as follows:

Material	Cost per ton
	₹
A	500
B	400
C	100
D	200

All materials will be purchased on 3rd of June, Prepare:

- (a) The Production Budget for the month of June,
- (b) The Material Requirement budget for June,
- (c) The Material Purchase Budget indicating the expenditure for material for the month of June.

Solution:

(a)

Production Budget

Particulars	AB	CD
Sales	60	200
Add: Closing stock	5	60
	65	260
Less: Opening stock	10	50
Production	55	210



(b) Material Requirement Budget

Particulars	A	B	C	D
Product AB	44	11	-	-
Product CD	-	-	105	105
Material Required	44	11	105	105

(c) Purchase Budget

Particulars	A	B	C	D
Material Required	44	11	105	105
Add: Closing stock	20	40	300	200
	64	51	405	305
Less: Opening stock	15	10	200	250
Purchases (By weight)	49	41	205	55
Cost per ton	500	400	100	200
Purchases (By Rupees)	24500	16400	20500	11000

Total Purchases = ₹ 24500+16400+20500+11000 = ₹ 72400.

Illustration 20:

The budget controller of a manufacturing organisation producing three products has compiled the following data for the annual budget for the year 2013.

	Price per kg	Products		
		A	B	C
Raw materials:			Kg per unit	
RM1	₹5.00	1	6	12
RM2	2.00	6	-	14
RM3	3.00	6	10	2
Direct Labour	Rate per hour		Hours per unit	
Dept1	₹2.00	9	4	4
Dept2	3.00	3	4	2
Dept3	4.00	2	5	4
Factory Overheads:				
Variable		4	8	6
Sales value (₹ Lakhs)		346.50	275.40	263.25
Stock of finished goods on 1.1.2013 (units)		1,200	800	1,000

Fixed factory overhead rate per direct labour hour

	₹
Dept1	5.00
Dept2	3.00
Dept3	6.00

The following policies have been laid down for the budgeted year 2013:

- (i) Fixed factory overheads will be absorbed on direct labour hour basis.
- (ii) Administration overheads are absorbed at the rate at 20% of factory cost.
- (iii) Selling and distribution overheads (one-third variable) are recovered at the rate of 25% of the cost of production including administration overheads.
- (iv) The mark up on the cost of sales for profit is:
Product 'A' 10%, Product 'B' 20%, Product 'C' 30%.
- (v) Inventories of finished goods will be reduced by 25% on 31-12-2013.
- (vi) The finished goods inventories are valued on marginal cost basis. The marginal cost of the opening stocks on 1.1.2013 were:
- (vii) Product 'A' ₹80, Product 'B' ₹120 and Product 'C' ₹140

You are required to compute:

- (a) The number of units of each product estimated to be sold in the budget year.
- (b) The number of unit of each product proposed to be produced in the budget year .
- (c) The contribution to sales ratio envisaged for each of the products
- (d) Valuation of opening and closing stock of finished goods on marginal cost basis.

Solution:

Computation of Selling Price for the Product

Particulars	A	B	C
(i) Material:			
RM 1	5.00	30.00	60.00
RM 2	12.00	0.00	28.00
RM 3	18.00	30.00	6.00
	35.00	60.00	94.00
(ii) Labour			
Dept-1	18.00	8.00	8.00
Dept-2	9.00	12.00	6.00
Dept-3	8.00	20.00	16.00
	35.00	40.00	30.00
PRIME COST (i +ii)	70.00	100.00	124.00
(iii) Factory Overheads:			
Variable	4.00	8.00	6.00
Fixed:			
Dept-1	45.00	20.00	20.00
Dept-2	9.00	12.00	6.00
Dept-3	12.00	30.00	24.00
	70.00	70.00	56.00
FACTORY COST (i+ii+iii)	140.00	170.00	180.00



(iv) Administration Overheads	28.00	34.00	36.00
(v) Cost of Production	168.00	204.00	216.00
(vi) Selling and distribution overheads	42.00	51.00	54.00
(vii) Total Cost	210.00	255.00	270.00
(viii) Profit	21.00	51.00	81.00
(ix) Selling Price	231.00	306.00	351.00
(x) Expected Number of Units to be sold			
	$\left(\frac{3,46,50,000}{231}\right)$	$\left(\frac{2,74,40,000}{306}\right)$	$\left(\frac{2,63,25,000}{351}\right)$
	= 1,50,000	= 90,000	= 75,000
(a)	1,50,000	90,000	75,000

(b) Production Budget

Particulars	A	B	C
Sales	1,50,000	90,000	75,000
Add: Closing Stock	900	600	750
	1,50,900	1,90,600	75,750
Less: Opening Stock	1,200	800	1,000
Production	1,49,700	89,800	74,750

(c) Computation of Contribution to Sales Ratio

Particulars	A	B	C
(i) Selling price	231	306	351
(ii) Variable cost	88	125	148
	[74+(42/3)]	[108+17]	[130+18]
(iii) Contribution [I – II]	143	181	203
(iv) P/V Ratio	61.90%	59.15%	57.83%

(d) Statement showing valuation of stocks

Particulars	A	B	C
Opening Stock (units)	1200	800	1000
Variable cost	80	120	140
Value	96,000	96,000	1,40,000
Closing Stock (units)	900	600	750
Variable cost	88	125	148
Value	72,900	75,000	1,11,000

Illustration 21:

From the information given below, prepare a cash budget of M/s Ram Limited for the first half of 2013, assuming that cost would remain unchanged:

- (i) Sales are both on credit and for cash, the later being one-third of the former.

- (ii) Realization from debtors are 25% in the month of sale, 60% in the month of following that and the balance in the month after that
- (iii) The company adopts a uniform pricing policy of the selling price being 25% over cost.
- (iv) Budgeted sales of each month are purchased and paid for in the preceding month.
- (v) The company has outstanding debentures of ₹ 2 lakhs on 1st January which carry interest at 15% per annum payable on the last date of each quarter on calendar year basis. 20% of the debentures are due for redemption on 30 June 2013.
- (vi) The company has to pay the last installment of advanced tax, for assessment year 2013-14, amounting to ₹ 54,000.
- (vii) Anticipated office costs for the six months period are : January ₹ 25,000; February ₹ 20,000; March ₹ 40,000; April ₹ 35,000; May ₹ 30,000 and June ₹ 45,000.
- (viii) The opening cash balance of ₹ 10,000 is the minimum cash balance to be maintained. Deficits have to be met by borrowers in multiples of ₹ 10,000 on which interest, on monthly basis, has to be paid on the first date of the sub-sequent month, at 12% p.a. Interest is payable for a minimum period of a month.
- (ix) Rent payable is ₹ 2,000 per month.
- (x) Sales forecast for the different months are :
 October 2012 ₹ 1,60,000; November ₹ 1,80,000; December ₹ 2,00,000;
 January 2013 ₹ 2,20,000; February ₹ 1,40,000; March ₹ 1,60,000;
 April ₹ 1,50,000; May ₹ 2,00,000; June ₹ 1,80,000; and July ₹ 1,20,000.

Solution:

Cash Budget for the Half Ended 30th June 2013

Particulars	Jan ₹	Feb ₹	Mar ₹	Apr ₹	May ₹	June ₹
Opening Balance (A)	10,000	77,500	11,0250	44,500	10,875	17,775
(B) Receipts:						
Cash Sales	55,000	35,000	40,000	37,500	50,000	45,000
Collection from Debtors	15,15,000	1,47,750	1,17,750	1,15,875	1,23,000	1,40,625
Borrowings	-	-	-	10000	10000	-
(A+B)	2,16,500	2,60,250	2,68,000	2,07,875	1,93,875	2,03,400
(C) Payments:						
Advance Tax	-	-	54,000	-	-	-
Office Costs	25,000	20,000	40,000	35,000	30,000	45,000
Rent	2,000	2,000	2,000	2,000	2,000	2,000
Purchases (80% on sales of next month)	1,12,000	1,28,000	1,20,000	1,60,000	1,44,000	96,000
Interest on Debentures	-	-	7,500	-	-	7,500
Redemption of Debentures	-	-	-	-	-	40,000
Payment of Interest	-	-	-	-	100	200
Total of C	1,39,000	1,50,000	2,23,500	19,7000	1,76,100	1,90,700
Closing Balance (A+B-C)	77,500	1,10,250	44,500	10,875	17,775	12,700



Working Notes:

Collection from Debtors

	Oct ₹	Nov ₹	Dec ₹	Jan ₹	Feb ₹	Mar ₹	Apr ₹	May ₹	Jun ₹
Total Sales	1,60,000	1,80,000	2,00,000	2,20,000	1,40,000	1,60,000	150,000	200,000	180,000
Credit Sales	1,20,000	1,35,000	1,50,000	1,65,000	1,05,000	1,20,000	1,12,500	1,50,000	1,35,000
Oct	30,000	72,000	18,000	-	-	-	-	-	-
Nov	-	33,750	81,000	20,250	-	-	-	-	-
Dec	-	-	37,500	90,000	22,500	-	-	-	-
Jan	-	-	-	41,250	99,000	24,750	-	-	-
Feb	-	-	-	-	26,250	63,000	15,750	-	-
Mar	-	-	-	-	-	30,000	72,000	18,000	-
Apr	-	-	-	-	-	-	28,125	67,500	16,875
May	-	-	-	-	-	-	-	37,500	90,000
Jun	-	-	-	-	-	-	-	-	33,750
Total Collections									
During the month	30,000	1,05,750	1,36,500	1,51,500	1,47,750	1,17,750	1,15,875	1,23,000	1,40,625

Purchases

Given that profit margin on Sales is 25% or 20% on Cost. Therefore remaining 80% is cost.

Illustration 22 :

Manufacturers Ltd. produce three products from three basic raw materials in three departments. The company operates a budgetary control system and values its stock of finished goods on a total cost basis. From the following data, you are required to produce for the month of July 2013 the following budgets.

- Production
- Material usage
- Purchases
- P & L A/c for each product and in total.

	Budget data for July 2013		
	Product		
	A ₹	B ₹	C ₹
Sales	15,00,000	10,80,000	16,80,000
Stock of finished products at July 1, 2013 in units	3,000	2,000	2,500
	Department		
	I	II	III
Product overhead (₹)	2,39,000	2,01,300	3,91,200
Direct labour hours	47,800	67,100	65,200
Direct material:	M ₁	M ₂	M ₃
Stock July 1, 2013 in units	24,500	20,500	17,500

Budgeting and Budgetary Control

The company is introduced a new system of inventory control which should reduce stocks. The forecast is that stocks as at 31st July 2013 will be reduced as follows:

Raw materials by 10% and finished products by 20%.

Fixed production overhead is absorbed on a direct labour hour basis. It is expected that there will be no work-in-progress as the beginning or end of the month.

Administration costs are absorbed by the products at a rate of 20% of production cost and selling and distribution cost is absorbed by products at a rate of 40% of production cost.

Profit is budgeted as a percentage of total cost as follows:

Product A 25%, Product B 12½% and product C 16 $\frac{2}{3}$ %

Standard data per unit of Product

	Price per unit	A	B	C
Direct Material	₹	Units	Units	Units
M ₁	2.00	5	-	12
M ₂	4.00	-	10	9
M ₃	1.00	5	5	-
	Rate per Hour			
Direct Wages	₹	Hours	Hours	Hours
Department I	2.50	4	2	2
Department II	2.00	6	2	3
Department III	1.50	2	4	6
Other variable costs		₹ 10	20	15

Solution:

Statement of Cost and Profit per Unit

Particulars	A (₹)	B (₹)	C (₹)
(i) Material:		₹	₹
M ₁	10	-	24
M ₂	-	40	36
M ₃	5	5	-
	15	45	60
(ii) Labour:			
Dept-I	10	5	5
Dept-II	12	4	6
Dept-III	3	6	9
	25	15	20
(iii) Other Variable cost	10	20	15
(iv) Production overheads:			
Dept-I	20	10	10
Dept-II	18	6	9
Dept-III	12	24	36



(v) TOTAL PRODUCTION COST (i+ii+iii+iv)	100	120	150
(vi) Administration overheads	20	24	30
(vii) Selling & Distribution Overheads	40	48	60
(viii) Total Cost (v+vi+vii)	160	192	240
(ix) PROFIT PER UNIT	40	24	40
	[25% x 160]	[12 ½ % x 192]	[16 2/3 % x 240]
(x) SELLING PRICE PER UNIT	200	216	280
(xi) Number of units sold	7500	5000	6000
(xii) Total Profit [ix × xi] (₹)	3,00,000	1,20,000	24,0000

(a) Production Budget

Particulars	A	B	C
Sales	7500	5000	6000
Add: Closing stock	2400	1600	2000
	9900	6600	8000
Less: Opening stock	3000	2000	2500
PRODUCTION	6900	4600	5500

(b) & (c) Material Usage and Purchase Budget

Particulars	M ₁	M ₂	M ₃
Material required for:			
Product A	34500	-	34500
Product B	-	46000	23000
Product C	66000	49500	-
	100500	95500	57500
Add: Closing stock	22050	18450	15750
	122550	113950	73250
Less: Opening stock	24500	20500	17500
PURCHASES	98050	93450	55750

Study Note - 4

STANDARD COSTING



This Study Note Includes

4.1 Standard Costing

4.2 Uniform Costing

4.1 STANDARD COSTING

4.1.1 Introduction:

During the first stages of development of cost accounting, historical costing was the only method available for ascertaining and presenting costs. Historical costs have, however, the following limitations:

- a. Historical cost is valid only for one accounting period, during which the particular manufacturing operation took place.
- b. Data is obtained too late for price quotations and production planning.
- c. Historical cost relating to one batch or lot of production is not a true guide for fixing price.
- d. Past actual are affected by the level of working efficiencies.
- e. Historical costing is comparatively expensive as it involves the maintenance of a large volume of records and forms.

The limitations and disadvantages attached to historical costing system led to further thinking on the subject and resulted in the emergence of standard costing which makes use of scientifically pre-determined standard costs under each element.

4.1.2 Definition:

Standard Costing is defined as "*the preparation and use of standard cost, their comparison with actual costs and the measurement and analysis of variances to their causes and points of incidence.*"

4.1.3 General Principles of Standard Costing:

1. Predetermination of technical data related to production. i.e., details of materials and labour operations required for each product, the quantum of inevitable losses, efficiencies expected, level of activity, etc.
2. Predetermination of standard costs in full details under each element of cost, viz., labour, material and overhead.
3. Comparison of the actual performance and costs with the standards and working out the variances, i.e., the differences between the actuals and the standards.
4. Analysis of the variances in order to determine the reasons for deviations of actuals from the standards.
5. Presentation of information to the appropriate level of management to enable suitable action (remedial measures or revision of the standards) being taken.

4.1.4 Difference between Standard Costing and Budgetary Control:

Like Budgetary Control, Standard Costing assume that costs are controllable along definite lines of supervision and responsibility and it aims at managerial control by comparison of actual performances with suitable predetermined yardsticks. The basic principles of cost control, viz., setting up of targets or standards, measurement of performance, comparison of actual with the targets and analysis

and reporting of variances are common to both standard costing and budgetary control systems. Both techniques are of importance in their respective fields and are complementary to each other. Thus, conceptually there is not much of a difference between standard costs and budgeted and the terms budgeted performance and standard performance mean, for many concerns one and the same thing.

Budgets are usually based on past costs adjusted for anticipated future changes but standard costs are of help in the preparation of production costs budgets. In fact, standards are often indispensable in the establishment of budgets. On the other hand, while setting standard overhead rates of standard costing purposes, the budgets framed for the overhead costs may be made use of with modifications, if necessary. Thus, standard costs and budgets are interrelated but not inter-dependent.

Despite the similarity in the basic principles of Standard Costing and Budgetary Control, the two systems vary in scope and in the matter of detailed techniques. The difference may be summarized as follows:

1. A system of Budgetary Control may be operated even if no Standard Costing system is in use in the concern.
2. While standard is an unit concept, budget is a total concept.
3. Budgets are the ceilings or limits of expenses above which the actual expenditure should not normally rise; if it does, the planned profits will be reduced. Standards are minimum targets to be attained by actual performance at specified efficiency.
4. Budgets are complete in as much as they are framed for all the activities and functions of a concern such as production, purchase, selling and distribution, research and development, capital utilisation, etc. Standard Costing relates mainly to the function of production and the related manufacturing costs.
5. A more searching analysis of the variances from standards is necessary than in the case of variations from the budget.
6. Budgets are indices, adherence to which keeps a business out of difficulties. Standards are pointers to further possible improvements.

4.1.5 Advantages of Standard Costing:

The advantages derived from a system of standard costing are tabulated below:

1. Standard Costing system establishes yard-sticks against which the efficiency of actual performances is measured.
2. The standards provide incentive and motivation to work with greater effort and vigilance for achieving the standard. This increase efficiency and productivity all round.
3. At the very stage of setting the standards, simplification and standardisation of products, methods, and operations are effected and waste of time and materials is eliminated. This assists in managerial planning for efficient operation and benefits all the divisions of the concern.
4. Costing procedure is simplified. There is a reduction in paper work in accounting and less number of forms and records are required.
5. Cost are available with promptitude for various purposes like fixation of selling prices, pricing of inter-departmental transfers, ascertaining the value of costing stocks of work-in-progress and finished stock and determining idle capacity.
6. Standard Costing is an exercise in planning - it can be very easily fitted into and used for budgetary planning.
7. Standard Costing system facilities delegation of authority and fixation of responsibility for each department or individual. This also tones up the general organisation of the concern.
8. Variance analysis and reporting is based on the principles of management by exception. The top management may not be interested in details of actual performance but only in the variances from the standards, so that corrective measures may be taken in time.
9. When constantly reviewed, the standards provide means for achieving cost reduction.



10. Standard costs assist in performance analysis by providing ready means for preparation of information.
11. Production and pricing policies may be formulated in advance before production starts. This helps in prompt decision-making.
12. Standard costing facilitates the integration of accounts so that reconciliation between cost accounts and financial accounts may be eliminated.
13. Standard Costing optimizes the use of plant capacities, current assets and working capital.

4.1.6 Limitations of standard costing:

1. Establishment of standard costs is difficult in practice.
2. In course of time, sometimes even in a short period the standards become rigid.
3. Inaccurate, unreliable and out of date standards do more harm than benefit.
4. Sometimes, standards create adverse psychological effects. If the standard is set at high level, its non achievement would result in frustration and build-up of resistance.
5. Due to the play of random factors, variances cannot sometimes be properly explained, and it is difficult to distinguish between controllable and non-controllable expenses.
6. Standard costing may not sometimes be suitable for some small concerns. Where production cannot be carefully scheduled, frequent changes in production conditions result in variances. Detailed analysis of all of which would be meaningless, superfluous and costly.
7. Standard costing may not, sometimes, be suitable and costly in the case of industries dealing with non-standardized products and for repair jobs which keep on changing in accordance with customer's specifications.
8. Lack of interest in standard costing on the part of the management makes the system practically ineffective. This limitation, of course, applies equally in the case of any other system which the management does not accept wholeheartedly.

4.1.7 Standard Cost:

Standard Cost is defined as *"the predetermined cost that is calculated at the management's standards of efficient operations and the relevant necessary expenditure"*.

From this we understand that it is the cost calculated when all the people working in the organisation to their utmost, the expenditure incurred for producing the product can be taken as standard cost. The optimum efficiency can not at all time exists. Therefore, optimum efficiency is assumed and that is why standard cost is called assumed cost. Further, all the inputs of cost scientifically analysed using so many industrial engineering techniques such as work measurement, method study, time and motion study, merit rating, job evaluation and other scientific techniques, it can also be called as Scientific Cost.

4.1.8 Standard Costs and Estimated Costs:

The distinction between Standard Costs and Estimated Costs should be clearly understood. While both Standard Costs and Estimated Costs are predetermined costs, their objectives are different. The main differences between the two types of costs are:

1. Estimated Costs are intended to determine what the costs 'will' be. Standard Costs aim at what costs 'should' be.
2. Estimated Costs are based on average of past actual figures adjusted for anticipated changes in future. Anticipated wastes, spoilage and inefficiencies, all of which tend to increase costs are included in estimated costs. Standard Costs are planned costs determined on a scientific basis and they are based upon certain assumed conditions of efficiency and other factors.

3. In Estimated Costing Systems, stress is not so much on cost control, but costs are used for other purposes such as fixation of prices to be quoted in advance. Standard Costs serve as effective tools for cost control.

4.1.9 Setting of Standard Costs:

While setting production costs standards, the following preliminaries should be considered:

- a. Study of the technical and operational aspects of the concern, such as methods of manufacture and the processes involved, management of organisation and line of assignment of responsibilities, division of the organisation into cost centres, units of measurement of input and output, anticipation of wastes, rejections and losses, expected efficiency, and capacity likely to be utilized.
- b. Review of the existing costing system and the cost records and forms in use.
- c. The type of standard to be used, i.e, whether current, basic, or normal standard costs are to be set. The choice of a particular type of standard will depend upon two factors, viz. which type would be most effective for cost control in the organization, and whether the standards will be merged in the accounting system or kept outside the accounts as statistical data.
- d. Proper classification of the accounts so that variances may be determined in the manner desired.
- e. Fixation of responsibility for setting standards. As definite responsibility for variances from standards is ultimately to be laid on individuals or departments, it is but natural that all those individuals or departments should be associated with the setting of standards.

4.1.10 Stock Valuation:

The function of a Balance Sheet is to give a true and fair view of the state of affairs of a company on a particular date. A true and fair view also implies the consistent application of generally accepted principles. Stocks valued at standard costs are required to be adjusted at actual costs in the following circumstances:

- (a) As per Accounting Standards – 2, closing stock to be valued either at cost price or at net realisable value (NRV) whichever is less.
- (b) The standard costing system introduced is still in an experimental stage and the variances merely represent deviations from poorly set standards.
- (c) Occurrence of certain variances which are beyond the control of the management. (Unless the stocks are adjusted for uncontrollable factors, the values are not correctly stated).

4.1.11 Maintenance of Raw Material Stock at Standard Cost:

In the single plan, the inventory in the stores ledger may be carried either at standard costs or at actual. Although both the methods are in use, the consensus is in favour of standard costs. The advantages of adopting standard costs for inventory valuation are as follows:

- a. Stores ledger may be maintained in quantities only and the standard price noted at the top in the ledger sheets. This economises the use of forms as well as reduces clerical costs as no columns for rates need be maintained.
- b. Pricing of materials requisitions is simplified as only one standard price for each item of material is required to be used.
- c. Price variance is promptly revealed at the time of purchase of material.

The disadvantages are:

- a. The stores ledger does not reveal the current prices.
- b. If the material stock is shown in the Balance Sheet at standard costs, the variances have the effect of



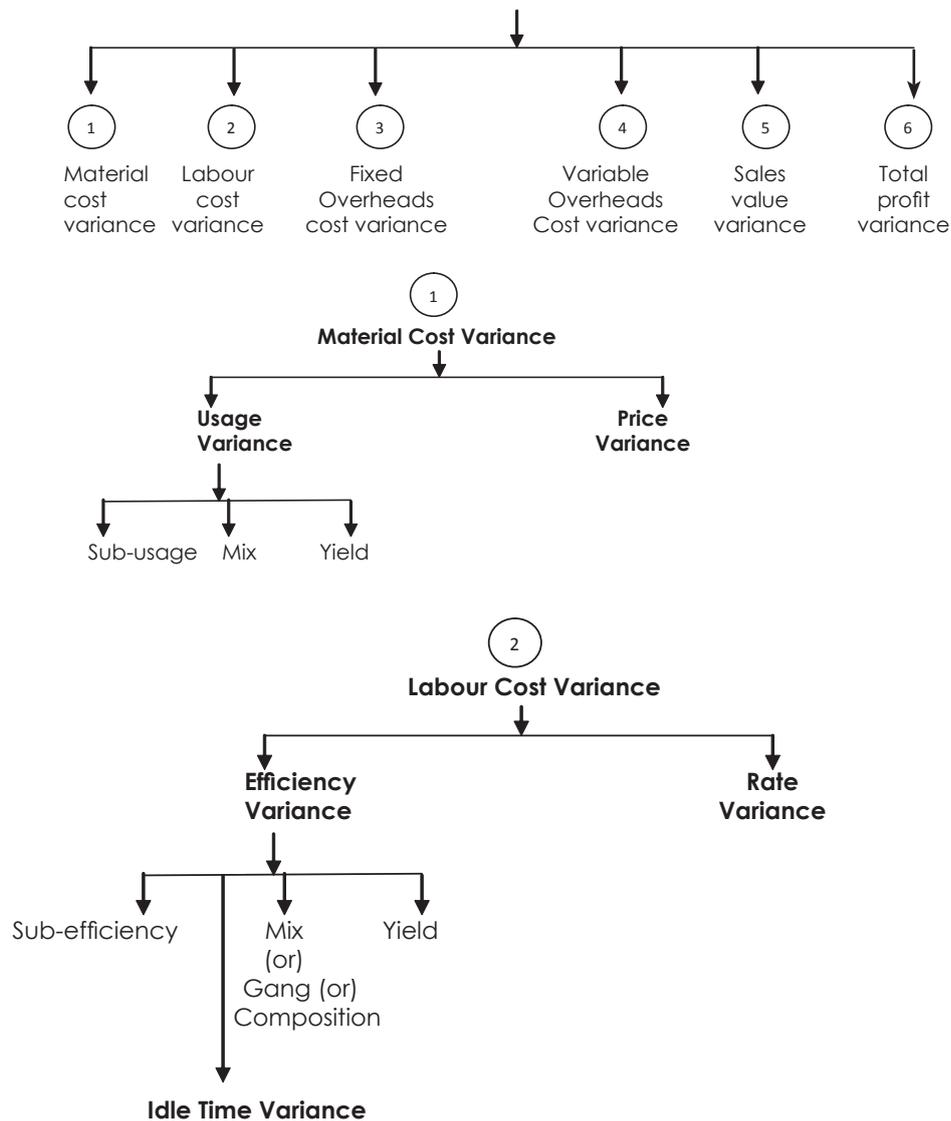
distorting the profit or loss. Standard cost of the closing inventory is required to be adjusted to actual cost based on price variance to comply with the statutory requirement of the Indian Companies Act.

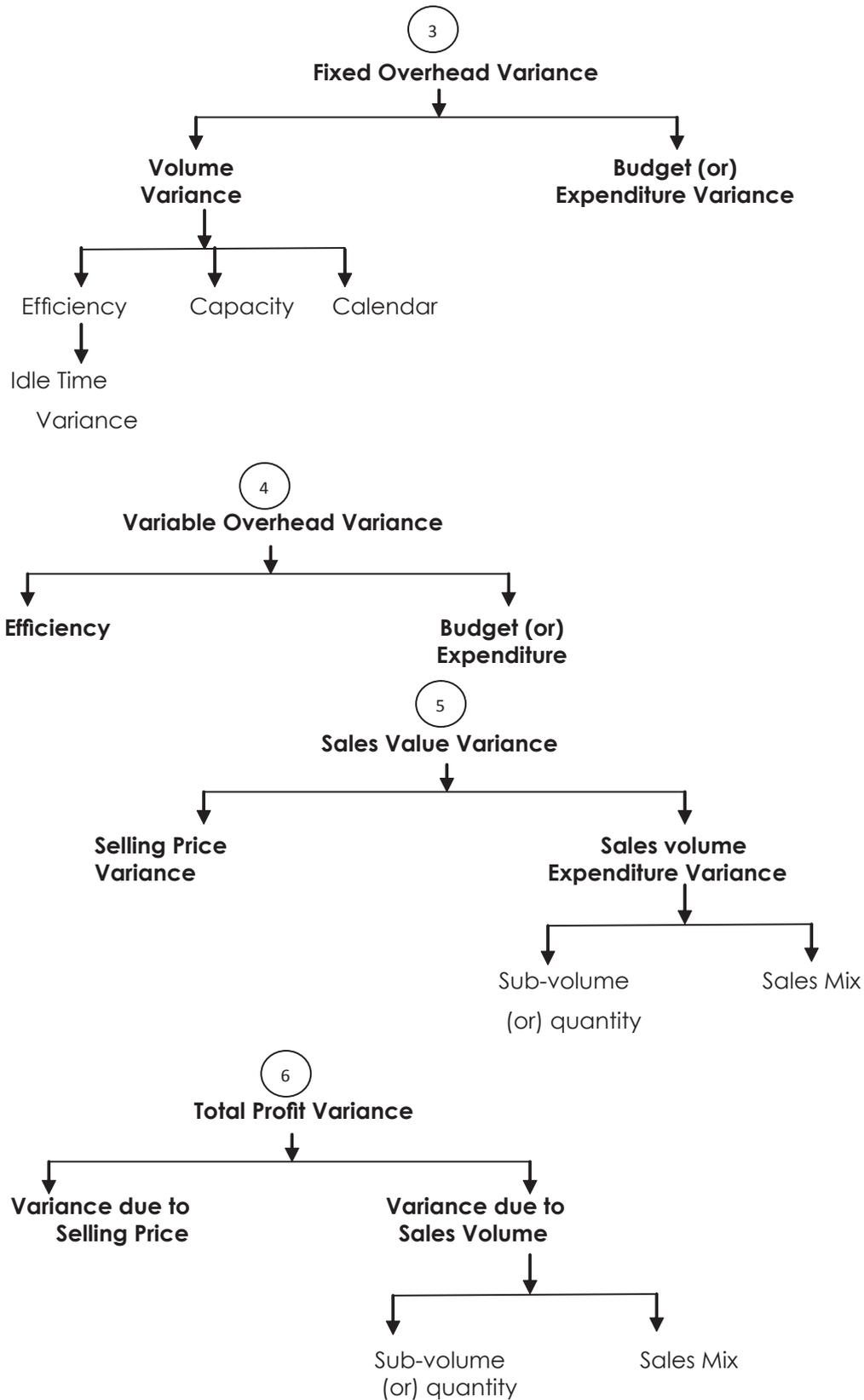
- c. A revision of the standard necessitates revision of the cost of the inventory.

4.1.12 Variance Analysis

Variance Analysis is nothing but the differences between Standard Cost and Actual Cost. Of course, in ordinary language we call it difference; in statistics we call it deviations and in costing terminology we call it as variances. When Standard Costing is adopted, the standards are set for all the costs, revenue and profit, and if the difference in case of cost is more than the standard we call it adverse variance, symbolized (A) and if the difference is less than the standard, we call it favourable variance, symbolized (F). However, in case of sales and profit, if the standard is more than the actual it is adverse variance and if the standard is less than the actual it is favourable variance. From this we understand that variances can be calculated in all the elements of costs, sales and profit too.

An overview of Variance Analysis is shown as follows:







- I. **Direct Materials Cost Variance:** Direct materials cost variance is the difference between the actual direct material cost incurred and the standard direct material cost specified for the production achieved.

1. Direct Materials Price Variance: The difference between the actual and standard price per unit of the material applied to the actual quantity of material purchased or used.

Direct materials price variance = (Standard Price *minus* Actual Price) x Actual Quantity, or

$$= (SP-AP) AQ$$

$$= (\text{Standard Price} \times \text{Actual Quantity}) \textit{ minus} (\text{Actual Price} \times \text{Actual Quantity})$$

$$= (AQSP-AQAP)$$

Causes of Material Price Variance:

- a. Change in basic purchase price of material.
- b. Change in quantity of purchase or uneconomical size of purchase order.
- c. Rush order to meet shortage of supply, or purchase in less or more favourable market.
- d. Failure to take advantage of off-season price, or failure to purchase when price is cheaper.
- e. Failure to obtain (or availability of) cash and trade discounts or change in the discount rates.
- f. Weak purchase organisation.
- g. Payment of excess or less freight.
- h. Transit losses and discrepancies, if purchase price is inflated to include the loss.
- i. Change in quality or specification of material purchased.
- j. Use of substitute material having a higher or lower unit price.
- k. Change in materials purchase, upkeep, and store-keeping cost. (This is applicable only when such changes are allocated to direct material costs on a predetermined or standard cost basis.)
- l. Change in the pattern or amounts of taxes and duties.

2. Direct Materials Usage Variance: The difference between the actual quantity used and the amount which should have been used, valued at standard price.

Direct materials usage variance = (Standard Quantity for actual output x Standard Price) *minus* (Standard Price x Actual Quantity)

$$= SQSP-AQSP \textit{ or}$$

$$= \text{Standard Price} \times (\text{Standard Quantity for actual output} \textit{ minus} \text{Actual Quantity})$$

$$= SP (SQ-AQ)$$

Causes of Materials Usage Variance:

- a. Variation in usage of materials due to inefficient or careless use, or economic use of materials.
- b. Change in specification or design of product.
- c. Inefficient and inadequate inspection of raw materials.
- d. Purchase of inferior materials or change in quality of materials
- e. Rigid technical specifications and strict inspection leading to more rejections which require more materials for rectification.

- f. Inefficiency in production resulting in wastages
- g. Use of substitute materials.
- h. Theft or pilferage of materials.
- i. Inefficient labour force leading to excessive utilisation of materials.
- j. Defective machines, tools, and equipments, and bad or improper maintenance leading to breakdowns and more usage of materials.
- k. Yield from materials in excess of or less than that provided as the standard yield.
- l. Faulty materials processing. Timber, for example, if not properly seasoned may be wasted while being used in subsequent processes.
- m. Accounting errors, e.g. when materials returned from shop or transferred from one job to another are not properly accounted for.
- n. Inaccurate standards
- o. Change in composition of a mixture of materials for a specified output.

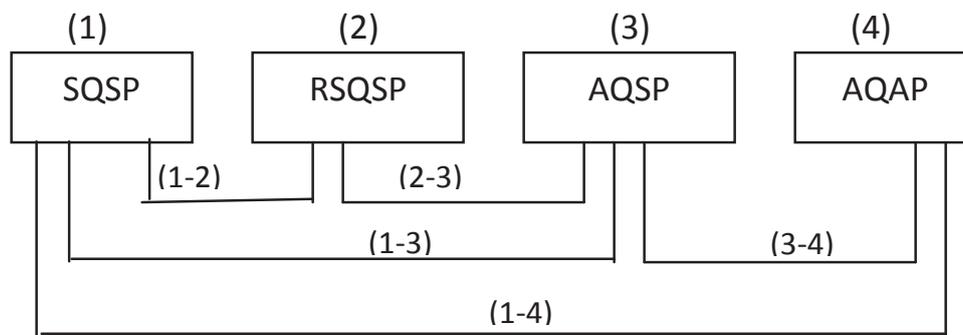
(i) Direct Materials Mix Variance: One of the reasons for materials usage variance is the change in the composition of the materials mix. The difference between the actual quantity of material used and the standard proportion, priced at standard price.

$$\begin{aligned} \text{Mix variance} &= (\text{Revised Standard Quantity} \textit{ minus} \textit{ Actual Quantity}) \times \text{Standard Price.} \\ &= \text{RSQSP} - \text{AQSP} \end{aligned}$$

(ii) Direct Materials Yield Variance: Yield variance is the difference between the standard cost of production achieved and the actual total quantity of materials used, multiplied by the standard weighted average price per unit.

$$\text{Material yield variance} = (\text{Standard Yield for Actual Mix} \textit{ minus} \textit{ Actual Yield}) \times \text{Standard Yield Price}$$

(Standard yield price is obtained by dividing the total cost of the standard units by the total cost of the standard mixture by the total quantity (number of physical units).



Where

SQ = Standard Quantity for Actual Production or Output

SP = Standard Price

AQ = Actual Quantity of Materials Consumed

AP = Actual Price

RSQ = Revised Standard Quantity



1. SQSP = Standard Cost of Standard Material
2. RSQSP = Revised Standard Cost of Standard Material
3. AQSP = Standard cost of Actual Material
4. AQAP = Actual Cost of Actual Material
 - (a) Material Sub-Usage or Yield Variance = 1-2
 - (b) Material Mix Variance = 2-3
 - (c) Material Usage Variance = 1-3
 - (d) Material Price Variance = 3-4
 - (e) Material Cost Variance = 1-4

II. Direct Labour Cost Variance: Direct Labour Cost Variance (also termed Direct Wage Variance) is the difference between the actual direct wages incurred and the standard direct wages specified for the activity achieved.

1. **Direct Labour Rate Variance (Wage Rate Variance):** The difference between the actual and standard wage rate per hour applied to the total hours worked.

Wages rate variance = (Standard Rate *minus* Actual Rate) x Actual Hours

$$= (SR-AR) \times AH$$

$$= SRAH-ARAH$$

Causes of Direct Labour Rate Variances:

- a. Change in basic wage structure or change in piece-work rate. These will give rise to a variance till such time the standards are not revised.
- b. Employment of workers of grades and rates of pay different from those specified, due to shortage of labour of the proper category, or through mistake, or due to retention of surplus labour.
- c. Payment of guaranteed wages to workers who are unable to earn their normal wages if such guaranteed wages form part of direct labour cost.
- d. Use of a different method of payment, e.g. payment at day-rates while standards are based on piece-work method of remuneration.
- e. Higher or lower rates paid to casual and temporary workers employed to meet seasonal demands, or urgent or special work.
- f. New workers not being allowed full normal wage rates.
- g. Overtime and night shift work in excess of or less than the standard, or where no provision has been made in the standard. This will be applicable only if overtime and shift differential payments form part of the direct labour cost.
- h. The composition of a gang as regards the skill and rates of wages being different from that laid down in the standard.

2. **Direct Labour Efficiency Variance (also termed Labour Time Variance):** The difference between the standard hours which should have been worked and the hours actually worked, valued at the standard wage rate.

Direct Labour Efficiency Variance = (Standard Hours for Actual Production *minus* Actual Hours) x Standard Rate

$$= (SH-AH) \times SR$$

$$= SRSH-SRAH$$

Causes for Labour Efficiency Variance:

- a. Lack of proper supervision or strict supervision than specified.
- b. Poor working conditions.
- c. Delays due to waiting for materials, tools, instructions, etc. if not treated as idle time.
- d. Defective machines, tools and other equipments.
- e. Machine break-down, if not booked to idle time.
- f. Work on new machines requiring less time than provided for, till such time standard is not revised.
- g. Basic inefficiency of workers due to low morale, insufficient training, faulty instructions, incorrect scheduling of jobs, etc.
- h. Use of non-standard material requiring more or less operation time.
- i. Carrying out operations not provided for a booking them as direct wages.
- j. Incorrect standards
- k. Wrong selection of workers, i.e., not employing the right type of man for doing a job.
- l. Increase in labour turnover.
- m. Incorrect recording of performances, i.e., time or output.

i. Direct Labour Composition or Mix or Gang Variance: This is a sub-variance of labour efficiency variance. This variance arises due to change in the composition of a standard gang, or, combination of labour force

Mix or Gang or Composition Variance = (Actual Hours at Standard Rate of Standard Gang) *minus* (Actual Hours at Standard Rate of Actual Gang)

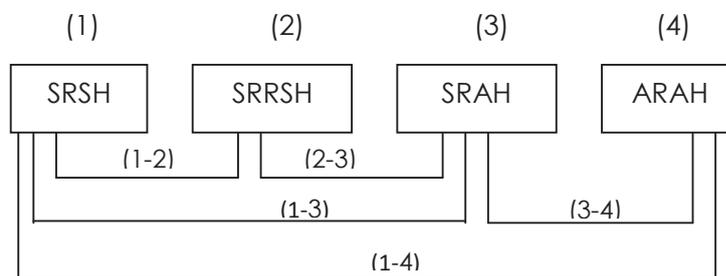
ii. Direct Labour Yield Variance: Just as material yield variance is calculated, similarly labour yield variance can also be known. It is the variation in labour cost on account of increase or decrease in yield or output as composed to the relative standard. The formula is –

$$\text{Direct Labour Yield Variance} = \text{Standard Cost Per Unit} \times \left[\frac{\text{Standard Output} - \text{Actual Output}}{\text{for Actual Mix}} \right]$$

3. Idle time variance: This variance which forms a portion of wages efficiency variance, is represented by the standard cost of the actual hours for which the workers remain idle due to abnormal circumstances.

Idle time variance = (Standard rate x Actual hours paid for) *minus* (Standard rate x Actual hours worked) or

= Standard Rate x Idle Hours





SR = Standard Rate of Labour Per Hour

SH = Standard Hours for Actual Production or Output

RSH = Revised Standard Hours

AH = Actual Hours

AR = Actual Rate of Labour per Hour

1. SRSR = Standard Cost of Standard Labour
2. SRRSH = Revised Standard Cost of Labour
3. SRAH = Standard Cost of Actual Labour
4. ARAH = Actual Cost of Labour
 - a. Labour Sub-Efficiency or Yield Variance = 1-2
 - b. Labour Mix or Gang or Composition Variance = 2-3
 - c. Labour Efficiency Variance = 1-3
 - d. Labour Rate Variance = 3-4
 - e. Labour Cost Variance = 1-4

Idle Time Variance = Idle Time Hours x Standard Rate per Hour.

It is to be noted that this is the part and parcel of efficiency ratio and always it is adverse.

III. Overhead Cost Variance: Overhead cost variance or Overall (or net) overhead variance is the difference between the actual overhead incurred and the overhead charged or applied into the job or process at the standard overhead rate.

1. Fixed Overhead Variance:

Fixed overhead cost variance is the difference between the standard cost of fixed overhead allowed for the actual output achieved and the actual fixed overhead cost incurred. The fixed overhead variance is analysed as below:

(i) Budget (or) Expenditure (or) Spending Variance:

Fixed overhead variance which arises due to the difference between the budgeted fixed overheads and the actual fixed overheads incurred during a particular period. It shows the efficiency in spending. Expenditure variance arises due to the following:

- Rise in general price level.
- Changes in production methods.
- Ineffective control.

Fixed Overhead Expenditure or Budget Variance = Budgeted Fixed Overhead – Actual Fixed Overhead

(ii) Volume Variance:

Fixed overhead volume variance is the difference between standard cost of fixed overhead allowed for actual output and the budgeted fixed overheads for the period. This variance shows the over (or) under absorption of fixed overheads during a particular period. If the actual output is more than the budgeted output then there will be over recovery of fixed overheads and volume variance will be favourable and vice-versa. This is so because fixed overheads are not expected to change with the change in output. Volume variance arises due to the following reasons:

- Poor efficiency of workers.

- Poor efficiency of machinery.
- Lack of orders.
- Shortage of power.
- Ineffective supervision.
- More or less working days.

Volume variance (Fixed Overhead) = Recovered Fixed Overhead – Budgeted Fixed Overhead

Volume variance can be further sub divided into three variances namely:

a. Capacity Variance:

It is that portion of the volume variance which is due to working at higher or lower capacity than the standard capacity. In other words, the variance is related to the under and over utilization of plant and equipment and arises due to idle time, strikes and lock-out, break down of the machinery, power failure, shortage of materials and labour, absenteeism, overtime, changes in number of shifts. In short, this variance arises due to more or less working hours than the budgeted working hours.

$$\begin{aligned} \text{Capacity Variance} &= \frac{\text{Standard Fixed Overhead Rate per hour}}{\text{Standard Fixed Overhead Rate per hour}} \times \left[\frac{\text{Actual Hour Worked}}{\text{Budgeted Hours}} - 1 \right] \\ &\text{or} \\ &= \text{Standard Overhead} - \text{Budgeted Overheads} \end{aligned}$$

b. Calendar Variance:

It is that portion of the volume variance which is due to the difference between the number of working days in the budget period and the number of actual working days in the period to which the budget is applicable. If the actual working days are more than the budgeted working days the variance will be favourable and vice-versa if the actual working days are less than the budgeted days.

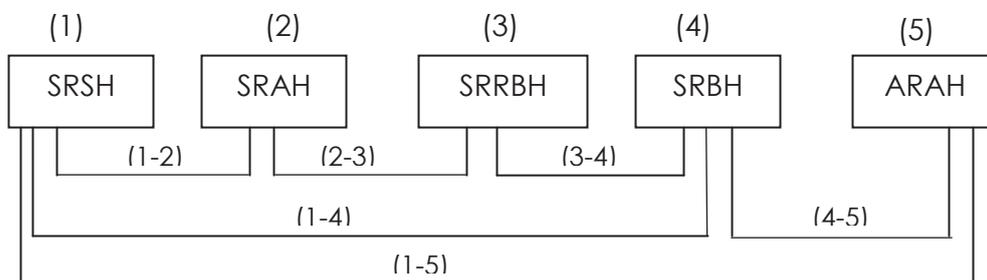
$$\text{Calendar Variance} = \frac{\text{Standard Rate Per Hour or Per Day}}{\text{Hour or Per Day}} \times \text{Excess or Deficit Hours or Days Worked}$$

c. Efficiency Variance:

It is that portion of the volume variance which is due to the difference between the budgeted efficiency of production and the actual efficiency achieved.

$$\begin{aligned} \text{Efficiency Variance} &= \frac{\text{Standard Fixed Overhead Rate per hour}}{\text{Standard Fixed Overhead Rate per hour}} \times \left[\frac{\text{Standard Hour for Actual Production}}{\text{Actual Hours}} - 1 \right] \\ &\text{or} \\ &= \text{Recovered Fixed Overheads} - \text{Standard Fixed Overheads} \end{aligned}$$

Fixed Overhead Variances:





Where,

SR = Standard Rate of Fixed Overhead Per Hour

SH = Standard Hours for Actual Production or Output

AH = Actual Hours

RBH = Revised Budgeted Hours

BH = Budgeted Hours

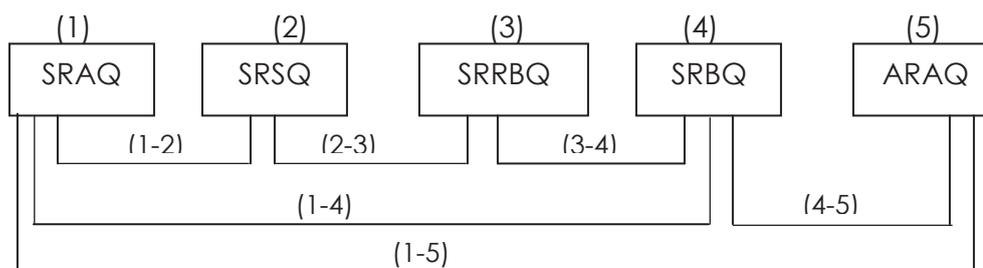
AR = Actual Rate of Fixed Over Head per Hour

1. SRSH = Standard Cost of Standard Fixed Overhead
2. SRAH = Standard Cost of Actual Fixed Overhead or Fixed Overhead Absorbed or Recovered
3. SRRBH = Revised Budgeted Fixed Overhead
4. SRBH = Budgeted Fixed Overhead
5. ARAH = Actual Fixed Overhead
 - a. Fixed Overheads Efficiency Variance = 1-2
 - b. Fixed Overheads Capacity Variance = 2-3
 - c. Fixed Overhead Calendar Variance = 3-4
 - d. Fixed Overhead Volume Variance = 1-4
 - e. Fixed Overhead Budget or Expenditure Variance = 4-5
 - f. Fixed Overhead Cost Variance = 1-5

Note1: - In the above values SR is found out in the following manner.

$$SR = \frac{BFO}{BH} \text{ (OR) } \frac{\text{Budgeted Fixed Overhead}}{\text{Budgeted Hours}}$$

Note 2: Fixed overhead variances can also be worked out using overhead rate per unit instead of rate per hour. In that event values and variances would be as follows:



Where,

SR = Budgeted Fixed Overheads / Budgeted Quantity

1. SRSQ = Standard Cost of Standard Fixed Overhead
2. SRAQ = Standard Cost of Actual Fixed Overhead or Fixed Overhead Absorbed or Recovered
3. SRRBQ = Revised Budgeted Fixed Overhead

4. SRBQ = Budgeted Fixed Overhead
5. ARAQ = Actual Fixed Overhead
 - a. Fixed Overheads Efficiency Variance = 1-2
 - b. Fixed Overheads Capacity Variance = 2-3
 - c. Fixed Overhead Calendar Variance = 3-4
 - d. Fixed Overhead Volume Variance = 1-4
 - e. Fixed Overhead Budget or Expenditure Variance = 4-5
 - f. Fixed Overhead Cost Variance = 1-5

Note 3:- Idle time variance in fixed overhead is part and parcel of efficiency variance and it is always adverse.

2. Variable overhead variance:

This is the difference between the standard variable overhead cost allowed for the actual output achieved and the actual variable overhead cost. The variance is represented by expenditure variance only because variable overhead cost will vary in proportion to output so that only a change in expenditure can cause such variance.

Sometimes, variable overhead efficiency variance can also be calculated just like labour efficiency variance. Variable overhead efficiency can be calculated if information relating to actual time taken and time allowed is given. In that event variable overhead variance can be divided into two parts.

- (i) Variable overhead efficiency variance.
- (ii) Variable overhead expenditure (or) budget (or) price variance.

$$\text{Idle Time Variance} = \text{Idle Time Hours} \times \text{Fixed Overhead Rate per Hour}$$

(i) Efficiency Variance: This variance is due to the difference between standard hours for actual output and the actual hours taken at the standard variable overhead rate. In other words, Variable Overhead Efficiency Variance is a measure of the extra overhead (or saving) incurred solely because direct labour usage exceeded (or was less than) the standard direct labour hours allowed.

$$\text{Efficiency Variance} = \text{Standard Variable Overhead Rate per Hour} \times [\text{Standard Hours for Actual production} - \text{Actual Hours}]$$

$$= \text{Recovered Variable overheads} - \text{Standards Variable Overheads}$$

(ii) Expenditure or Budget or Price Variance: This variance is due to the difference between standard variable overhead rate and actual variable overhead rate for the actual time taken. It is calculated on the pattern of Direct Labour rate Variance.

$$\text{Expenditure Variance} = \text{Actual Time} \times [\text{Standard Variable Overhead Rate per Hour} - \text{Actual Variable Overhead rate per hour}]$$

$$= \text{Standard Variable Overheads} - \text{Actual Variable overheads}$$

(iii) Sales Variance: The analysis of variances will be complete only when the difference between the actual profit and standard profit is fully analysed. It is necessary to make an analysis of sales variances to have a complete analysis of profit variance, because profit is the difference between sales and cost. Thus, in addition to the analysis of cost variances i.e., material cost variance, labour cost variance and overhead variance, an analysis of sales variance should be made. Sales variances



analysis may be categorized into two:

1. Sales Value (or) Revenue variance.
2. Sales Margin (or) Profit variance.

Sales Value Variance is the difference between the budgeted value of sales and the actual value of sales during a period. Sales Value Variance may arise due to the following reasons:

- Actual selling price may be higher or lower than the standard price.
- Actual quantity of goods sold may be more or less than the standard.
- Actual mix of the sales may be different than the standard mix.

Sales Margin Variance is the difference between the budgeted profit and actual profit and this is also the sum total of all variances. Sales Margin Variance may arise due to the following reasons:

- Raise in general price level.
- Unexpected competition.
- Ineffective sales promotion.

1. **Sales Value Variance:** The difference between budgeted sales and actual sales results in Sales Value Variance. If the actual sales are more than the budgeted sales, a favourable variance would be shown and vice versa. The formula is:

Sales Value variance = Budgeted Sales – Actual Sales

- (i) **Price Variance:** This can be calculated just like Material Price Variance. It is an account of the difference in actual selling price and the standard selling price for actual quantity of sales. The formula for this is:

Price variance = Actual Quantity Sold × (Standard Price – Actual Price)

Or

= Standard Sales – Actual Sales

- (ii) **Volume Variance:** It can be computed as Material Usage Variance. Budgeted sales may be different from the standard sales. In other words, budgeted quantity of sales at standard prices may vary from the actual quantity of sales at standard prices. Thus, the variance is as a result of difference in budgeted and actual quantities of goods sold. The formula is:

Volume Variance = Standard Price × (Budgeted Quantity – Actual Quantity)

Or

= Budgeted Sales – Standard Sales

- (a) **Mix variance:** When more than one product is manufactured and sold, the budgeted sales of different products are in a given ratio. If the actual quantities sold are not in the same proportion as budgeted, it would cause a mix variance.

It can be calculated according to two methods:

- Based on Quantity: This method is followed on those cases where products are homogenous. In case the formula for calculating Sales Mix Variance is on the same pattern as is used in case of Material Mix Variance.

Mix Variance = Standard Price × (Revised Standard Quantity – Actual Quantity)

= Revised Standard Sales – Standard Sales

If actual quantity is more than the revised standard quantity, it will result in favourable variance

or vice versa.

$$\text{Revised Standard Quantity} = \frac{\text{Total Quantity of Actual Mix}}{\text{Total Quantity of Standard Mix}} \times \text{Standard Quantity}$$

- Based on Value: This method is followed in those cases where products are not homogeneous. In such a case, the actual sales at standard prices, i.e. standard sales are to be expressed in budgeted ratios so as to calculate 'revised standard sales' and then is compared with the actual sales at standard prices. The formula is:

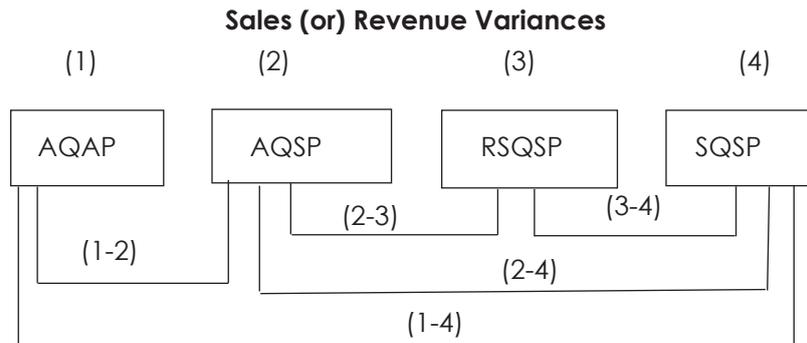
$$\text{Mix Variance} = \text{Revised Standard Sales} \times \text{Standard Sales}$$

$$\text{Revised Standard Sales} = \text{Budgeted Ratio of Sales} \times \text{Standard Sales}$$

$$\text{Budgeted Ratio of Sales} = \frac{\text{Budgeted Sales Of a Product}}{\text{Total Budgeted Sales}}$$

- (b) **Quantity Variance:** It is the difference between budgeted sales and the revised standard sales. The formula is:

$$\text{Quantity variance} = \text{Budgeted Sales} - \text{Revised Standard Sales}$$



Where,

AQ = Actual Quantity Sold

AP = Actual Selling Price

SP (or) BP = Standard Selling Price (or) Budgeted Price

RSQ = Revised Standard Quantity

SQ (or) BQ = Standard (or) Budgeted Quantity

1. AQAP = Actual Sales
 2. AQSP = Actual Quantity of Sales at Standard Selling Prices.
 3. RSQSP = Revised Standard or Budgeted Sales.
 4. SQSP = Standard (or) Budgeted Sales.
- a. Sales Sub-Volume (or) Quantity Variance = 3-4
 - b. Sales Mix Variance = 2-3
 - c. Sales Volume Variance = 2-4
 - d. Sales Price Variance = 1-2
 - e. Total Sales Value Variance = 1-4



V. Profit Variance: This represents the difference between budgeted profit and actual profit. The formula is: Profit Variance = Budgeted Profit – Actual Profit

- (i) **Price Variance:** It shall be equal to the price variance calculated with reference to turnover. It represents the difference of standard and actual profit on actual volume of sales. The formula is:

$$\text{Price Variance} = \text{Standard Profit} - \text{Actual Profit}$$

Or

$$= \text{Actual Quantity Sold} \times (\text{Standard Profit per Unit} - \text{Actual Profit per Unit})$$

- (ii) **Volume Variance:** The profit at the standard rate on the difference between the standard and the actual volume of sales would be the amount of volume variance. The formula is:

$$\text{Volume Variance} = \text{Budgeted Profit} - \text{Standard profit}$$

Or

$$= \text{Standard Rate of Profit} \times (\text{Budgeted Quantity} - \text{Actual Quantity})$$

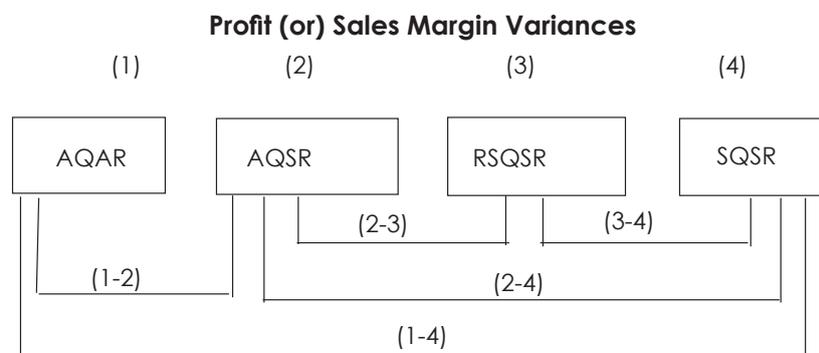
The Volume Variance can be divided into:

- (a) **Mix Variance:** When more than one product is manufactured and sold, the difference in profit can result because of the variation of actual mix and budgeted mix of sales. The difference between revised standard profit and the standard profit, therefore is the mix variance. The formula is:

$$\text{Mix Variance} = \text{Revised Standard Profit} - \text{Standard Profit}$$

- (b) **Quantity Variance:** It results from the variation in profit because of difference in actual quantities sold and the budgeted quantities both taken in the same ratio. The actual quantities are to be revised in the ratio of standard mixture. The formula is:

$$\text{Quantity Variance} = \text{Budgeted Profit} - \text{Revised Standard Profit}$$



Where,

AQ = Actual Quantity Sold

AR = Actual Rate of Profit

SR (or) BR = Standard (or) Budgeted Rate of Profit

RSQ = Revised Standard Quantity

SQ (or) BQ = Standard (or) Budgeted Quantity

1. AQAR = Actual Profit
2. AQSR = Actual Quantity of Sales at Standard Rate of Profit
3. RSQSR = Revised Standard (or) Budgeted Profit
4. SQSR = Standard (or) Budgeted Profit
- a. Profit Sub-Volume or Quantity Variance = 3-4
- b. Profit Variance due to Sales Mix = 2-3
- c. Profit Variance due to Sales Volume = 2-4
- d. Profit Variance due to Selling Price = 1-2
- e. Total Profit Variance = 1-4

4.1.13 Reporting of Variances:

In order that variance reporting should be effective, it is essential that the following *requisites* are fulfilled:

1. The variances arising out of each factor should be correctly segregated. If part of a variance due to one factor is wrongly attributed to or merged with that of another, the analysis report submitted to the management would be misleading and wrong conclusions may be drawn from it.
2. Variances, particularly the controllable variances should be reported with promptness as soon as they occur. Mere operation of Standard Costing and reporting of variances is of no avail. The success of a Standard Costing system depends on the extent of responsibility which the management assumes in correcting the conditions which cause variances from standard. In order to assist the management in assuming this responsibility, the variances should be reported frequently and on time. This would enable corrective action being taken for future production while work is in progress and before the project or job is completed.
3. For effective control, the line of organisation should be properly defined and the authority and responsibility of each individual should be laid down in clear terms. This will avoid 'passing on the buck' and shirking of responsibility and will enable the tracing of the causes of variances to the appropriate levels of management.
4. In certain cases, a particular variance may be the joint responsibility of more than one individual or department. It is obvious that if corrective action has to be effective in such cases, it should be taken jointly.
5. Analysis of uncontrollable variances should be made with the same care as for controllable variances. Though a particular variance may not be controllable at the lower level of management, a detailed analysis of the off-standard situation may reveal far reaching effects on the economy of the concern. This should compel the top management to take corrective action, say, by changing the policy which gave rise to the uncontrollable variance.

4.1.14 Forms of Variance Reports:

The forms of reports for the different types of variances should be designed keeping in view the needs of the management and the size of the concern, and no standard forms are, therefore, suggested. Variance Analysis Reports prepared for the top management would obviously be more formal and would contain broad details only, while those meant for presentation to the lower levels would contain details showing the causes of each variance and the specific responsibilities of the individuals concerned.



4.1.15 Variance Ratios and Cost Ratios:

We have so far considered the various cost variances in absolute monetary terms. Although these show the extent of the variances, the information is insufficient if the management wants to study the trend of variances from period to period. Absolute figures in themselves do not give the full picture and it is only by comparison of one item with another that their correct relationship is obtained. Variance Ratios serve this need and comparison of these ratios from one period to another can be gainfully made. Another advantage of Variance Ratio is in regard to its applicability in the dual plan of standard cost accounting. With the help of the Cost Variance Ratios, standard costs of production and the standard values of inventory can be easily converted into actual costs for the purpose of incorporation in the financial accounts.

A number of ratios are used for reporting to the management the effective use of capacity, material, labour and other resources of a concern. Some of these are considered below:

1. Efficiency Ratio.
2. Activity Ratio.
3. Calendar Ratio.
4. Capacity Usage Ratio
5. Capacity Utilization Ratio.
6. Idle Time Ratio.

1. **Efficiency Ratio:** It is the standard hours equivalent to the work produced, expressed as a percentage of the actual hours spent in producing that work.

$$\text{Efficiency Ratio} = \frac{(\text{Standard Hours})}{(\text{Actual Hours})} \times 100$$

2. **Activity Ratio:** It is the number of standard hours equivalent to the work produced, expressed as a percentage of the budgeted standard hours.

$$\text{Activity Ratio} = \frac{\text{Standard Hours for Actual Work}}{\text{Budgeted standard hours}} \times 100$$

3. **Calendar Ratio:** It is the relationship between the number of working days in a period and the number of working days in the relative budget period.

$$\text{Calendar Ratio} = \frac{\text{Available Working Days}}{\text{Budgeted Working Days}} \times 100$$

4. **Capacity Usage Ratio:** It is the relationship between the budgeted number of working hours and the maximum possible number of working hours in a budget period.

$$\text{Capacity Usage Ratio} = \frac{\text{Budgeted Hours}}{\text{Maximum Possible Hours in Budget Period}} \times 100$$

5. **Capacity Utilisation Ratio:** It is the relationship between actual hours in a budget period and the budgeted working hours in the period.

$$\text{Capacity Utilisation Ratio} = \frac{\text{Actual Hours}}{\text{Budgeted Hours}} \times 100$$

6. **Idle Time ratio:** It is the ratio of idle time hours to the total hours budgeted.

$$\text{Idle Time Ratio} = \frac{\text{Idle Time Hours}}{\text{Budgeted Hours}} \times 100$$

4.1.16 Treatment of Cost Variances in Accounts:

In Standard Cost Accounting Systems which contain both actual and standard costs in the accounting records and financial statements, the question of adjustment of the cost variances at the end of the accounting period arises. Three methods of disposal of variances and the advantages and disadvantages of each are discussed below:

1. Transfer to Profit and Loss Account.
2. Allocation of Variances to Finished Stock, Work-in-Progress and Cost of Sales Account.
3. Transfer of Variances to the Reserve Account.

1. Transfer to Profit and Loss Account:

In this method, the stocks of work-in-process and finished goods and cost of sales are maintained at standard costs and all variances are closed to the Profit and Loss Account at the end of the accounting period.

The opinions advanced in favour of transfer of variances to profit or loss are:

- a. Standard costs are considered to be the correct or real costs. Any variances from the standard costs should, therefore, be taken to mean deviations from the 'should be' costs due to the efficiencies or inefficiencies, abnormal activity, excessive or less spending etc. The variances cannot, therefore, be considered as the normal increases or decreases in costs and should be debited or credited to the Profit and Loss Account.
- b. The method ensures conservative inventory valuation as all extraneous factors like costs of inefficiencies, waste and losses are eliminated.
- c. Exclusion of variations makes gross profit for different periods comparable.
- d. Standard costs facilitate prompt inventory valuation.
- e. Variances separated out and reflected as profit or loss attracts the management's attention.
- f. Distribution of variances to product costs is difficult where a large number of diverse products is manufactured.

Some Accountants prefer to transfer only the debit variances, and credit variances are not credited to the Profit and Loss Account. Another practice is to adjust a proportionate part of the Material Price Variance to the closing stock of materials when price variance at the point of purchase is worked out.

2. Allocation of variances to Finished Stock, Work-in-Progress and Cost of Sales Account:

Under this method, the variances are distributed over stocks of finished and partly finished products and to the cost of sales. The distribution of each variance is made to the three accounts on a percentage basis according to the closing balance (value) of each account.

The opinions put forth in support of this method are, in brief, as follows:

- a. Standard costs are only tools of control and they do not represent true or correct costs. Only actual costs should, therefore, be reflected in the financial statements.
- b. Variances are not actual losses and as such, they should not be allowed to distort profits.
- c. Unless the standards are accurate and up-to-date, inventory valuation on the basis of standard costs will be inaccurate.
- d. Variances when credited to the Profit and Loss Account inflate the Work-in-Progress Account to the extent of the unrealized profit.



3. Transfer of variances to the Reserve Account:

In this method, the various costs variances are carried over to the subsequent financial year as deferred credits or charges. Thus, variance losses and gains may be set off against the gains and losses in the subsequent years. This method is not in common use but it might be useful in cases where seasonal fluctuations occur so that the favourable and adverse variances may cancel each other in a complete business cycle covering more than one financial year.

Illustration 1:

Product A required 10 kg of material at a rate of ₹4 per kg. The actual consumption of material for the manufacturing product A comes to 12 kg of material at the rate of ₹4.50 per kg.

Calculate: (a) Material Cost Variance
(b) Material Usage Variance
(c) Material Price Variance.

Solution:

Computation of Required Values

Let (1) SQSP = Standard Cost of Standard Material
(2) AQSP = Standard Cost of Actual Material
(3) AQAP = Actual Cost of Material

Given Values:

SQ = Standard Quantity of Material = 10 kg

AQ = Actual Quantity of Material = 12 kg

SP = Standard Price = ₹ 4 per kg

AP = Actual Price = ₹ 4.50 per kg.

(1) SQSP = $(10 \times 4) = ₹ 40$

(2) AQSP = $(12 \times 4) = ₹ 48$

(3) AQAP = $(12 \times 4.50) = ₹ 54$

Computation of Required Material Variances

a. Material Usage Variance = $(1) - (2) = 40 - 48 = ₹8 (A)$

b. Material Price Variance = $(2) - (3) = 48 - 54 = ₹6 (A)$

c. Material Cost Variance = $(1) - (3) = 40 - 54 = ₹14 (A)$

Illustration 2:

The standard quantity and standard price of raw material required for one unit of product A are given as follows

	Quantity (kg.)	S.P. (₹)
Material X	2	3
Material Y	4	2

The actual production and relevant data are as follows:

Material X 1,100 kgs. @ ₹ 3,410

Material Y 1,800 kgs. @ ₹ 3,960

Calculate Variances. Actual production was 500 units.

Solution:**Analysis of Given Data**

Material	Standard Data			Actual Data		
	Quantity (Kg.)	Price (₹)	Value (₹)	Quantity (Kg.)	Price (₹)	Value (₹)
A	1000 (500 x 2)	3.00	3,000	1,100	3.10	3,410
B	2000 (500 x 4)	2.00	4,000	1,800	2.20	3,960
	3000		7,000	2,900		7,370

Material	SQSP (₹)	RSQSP (₹)	AQSP (₹)	AQAP (₹)
X		$966.67 \times 3 = 2,900$	$1,100 \times 3$	
Y		$1933.33 \times 2 = 3,867$	$1,800 \times 2$	
Total	7,000	6,767	6,900	7,370

Where (1) **SQSP** = Standard Cost of Standard Material = ₹ 7,000

(2) **RSQSP** = Revised Standard Cost of Material = ₹ 6,767

(3) **AQSP** = Standard Cost of Actual Material = ₹ 6,900

(4) **AQAP** = Actual Cost of Material = ₹ 7,370

Computation of Variances

(a) Material Sub-usage variance = (1) – (2) = 7,000 – 6,767 = ₹ 233 (F)

(b) Material Mix variance = (2) – (3) = 6,767 – 6,900 = ₹ 133 (A)

(c) Material Usage variance = (1) – (3) = 7,000 – 6,900 = ₹ 100 (F)

(d) Material price variance = (3) – (4) = 6,900 – 7,370 = ₹ 470 (A)

(e) Material cost variance = (1) – (4) = 7,000 – 7,370 = ₹ 370 (A)

Illustration 3:

From the following you are required to calculate

(a) Material Usage Variance

(b) Material Price Variance

(c) Material Cost Variance

Quantity of material purchased	3,000 units
Value of material purchased	₹ 9,000
Standard quantity of material required for one tonne of finished product	25 units
Standard rate of material	₹ 2 per unit
Opening stock of material	NIL
Closing stock of material	500 units
Finished production during the period	80 tonnes



Solution:

Given Values:

SQ = Standard Quantity for Actual Production = $25 \times 80 = 2,000$ units.

AQ = Actual Quantity = 2,500 units (3,000 units – 500 units)

SP = Standard Price = ₹ 2

AP = Actual Price = ₹ 3

(1) SQSP = Standard Cost of Standard Material = $2,000 \times 2 = ₹ 4,000$

(2) AQSP = Standard Cost of Actual Material = $2,500 \times 2 = ₹ 5,000$

(3) AQAP = Actual Cost of Material = ₹ 7,500 (2,500 units \times ₹ 3 per unit)

Computation Of Material Variances:

a. Material usage variance = $(1) - (2) = ₹ (4,000 - 5,000) = ₹ 1,000$ (A)

b. Material price variance = $(2) - (3) = ₹ (5,000 - 7,500) = ₹ 2,500$ (A)

c. Material cost variance = $(1) - (3) = ₹ (4,000 - 7,500) = ₹ 3,500$ (A)

Illustration 4:

From the following information, compute (a) Mix, Price and Usage Variances.

	Quantity (Kg.)	Unit Rate (₹)	Total (₹)
Standard:			
Material A	10	2	20
Material B	20	3	60
Material C	20	6	120
	50		200
Actual:			
Material A	5	3	15
Material B	10	6	60
Material C	15	5	75
	30		150

Solution:

Computation of Required Values

Materials	(1) SQSP (₹)	(2) RSQSP (₹)	(3) AQSP (₹)	(4) AQAP (₹)
A	$10 \times 2 = 20$	$6 \times 2 = 12$	$5 \times 2 = 10$	$5 \times 3 = 15$
B	$20 \times 3 = 60$	$12 \times 3 = 36$	$10 \times 3 = 30$	$10 \times 6 = 60$
C	$20 \times 6 = 120$	$12 \times 6 = 72$	$15 \times 6 = 90$	$15 \times 5 = 75$
	<u>200</u>	<u>120</u>	<u>130</u>	<u>150</u>

RSQ For A = $10/50 \times 30 = 6$ units

RSQ For B = $20/50 \times 30 = 12$ units

RSQ For C = $20/50 \times 30 = 12$ units

Where **(1) SQSP** = Standard Cost of Standard Material = ₹ 200

(2) RSQSP = Revised Standard Cost of Material = ₹ 120

(3) AQSP = Standard Cost of Actual Material = ₹ 130

(4) AQAP = Actual Cost of Material = ₹ 150

Computation of Required Variances:

(a) Material Sub-Usage Variance = (1) – (2) = ₹ 200 – ₹ 120 = ₹80 (F)

(b) Material Mix Variance = (2) – (3) = ₹ 120 – ₹ 130 = ₹10 (A)

(c) Material Usage Variance = (1) – (3) = ₹ 200 – ₹130 = ₹70 (F)

(d) Material Price Variance = (3) – (4) = ₹130 – ₹150 = ₹20 (A)

(e) Material Cost Variance = (1) – (4) = ₹ 200 – ₹ 150 = ₹50 (F)

Illustration 5:

From the data given below, calculate the Material Price Variance, Material Usage Variance and Material Mix Variance:

Raw Material	Standard	Actual
A	40 units @ ₹50 per unit	50 units @ ₹50 per unit
B	60 units @ ₹40 per unit	60 units @ ₹45 per unit

Solution:

Material	Q	P (₹)	Value (₹)	Q	P (₹)	Value (₹)
A	40	50	2,000	50	50	2,500
B	60	40	2,400	60	45	2,700
	100		4,400	110		5,200

Computation of Required Values

Material	(1)SQSP (₹)	(2) RSQSP (₹)	(3) AQSP (₹)	(4) AQAP (₹)
A	$40 \times 50 = 2,000$	$44 \times 50 = 2,200$	$50 \times 50 = 2,500$	$50 \times 50 = 2,500$
B	$60 \times 40 = 2,400$	$66 \times 40 = 2,640$	$60 \times 40 = 2,400$	$60 \times 45 = 2,700$
	4,400	4,840	4,900	5,200



RSQ For A = $40/100 \times 110 = 44$ units

RSQ For B = $60/100 \times 110 = 66$ units

Where **(1) SQSP** = Standard Cost of Standard Material = ₹ 4,400

(2) RSQSP = Revised Standard Cost of Material = ₹ 4,840

(3) AQSP = standard Cost of Actual Material = ₹ 4,900

(4) AQAP = Actual Cost of Material = ₹ 5,200

Computation of Required Variances:

(a) Material Sub-Usage Variance = (1) – (2) = ₹ 440 (A) [₹ 4,400 – ₹ 4,840]

(b) Material Mix Variance = (2) – (3) = ₹ 60 (A) [₹ 4,840 – ₹ 49,00]

(c) Material Usage Variance = (1) – (3) = ₹ 500 (A) [₹ 4,400 – ₹ 4,900]

(d) Material Price Variance = (3) – (4) = ₹ 300 (A) [₹ 4,900 – ₹ 5,200]

(e) Material Cost Variance = (1) – (4) = ₹ 800 (A) [₹ 4,400 – ₹ 5,200]

Illustration 6:

The standard material cost for 100 kg of chemical D is made up :

Chemical A 30 kg. @ ₹ 4 per kg

Chemical B 40 kg. @ ₹ 5 per kg

Chemical C 80 kg. @ ₹ 6 per kg

In a batch 500 kg. of chemical D were produced from a mix of

Chemical A 140 kg. @ ₹ 588

Chemical B 220 kg. @ ₹ 1,056

Chemical C 440 kg. @ ₹ 2,860

How do you yield mix and price of factors contribute to the variance in the actual cost per 100 kg. of chemical D over the standard cost ?

Solution:

Analysis of Given Data

Chemical	Standard Data			Actual Data		
	Quantity	Price (₹)	Value (₹)	Quantity	Price (₹)	Value (₹)
A	30	4	120	28		117.60
B	40	5	200	44		211.20
C	80	6	480	88		572.00
	150		800	160		900.80
Less: Loss	50		-	60		-
	100		800	100		900.80

Computation of Required Values

Chemical	(1) SQSP (₹)	(2) RSQSP (₹)	(3) AQSP (₹)	(4) AQAP (₹)
A	30 × 4 = 120	32.00 × 4 = 128.00	28 × 4 = 112.00	117.60
B	40 × 5 = 200	42.67 × 5 = 213.35	44 × 5 = 220.00	211.20
C	80 × 6 = 480	85.33 × 6 = 512.00	88 × 6 = 528.00	572.20
	800.00	853.35	860.00	900.80

Computation of RSQ:

$$\text{RSQ} = \left(\frac{\text{SQ for that product}}{\text{SQ for all product}} \right) \times \text{AQ for that product}$$

$$\text{For A} = \left(\frac{30}{150} \right) \times 160 = 32.00 \text{ units.}$$

$$\text{For B} = \left(\frac{40}{150} \right) \times 160 = 42.67 \text{ units.}$$

$$\text{For C} = \left(\frac{80}{150} \right) \times 160 = 85.33 \text{ units.}$$

- Where (1) SQSP = Standard cost for Standard material = ₹800
 (2) RSQSP = Revised standard cost of material = ₹ 853.35
 (3) AQSP = Standard cost of actual material = ₹ 860.00
 (4) AQAP = Actual cost of material = ₹ 900.80

Computation of Required Variances

- (a) Material Yield variance = (1) – (2) = ₹53.35 (A) [₹800 – ₹853.35]
 (b) Material Mix variance = (2) – (3) = ₹6.65 (A) [₹853.35 – ₹860]
 (c) Material usage variance = (1) – (3) = ₹60 (A) [₹800 – ₹860]
 (d) Material price variance = (3) – (4) = ₹40.80 (A) [₹860 – ₹900.80]
 (e) Material cost variance = (1) – (4) = ₹100.80 (A) [₹800 – ₹900.80]

Illustration 7:

Material	Standard Quantity (Kg.)	Price (₹)	Total (₹)
A	500	6.00	3,000
B	400	3.75	1,500
C	300	3	900
	1,200		5,400
Less: 10% Normal loss	120		
	1,080		5,400



Material	Actual Quantity	Price	Total
A	400	6.00	2,400
B	500	3.60	1,800
C	400	2.80	1,120
Less: Actual loss	1,300		5,320
	220		
	1,080		5,320

Calculate:

- Material Cost Variance
- Material Price Variance
- Material Mix Variance
- Material Yield Variance
- Material Usage Variance

Solution:

Computation of Required Values

	SQSP (1) (₹)	RSQSP (2) (₹)	AQSP (3) (₹)	AQAP (4) (₹)
A	3,000	$541.67 \times 6 = 3,250$	$400 \times 6 = 2,400$	2,400
B	1,500	$433.33 \times 3.75 = 1,625$	$500 \times 3.75 = 1,875$	1,800
C	900	$325 \times 3 = 975$	$400 \times 3 = 1,200$	1,120
	5400	5,850	5,475	5,320

Computation of RSQ:

$$\text{For A} = \left(\frac{500}{1,200} \right) \times 1,300 = 541.67 \text{ units.}$$

$$\text{For B} = \left(\frac{400}{1,200} \right) \times 1,300 = 433.33 \text{ units.}$$

$$\text{For C} = \left(\frac{300}{1,200} \right) \times 1,300 = 325.00 \text{ units.}$$

Where

- SQSP** = Standard Cost for Standard Material = ₹ 5,400
- RSQSP** = Revised Standard Cost of Material = ₹ 5,850
- AQSP** = Standard Cost of Actual Material = ₹ 5,475
- AQAP** = Actual Cost of Material = ₹ 5,320

Computation of Required Variances

- a. Material Yield Variance = (1) – (2) = ₹ 450 (A) [₹(5,400 – 5,850)]
- b. Material Mix Variance = (2) – (3) = ₹ 375 (F) [₹(5,850 – 5,475)]
- c. Material usage variance = (1) – (3) = ₹75 (A) [₹(5,400 – 5,475)]
- d. Material price variance = (3) – (4) = ₹155 (F) [₹(5,475 – 5,320)]
- e. Material cost variance = (1) – (4) = ₹80 (F) [₹(5,400 – 5,320)]

Illustration 8:

The standard costs of a certain chemical mixture is:

40% Material A at ₹200 per ton

60% Material B at ₹300 per ton

A standard loss of 10% is expected in production

During a period they used

90 tons of Material A at the cost of ₹180 per ton

110 tons of Material B at the cost of ₹340 per ton

The weight produced is 182 tons of good production.

Calculate and present Material price, Usage, Mix

Solution:

Analysis of Given Data

Material	Standard Data			Actual Data		
	Quantity	Price (₹)	Value (₹)	Quantity	Price (₹)	Value (₹)
A	80	200	16,000	90	180	16,200
B	120	300	36,000	110	340	37,400
	200		52,000	200		53,600
Less: Loss	20		-	18		-
	180		52,000	182		53,600

Computation of Required Values

Material	SQSP (1) (₹)	RSQSP (2) (₹)	AQSP (3) (₹)	AQAP (4) (₹)
A	80.88 x 200 = 16,176	16,000	90 x 200 = 18,000	16,200
B	121.33 x 300 = 36,400	36,000	110 x 300 = 33,000	37,400
	52,578	52,000	51,000	53,600

Computation of SQ:

$$SQ = \left(\frac{RSQ \text{ for that product}}{RSQ \text{ for all product}} \right) \times AQ \text{ for that product}$$

$$\text{For A} = \left(\frac{80}{180} \right) \times 182$$



= 80.88 units

$$\text{For B} = \left(\frac{120}{80}\right) \times 182$$

= 121.33

Where (1) SQSP = Standard cost of Standard Material = ₹ 52,578

(2) RSQSP = Revised Standard Cost of Material = ₹ 52,000

(3) AQSP = Standard Cost of Actual Material = ₹ 51,000

(4) AQAP = Actual Cost of Material = ₹ 53,600

Computation of Required Variances:

- Material Yield Variance = (1) – (2) = ₹578 (F) [₹(52,578 – 52,000)]
- Material Mix Variance = (2) – (3) = ₹1,000 (F) [₹(52,000 – 51,000)]
- Material Usage Variance = (1) – (3) = ₹1,578 (F) [₹(52,578 – 51,000)]
- Material Price Variance = (3) – (4) = ₹2,600 (A) [₹(51,000 – 53,600)]
- Material Cost Variance = (1) – (4) = ₹1,022 (A) [₹(52,578 – 53,600)]

Illustration 9:

SV Ltd., manufactures BXE by mixing 3 raw materials. For every batch of 100 kg. Of BXE, 125 kg of raw materials are used. In April 2012, 60 batches were prepared to produce an output of 5600 kg of BXE. The standard and actual particulars for April, 2012 are as under:

Raw material	Standard Mix %	Price per kg (₹)	Actual Mix %	Price per kg (₹)	Quantity of raw materials purchased (Unit)
A	50	20	60	21	5000
B	30	10	20	8	2000
C	20	5	20	6	1000

Calculate all variances.

Solution:

Analysis of Given Data

Material	Standard Data			Actual Data		
	Quantity	Price (₹)	Value (₹)	Quantity	Price (₹)	Value (₹)
A	3,750	20	75,000	4,500	21	94,500
B	2,250	10	22,500	1,500	8	12,000
C	1,500	5	7,500	1,500	6	9,000
	7,500		1,05,000	7,500		1,15,500
Less: Loss	1,500		-	1,900		-
	6,000		1,05,000	5,600		1,15,500

Computation of Required Values

Material	SQSP (1) (₹)	RSQSP (2) (₹)	AQSP (3) (₹)	AQAP (4) (₹)
A	75,000	3,500 x 20 = 70,000	4,500 x 20 = 90,000	94,500
B	22,500	2,100 x 10 = 21,000	1,500 x 10 = 15,000	12,000
C	7,500	1,400 x 5 = 7,000	1,500 x 5 = 7,500	9,000
	1,05,000	98,000	1,12,500	1,15,500

Computation of SQ:

$$SQ = \left(\frac{\text{RSQ for that product}}{\text{RSQ for all product}} \right) \times \text{AQ for that product}$$

$$\text{For A} = \left(\frac{3,750}{6,000} \right) \times 5,600 = 3,500 \text{ units}$$

$$\text{For B} = \left(\frac{2,250}{6,000} \right) \times 5,600 = 2,100 \text{ units}$$

$$\text{For C} = \left(\frac{1,500}{6,000} \right) \times 5,600 = 1,400 \text{ units.}$$

Where **(1) SQSP** = Standard Cost of Standard Material = ₹ 98,000

(2) RSQSP = Revised Standard Cost of Material = ₹ 1,05,000

(3) AQSP = standard Cost of Actual Material = ₹ 1,12,500

(4) AQAP = Actual Cost of Material = ₹ 1,15,500.

Computation of Required Variances:

(a) Material Yield Variance = (1) – (2) = ₹7,000 (A) [₹(98,000 – 1,05,000)]

(b) Material Mix Variance = (2) – (3) = ₹7,500 (A) [₹(1,05,000 – 1,12,500)]

(c) Material Usage Variance = (1) – (3) = ₹14,500 (A) [₹(98,000 – 1,12,500)]

(d) Material Price Variance = (3) – (4) = ₹3,000 (A) [₹(1,12,500 – 1,15,500)]

(e) Material Cost Variance = (1) – (4) = ₹17,500 (A) [₹(1,05,000 – 1,15,500)]

Illustration 10:

A brass foundry making castings which are transferred to the machine shop of the company at standard price uses a standard costing system. Basing standards in regard to material stocks which are kept at standard price are as follows

Standard Mixture: 70% Copper and 30% Zinc

Standard Price: Copper ₹ 2,400 per ton and Zinc ₹ 650 per ton

Standard loss in melt: 5% of input

Figures in respect of a costing period are as follows:



Commencing stocks:

Copper 100 tons

Zinc 60 tons

Finished stock:

Copper 110 tons

Zinc 50 tons

Purchases:

Copper 300 tons cost ₹7,32,500

Zinc 100 tons cost ₹62,500

Metal melted 400 tons

Casting produced 375 tons

Present figures showing: Material price, Mixture and Yield Variance

Solution:

Computation of Actual Quantity (AQ)

Particulars	Copper		Zinc	
	Quantity (tons)	Value (₹)	Quantity (tons)	Value (₹)
Opening Stock	100	2,40,000	60	39,000
Add: Purchases	300	7,32,500	100	62,500
	400	9,72,500	160	1,01,500
Less: Closing stock	110	2,64,000	50	32,500
AQ	290	7,08,500	110	69,000

Analysis of Given Data

Material	Standard Data			Actual Data		
	Quantity (tons)	Price (₹)	Value (₹)	Quantity (tons)	Price (₹)	Value (₹)
Copper	280	2,400	6,72,000	290		7,08,500
Zinc	120	650	78,000	110		69,000
	400		7,50,000	400		7,77,500
Less: Loss @ 5%	20		-	25		-
	380		7,50,000	375		7,77,500

Computation of Required Values

Material	SQSP (1)	RSQSP (2)	AQSP (3)	AQAP (4)
Copper	276.31 x 2,400 = 6,63,157.87	6,72,000	290 x 2,400 = 6,96,000	7,08,500
Zinc	118.42 x 650 = 76,973.68	78,000	110 x 650 = 71,500	69,000
Total	7,40,132	7,50,000	7,67,500	7,77,500

Computation of SQ

$$SQ = \left(\frac{\text{RSQ for that material}}{\text{RSQ for all material}} \right) \times \text{AQ for that material}$$

$$\text{For Copper} = \left(\frac{280}{380} \right) \times 375 = 276.31 \text{ units.}$$

$$\text{For Zinc} = \left(\frac{120}{380} \right) \times 375 = 118.42 \text{ units.}$$

- Where (1) SQSP = Standard Cost of Standard Material = ₹ 7,40,132
 (2) RSQSP = Revised Standard Cost of Material = ₹ 7,50,000
 (3) AQSP = standard Cost of Actual Material = ₹ 7,67,500
 (4) AQAP = Actual Cost of Material = ₹ 7,77,500.

Computation of Required Variances:

- a. Material Yield Variance = (1) – (2) = ₹9,868 (A) [₹(7,40,132 – 7,50,000)]
- b. Material Mix Variance = (2) – (3) = ₹17,500 (A) [₹(7,50,000 – 7,67,500)]
- c. Material Usage Variance = (1) – (3) = ₹27,368 (A) [₹(7,40,132 – 7,67,500)]
- d. Material Price Variance = (3) – (4) = ₹10,000 (A) [₹(7,67,500 – 7,77,500)]
- e. Material Cost Variance = (1) – (4) = ₹37,368 (A) [₹(7,40,132 – 7,77,500)]

Illustration 11:

A company manufacturing a special type of fencing tile 12"X 8" X 1/2" used a system of standard costing. The standard mix of the compound used for making the tiles is:

- 1,200 kg. of Material A @ ₹0.30 per kg.
- 500 kg. of Material B @ ₹0.60 per kg.
- 800 kg. of Material C @ ₹0.70 per kg.

The compound should produce 12,000 square feet of tiles of 1/2" thickness. During a period in which 1,00,000 tiles of the standard size were produced, the material usage was:-

Kg		₹
7,000	Material A @ ₹ 0.32 per kg.	2,240
3,000	Material B @ ₹ 0.65 per kg.	1,950
5,000	Material C @ ₹ 0.75 per kg.	3,750
15,000		7,940

Present the cost figures for the period showing Material Price, Mixture, Sub-Usage Variance.

Solution:

Area of tile = 12 x 8/12 x 12 = 2/3 sq. ft.

No of tiles that can be laid in 12,000 sq. ft. is 12,000 / (2/3) = 18,000 tiles.



	Standard Data			Actual Data		
	Q	P (₹)	V (₹)	Q	P (₹)	V (₹)
A	6,666.67	0.3	2,000	7,000	0.32	2,240
B	2,777.77	0.6	1,666.67	3,000	0.65	1,950
C	4,444.44	0.7	3,111.11	5,000	0.75	3,750
	13,888.89		6,778	15,000		7,940

Q for A = $1,200 / 18,000 \times 1,00,000 = 6,666.67$

Q for B = $\frac{500}{18,000} \times 1,00,000 = 2,777.77$

Q for C = $\frac{800}{18,000} \times 1,00,000 = 4,444.44$

	(1)	(2)	(3)	(4)
	SQSP (₹)	RSQSP (₹)	AQSP (₹)	AQAP (₹)
A	2,000	7,200 x 0.3	7,000 x 0.3	2,240
B	1,666.67	3,000 x 0.6	3,000 x 0.6	1,950
C	3,111.11	4,800 x 0.7	5,000 x 0.7	3,750
A		2,160	2,100	
B		1,800	1,800	
C		3,360	3,500	
	(₹) 6,778	(₹) 7,320	(₹) 7,400	(₹) 7,940

RSQ for A = $(15,000 / 13,888.89) \times 6,666.67 = 7,200$ units.

1. **SQSP** = Standard Cost of Standard Material = ₹ 6,778
2. **RSQSP** = Revised Standard Cost of Material = ₹ 7,320
3. **AQSP** = Standard Cost of Actual Material = ₹ 7,400
4. **AQAP** = Actual Cost of Material = ₹ 7,940
 - a. Material Sub-Usage Variance = $(1 - 2) = ₹ 542(A)$
 - b. Material Mix Variance = $(2 - 3) = ₹ 80(A)$
 - c. Material Usage Variance = $(1 - 3) = ₹ 622(A)$
 - d. Material Price Variance = $(3 - 4) = ₹ 540(A)$
 - e. Material Cost Variance = $(1 - 4) = ₹ 1,162(A)$

Illustration 12:

The standard mix of product M5 is as follows :

Lbs	Material Price Per LB
50% A	5.00
20% B	4.00
30% C	10.00

Standard loss is 10% of input. There is no scrap value. Actual production for month was LB.7240 of M5 from 80 mixes. Purchases and consumption is as follows:

Lbs Material	Price
4160 A	5.5
1680 B	3.75
2560 C	9.5

Calculate variances.

Solution:**Analysis of Given Data**

Material	Standard Data			Actual Data		
	Quantity	Price	Value	Quantity	Price	Value
A	4,200	5	21,000	4,160	5.50	22,880
B	1,680	4	6,720	1,680	3.75	6,300
C	2,520	10	25,200	2,560	9.50	24,320
	8,400		52,920	8,400		53,500
Less: Loss	840		-	1,160		-
	7,560		52,920	7,240		53,500

Computation of Required Values

Material	SQSP (1) (₹)	RSQSP (2) (₹)	AQSP (3) (₹)	AQAP (4) (₹)
A	4,022.22 × 5 = 20,111.11	21,000	4,160 × 5 = 20,800	22,880
B	1,608.889 × 4 = 6,435.56	6,700	1,680 × 4 = 6,720	6,300
C	2,413.33 × 10 = 24,133.33	25,200	2,560 × 10 = 25,600	24,320
	50,680	52,920	53,120	53,500

Computation of SQ:

$$SQ = \left(\frac{SQ \text{ for that material}}{SQ \text{ for all material}} \right) \times AQ \text{ for that material}$$

$$\text{For A} = \left(\frac{4,200}{7,560} \right) \times 7,240 = 4,022.22$$

$$\text{For B} = \left(\frac{1,680}{7,560} \right) \times 7,240 = 1,608.889$$

$$\text{For C} = \left(\frac{2,520}{7,560} \right) \times 7,240 = 2,413.33$$

- Where (1) SQSP = Standard Cost of Standard Material = ₹ 50,680
 (2) RSQSP = Revised Standard Cost of Material = ₹ 52,920
 (3) AQSP = Standard Cost of Actual Material = ₹ 53,120
 (4) AQAP = Actual Cost of Material = ₹ 53,500.

Computation Of Required Variances:

- Material Yield variance = (1) – (2) = ₹ 2,240(A)
- Material Mix Variance = (2) – (3) = ₹ 200(A)
- Material Usage Variance = (1) – (3) = ₹ 2,440(A)
- Material Price Variance = (3) – (4) = ₹ 380(A)
- Material Cost Variance = (1) – (4) = ₹ 2,820(A)

**Illustration 13:**

A manufacturing concern which has adopted standard costing furnishes the following information.

Standard

Material for 70 Kg of finished product of 100 Kg

Price of materials Re.1 per kg

Actual

Output	2,10,000 kg.
Material used	2,80,000 kg.
Cost of materials	₹ 2,52,000

Calculate:

- Material Usage Variance
- Material Price Variance
- Material cost Variance

Solution:**Computation of Required Values**

(1) SQSP (₹)	(2) AQSP (₹)	(3) AQAP (₹)
$[2,10,000 \times 100/70] \times 1$	$2,80,000 \times 1$	
3,00,000	2,80,000	2,52,000

Computation of Required Variances:

- Material Usage Variance = (1) – (2) = ₹ 20,000 (F)
- Material Price Variance = (2) – (3) = ₹ 28,000(F)
- Material Cost Variance = (1) – (3) = ₹ 48,000(F)

Illustration 14:

The standard set for material consumption was 100kg. @ ₹ 2.25 per kg.

In a cost period:

Opening stock was 100 kg. @ ₹ 2.25 per kg.

Purchases made 500 kg. @ ₹ 2.15 per kg.

Consumption 110 kg.

Calculate: a) Usage b) Price variance

- When variance is calculated at point of purchase
- When variance is calculated at point of issue on FIFO basis
- When variance is calculated at point of issue on LIFO basis

Solution:**a) Computation of Material Usage Variance**

$$\begin{aligned}\text{Material Usage Variance} &= \text{SQSP} - \text{AQSP} \\ &= \text{SP} (\text{SQ} - \text{AQ}) \\ &= 2.25(100-110) \\ &= 22.50 \text{ (A)}\end{aligned}$$

b) Computation of Price variance:

1) When Variance is calculated at the point of purchase:

$$\begin{aligned} \text{Price variance} &= \text{AQSP} - \text{AQAP} \\ &= (110 \times 2.25) - (110 \times 2.15) \\ &= 11 \text{ (F)} \end{aligned}$$

2) When variance is calculated at the point of issue on FIFO basis

$$\begin{aligned} \text{Price variance} &= \text{AQSP} - \text{AQAP} \\ &= (110 \times 2.25) - [(100 \times 2.25) + [10 \times 2.15]] \\ &= 1 \text{ (F)} \end{aligned}$$

3) When variance is calculated at the point of issue on LIFO basis

$$\begin{aligned} \text{Price variance} &= \text{AQSP} - \text{AQAP} \\ &= (110 \times 2.25) - (110 \times 2.15) \\ &= 247.50 - 236.50 \\ &= 11 \text{ (F)} \end{aligned}$$

Illustration 15:

Using the following information calculate each of three labour variance for each department.

		Dept X	Dept Y
Gross wages direct	(₹)	28,080	19,370
Standard hours produced		8,640	6,015
Standard rate per hour	(₹)	3	3.40
Actual hours worked		8,200	6,395

Solution:

Dept. X : Computation of Required Values

SRSH (1)	SRAH (2)	ARAH (3)
3 x 8640	3 x 8200	
₹ 25,920	₹ 24,600	₹ 28080

1. SRSH = Standard Cost of Standard Labour
 2. SRAH = Standard Cost of Actual Labour
 3. ARAH = Actual Cost of Labour
- a. Labour Efficiency Variance = (1) – (2) = ₹ 1,320 (F) [₹ (25,920 – 24,600)]
 - b. Labour Rate Variance = (2) – (3) = ₹ 3,480 (A) [₹ (24,600 – 28,080)]
 - c. Labour Cost Variance = (1) – (3) = ₹ 2,160 (A) [₹ (25920 – 28,080)]

Dept. Y Computation of Required Values

SRSH (1) (₹)	SRAH (2) (₹)	ARAH (3) (₹)
3.4 x 6,015	3.4 x 6,395	
₹ 20,451	₹ 21,743	₹ 19,370



- a. Labour efficiency variance = (1) – (2) = ₹ 1,292 (A)
 b. Labour rate variance = (2) – (3) = ₹ 2,373 (F)
 c. Labour Cost Variance = (1) – (3) = ₹ 1,081 (F)

Illustration 16:

The standard labour complement and the actual labour complement engaged in a week for a job are as under:

	Skilled workers	Semi- skilled workers	Unskilled workers
a) Standard no. of workers in the gang	32	12	6
b) Standard wage rate per hour (₹)	3	2	1
c) Actual no. of workers employed in the gang during the week	28	18	4
d) Actual wage rate per hour (₹)	4	3	2

During the 40 hour working week the gang produced 1,800 standard labour hours of work. Calculate

- 1) Labour Efficiency Variance 2) Mix Variance
 3) Rate of Wages Variance 4) Labour Cost Variance

Solution:

Analysis of Given Data

	Standard Data			Actual Data		
	Hours	Rate (₹)	Value (₹)	Hours	Rate (₹)	Value (₹)
Skilled	1,280	3	3,840	1,120	4	4,480
Semi skilled	480	2	960	720	3	2,160
Unskilled	240	1	240	160	2	320
	2,000		5,040	2,000		6,960

Computation of Required Values

	SRSH (1) (₹)	SRRSH (2) (₹)	SRAH (3) (₹)	ARAH (4) (₹)
Men	3 x 1,152 = 3,456	3,840	3 x 1,120 = 3,360	4,480
Women	2 x 432 = 864	960	2 x 720 = 1,440	2,160
Boys	1 x 216 = 216	240	1 x 160 = 160	320
	4,536	5040	4,960	6,960

Computation of SH

$$SH = \left(\frac{\text{SH for that worker}}{\text{SH for all the worker}} \right) \times \text{AQ for that worker}$$

$$\text{For Skilled worker} = \left(\frac{1,280}{2,000} \right) \times 1,800 = 1,152$$

$$\text{For Semiskilled worker} = \left(\frac{480}{2,000} \right) \times 1,800 = 432$$

$$\text{For Unskilled worker} = \left(\frac{240}{2,000} \right) \times 1,800 = 216$$

- Where (1) SRSH = Standard Cost of Standard Labour = ₹ 4,536
 (2) SRRSH = Revised Standard Cost of Labour = ₹ 5,040
 (3) SRAH = Standard Cost of Actual Labour = ₹ 4,960
 (4) ARAH = Actual Cost of Labour = ₹ 6,960

Computation of Labour Variances:

- a. Labour Sub-Efficiency Variance = (1) – (2) = ₹ 504 (A) [₹(4,536 – 5,040)]
- b. Labour Mix or Gang Variance = (2) – (3) = ₹80 (F) [₹(5,040 – 4,960)]
- c. Labour Efficiency Variance = (1) – (3) = ₹424 (A) [₹(4,536 – 4,960)]
- d. Labour Rate Variance = (3) – (4) = ₹2,000 (A) [₹(4,960 – 6,960)]
- e. Labour Cost Variance = (1) – (4) = ₹2,424 (A) [₹(4,536 – 6,960)]

Illustration 17:

Standard labour hours and rate for production of article A given below:

	Hours	Rate (₹)	Total (₹)
Skilled workers	5	1.50 per hour	7.50
Unskilled	8	0.50 per hour	4.00
Semi-skilled	4	0.75 per hour	3.00
			14.50

Actual data	Hours	Rate (₹)	Total (₹)
Skilled workers	4,500	2.00 per hour	9,000
Unskilled	10,000	0.45 per hour	4,500
Semi-skilled	4,200	0.75 per hour	3,150
	18,700		16,650

Articles produced 1,000 units



Calculate:

Labour Cost, Rate, Efficiency and Mix Variances.

Solution:

	SRSH (1) (₹)	SRRSH (2) (₹)	SRAH (3) (₹)	ARAH (4) (₹)
Skilled		1.5 x 5,500	1.5 x 4,500	
Unskilled		0.5 x 8,800	0.5 x 10,000	
Semi-skilled		0.75 x 4,400	0.75 x 4,200	
Skilled	7,500	8,250	6,750	9,000
Un skilled	4,000	4,400	5,000	4,500
Semi skilled	3,000	3,300	3,150	3,150
	14,500	15,950	14,900	16,650

$$\text{RSH for skilled} = \frac{5,000}{17,000} \times 18,700 = 5,500 \text{ units.}$$

$$\text{RSH for Unskilled} = \frac{8,000}{17,000} \times 18,700 = 8,800 \text{ units.}$$

$$\text{RSH for Semi-skilled} = \frac{4,000}{17,000} \times 18,700 = 4,400 \text{ units.}$$

1. SRSH – Standard Cost of Standard Labour = ₹ 14,500
2. SRRSH – Revised Standard Cost of Labour = ₹ 15,950
3. SRAH = Standard Cost of Actual Labour = ₹ 14,900
4. ARAH = Actual Cost of Labour = ₹ 16,650

- | | | |
|-----------------------------------|---------|---------------|
| a. Labour Sub-Efficiency Variance | = 1 – 2 | = ₹ 1,450 (A) |
| b. Labour Mix Variance | = 2 – 3 | = ₹ 1,050 (F) |
| c. Labour Efficiency Variance | = 1 – 3 | = ₹ 400 (A) |
| d. Labour Rate Variance | = 3 – 4 | = ₹ 1,750 (A) |
| e. Labour Cost Variance | = 1 – 4 | = ₹ 2,150 (A) |

Illustration 18:

A chemical company gives you the following standard and actual data of its Chemical No.1456. You are required to calculate variances (material).

Standard Data

450	kg. of Material A @ ₹20 per kg.	9,000
360	kg. of Material B @ ₹10 per kg.	3,600
810		12,600
	2,400 Skilled hours @ ₹2	4,800
	1,200 Unskilled hours @ ₹1	1,200
		6,000
90	Normal loss	
720		18,600

Actual Data

450	kg. of Material A @ ₹19 per kg.	8,550
360	kg. of Material B @ ₹11 per kg.	3,960
810		12,510
	2,400 Skilled hours @ ₹2.25	5,400
	1,200 Unskilled hours @ ₹1.25	1,500
		6,900
50	Normal loss	
760		19,410

Solution:**Computation of Required Values**

Material	SQSP (1)	RSQSP (2)	AQSP (3)	AQAP (4)
A	475 x 20 = 9,500	9,000	450 x 20 = 9,000	
B	380 x 10 = 3,800	3,600	360 x 10 = 3,600	
	13,300	12,600	12,600	12,510

Computation of Sq:

$$SQ = \left(\frac{SQ \text{ for that material}}{SQ \text{ for all material}} \right) \times AQ \text{ for that material}$$

$$\text{For A} = \left(\frac{450}{720} \right) \times 760 = 475 \text{ units.}$$

$$\text{For B} = \left(\frac{360}{720} \right) \times 760 = 380 \text{ units.}$$



- Where (1) SQSP = Standard Cost of standard Material = ₹ 13,300
 (2) RSQSP = Revised Standard Cost of Material = ₹ 12,600
 (3) AQSP = Standard Cost of Actual Material = ₹ 12,600
 (4) AQAP = Actual Cost of Material = ₹ 12,510.

Computation of Required Variances:

- a. Material Yield Variance = (1) – (2) = ₹700 (F) [₹(13,300 – 12,600)]
 b. Material Mix Variance = (2) – (3) = Nil [₹(12,600 – 12,600)]
 c. Material Usage Variance = (1) – (3) = ₹700 (F) [₹(13,300 – 12,600)]
 d. Material Price Variance = (3) – (4) = ₹90 (F) [₹(12,600 – 12,510)]
 e. Material Cost Variance = (1) – (4) = ₹790 (F) [₹(13,300 – 12,510)]

Illustration 19:

Calculate variances from the following:

STANDARD				ACTUAL			
INPUT	MATERIAL	(₹)/KG	TOTAL	INPUT	MATERIAL	(₹)/KG	TOTAL
400	A	@ 50	20,000	420	A	@ 45	18,900
200	B	@20	4,000	240	B	@ 25	6,000
100	C	@15	1,500	90	C	@15	1,350
700			25,500	750			26,250
LABOUR HOURS				LABOUR HOURS			
	100 @ ₹2 per hour	200			120 @ ₹2.50 per hour	300	
	200 woman @ ₹ 1.50	300	500		240 woman @ ₹ 1.60	384	684
25	Normal Loss			75	Actual Loss		
675			26000	675			26,934

Solution:

Calculation of Material Variances:

	(1)	(2)	(3)	(4)
	SQSP (₹)	RSQSP (₹)	AQSP (₹)	AQAP (₹)
A		428.57 x 50	420 x 50	
B		214.29 x 20	240 x 20	
C		107.14 x 15	90 x 15	
A	20,000	21,429	21,000	18,900
B	4,000	4,289	4,800	6,000
C	1,500	1,607	1,350	1,350
	₹ 25,500	₹ 27,325	₹ 27,150	₹ 26,250

RSQ for

A = 400/700 x 750 = 428.67 units

B = 200/700 x 750 = 214.29 units

C = 100/700 x 750 = 107.14 units

1. SQSP = Standard Cost of Standard Material = ₹ 25,500
2. RSQSP= Revised Standard Cost of Material = ₹ 27,325
3. AQSP= Standard Cost of Actual Material = ₹ 27,150
4. AQAP= Actual Cost of Material = ₹ 26,250
- a. Material Yield Variance (1-2) = ₹ 1,825 (A)
- b. Material Mix Variance (2-3) = ₹ 175 (F)
- c. Material Usage Variance (1-3) = ₹ 1,650 (A)
- d. Material Price Variance (3-4) = ₹ 900 (F)
- e. Material Cost Variance (1-4) = ₹ 750 (A)

Calculation of Labour Variances:

	(1)	(2)	(3)	(4)
	SRSH (₹)	SRRSH (₹)	SRAH (₹)	ARAH (₹)
Men		2 x 107.14	2 x 120	
Women		1.50 x 214.28	1.50 x 240	
Men	200	214.28	240	300
Women	300	321.42	360	384
	₹ 500	₹ 536	₹ 600	₹ 684

RSH for

Men = $100/700 \times 750 = 107.14$ units.

Women = $200/700 \times 750 = 214.28$ units.

1. SRSH = Standard Cost of Standard Labour = ₹ 500
2. SRRSH = Revised Standard Cost of Labour = ₹ 536
3. SRAH = Standard Cost of Actual Labour = ₹ 600
4. ARAH = Actual Cost of Labour = ₹ 684
- a. Labour Yield Variance (1-2) = ₹ 36 (A)
- b. Labour Mix Variance (2-3) = ₹ 64 (A)
- c. Labour Efficiency Variance (1-3) = ₹ 100 (A)
- d. Labour Rate Variance (3-4) = ₹ 84 (A)
- e. Labour Cost Variance (1-4) = ₹ 184 (A)

Illustration 20:

Budgeted hours for month of March, 2012	180 Hrs
Standard rate of article produced per hour	50 Units
Budgeted fixed overheads	₹ 2,700
Actual production March, 2012	9,200 Units
Actual hours for production	175 Hrs



Actual fixed overheads ₹ 2,800

Calculate overhead cost, budgeted variances.

Solution:

Computation of Required Values

SRSH (1) (₹)	SRAH (2) (₹)	SRBH (3) (₹)	ARAH (4) (₹)
15 x 184	15 x 175		
2,760	2,625	2,700	2,800

$$SR = \left(\frac{\text{Budgeted Fixed Overheads}}{\text{Budgeted Hours}} \right) = \left(\frac{2,700}{180} \right) = ₹15$$

Actual quantity = 9,200 units

$$\text{Standard Hours for Actual Production} = \left(\frac{9,200}{50} \right) = 184 \text{ hours}$$

Where (1) SRSH = Standard Cost of Standard Fixed Overheads = ₹ 2,760

(2) SRAH = Standard Cost of Actual Fixed Overheads = ₹ 2,625

(3) SRBH = Budgeted Fixed Overheads = ₹ 2,700

(4) ARAH = Actual Fixed Overheads = ₹ 2,800

Computation of Fixed Overhead Variances:

- Fixed Overheads Efficiency Variance = (1) – (2) = ₹135(F)
- Fixed Overhead capacity Variance = (2) – (3) = ₹75 (A)
- Fixed Overhead Volume Variance = (1) – (3) = ₹60 (F)
- Fixed Overhead Budget/ Expenditure Variance = (3) – (4) = ₹100 (A)
- Fixed Overhead Cost Variance = (1) – (4) = ₹ 40 (A)

Illustration 21:

In Dept. A the following data is submitted for the week ended 31st Oct:

Standard output for 40 hours per week	1,400 units
Standard fixed overhead	₹1,400
Actual output	1,200 units
Actual fixed overhead	₹1,500
Actual hours worked	32 hours

Prepare a statement of variances

Solution:

Computation of Required Values

SRSH (1) (₹)	SRAH (2) (₹)	SRBH (3) (₹)	ARAH (4) (₹)
$35 \times \left(\frac{1,200}{35} \right)$	35 x 32		
1,200	1,120	1,400	1,500

$$SR = \left(\frac{\text{Budgeted Fixed Overheads}}{\text{Budgeted Hours}} \right) = \left(\frac{1,400}{40} \right) = 35 \text{ units.}$$

$$SH = \left(\frac{1,200}{35} \right) = 34.29 \text{ hrs. (approx.)}$$

- Where (1) SRSH = Standard Cost of Standard Fixed Overheads = 1,200
 (2) SRAH = Standard Cost of Actual Fixed Overheads = 1,120
 (3) SRBH = Budgeted Fixed Overheads = 1,400
 (4) ARAH = Actual Fixed Overheads = 1,500.

Computation of Fixed Overhead Variances:

- Fixed Overheads Efficiency Variance = (1) – (2) = ₹80 (F)
- Fixed Overhead Capacity Variance = (2) – (3) = ₹280 (A)
- Fixed Overhead Volume Variance = (1) – (3) = ₹200 (A)
- Fixed Overhead Budget / Expenditure Variance = (3) – (4) = ₹100 (A)
- Fixed Overhead Cost variance = (1) – (4) = ₹300 (A)

Illustration 22:

Item	Budget	Actual
No. of working days	20	22
Output per man hour	1.0 Units	0.9 Units
Overhead Cost (₹)	1,60,000	1,68,000
Man-hours per day	8,000	8,400

Calculate Overhead Variances.

Solution:

(1) SRSH (₹)	(2) SRAH (₹)	(3) SRRBH (₹)	(4) SRBH (₹)	(5) ARAH (₹)
1 x 166320 ₹ 166320	1 x 184800 ₹ 184800	1 x 176000 ₹ 176000	₹ 160000	₹ 168000

Working Notes:

$$SR = \text{budgeted FOH/budgeted hours} = 1,60,000/1,60,000 = 1$$

$$RBH = (22/20) \times 1,60,000 = 1,76,000$$

$$AH = 22 \times 8,400 = 1,84,800$$

$$AQ = 1,84,800 \times 0.9 = 1,66,320$$

$$SH = 1,66,320/1 = 1,66,320$$

- SRSH = Standard Cost of Standard Fixed Overheads = ₹ 1,66,320
- SRAH = Standard Cost of Actual Fixed Overheads (or)
Fixed Overheads Absorbed or Recovered = ₹ 1,84,800
- SRRBH = Revised Budgeted Fixed Overheads = ₹ 1,76,000
- SRBH = Budgeted Fixed Overheads = ₹ 1,60,000



5. ARAH = Actual Fixed Overheads = ₹ 1,68,000
- a. FOH Efficiency Variance = 1-2 = ₹ 18,480(A)
 - b. FOH Capacity Variance = 2-3 = ₹ 8,800(F)
 - c. FOH Calendar Variance = 3-4 = ₹ 16,000(F)
 - d. FOH Volume Variance = 1-4 = ₹ 6,320(F)
 - e. FOH Budget Variance = 4-5 = ₹ 8,000(A)
 - f. FOH Cost Variance = 1-5 = ₹ 1,680(A)

Illustration 23:

A manufacturing co. operates a costing system and showed the following data in respect of the month of November.

Actual No. of working days	22
Actual man hours worked during the month	4,300
No. of Products Produced	425
Actual overhead incurred	₹ 1,800

Relevant information from the company's budget and standard cost data is as follows:

Budgeted No. of working days per month	20
Budgeted man hours per month	4,000
Standard man hours per product	10
Standard overhead rate per month per hour	50 p.

You are required to calculate the overhead variances for the month of November

Solution:

COMPUTATION OF REQUIRED VALUES

SRSH (1) (₹)	SRAH (2) (₹)	SRRBH (3) (₹)	SRBH (4) (₹)	ARAH (5) (₹)
$0.5 \times 4,250$	$0.5 \times 4,300$	$0.5 \times 4,400$	$0.5 \times 4,000$	
2,125	2,150	2,200	2,000	1,800

$$SR = \left(\frac{\text{Budgeted Fixed Overheads}}{\text{Budgeted Hours}} \right) = \left(\frac{2,000}{4,000} \right) = 0.50$$

$$RBH = \left(\frac{22}{20} \times 4,000 \right) = ₹ 4,400$$

$$SH = 425 \times 10 = 4,250.$$

Where (1) SRSH = Standard Cost of Standard Fixed Overhead = ₹ 2,125

(2) SRAH = Standard Cost of Actual Overhead = ₹ 2,150

(3) SRRBH = Revised Budgeted Overheads = ₹ 2,200

(4) SRBH = Budgeted Overheads = ₹ 2,000

(5) ARAH = Actual Overheads = ₹ 1,800

Computation of Required Variances:

- a. FOH Efficiency Variance = (1) – (2) = ₹ 25 (A)
- b. FOH Capacity Variance = (2) – (3) = ₹ 50 (A)
- c. FOH Calendar Variance = (3) – (4) = ₹ 200 (F)
- d. FOH Volume Variance = (1) – (4) = ₹ 125 (F)
- e. FOH Budget Variance = (4) – (5) = ₹ 200 (F)
- f. FOH Cost Variance = (1) – (5) = ₹ 325 (F)

Illustration 24:

SV Ltd has furnished you the following data:

	Budgeted	Actual
No. of working days	25	27
Production in units	20,000	22,000
Fixed overheads (₹)	30,000	31,000

Budgeted fixed OH rate is ₹1 per hour. In July, 2012 the actual hours worked were 31,500 / hrs

Calculate the following variances:

- 1) Efficiency 2) Capacity 3) Calendar 4) Volume 5) Expenditure 6) Total OH

Solution:

Computation of Required Values

SRSB (1) (₹)	SRAH (2) (₹)	SRRBH (3) (₹)	SRBH (4) (₹)	ARAH (5) (₹)
1 x 33,000	1 x 31,500	1 x 32,400		
33,000	31,500	32,400	30,000	31,000

$$RBH = 30,000 \times \frac{27}{25} = 32,400$$

$$\text{Standard time per unit} = \frac{30,000 \text{ hrs}}{20,000} = 1.5 \text{ hours}$$

$$SH = 22,000 \times 1.5 = 33,000$$

Using unit rate:

SRAQ (1) (₹)	SRSQ (2) (₹)	SRRBQ (3) (₹)	SRBQ (4) (₹)	ARAQ (5) (₹)
1.5 x 22,000	1.5 x 21,000	1.5 x 21,600	1.5 x 20,000	
33,000	31,500	32,400	30,000	31,000

$$SR = \frac{\text{B.FOH's}}{\text{Budgeted quantity}} = \frac{30,000}{20,000} = 1.5 \text{ hours}$$

$$RBQ = 20,000 \times \frac{27}{25} = 21,600$$



$$\text{Units in one hour} = \frac{20,000}{30,000} \text{ units}$$

$$\text{SQ} = 31,500 \times \frac{2}{3} = 21,000$$

1. SRSH / SRAQ Standard Cost of Standard FOH's = ₹ 33,000
2. SRAH / SRSQ – Standard Cost of Actual FOH's = ₹ 31,500
3. SRRBH/ SRRBQ – Revised Budgeted FOH's = ₹ 32,400
4. SRBH / SRBQ – Standard Fixed Overheads = ₹ 30,000
5. ARAH/ARAQ – Actual Fixed Overheads = ₹ 31,000
- a. FOH Efficiency Variance = (1) – (2) = 1,500 (F)
- b. FOH Capacity Variance = (2) – (3) = 900 (A)
- c. FOH Calendar Variance = (3) – (4) = 2,400 (F)
- d. FOH Volume Variance = (1) – (4) = 3,000 (F)
- e. FOH Budget or Expensive Variance = (4) – (5) = 1,000 (A)
- f. FOH Cost Variance = (1) – (5) = 2,000 (F)

Illustration 25:

A Co. manufacturing two products operates a standard costing system. The standard OH content of each product in cost center 101 is

Product A ₹ 2.40 (8 direct labour hours @ 30 p. per hour)

Product B ₹ 1.80 (6 direct labour hours @ 30 p. per hour)

The rate of 30 p. per hour is arrived at as follows:

Budgeted OH	₹ 570
Budgeted Direct labour Hours	₹1,900
Output of product A	100 units
Output of product B	200 units
No opening or closing stock	
Actual direct labor hours worked	2,320
Actual OH incurred	₹ 640

a) You are required to calculate total OH for the month of October

b) Show division into : 1) Expenditure 2) Volume 3) Efficiency Variances.

Solution:

Computation of Required Values

SRSH (1) (₹)	SRAH (2) (₹)	SRBH (3) (₹)	ARAH (4) (₹)
0.3×2000	0.3×2320	$0.3 \times 1,900$	
600	696	570	640

$$\text{SH} = (100 \times 8) + (200 \times 6) = 2000 \text{ hrs}$$

Where (1) SRSH = Standard Cost of Standard Fixed Overhead = ₹ 600

(2) SRAH = Standard Cost of Actual Overhead = ₹ 696

(3) SRBH = Budgeted Overheads = ₹ 570

(4) ARAH = Actual Overheads = ₹ 640

Computation of Required Variances:

- a. FOH Efficiency Variance = (1) – (2) = 96 (A)
- b. FOH Capacity Variance = (2) – (3) = 126 (F)
- c. FOH Volume Variance = (1) – (3) = 30 (F)
- d. FOH Budget Variance = (3) – (4) = 70 (A)
- e. FOH Cost Variance = (1) – (4) = 40 (A)

Illustration 26:

The following information was obtained from the records of a manufacturing unit using standard costing system.

	Standard	Actual
Units	4,000	3,800
No. of working days	20	21
Fixed overheads (₹)	40,000	39,000
Variable overhead (₹)	12,000	12,000

You are required to calculate the following overhead variances

- 1) Variable OH 2) Fixed 3) a) Expenditure b) Volume c) Efficiency d) Calendar.

Also prepare a reconciliation statement for the standard fixed expenses worked out at standard fixed OH rate and actual OH.

Solution:

Computation of Required Values

SRAQ (1) (₹)	SRRBQ (2) (₹)	SRBQ (3) (₹)	ARAQ (4) (₹)
10 x 3800	10 x 4200	10 x 4000	
38000	42000	40000	39000

$$SR = \left(\frac{\text{Budgeted Fixed Overheads}}{\text{Budgeted Units}} \right) = ₹ 10 \text{ per unit}$$

$$RBQ = \frac{21}{20} \times 4,000 = ₹ 4,200$$

Where (1) SRAQ = Standard Cost of Standard Fixed Overhead = ₹ 38,000

(2) SRRBQ = Revised Budgeted Overheads = ₹ 42,000

(3) SRBQ = Budgeted Overheads = ₹ 40,000

(4) ARAQ = Actual Overheads = ₹ 39,000

Computation of Required Variances:

- a. FOH Efficiency Variance = (1) – (2) = 4,000 (A)
- b. FOH Calendar Variance = (2) – (3) = 2,000 (F)



- c. FOH Volume Variance = (1) – (3) = 2,000 (A)
- d. FOH Budget Variance = (3) – (4) = 1,000 (F)
- e. FOH Cost Variance = (1) – (4) = 1,000 (A)

$$\begin{aligned}\text{Variable Overhead Variance} &= \text{SRAQ} - \text{ARAQ} \\ &= (3 \times 3,800) - 12,000 \\ &= 11,400 - 12,000 \\ &= ₹ 600 \text{ (A)}\end{aligned}$$

$$\text{SR} = \left(\frac{\text{Budgeted Variable Overheads}}{\text{Budgeted Hours}} \right) = \frac{12,000}{4,000} = ₹ 3 \text{ per hour.}$$

Illustration 27:

Vinayak Ltd. has furnished you the following information for the month of August, 2012.

	Budget	Actual
Output (units)	30,000	32,500
Hours	30,000	33,000
Fixed OH (₹)	45,000	50,000
Variable OH (₹)	60,000	68,000
Working days	25	26

Calculate Variances.

Solution:

Computation of Required Values

(1) SRSH (₹)	(2) SRAH (₹)	(3) SRRBH (₹)	(4) SRBH (₹)	(5) ARAH (₹)
$1.5 \times 32,500$	$1.5 \times 33,000$	$1.5 \times 31,200$		
48,750	49,500	46,800	45,000	50,000

$$\text{SR} = \left(\frac{\text{Budgeted Variable Overheads}}{\text{Budgeted Hours}} \right) = \frac{45,000}{30,000} = ₹ 1.50$$

$$\text{RBH} = \left(\frac{26}{25} \times 30,000 \right) = ₹ 31,200$$

- Where
- (1) SRSH = Standard Cost of Standard Fixed Overhead = ₹ 48,750
 - (2) SRAH = Standard Cost of Actual Overhead = ₹ 49,500
 - (3) SRRBH = Revised Budgeted Overheads = ₹ 46,800
 - (4) SRBH = Budgeted Overheads = ₹ 45,000
 - (5) ARAH = Actual Overheads = ₹ 50,000

Computation of Required Variances:

- a. FOH Efficiency Variance = (1) – (2) = 750 (A)
- b. FOH Capacity Variance = (2) – (3) = 2,700 (F)
- c. FOH Calendar Variance = (3) – (4) = 1,800 (F)
- d. FOH Volume Variance = (1) – (4) = 3,750 (F)
- e. FOH Budget Variance = (4) – (5) = 5,000 (A)
- f. FOH Cost Variance = (1) – (5) = 1,250 (A)

Variable Overhead Variances:

Computation of Required Values

SRSH (1) (₹)	SRAH (2) (₹)	ARAH (3) (₹)
2 x 32,500	2 x 33,000	
65,000	66,000	68,000

$$SR = \left(\frac{\text{Budgeted Variable Overheads}}{\text{Budgeted Hours}} \right) = \frac{60,000}{30,000} = ₹ 2 \text{ per unit}$$

Where (1) SRSH = Standard Cost of Variable Overheads = ₹ 65,000

(2) SRAH = Standard Variable Overhead for Actual Hours = ₹ 66,000

(3) ARAH = Actual Variable Overhead = ₹ 68,000.

Computation of Required Variances:

- a. Variable Overhead Efficiency Variance = (1) – (2) = 1,000 (A)
- b. VOH Budget/ Expenditure Variance = (2) – (3) = 2,000 (A)
- c. VOH Cost Variance = (1) – (3) = 3,000 (A)

Illustration 28:

The Cost Accountant of a Co. was given the following information regarding the OHs for Feb, 2013:

- a. Overhead Cost Variance ₹1,400 (A)
- b. Overheads Volume Variance ₹ 1,000 (A)
- c. Budgeted Hours for Feb, 2013: 1,200 Hours
- d. Budgeted OH for Feb, 2013: ₹ 6,000
- e. Actual Rate of Recovery of OH ₹ 8 per hour

You are required to assist him in computing the following for Feb, 2013

- 1) OHs Expenditure Variance
- 2) Actual OH's incurred
- 3) Actual Hours for Actual Production



- 4) OHs Capacity Variance
- 5) OHs Efficiency Variance
- 6) Standard Hours for Actual Production

Solution:

Computation of Required Values

SRSH (1) (₹)	SRAH (2) (₹)	SRBH (3) (₹)	ARAH (4) (₹)
5 x 1,000	5 x 800	5 x 1,200	8 x 800
5,000	4,000	6,000	6,400

1. SRSH - SRBH = Volume Variance
SRSH - 6,000 = 1,000
SRSH = 5,000 or SH = $\frac{5,000}{5} = 1,000$
2. SRSH - ARAH = Cost Variance
5,000 - ARAH = 1,400
ARAH = 6,400
 - a. Overhead Expenditure Variance = 6,000 - 6,400 = ₹400 (A)
 - b. Actual OH's Incurred = ₹ 6,400
 - c. Actual Hours for Actual Production = 800 hours
 - d. Overheads Capacity Variance = 4,000 - 6,000 = ₹ 2,000 (A)
 - e. Overheads Efficiency Variance = 5,000 - 4,000 = 1,000 (F)
 - f. Standard Hours for Actual Production = 1,000 hours

Illustration 29:

Standard			Actual		
Quantity	S.P.	Total	Quantity	A.P.	Total
A - 1600	24	38,400	A - 2400	20	48,000
B - 1400	18	25,200	B - 1400	18	25,200
C - 600	12	7,200	C - 750	14	10,500
D - 400	15	6,000	D - 450	14	6,300
4000		76,800	5000		90,000

From the above data calculate various sales variances

Solution:

Material	AQAP (1) (₹)	AQSP (2) (₹)	RSQSP (3) (₹)	SQSP (4) (₹)
A		2,400 x 24	2,000 x 24	
B		1,400 x 18	1,750 x 18	
C		750 x 12	750 x 12	
D		450 x 15	500 x 15	

Standard Costing

A	48,000	57,600	48,000	38,400
B	25,200	25,200	31,500	25,200
C	10,500	9,000	9,000	7,200
D	6,300	6,750	7,500	6,000
	90,000	98,550	96,000	76,800

$$RSQ = \left(\frac{SQ \text{ for that product}}{SQ \text{ for all products}} \right) \times AQ \text{ for all products}$$

e.g. = $\frac{1,600}{4,000} \times 5,000 = 2,000$ units

1. AQAP = Actual Sales = ₹ 90,000
2. AQSP = Actual Quantity of Sales at Standard Prices = ₹ 98,550
3. RSQSP = Revised Standard on Budgeted Sales = ₹ 96,000
4. SQSP = Standard or Budgeted Sales ₹ 76,800
 - a. Sales Sub-Volume Variance 3 -4 ₹ 19,200 (F)
 - b. Sales Mix Variance 2-3 ₹ 2,550 (F)
 - c. Sales Volume Variance 2 -4 ₹ 21,750 (F)
 - d. Sales Price Variance 1-2 ₹ 8,550 (A)
 - e. Sales Volume Variance 1-4 ₹ 13,200 (F)

Illustration 30:

Budgeted and actual sales for the month of December, 2012 of two products A and B of M/s. XY Ltd. were as follows:

Product	Budgeted Units	Sales Price/Unit (₹)	Actual Units	Sales Price / Unit (₹)
A	6,000	₹5	5,000	5.00
			1,500	4.75
B	10,000	₹2	7,500	2.00
			1,750	8.50

Budgeted costs for Products A and B were ₹4.00 and ₹ 1.50 unit respectively. Work out from the above data the following variances.

Sales Volume Variance, Sales Value Variance, Sales Price Variance, Sales Sub Volume Variance, Sales Mix Variance

Solution:

	(1)	(2)	(3)	(4)
	AQAP (₹)	AQSP (₹)	RSQSP (₹)	SQSP (₹)
A	5,000 X 5.00	6,500 X 5	5,906.25 X 5	6,000 X 5
	1,500 X 4.75			
B	7,500 X 2.00			



	1,750 X 1.90	9,250 X 2	9,843.75 X 2	10,000 X 2
A	25,000	32,500	29,531.25	30,000
	7,125			
B	15,000			
	3,325	18,500	19,687.5	20,000
	₹50,450	₹51,000	₹49,219	₹50,000

Revised Standard Quantity for

A = $6,000/16,000 \times 15,750 = 5,906.25$ units

B = $10,000/16,000 \times 15,750 = 9,843.75$ units

1. AQAP = Actual Sales = ₹50,450
2. AQSP = Actual Quantity of Sales at Standard Price = ₹51,000
3. RSQSP = Revised Budgeted or Standard Sales = ₹49,219
4. SQSP = Standard or Budgeted Sales = ₹50,000
- a. Sales Sub Volume or Quantity Variance = 3 – 4 = ₹781 (A)
- b. Sales Mix Variance = 2 – 3 = ₹1,781 (F)
- c. Sales Volume Variance = 2 – 4 = ₹1,000 (F)
- d. Sales Price Variance = 1 – 2 = ₹550 (A)
- e. Sales Value Variance = 1 – 4 = ₹450 (F)

Illustration 31:

From the following particulars for a period reconcile the actual profit with the budgeted profit.

	Budgeted	Actual
	(₹ lac)	(₹ lac)
Direct Material	50.00	66.00
Direct Wages	30.00	33.00
Variable overheads	6.00	7.00
Fixed overheads	10.00	12.00
Net Profit	4.00	8.50
	100.00	126.50

Actual material price and wage rates were higher by 10%. Actual sales prices are also higher by 10%.

Solution:

(Amount in ₹ lac)

Sales Price Variance =	$126.5 - [126.5 \times \frac{100}{110}] =$	11.5 (F)
Sales Volume Variance =	$[126.5 \times \frac{100}{110}] - 100 =$	15.0 (F)
Sales Value Variance =	$126.5 - 100 =$	26.5 (F)
% of Volume Increase =	15%	

Material Price Variance =	$[66 \times \frac{100}{110}] - 66 =$	6 (A)
Material Volume Variance =	$[50 \times \frac{15}{100}] =$	7.5 (A)
Material Usage Variance =	$[50 \times \frac{115}{100}] - [66 \times \frac{100}{110}] =$	2.5 (A)
Material Cost Variance =	$50 - 66 =$	16 (A)
Wage Rate Variance =	$[33 \times \frac{100}{110}] - 33 =$	3 (A)
Wage Volume Variance =	$[30 \times \frac{15}{100}] =$	4.5 (A)
Wage Efficiency Variance =	$[30 \times \frac{115}{100}] - [33 \times \frac{100}{110}] =$	4.5 (F)
Wage Cost Variance =	$30 - 33 =$	3.0 (A)
Variable Overhead Volume Variance =	$[6 \times \frac{15}{100}] =$	0.9 (A)
Variable Overheads Efficiency Variance =	$[6 \times \frac{115}{100}] - 7 =$	0.1 (A)
Variable Overhead Cost Variance =	$6 - 7 =$	1.0 (A)
Fixed Overhead Cost Variance =	$10 - 12 =$	2.0 (A)

**Statement showing the reconciliation of budgeted profit with actual profit
OR
Profit Variance Statement**

		(₹ in lakhs)
Budgeted Profit		4.00
Add: Sales Price Variance	11.50	
Sales Volume Variance	15.00	
Wage Efficiency Variance	4.50	31.00
		35.00
Less: Material Price Variance	6.00	
Material Volume Variance	7.50	
Material Usage Variance	2.50	
Wage Rate Variance	3.00	
Wage Volume variance	4.50	
Variable Overhead Volume Variance	0.90	
Variable Overheads Efficiency Variance	0.10	
Fixed Overhead Cost Variance	2.00	26.50
Actual Profit		8.50

Illustration 32:

	(₹ in lakhs)	
	31-3-2012	31-3-2013
Sales	120	129.6
Prime cost of sales	80	91.1
Variable Overheads	20	24.0
Fixed expenses	15	18.5
Profit	5	(4.0)



During 2012-13, average prices increased over these of the previous years
 (1) 20% in case of Sales (2) 15% in case of Prime Cost (3) 10% in case of Overheads.
 Prepare a profit variance statement from the above data.

Solution:

Calculation of variances:

(₹ in lakhs)

1. Sales Price Variance : $129.60 - (129.60 \times 100/120) = 21.60$ (F)
2. Sales Volume Variance : $[120 - (129.60 \times 100/120)] = 12$ (A)
3. Sales Value Variance : $129.60 - 120 = ₹9.60$ (F)
 Decrease in Volume = $120 - 12$
 $100 - ? = 10\%$
4. Prime Cost Price Variance : $(91.10 \times 100/115) - 91.10 = ₹11.88$ (A)
5. Prime Cost Volume Variance = $80 \times 10/100 = ₹8$ (F)
6. Prime Cost Usage or Efficiency Variance = $(80 \times 90/100) - (91.10 \times 100/115) = ₹ 7.22$ (A)
7. Prime Cost Variance : $80 - 90.1 = ₹ 11.1$ (A)
8. Variable Overhead Price Variance = $(24 \times 100/110) - 24 = ₹ 2.18$ (A)
9. Variable Overhead Volume Variance = $20 \times 10/100 = ₹ 2$ (F)
10. Variable Overhead Efficiency Variance = $(20 \times 90/100) - (24 \times 100/110) = ₹ 3.82$ (A)
11. Variable Overhead Cost Variance = $20 - 24 = ₹ 4$ (A)
12. Fixed Overhead Price Variance = $(18.50 \times 100/110) - 18.50 = ₹ 1.68$ (A)
13. Fixed Overhead Efficiency Variance = $15 - (18.50 \times 100/110) = ₹ 1.82$ (A) [Fixed Overhead will not change give to variation in volume]
14. Fixed Overhead Cost Variance = $15 - 18.50 = ₹ 3.5$ (A)

Profit Variance Statement

Particulars		(₹ in lakhs)
Profit for the year ending 31-3-2012		5.00
Add: Sales Price Variance	21.60	
Prime Cost Variance	8.00	
Variable Overhead Variance	2.00	31.60
		36.60
Less: Sales Volume Variance	12.00	
Price Cost Price Variance	11.88	
Price Cost usage Variance	7.22	
Variable Overhead Price Variance	2.18	
Variable Overhead Efficiency Variance	3.82	
Fixed Overhead Price Variance	1.68	
Fixed Overhead Efficiency Variance	1.82	40.60
Loss for the year ending 31-3-2013		4.00

Illustration 33:

ABC Ltd; adopts a Standard Costing System. The standard output for a period is 20,000 units and the standard cost and profit per unit is as under:

	₹
Direct Material (3 units @ ₹1.50)	4.50
Direct Labour (3 hrs. @ ₹1.00)	3.00
Direct Expenses	0.50
Factory Overheads : Variable	0.25
Fixed	0.30
Administration Overheads	0.30
Total Cost	8.85
Profit	1.15
Selling Price (Fixed by Government)	10.00

The actual production and sales for a period was 14,400 units. There has been no price revision by the Government during the period.

The following are the variances worked out at the end of the period:

		Favourable (₹)	Adverse (₹)
Direct Material			
	Price		4,250
	Usage	1,050	
Direct labour			
	Rate		4,000
	Efficiency	3,200	
Factory Overheads			
	Variable – Expenditure	400	
	Fixed – Expenditure	400	
	Fixed – Volume		1,680
Administration Overheads			
	Expenditure		400
	Volume		1,680

You are required to:

Ascertain the details of actual costs and prepare a Profit and Loss Statement for the period showing the actual Profit/Loss. Show working clearly.

Reconcile the Actual Profit with Standard Profit.



Solution:

Statement showing the Actual Profit and Loss Statement

Particulars	Amount	Amount
	₹	₹
Standard Material Cost (14,400 x 4.50)	64,800	
Add: Price Variance	4,250	
Less: Usage Variance	(1,050)	68,000
Standard Labour Cost (14,400 x 3)	43,200	
Add: Rate Variance	4,000	
Less: Efficiency Variance	(3,200)	44,000
Direct Expenses (14,400 x 0.50)		7,200
Prime Cost		1,19,200
Factory Overhead:		
Variable (14,400 x 0.25)	3,600	
Less: Expenditure Variance	(400)	3,200
Fixed (14,400 x 0.30)	4,320	
Add: Volume Variance	1,680	
Less: Expenditure Variance	(400)	5,600
Administration Overhead (14,400 x 0.3)	4,320	
Add: Volume Variance	1,680	
Add: Exp. Variance	400	6,400
Total Cost		1,34,400
Profit (B/F)		9,600
Sales		1,44,000

Statement showing Reconciliation of Standard Profit with Actual Profit

Particulars	₹	₹
	Standard Profit (14,400 x 1.15)	
Add: Material Usage Variance	1,050	
Labour efficiency Variance	3,200	
Variable Overhead Expenditure Variance	400	
Fixed Overhead Expenditure Variance	400	5,050
		21,610
Less: Material Price Variance	4,250	
Labour Rate Variance	4,000	
Fixed Overhead Volume Variance	1,680	
Administration Expenditure Variance	400	
Administration Volume Variance	1,680	12,010
Actual Profit		9,600

Illustration 34:

You have been appointed as Management Accountant of S.M. Ltd. Given below is the Company's operating profit and loss Statement for the month of April, 2012.

	Standard and Variances	Actual
	₹	₹
Budgeted Sales:	90,000	
Variances due to : (i) Volume of Orders	5,000	
(ii) Selling prices	2,000	97,000
Budgeted Profit	19,000	
Profit Variance due to : (i) Sales Volume	1,200	
(ii) Selling Price	2,000	22,200
Production Cost Variances:		
Materials:		
Price	750	
Usage	(300)	450
Labour:		
Rate	(1,250)	
Efficiency	(500)	(1,750)
Overheads Expenditure: Fixed	500	
Variable	(1,250)	
Efficiency	1,000	
Capacity	500	750
Operating Profit		21,650

The Costing Department provides you with the following information about sales and costs for the month of May, 2012.

Product	Standard Cost per unit (₹)	Budgeted Sales		Actual Sales	
		Number of Units	Sales Value (₹)	Number of Units	Sales Value (₹)
A	31	1,250	50,000	1,400	54,000
B	25	1,000	30,000	950	27,500
C	15	750	15,000	900	17,500

Materials:	₹
Standard Cost of materials actually used	26,150
Standard Cost of materials allowed	26,650
Actual Cost of materials used	27,150
Labour:	
Standard Labour Cost per hour	₹ 0.90
Actual Clocked Hours	22,000
Actual Labour Cost	₹ 21,300
Budgeted Hours	(hours) 20,000
Standard Hours produced	(hours) 22,500

**Overheads:**

Budgeted rates of overheads recovery per direct labour hour:

Variable ₹ 1.00 Fixed ₹ 0.50

Actual Overhead Costs.

Variable ₹ 21,500 Fixed ₹ 12,000

Prepare an Operating Profit and Loss Statement for May, 2012 in the same form as for April, 2012.

Solution:

	AQAP (1) (₹)	AQSP (2) (₹)	SQSP (3) (₹)
A	54,000	56,000	50,000
B	27,500	28,500	30,000
C	17,500	18,000	15,000
	₹99,000	₹1,02,500	₹95,000

1. AQAP = Actual Sales = ₹ 99,000
 2. AQSP = Actual Quality of Sales = ₹1,02,500
 3. SQSP = Standard or Budgeted Sales = ₹ 95,000
- a. Sales Volume Variance = 2 – 3 = ₹ 7,500 (F)
- b. Sales Price Variance = 1 – 2 = ₹ 3,500 (A)

	AQAR (1) (₹)	AQSR (2) (₹)	SQSR (3) (₹)
A	1,400 × 7.5714	1,400 × 9	1,250 × 9
B	950 × 3.9473	950 × 5	1,000 × 5
C	900 × 4.4444	900 × 5	750 × 5
A	10,600	12,600	11,250
B	3,750	4,750	5,000
C	4,000	4,500	3,750
	₹18,350	₹21,850	₹20,000

SR = Standard Selling Price – Standard Cost per unit

AR = Actual Selling Price – Standard Cost per unit

SR: A = 9; B = 5; and C = 5

AR:

A = (54000/1400) – 31 = ₹ 7.5714

B = (27500/950) – 25 = ₹3.9473

C = (17500/900) – 15 = ₹4.4444

1. AQAR = Actual Profit = ₹ 18,350
 2. AQSR = Actual Sales at Standard Rate of Profit = ₹ 21,850
 3. SQSR = Budgeted Profit = ₹ 20,000
- a. Profit Variance Due to Sales Volume = 2 – 3 = ₹ 1,850 (F)
- b. Profit Variance due to Selling Price = 1 – 2 = ₹3,500 (A)
- c. Total Profit Variance = 1 – 3 = ₹ 1,650 (A)

Material Variance:

SQSP (1) (₹)	AQSP (2) (₹)	AQAP (3) (₹)
26,650	26,150	27,150

1. SQSP = Standard Cost of Standard Material = ₹ 26,650
2. AQSP = Standard Cost of Actual material = ₹ 26,150
3. AQAP = Actual Cost of Material = ₹ 27,150
 - a. Material Usage Variance = 1 – 2 = ₹ 500 (F)
 - b. Material Price Variance = 2 – 3 = ₹ 1,000 (A)

Labour Variances:

SRSH (1) (₹)	SRAH (2) (₹)	ARAH (3) (₹)
$0.9 \times 22,500$	$0.9 \times 22,000$	
20,250	19,800	21,300

1. SRSH = Standard Cost of Standard Labour = ₹ 20,250
2. SRAH = Standard Cost of Actual Labour = ₹ 19,800
3. ARAH = Actual Cost of Labour = ₹ 21,300
 - a. Labour Efficiency Variance = 1 – 2 = ₹ 450 (F)
 - b. Labour Rate Variance = 2 – 3 = ₹ 1,500 (A)

Variable Overhead Variances:

SRSH (1) (₹)	SRAH (2) (₹)	ARAH (3) (₹)
$1 \times 22,500$	$1 \times 22,000$	
₹ 22,500	₹ 22,000	₹ 21,500

1. SRSH = Standard Cost Standard Variable Overheads = ₹ 22,500
2. SRAH = Standard Cost of Actual Variable Overheads = ₹ 22,000
3. ARAH = Actual Variable Overheads = ₹ 21,500
 - a. Variable Overheads Efficiency Variance = 1 – 2 = ₹ 500 (F)
 - b. Variable Overheads Expenditure Variance = 2 – 3 = ₹ 500 (A)

Fixed Overhead Variances:

(1) SRSH (₹)	(2) SRAH (₹)	(3) SRBH (₹)	(4) ARAH (₹)
$0.5 \times 22,500$	$0.5 \times 22,000$	$0.5 \times 20,000$	
₹11,250	₹11,000	₹10,000	₹12,000

1. SRSH = Standard Cost of Standard Fixed Overheads = ₹ 11,250
2. SRAH = Standard Cost of Actual Fixed Overheads = ₹ 11,000
3. SRBH = Budgeted Fixed Overheads = ₹ 10,000
4. ARSH = Actual Fixed Overheads = ₹ 12,000
 - a. Fixed Overheads Efficiency Variance = 1 – 2 = ₹ 250 (F)
 - b. Fixed Overheads Capacity Variance = 2 – 3 = ₹ 1,000 (F)
 - c. Fixed Overheads Expenditure Variance = 3 – 4 = ₹ 2,000 (A)



Operating Profit and Loss Statement for the month of May, 2012:

	Standard Variances	Actual Variances
	₹	₹
Budgeted Sales	95,000	
Variances due to Volume	7,500	
Variances due to Selling Prices	(3,500)	99,000
Budgeted Profit	20,000	
Variance due to Sales Volume	1,850	
Variance due to Selling prices	(3,500)	18,350
Production Cost Variances:		
Material usage	500	
Material Price	(1,000)	(500)
Labour efficiency	450	
Labour Rate	(1,500)	(1,050)
Overheads:		
Expenditure: Variable	(500)	
Fixed	(2,000)	
Efficiency (Variable and Fixed)	750	
Capacity	1,000	(750)
Operating Profit		16,050

4.2 UNIFORM COSTING

4.2.1 Introduction:

Uniform Costing is not a separate method or type of Costing. It is a technique of Costing and can be applied to any industry. *Uniform Costing may be defined as the application and use of the same costing principles and procedures by different organisations under the same management or on a common understanding between members of an association.* The main feature of uniform costing is that whatever be the method of costing used, it is applied uniformly in a number of concerns in the same industry, or even in different but similar industries. This enables cost and accounting data of the member undertakings to be compiled on a comparable basis so that useful and crucial decisions can be taken. The principles and methods adopted for the accumulation, analysis, apportionment and allocation of costs vary so widely from concern to concern that comparison of costs is rendered difficult and unrealistic. Uniform Costing attempts to establish uniform methods so that comparison of performances in the various undertakings can be made to the common advantage of all the constituent units.

4.2.2 Scope of Uniform Costing:

Uniform Costing methods may be advantageously applied:

- In a single enterprise having a number of branches or units, each of which may be a separate manufacturing unit.
- In a number of concerns in the same industry bound together through a trade association or otherwise, and
- In industries which are similar in nature such as gas and electricity, various types of transport, and cotton, jute and woolen textiles.

The need for application of Uniform Costing System exists in a business, irrespective of the circumstances and conditions prevailing therein. In concerns which are members of a trade association, the procedure for Uniform Costing may be devised and controlled by the association or by any other central body specially formed for the purpose.

4.2.3 Requisites for Installation of a Uniform Costing System:

The organisational set up for implementing the principles and methods of Uniform Costing may take different forms. It may range from a small association of a number of concerns who agree to have uniform information regarding a few specific cost accounting respects, to be a large organisation which has a fully developed scheme covering all the aspects of costing. The success of a uniform costing system will depend upon the following:

- a. There should be a spirit of mutual trust, co-operation and a policy of give and take amongst the participating members.
- b. There should be a free exchange of ideas and methods.
- c. The bigger units should be prepared to share with the smaller ones, improvements, achievements of efficiency, benefits of research and know-how.
- d. There should not be any hiding or withholding of information.
- e. There should be no rivalry or sense of jealousy amongst the members.

In the application of Uniform Costing, the fundamental requirement is, therefore, to locate such differences and to eliminate or overcome, as far as practicable, the causes giving rise to such differences. The basic reasons for the differences may be as follows:

a. Size and organisational set up of the business:

The number and size of the departments, sections and services also vary from one concern to another according to their size and organisation. The difficulty in operating Uniform Cost Systems for concerns which vary widely in regard to size and type of business may to some extent be overcome by arranging the various units in a number of size or type ranges, and applying different uniform systems for each such type.

b. Methods of production:

The use of different types of machines, plant and equipments, degree of mechanization, difference in materials mix and sequence and nature of operations and processes are mainly responsible for the difference in costs.

c. Methods and principles of cost accounting applied:

It is in this sphere that the largest degree of difference arises. Undertakings manufacturing identical or similar products and having the same system of cost accounting would generally employ different methods of treatment of expenditure on buying, storage and issue of materials, pricing of stores issues, payment to workers, basis of classification and absorption of overhead, calculation of depreciation, charging rent on freehold or leasehold assets etc.

4.2.4 Fields covered by Uniform Costing:

There is no system of Uniform Costing which may be found to fit in all circumstances. The system to be installed should be tailored to meet the needs of each individual case. The essential *points* on which uniformity is normally required may be summarized as follows:

- a. Whether costs are required for the individual products i.e for the cost units or for cost centres.
- b. The method of costing to be applied.
- c. The technique employed such as Standard Costing, Marginal Costing.



- d. Items to be excluded from costs.
- e. The basis of departmentalization.
- f. The basis of allocation of costs to departments and/or service department costs to production departments.
- g. The methods of application administration, selling and distribution overhead to cost of sales.
- h. The method of valuation of work-in-progress.
- i. Methods of treating cost of spoilage, defective work, scrap and wastage.
- j. Methods of accounting of overtime pay bonus and other miscellaneous allowances paid to workers.
- k. Whether purchase, material handling and upkeep expenses are added to the cost of stores or are treated as overhead expenses.
- l. The system of materials control-pricing of issues and valuation of stock.
- m. The system of classification and coding of accounts.
- n. The method of recording accounting information.

4.2.5 Advantages of Uniform Costing:

Main advantages of a Uniform Costing System are summarised below:

- (i) It provides comparative information to the members of the organisation / association which may by them to reduce or eliminate the evil effects of competition and unnecessary expenses arising from competition.
- (ii) It enables the industry to submit the statutory bodies reliable and accurate data which might be required to regulate pricing policy or for other purposes.
- (iii) It enables the member concerns to compare their own cost data with that of the others detect the weakness and to take corrective steps for improvement in efficiency.
- (iv) The benefits of research and development can be passed on the smaller members of the association lead to economy of the industry as a whole.
- (v) It provides all valuable features of sound cost accounting such as valued and efficiency of the workers, machines, methods, etc., current reports of comparing major cost items with the predetermined standards, etc.
- (vi) It serves as a prerequisite to Cost Audit and inter firm comparison.
- (vii) Uniform Costing is a useful tool for management control. Performance of individual units can be measured against norms set for the industry as a whole.
- (viii) It avoids cut-throat competition by ensuring that competition among member units proceeds on healthy lines.
- (ix) The process of pricing policy becomes easier when Uniform Costing is adopted.
- (x) By showing the one best way of doing things, Uniform Costing creates cost consciousness and provides the best system of cost control and cost presentation in the entire industry.
- (xi) Uniform costing simplifies the work of wage boards set up to fix minimum wages and fair wages for an industry.

4.2.6 Limitations of Uniform Costing:

- (i) Uniform costing presumes the application of same principles and methods of Costing in each of the member firms. But individual units generally differ in respect of certain key factors and methods.

- (ii) For smaller units the cost of installation and operation of Uniform Costing System may be more than the benefits derived by them.
- (iii) Uniform costing may create conditions that are likely to develop monopolistic tendencies within the industry. Prices may be raised artificially and supplies curtailed.
- (iv) If complete agreement between the members is not forthcoming, the statistics presented cannot be relied upon. This weakens the Uniform Costing System and reduces its usefulness.

4.2.7 Inter Firm Comparison

Inter-firm comparison as the name denotes means the techniques of evaluating the performances, efficiencies, deficiencies, costs and profits of similar nature of firms engaged in the same industry or business. It consists of exchange of information, voluntarily of course, concerning production, sales cost with various types of break-up, prices, profits, etc., among the firms who are interested or willing to make the device a success. The basic purposes of such comparison are to find out the work points in an organisation and to improve the efficiency by taking appropriate measures to wipe out the weakness gradually over a period of time.

The benefits which are derived from Inter-firm Comparison are appended below :

- a. Inter-firm Comparison makes the management of the organisation aware of strengths and weakness in relation to other organisations in same industry.
- b. As only the significant items are reported to the Management time and efforts are not unnecessary wasted.
- c. The management is able to keep up to data information of the trends and ratios and it becomes easier for them to take the necessary steps for improvement.
- d. It develops cost consciousness among the members of the industry.
- e. Information about the organisation is made available freely without the fear of disclosure of confidential data to outside market or public.
- f. Specialized knowledge and experience of professionally run and successful organisations are made available to smaller units who can take the advantages it may be possible for them to have such an infrastructure.
- g. The industry as a whole benefits from the process due to increased productivity, standardization of products, elimination of unfair comparison and the trade practices.
- h. Reliable and collective data enhance the organising power in deal in with various authorities and Government bodies.
- i. Inter firm comparison assists in a big way in identifying industry sickness and gives a timely warning so that effective remedial steps can be taken to save the organisation.

4.2.8 Limitations of Inter-firm Comparison:

The practical difficulties that are likely to arise in the implementation of a scheme of inter-firm comparison are:

- a. The top management may not be convinced of the utility of inter-firm comparison.
- b. Reluctance to disclose data which a concern considers to be confidential.
- c. A sense of complacency on the part of the management who may be satisfied with the present level of profits.
- d. Absence of a proper system of Cost Accounting so that the costing figures supplied may not be relied upon for comparison purposes.
- e. Non-availability of a suitable base for comparison.



These difficulties may be overcome to a large extent by taking the following steps:

- 'Selling' the scheme through education and propaganda. Publication of articles in journals and periodicals, and lectures, seminars and personal discussions may prove useful.
- Installation of a system which ensures complete secrecy.
- Introduction of a scientific cost system.

Illustration 35:

The share of total production and the cost-based fair price computed separately for each of the four units in industry are as follows:

	₹ per unit			
	40%	25%	20%	15%
Share of Production	40%	25%	20%	15%
Material Costs	150	180	170	190
Direct Labour	100	120	140	160
Depreciation	300	200	160	100
Other Overheads	300	300	280	240
	850	800	750	690
20% return on capital employed	630	430	350	230
Fair Price	1,480	1,230	1,100	920
Capital employed per unit is worked out as follows:				
Net Fixed Assets	3,000	2,000	1,600	1,000
Working Capital	140	150	150	150
Total	3,140	2,150	1,750	1,150

Indicate with reasons, what should be the Uniform Price fixed for the product.

Solution:

Computation of Uniform Price :

$$\begin{aligned} \text{Weighted Average Cost} &= [850 \times 40\%] + [800 \times 25\%] + [750 \times 20\%] + [690 \times 15\%] \\ &= 340 + 200 + 150 + 103.5 \\ &= ₹ 793.5 \end{aligned}$$

$$\begin{aligned} \text{Weighted Average Return on Capital Employed (profit)} &= [630 \times 40\%] + [430 \times 25\%] + [350 \times 20\%] + [230 \times 15\%] \\ &= 252 + 107.5 + 70 + 34.5 \\ &= ₹ 464 \end{aligned}$$

$$\text{Uniform Price} = 793.5 + 464 = ₹ 1,257.5$$



Section – B

Cost Records And Cost Audit





Study Note - 5

COST ACCOUNTING RECORDS AND COST AUDIT



This Study Note includes:

- 5.1 Introduction to Cost Audit**
- 5.2 Origin of Cost Audit**
- 5.3 Relevance of Cost Audit**
- 5.4 Objectives of Cost Audit**
- 5.5 Provision for Cost Audit**
- 5.6 Companies (Cost Accounting Records) Rules 2011 and Companies (Cost Audit Report) Rules 2011 (To be substituted by relevant Rules of 2014)**

5.1 INTRODUCTION TO COST AUDIT

Cost Audit involves an examination of cost books, cost accounts, cost statements and subsidiary and prime documents with a view to satisfying the auditor that these represent true and fair view of the cost of production. This includes the examination of the appropriateness of Cost Accounting system.

Cost Audit is an innovation introduced for the first time in the world and India with a view to regulate industries on healthy and sound lines. It is for cost-effective products and services to customers, proper revenue to government's treasury and proper returns to other stakeholders of the enterprise. India is the first country in the world introducing the legal provisions for compulsory maintenance of cost records, so that industries become cost conscious and industrial efficiency is increased for the benefit of the society as a whole. It fully conforms to the requirements of planning for 'sustainable development'. If an enterprise is to work effectively all its assets and liabilities must be used in the most rational manner. This means that the productive areas within the control of the enterprise, its buildings, equipment, machineries etc. must be used to the maximum and this in turn presupposes the economical expenditure of circulating assets or working capital. Efficient use of productive resources for the maximum benefit to the society is an immutable law of economic development and cost accounting system, and its audit is the most significant means of ensuring the same.

According to Chartered Institute of Management Accountants, London (CIMA), cost audit is "the verification of the correctness of cost accounts and of the adherence to the cost accounting plan". In other words, cost audit is the verification of the cost of production of any product, service or activity on the basis of accounts maintained by an enterprise in accordance with the accepted principles of cost accounting. This definition of Cost Audit is relevant to the voluntary Cost Audit without any statutory backing.

The Institute of Cost Accountants of India on the other hand, defines cost audit as "a system of audit introduced by the Government of India for the review, examination and appraisal of the cost accounting records and attendant information, required to be maintained by specified industries." Thus the concept and scope of cost audit as defined in India is more specific and lays emphasis on the evaluation of the efficiency of operations and the propriety of management actions as introduced by the Government of India for specified industries. In this sense, cost audit in India appears to be synonymous with efficiency audit mainly as a guide for management policy and decision making besides being a barometer of actual performance.

Thus Cost Audit in India refers to the statutory Cost Audit of the selected companies covered under the relevant provisions of the Companies Act, 2013. These requirements are mandatory and non-compliance may invite penal provisions also.

5.2 ORIGIN OF COST AUDIT

In India, methods and techniques of cost accounting and audit of cost accounts can be traced back to pre-independence era when a large number of firms were given contracts by the Government of India on cost plus basis. The Government then started verifying and investigating into the cost structure of such firms. This trend continued on a large scale during World War II that led to the recognition of cost as a distinct concept not only in India but also in the industrial economies of the world. A phenomenon of cost consciousness started taking shape in the country and the Institute of Cost and Works Accountants of India was set up in 1944 with the objectives of promoting, regulating, and developing the profession of cost accountancy in the country.

The Institute of Cost and Works Accountants of India was later incorporated as a statutory body by an Act of Parliament in 1959. In moving the Cost and Works Accountants Bill for reference to the Joint Committee, the Deputy Minister of Commerce and Industry explained the nature and purpose of cost accounting as follows (*Lok Sabha Debates, Vol. XXIV, dated 20th December, 1958, pp. 6608-09*):

"Cost accounting is a function entirely different from general or financial accounting. Cost accountancy covers a wide range of subjects, with special emphasis on cost accounting, factory organization and management, engineering techniques, and knowledge of the working of the factories. The cost accountant performs services involving pricing of goods, preparation, verification, certification of cost accounts and related statements, or recording presentation or certification of cost facts or data. In a manufacturing concern, he works out the economical cost of production and evaluates its progress at each stage of production. In mass production enterprises, he points out wastage of manpower due to overstaffing or inefficient organization and indicates the output, the capacity of the machines and labour, the stock position, the movement of stores and weakness in the production process. The systematic determination of cost in every single and distinct process of manufacturing provides a continuous check on the margin of waste in the processing of raw and semi-finished materials, on the utilisation of machinery installed, on manpower expended and the percentage of rejection of finished products. This pinpoints also the particular process in which defects and deficiencies exist, thereby enabling immediate remedial measure being taken. Costing, in short, aims at making the organization efficient and economical, by providing the minimum of labour and material and getting the full capacity of the machine output. The cost accountant, therefore, is concerned solely and mainly with the internal economy of the industry, and renders services essential to the day-to-day management of the undertaking."

5.3 RELEVANCE OF COST AUDIT

In the initial years, Cost Audit was taken merely as a tool for 'price control mechanism' for consumer and infrastructure industries in India. The main objective of Cost Audit when statutorily introduced under the provisions of Companies Act, 2013 was to meet the Government requirements for regulating the price mechanism in core industries. The objective was to provide an authentic data to the Government to regulate the demand and supply in the country through a price control mechanism.

The liberalization of the economy and consequential globalization has further enhanced the need for authentic data.

Expert Committee (formed by the Government of India to study the Cost Audit) scenario in the country, highlighted the following benefits of cost information:

- Cost Information enables the organization to structure the cost, understand it and use it for communicating with the stakeholders.
- Costing is an important tool in assessing organizational performance in terms of shareholder and stakeholder value. It informs how profits and value are created, and how efficiently and effectively operational processes transform input into output. It contributes to the data input on economy level parameters like resources efficiency, waste management, resources allocation policies etc.



- Costing includes product, process, and resource-related information covering the functions of the organization and its value chain. Costing information can be used to appraise actual performance in the context of implemented strategies.
- Good practice in costing should support a range of both regular and non-routine decisions when designing products and services to
 - meet customer expectations and profitability targets;
 - assist in continuous improvements in resources utilisation; and
 - guide product mix and investment decisions.
- Working from a common data source (or a single set of sources) also helps to ensure that output reports for different audiences are reconcilable with each other.
- Integrating databases and information systems can help to provide useful costing information more efficiently as well as reducing source data manipulation.

As per International Federation of Accountants (IFAC), the general principles of costing and the design of costing systems in this Guidance are generally applicable to all types of organization. For example, cost information is an equally important driver of performance information and reporting in public and not-for-profit organizations. However, some jurisdictions apply legislative expectations on performance. These legislative mandates require reporting entities to develop and report cost information on a consistent and regular basis. Rules in some jurisdictions prescribe the calculation of unit costs to (a) allow comparisons between public authorities, and (b) establish the performance of specific activities.

Cost audits help to ascertain whether an organization's cost accounting records are so maintained as to give a true and fair view of the cost of production, processing, manufacturing, and mining of a product. Therefore, cost audits can be used to the benefit of management, consumers and shareholders by (a) helping to identify weaknesses in cost accounting systems, and (b) to help drive down costs by detecting wastage and inefficiencies. Cost audits are also of assistance to governments in helping to formulate tariff and taxation policies.

5.4 OBJECTIVES OF COST AUDIT

Cost Audit has both general and social objectives. The *general objectives* can be described to include the following :

- Verification of cost accounts with a view to ascertaining that these have been properly maintained and compiled according to the cost accounting system followed by the enterprise.
- Ensuring that the prescribed procedures of cost accounting records rules are duly adhered to detection of errors and fraud.
- Verification of the cost of each "cost unit" and "cost center" to ensure that these have been properly ascertained.
- Determination of inventory valuation.
- Facilitating the fixation of prices of goods and services.
- Periodical reconciliation between cost accounts and financial accounts.
- Ensuring optimum utilization of human, physical and financial resources of the enterprise.
- Detection and correction of abnormal loss of material and time.
- Inculcation of cost consciousness.
- Advising management, on the basis of inter-firm comparison of cost records, as regards the areas where performance calls for improvement.
- Promoting corporate governance through various operational disclosures to the directors.

Among the *social objectives of cost audit*, the following deserve special mention :

- Facilitation in fixation of reasonable prices of goods and services produced by the enterprise. Improvement in productivity of human, physical and financial resources of the enterprise.
- Channelising of the enterprise resources to most optimum, productive and profitable areas.
- Availability of audited cost data as regards contracts containing escalation clauses.
- Facilitation in settlement of bills in the case of cost-plus contracts entered into by the Government.
- Pinpointing areas of inefficiency and mismanagement, if any for the benefit of shareholders, consumers, etc., such that necessary corrective action could be taken in time.

5.5 PROVISION FOR COST AUDIT

As per section 2(13) of Companies Act, 2013, "books of account" includes records maintained in respect of—

- (i) all sums of money received and expended by a company and matters in relation to which the receipts and expenditure take place;
- (ii) all sales and purchases of goods and services by the company;
- (iii) the assets and liabilities of the company; and
- (iv) the items of cost as may be prescribed under section 148 in the case of a company which belongs to any class of companies specified under that section;

Books of account, etc., to be kept by company [Section 128]

- (1) Every company shall prepare and keep at its registered office books of account and other relevant books and papers and financial statement for every financial year which give a true and fair view of the state of the affairs of the company, including that of its branch office or offices, if any, and explain the transactions effected both at the registered office and its branches and such books shall be kept on accrual basis and according to the double entry system of accounting:

Provided that all or any of the books of account aforesaid and other relevant papers may be kept at such other place in India as the Board of Directors may decide and where such a decision is taken, the company shall, within seven days thereof, file with the Registrar a notice in writing giving the full address of that other place:

Provided further that the company may keep such books of account or other relevant papers in electronic mode in such manner as may be prescribed.

- (2) Where a company has a branch office in India or outside India, it shall be deemed to have complied with the provisions of sub-section (1), if proper books of account relating to the transactions effected at the branch office are kept at that office and proper summarised returns periodically are sent by the branch office to the company at its registered office or the other place referred to in sub-section (1).
- (3) The books of account and other books and papers maintained by the company within India shall be open for inspection at the registered office of the company or at such other place in India by any director during business hours, and in the case of financial information, if any, maintained outside the country, copies of such financial information shall be maintained and produced for inspection by any director subject to such conditions as may be prescribed:

Provided that the inspection in respect of any subsidiary of the company shall be done only by the person authorised in this behalf by a resolution of the Board of Directors.

- (4) Where an inspection is made under sub-section (3), the officers and other employees of the company shall give to the person making such inspection all assistance in connection with the inspection which the company may reasonably be expected to give.



- (5) The books of account of every company relating to a period of not less than eight financial years immediately preceding a financial year, or where the company had been in existence for a period less than eight years, in respect of all the preceding years together with the vouchers relevant to any entry in such books of account shall be kept in good order:

Provided that where an investigation has been ordered in respect of the company under Chapter XIV, the Central Government may direct that the books of account may be kept for such longer period as it may deem fit.

- (6) If the managing director, the whole-time director in charge of finance, the Chief Financial Officer or any other person of a company charged by the Board with the duty of complying with the provisions of this section, contravenes such provisions, such managing director, whole-time director in charge of finance, Chief Financial officer or such other person of the company shall be punishable with imprisonment for a term which may extend to one year or with fine which shall not be less than fifty thousand rupees but which may extend to five lakh rupees or with both.

Central Government to Specify Audit of Items of Cost in respect of Certain Companies [Section 148]

- (1) The Central Government may, by order, in respect of such class of companies engaged in the production of such goods or providing such services as may be prescribed, direct that particulars relating to the utilisation of material or labour or to other items of cost as may be prescribed shall also be included in the books of account kept by that class of companies.

Provided that the Central Government shall, before issuing such order in respect of any class of companies regulated under a special Act, consult the regulatory body constituted or established under such special Act.

- (2) If the Central Government is of the opinion, that it is necessary to do so, it may, by order, direct that the audit of cost records of class of companies, which are covered under sub-section (1) and which have a net worth of such amount as may be prescribed or a turnover of such amount as may be prescribed, shall be conducted in the manner specified in the order.
- (3) The audit under sub-section (2) shall be conducted by a Cost Accountant in practice who shall be appointed by the Board on such remuneration as may be determined by the members in such manner as may be prescribed.

Provided that no person appointed under section 139 as an auditor of the company shall be appointed for conducting the audit of cost records.

Provided further that the auditor conducting the cost audit shall comply with the cost auditing standards.

Explanation.— For the purposes of this sub-section, the expression “cost auditing standards” mean such standards as are issued by the Institute of Cost and Works Accountants of India, constituted under the Cost and Works Accountants Act, 1959, with the approval of the Central Government.

- (4) An audit conducted under this section shall be in addition to the audit conducted under section 143.
- (5) The qualifications, disqualifications, rights, duties and obligations applicable to auditors under this Chapter shall, so far as may be applicable, apply to a cost auditor appointed under this section and it shall be the duty of the company to give all assistance and facilities to the cost auditor appointed under this section for auditing the cost records of the company.

Provided that the report on the audit of cost records shall be submitted by the cost accountant in practice to the Board of Directors of the company.

- (6) A company shall within thirty days from the date of receipt of a copy of the cost audit report prepared in pursuance of a direction under sub-section (2) furnish the Central Government with such report along with full information and explanation on every reservation or qualification contained therein.

- (7) If, after considering the cost audit report referred to under this section and the information and explanation furnished by the company under sub-section (6), the Central Government is of the opinion that any further information or explanation is necessary, it may call for such further information and explanation and the company shall furnish the same within such time as may be specified by that Government.
- (8) If any default is made in complying with the provisions of this section,—
 - (a) the company and every officer of the company who is in default shall be punishable in the manner as provided in sub-section (1) of section 147;
 - (b) the cost auditor of the company who is in default shall be punishable in the manner as provided in sub-sections (2) to (4) of section 147.

5.6 COMPANIES (COST ACCOUNTING RECORDS) RULES 2011 AND COMPANIES (COST AUDIT REPORT) RULES 2011 [TO BE SUBSTITUTED BY RELEVANT RULES OF 2014]

Supplementary Study Material on relevant Rules of 2014 would be provided in due course pursuant to final notification by the Ministry of Corporate Affairs, Government of India.



Section – C
Economics For Managerial
Decision Making



Study Note - 6

ECONOMICS FOR MANAGERIAL DECISION-MAKING



This Study Note Includes

- 6.1 Concepts of Market and Demand
- 6.2 Government Intervention and Effect
- 6.3 Business and Economic Forecasting
- 6.4 Production Function and Cost Analysis
- 6.5 Factor demand and input decision
- 6.6 Pricing Policies

6.1 CONCEPTS OF MARKET AND DEMAND

The concept of demand seeks to establish the relationship between the quantity demanded of a commodity and its price. "The demand for anything at a given price is the amount of it which will be bought per unit of time at a given price". Thus, the demand for any commodity always involves two things:

- i) Price, and
- ii) Unit of time.

Demand has no significance unless related to both these factors. Unit of time may be a day, a week, a month, etc. The Statement that demand for Sugar is 1 kg at ₹ 50 per kg carries no meaning unless we state explicitly the period for which this quantity is demanded. "Desire or need becomes a demand only when it is backed by willingness and ability to pay." The quantity demanded by an individual purchaser at a given price is known as **individual demand** where as the total quantity demanded by all the buyers are known as total demand or **market demand**.

Demand Schedule: The demand schedule explains the relationship between price and demand. Demand schedules are two types.

- a) Individual Demand Schedule,
- b) Market Demand Schedule

Individual Demand Schedule: Various quantities of commodity that would be purchased by an individual consumer at different prices is called individual demand schedule.

Price (in ₹)	Demand (in units)
5	1
4	2
3	3
2	4
1	5

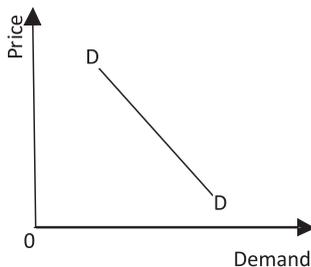
In the table at ₹ 5 price the consumer is demanding 1 unit of commodity at ₹ 4 price the demand is 2 units, at 3, 2 and 1 rupee price the demand is 3, 4 and 5 units respectively.

Market Demand Schedule: Various quantities of goods that would be purchased by all the consumers in the market is called market demand schedule.

Price (in ₹)	Demand of					Market Demand (in units)
	A	B	C	D	E	
1	35	30	25	20	15	135
2	30	25	20	20	10	105
3	25	20	15	20	0	80
4	20	15	10	20	0	65
5	15	10	0	20	0	45

In the table at ₹ 1 price the market demand is 135 units (i.e., demand of A+B+C+D+E (35+30+25+20+15=135 units). Similarly at ₹ 2 price the market demand is 100 units, at ₹ 3, ₹ 4 and ₹ 5 prices the market demand is 80, 65, 45 units respectively.

Demand Curve: As there is inverse relationship between price and demand the individual demand curve slopes downwards from left to right.



In the Diagram DD is the Demand Curve. It slopes downwards from left to right.

Derived Demand:

The commodities, which are not needed for direct consumption but are demanded to help in the production of other commodities which have direct demand, are said to have derived demand. For example, the demand for raw materials, labour, machines, etc., has a derived demand.

Determinants of demand or Factors on which demand depends:

The quantity demanded per unit of time of a commodity X by a consumer denoted by D_x mainly depends on:

- i) Price of the commodity (P)
- ii) Prices of substitutes (P_s)

Substitutes are those goods which can be used in place of each other. For example: Tea and Coffee.

- iii) Price of complements (P_c)

Complementary goods are those goods which are related to each other in such a way that an increase (or decrease) in demand for one leads to an increase (or decrease) in the demand of the other. For example: Pen and ink, petrol and car etc.

- iv) Income of house household (I)
- v) Tastes and preferences of the households (T), and
- vi) The amount annually spent on advertisement of the product and sales promotion (A)

Mathematically.

$$D_x = f (P, P_s, P_c, I, T, A)$$

Law of Demand:

The Law of Demand simply expresses the relation between quantity of a commodity demanded and its price. The law states that “demand varies inversely with price, not necessarily proportionately”. If the price falls, demand will extend, and vice versa. The law of demand indicates this inverse relationship between

price and quantity demanded. "Other things remaining same, higher will be demanded at a lower price and lower will be demanded at a higher price" - Prof. Benham.

The exceptions of Law of Demand:

- 1. Giffen Paradox:** According to the Law of demand when the price rises demand decreases and vice-versa. But, according to Sir Robert Giffen even though the price, for necessary goods rise, the demand for them will not decrease. These goods are called Giffen goods.
- 2. Prestigious goods:** The law of demand will not operate in case of prestige goods like diamonds, cars etc. The demand for these goods does not decrease with the rise in the price as these goods are attached with prestige.
- 3. Speculative Business:** The law of demand do not operate in case of the speculative business. If people think that the prices of goods increase in the future, now they will buy more units of that commodity. This is against to the law of demand. This is another limitation to the law of demand.
- 4. Trade cycles:** The law of demand do not operate in periods of trade cycles. During the prosperity period people may buy more goods at higher prices. In periods of depression, people buy fewer goods even though the prices are less.
- 5. Ignorance of the consumers:** The law of demand is not applicable in case of the ignorant consumers. By ignorance people think that high priced goods are qualitative goods. Therefore the consumers may buy the goods even at high prices.

Demand Function and Demand Curve:

Other factors remaining constant the quantity demanded (x), for any commodity is a function of its price (p) per unit, i.e.,

$$x = f(p)$$

This is called the demand function, the graph between the quantity demanded on x-axis and price on y-axis is a down ward sloping (falling) curve (called demand curve) having negative slope, showing that the demand is a decreasing function of price.

The demand curve concentrates exclusively on the price-quantity relationship. The relationship between quantity demanded and other factors which influence demand is not shown by demand curve. The demand curve shows:

- The maximum quantity of a commodity a consumer will purchase at a particular price.
- The maximum price for a particular quantity.

Notes:

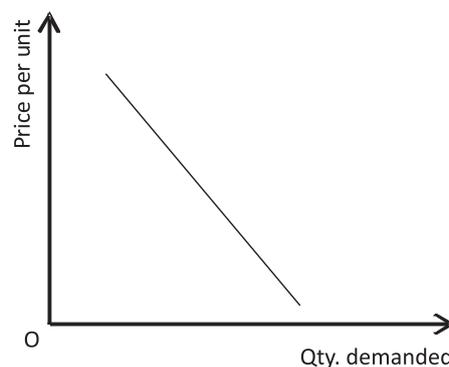
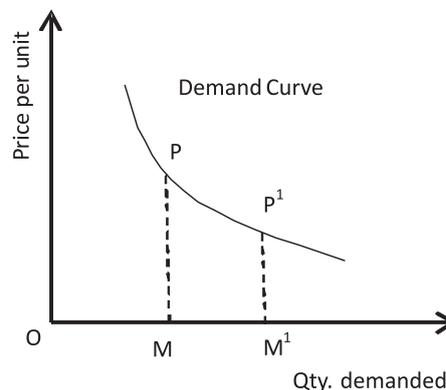
- If the relation between the quantity demanded (x) and the price per unit (p) is a linear relation of the form

$$X = \alpha - \beta p$$

- Where α, β are positive constants, the demand curve is a straight line.
- The equation of straight line in slope form is $y = mx + c$. If the slope is negative the equation becomes

$$Y = c - mx$$

- The slope of the demand curve is always negative.



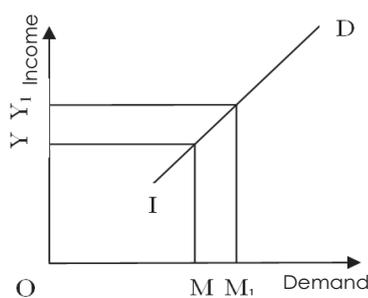
INCOME DEMAND

Income demand explains the relationship between the income and demand. Various quantities of goods that would be purchased by the consumer at different levels of income is called income demand. Other things remaining the same, when the income increases the demand for the commodities will also increase. Thus, direct relationship existed between income and demand. This can be explained with the help of the following table.

Income (in ₹)	Demand (In units)
100	50
200	100
300	150

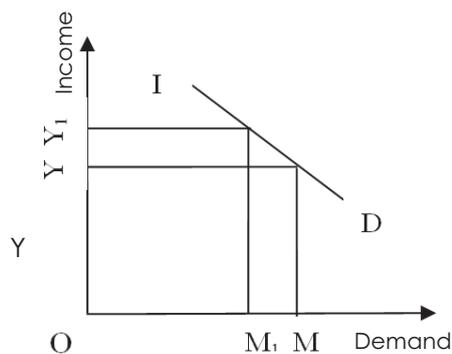
In the table at ₹ 100/- income per unit, the consumer purchased 50 units of a commodity, at ₹ 300/- he purchased 150 units of commodity.

Diagrammatic Representation: In case of the superior goods the income demand curve is upward rising from left to right as shown in the given figure.



In the diagram on the X – axis demand and on the Y-axis income are shown. ID is the income demand curve. When the income increases from OY to OY₁, the demand for superior goods is also increases from OM to OM₁.

Inferior goods: In case of inferior goods when the income increases, the demands for inferior goods decrease. For example: If the income of the people increases, they purchase superior quality of food grains like wheat & rice instead of inferior food grains. So, the income demand curve for inferior goods slopes downwards from left to right as shown under.

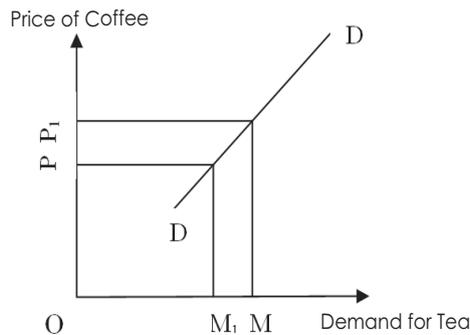


In the diagram on the X – axis demand and on the Y-axis income are shown. ID is the income demand curve. If the income, increases from OY to OY₁, the demand for inferior goods is decreased from OM to OM₁.

CROSS DEMAND

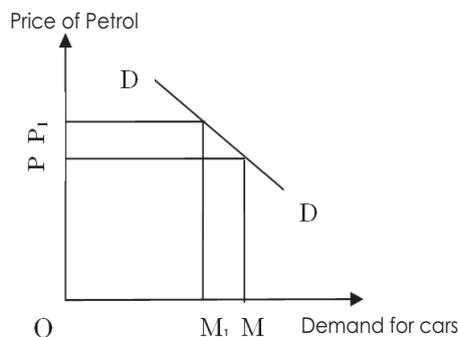
The change in the demand for one commodity due to the changes in the prices of related goods like substitutes and complementary goods is called cross demand.

Substitutes: In the case of substitutes, if the price of one commodity increases, the demand for its substitutes will increase. For example if the price of coffee increases the demand for its substitute i.e., tea's demand will increase. So, the demand curve for substitutes will be an upward sloping from left to right as it is shown in the following diagram.



In the diagram on the X – axis demand for tea and on the Y-axis price of coffee are shown. DD is the demand curve for substitutes. When the price of coffee increases from OP to OP₁ the demand for its substitute i.e., tea will increase from OM to OM₁.

Complementary goods: In the case of complementary goods, if the price of a commodity decreases the demand for its complementary goods will increase. For example car and petrol if the price of petrol decreases the demand for cars will increase. So, the demand curve for complementary goods is falling from left to right.



In the diagram on the X – axis demand for cars and on the Y-axis price of petrol are shown. DD is the demand curve for complementary goods. When the price of petrol increases from OP to OP₁, the demand for cars will decrease from OM to OM₁.

EXPANSION, CONTRACTION OF DEMAND:

Expansion or contraction of demand indicates the change in quantity demanded due to change in the factors except price. Now factors other than price include change in income, change in price of a substitute or complementary goods or change in habits, change in taste, technological changes etc.

ELASTICITY OF DEMAND:

The Quantitative responsiveness of demand to the change in the price called Elasticity of Demand. The rate of change in demand to a change in price is called elasticity of demand. If the change in the demand is more than the change in the price it is called elastic demand. If the change in the demand is less than the change in the price it is called inelastic demand.

Definition:

“The elasticity of demand in a market is great or small according to the amount demanded increases much or little for a given fall in the price and diminishes with much or little for a given rise in price”. – Marshall. *“Elasticity is the degree of change in demand as a result of change in price”.* – Samuelson.

The elasticity of demand explains the relationship between proportionate change in demand to a proportionate change in price.

$$\text{Elasticity of demand} = \frac{\text{Proportionate change in Demand}}{\text{Proportionate change in Price}}$$

Types of Elasticity of demand: Elasticity of demand is of 3 types:

1. Price elasticity of demand
2. Income elasticity of Demand.
3. Cross elasticity of demand

1. **Price Elasticity of demand:**

Price Elasticity of Demand (E_d) explains the proportionate or percentage change in demand to a proportionate or percentage change in price.

$$E_d = \frac{\text{Proportionate change in Demand}}{\text{Proportionate change in Price}}$$

(or)

$$E_d = \frac{\text{Percentage change in Demand}}{\text{Percentage change in Price}}$$

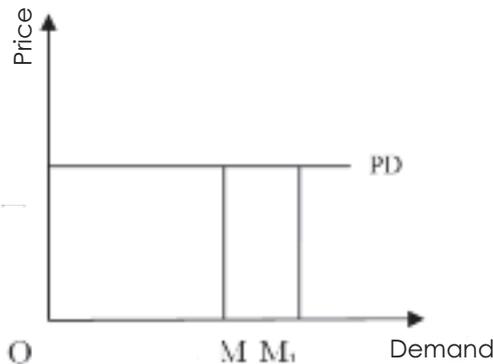
$$E_d = \frac{\frac{\text{Change in Quantity Demanded}}{\text{Quantity demanded at original price}}}{\frac{\text{Change in price}}{\text{Original Price}}}$$

$$E_d = \frac{\Delta x}{x} \div \frac{\Delta p}{p} = \frac{p}{x} \times \frac{\Delta x}{\Delta p}$$

Types of Price Elasticity of Demand: The price elasticity of demand is of 5 types.

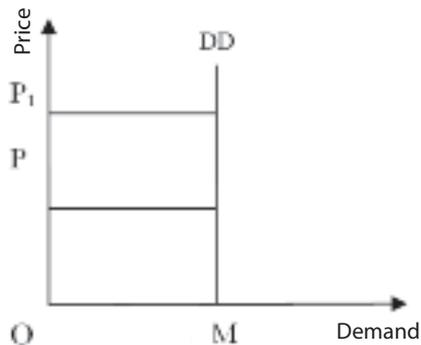
1. Perfectly elastic demand.
2. Perfectly inelastic demand
3. Relatively elastic demand
4. Relatively inelastic demand
5. Unitary elastic demand

1. **Perfectly Elastic Demand:** A small change in the price brings an infinite change in the demand is known as perfectly elastic demand. The perfectly elastic demand curve is a line parallel to the X-axis as shown in the following diagram. ($E_d = \alpha$)



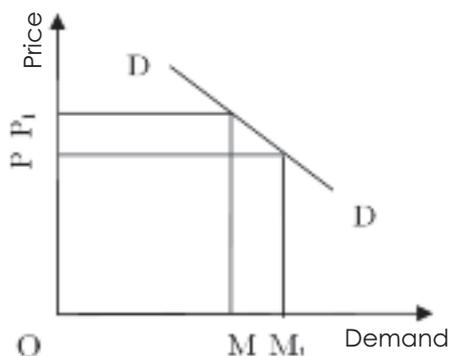
In the diagram on the X – axis demand and on the Y-axis Price are shown. DD is the perfectly elastic demand curve. At OP price level the demand increases to OM_1 to OM. This shows any amount is demanded at a given price.

2. Perfectly Inelastic demand: If a change in price does not bring any change in demand, it is called perfectly inelastic demand. In the case of perfectly inelastic demand, the demand curve is parallel to Y – axis ($E_d=0$)



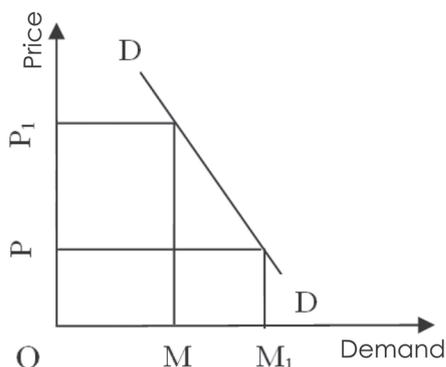
In the diagram on the X – axis demand and on the Y-axis Price are shown. DD is the perfectly inelastic demand curve. Even though price increases from OP to OP₁, the demand remains the same at OM.

3. Relatively Elastic Demand: If the proportionate change in the demand is more than the proportionate change in the price, it is called relatively elastic demand. Here the elasticity of demand is more than one ($E_d>1$)



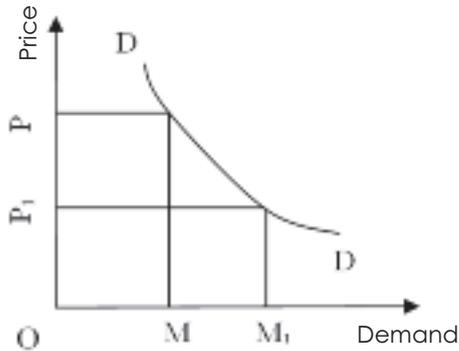
In the diagram on the X – axis demand and on the Y-axis Price are shown. DD is the demand curve. When the price is decreased from OP to OP₁, the demand has increased from OM to OM₁. Here the change in the demand (MM₁) is more than the change in the price (PP₁). So the demand is elastic.

4. Relatively Inelastic demand: If the proportionate change in the price is more than the proportionate change in the demand, it is called relatively inelastic demand. The demand is less elastic ($E_d<1$)



In the diagram on the X – axis demand and on the Y-axis Price are shown. DD is the demand curve. When the price is decreased from OP to OP₁, the demand has increased from OM to OM₁. The change in the price (PP₁) is more than the change in the demand (MM₁). So, the demand is less elastic.

5. Unitary Elastic demand: If the proportionate change in the demand and the proportionate change in the price are equal, it is called unitary elastic demand. ($E_d = 1$)



In the diagram DD is the demand curve. It is a rectangular hyperbola. When the price is decreased from OP to OP₁, the demand has increased from OM to OM₁. Here, the change in the price (PP₁) and the change in the demand (MM₁) are equal.

Summary of the characteristics of various types of price elasticity of demand:

Type	Numerical Expression	Description	Shape of Curve
1. Perfectly Elastic	∞	Infinite	Horizontal
2. Perfectly Inelastic	0	Zero	Vertical
3. Unity Elasticity	1	One	Rectangular Hyperbola
4. Relatively Elastic	>1	More than one	Flat
5. Relatively Inelastic	<1	Less than one	steep

INCOME ELASTICITY OF DEMAND:

The income elasticity of demand explains the proportionate change in income and proportionate change in demand. The rate of change in the demand due to the change in the income is called income elasticity of demand.

$$\text{Income elasticity of demand} = \frac{\text{Proportionate change in demand}}{\text{Proportionate change in income}}$$

Types of income elasticity of demand:

- 1. Zero income elasticity of demand:** If the change in the income fails to bring any change in demand, it is called zero income elasticity of demand. ($E_y=0$).
- 2. Negative income elasticity of demand:** If the demand decreases with the increase in the income is called negative income elasticity of demand.
- 3. Unitary income elasticity of demand:** If the proportionate change in the demand is equal to proportionate change in the income, it is called unitary income elasticity of demand ($E_y=1$)
- 4. Income elasticity of demand is greater than one:** If the proportionate change in the demand is more than the proportionate change in income, it is called relatively income elastic of demand ($E_y>1$).
- 5. Income elasticity of demand is less than one:** If the proportionate change in the demand is less than the proportionate change in the income, it is called relatively income inelastic demand ($E_y<1$).



CROSS ELASTICITY OF DEMAND:

The rate of change in the demand for one commodity due to the change in the price of its substitutes and complementary goods is called cross elasticity of demand.

$$\text{Cross Elasticity of Demand} = \frac{\text{Percentage change in the demand for commodity X}}{\text{Percentage change in the price of Y}}$$

If the percentage change in the demand for commodity X is more than the percentage change in the price of Y, then the cross elasticity of demand is greater than one ($E_d > 1$). If the percentage change in the demand for commodity X is less than percentage change in the price of commodity Y, then the cross elasticity of demand is less than one ($E_d < 1$). If the percentage change in the demand for commodity X is equal to percentage change in the price of commodity Y, then the cross elasticity of demand is equal to one ($E_d = 1$).

Measurement of Elasticity of Demand:

The elasticity of demand can be measured by using 3 methods.

1. Percentage method,
2. Total outlay (or) Expenditure method
3. Diagrammatic method:
 - a) Point method
 - b) Arc method

1. Percentage method: With this method the elasticity of demand can be measured by comparing the percentage change in the price and percentage change in demand.

$$E_d = \frac{\text{Percentage change in demand}}{\text{Percentage change in price}}$$

2. Total outlay (or) Expenditure method:

$$\begin{aligned} \text{Total outlay} &= \text{Price per unit} \times \text{Quantity bought} \\ &= \text{Price per unit} \times \text{Quantity demanded} \\ &= \text{Total revenue} \end{aligned}$$

If the demand is inelastic, i.e., if the elasticity of demand is < 1 , the total outlay falls with fall in price and rises with increase in price.

If the demand is unit elastic, the total outlay remains unchanged with the change in price, i.e., for a fall in price, the demand increases proportionately and for a rise in price the demand decreases proportionately.

If the demand is elastic, i.e., elasticity of demand is > 1 the total outlay increases with fall in price and decreases with rise in price because the quantity demanded changes in greater proportion than the change in price.

3. Diagrammatic Method: The elasticity computed at a single point on the demand curve for an infinitesimal change in price is called point elasticity. The elasticity between two separate points of demand curve is called arc elasticity.

a) Point Elasticity: In this method the elasticity of demand at a particular point on the demand curve can be calculated. The point elasticity of demand is equal to distance between the points on X-axis divided by the distance between point on Y-axis. This can be explained in the following. In the diagram, on X-axis demand and on Y-axis price are shown. K is the price demand curve. At that point we can know the

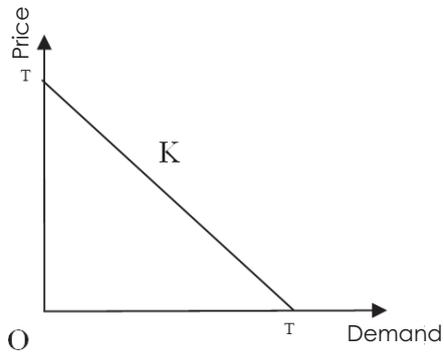
elasticity of demand by the following formula.

Point elasticity of demand can be found out:

$$\frac{\text{Marginal Quantity demanded}}{\text{Average quantity demanded}} = \frac{dx/x}{dp/p} = \frac{dx}{dp} \times \frac{x}{p}$$

$$\text{Point Elasticity} = \frac{KT \text{ Lower Segment}}{KT \text{ Upper Segment}}$$

$$E_d = \frac{\Delta q}{\Delta p} \times \frac{p}{q}$$



After application of this formula if we get the result more than one, it is elastic demand. If the result is less than one, it is inelastic demand and if the result is equal to one then it is unitary elastic demand.

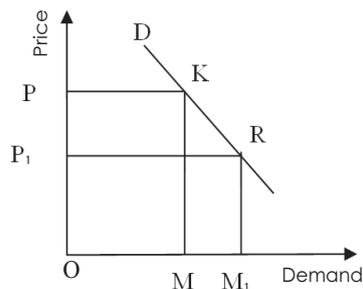
Thus point elasticity is defined as the proportionate change in quantity demanded resulting from a very small change in the price of commodity. It also expressed:

$$E_d = \frac{dQ}{dP} \times \frac{P}{Q}$$

Where E_d is Point Price Elasticity of demand, $\left[\frac{dQ}{dP}\right]$ is the first order derivative of demand equation and

$\frac{P}{Q}$ is the ratio of price to quantity. Point elasticity can be calculated with the help of Differential calculus.

b) Arc Elasticity: In arc elasticity we calculate the elasticity of demand between two points on the demand curve.



In the diagram on X-axis the demand and ON Y-axis the price are taken. K and R are the two points on the demand curve. We can measure the elasticity of demand between these points by using the following formula.

$$\text{Arc Elasticity of demand} = \frac{\text{Change in Demand}}{\text{1st demand} + \text{2nd demand}} \times \frac{\text{Change in price}}{\text{1st Price} + \text{2nd price}}$$

$$\text{In diagram Arc elasticity of demand} = \frac{M M_1}{OM + OM_1} \times \frac{PP_1}{OP + OP_1}$$



$$E_d = \left[\frac{\Delta q}{\Delta p} \right] \times \left[\frac{P_1 + P_2}{Q_1 + Q_2} \right]$$

After application of the above formula if we get result more than one then it is elastic demand, if the result is less than one then it is inelastic demand and if the result is equal to one then it is unitary demand.

Consumer's Surplus:

In the words of Marshall, "The excess of the price which he (i.e., consumer) would be willing to pay rather than go without the thing over that which he actually does pay is the economic measure of this surplus satisfaction It may be called Consumer's Surplus." To use Hicks words "It is the difference between the marginal valuation of a unit and the price which is actually paid for it".

In short, consumer's surplus is what we are prepared to pay minus what we actually pay. As will be clear from the following section, the consumer's surplus is measured by the difference between total utility and the amount spent.

Producer's Surplus:

It is the difference between the amount that a producer of a good receives and the minimum amount that he or she would be willing to accept for the good. The difference, or surplus amount, is the benefit that the producer receives for selling the good in the market.

Demand Forecasting:

Expecting future demand for a product is called "Demand Forecasting". This estimate is made considering various factors like controllable and non-controllable and present and anticipated market conditions. Accurate forecasting is essential for a firm to enable it to produce the required quantities at the right time and arrange well in advance for the various factors of production viz., material, money, men, management, machinery etc. Demand forecasting is not a speculation. It cannot be hundred per cent correct. But it gives a reliable information and estimation of future demand. It is based on mathematical law of probability. Business planning is based on forecasting of sales or demand. Most of the business decisions depend on the basis of expected sales in future. The success of business is also influenced by the accuracy of forecasted reports. A firm can maximise profits only when it produces on the basis on the demand for its products. There will be no problem of over and under production if the figure of sales forecasts or demand forecasts is accurate. As it will reduce or have control over costs, the profits will certainly go up. Hence, the importance of forecasting is more or less depends upon the nature of business.

Factors involved in Demand Forecasting:

1. Time factor: Forecasting may be done for short-term or long-term. Short-term forecasting is generally taken for one year while long-term forecasting covering a period of more than 1 year.
2. Level factor: Demand forecasting may be undertaken at three different levels.
 - a. Macro level: It is concerned with business conditions over the whole economy.
 - b. Industry level: Prepared by different industries.
 - c. Firm-level: Firm-level forecasting is the most important from managerial view point.
3. General or specific purpose factor: The firm may find either general or specific forecasting or both useful according to its requirement.
4. Product: Forecasting varies type of product i.e., new product or existing product or well established product.
5. Nature of the product: Goods can be classified into
 - (i) consumer goods and
 - (ii) producer goods.

Demand for a product will be mainly dependent on nature of the product. Forecasting methods for producer goods and consumer goods will be different accordingly.

6. Competition: While making forecasting, market situation and the product position in particular market should be analyzed.

7. Consumer Behaviour: What people think about the future, their own personal prospects and about products and brands are vital factors for firm and industry.

Methods of Forecasting: Demand forecasting is not a speculation. It cannot be hundred per cent correct. But it gives a reliable information and estimation of future demand. It is based on mathematical law of probability.

Demand Forecasting methods can be broadly categorized into two types

- (1) Opinion Survey Methods or Qualitative Techniques and
- (2) Statistical Methods or Quantitative Techniques.

1. Opinion Survey Methods or Qualitative Techniques:

Opinion Survey Methods are also called as Qualitative Techniques. These are based on subjective assessment. When available data is irrelevant, then researcher requires primary data. Consumer plays a dominant role in creating demand for a product. If the businessman wants to know the expected demand in future, he has to get the information based on consumers opinions. Opinion survey methods are most popular in "Demand Forecasting." Managerial decisions that are taken after analyzing opinions, made a favourable impact on sales progress.

The opinion survey methods further classified into three types:

a. 100% Enumerator Survey: This is the most direct method of forecasting demand in the short-run. Customers will be asked questions like what they are planning to buy for the forthcoming time period- usually a year. But it is observed fact that complete 100% enumerator survey will not be possible and at the same time a number of biases may creep into the surveys. It is very expensive, when it compared with other methods.

b. Delphi Method: Delphi method is a group process and aims at achieving 'consensuses' of the members. Herein experts in the field of marketing research and demand forecasting are engaged in

- analyzing economic conditions
- carrying out sample surveys of market
- conducting opinion polls

Based on the above, demand forecast is worked out in following steps:

- i) Co-coordinator sends out a set of questions in writing to all the experts co-opted on the panel who are requested to write back a brief prediction.
- ii) Written predictions of experts are collated, edited and summarized together by the Co-coordinator.
- iii) Based on the summary, Co-coordinator designs a new set of questions and gives them to the same experts who answer back again in writing.
- iv) Co-coordinator repeats the process of collating, editing and summarizing the responses.
- v) Steps 3 and 4 are repeated by the Co-coordinator to experts with diverse backgrounds until consensus is reached.

If there is divergence of opinions and hence conclusions, Co-ordinator has to sort it out through mutual discussions. Co-ordinator has to have the necessary experience and background as he plays a key role in designing structured 'questionnaires and synthesising the data.



Direct interaction among experts is avoided nor their identity is disclosed. Procedures also neither avoid inter-personnel conflicts nor are strong-willed experts able to dominate the group. This method is also used for technology forecasting.

a. Sales Force Opinion Survey or Collective Opinion: Salesman is expected to estimate expected sales in their respective territories and zones. The rationale of this method is that salesmen, being the closest to the customers are likely to have the most intimate feel of the market i.e., customer response to the product of the firm. This method is based on historical data and consumer's opinion. This method is known as the "Collective Opinion Method" as it takes advantages of the collective wisdom of salesman, managerial economist, marketing manager and personnel relating to sales department.

"Opinion Survey Methods" are purely based on data collected from consumer's opinions which are always volatile. So decisions made with the help of opinion survey methods may not be successful in future. Hence, statistical analysis should be considered for expecting future, because past experience may represent future performance.

2. Statistical Methods or Quantitative Techniques:

a) Simple Average Method

Among the quantitative techniques for demand analysis, simple Average Method is the first one that comes to one's mind. Herein, we take simple average of all past periods - simple monthly average of all consumption figures collected every month for the last twelve months or simple quarterly average of consumption figures collected for several quarters in the immediate past. Thus,

$$\text{Simple Average} = \frac{\text{Sum of Demands of all periods}}{\text{Number of periods}}$$

b) Moving Average Method

Method of Simple Average is faulted on account of the fact that all past periods are given same importance whereas it is justifiable to accord higher importance to recent past periods. Moving Average Method takes a fixed number of periods and after the elapse of each period, data for the oldest time period is discarded and the most recent past period is included. Whatever the period selected, it must be kept constant - it may be three, four or twenty periods by once it decided, we must continue with same number of periods.

$$\text{Moving Average} = \frac{\text{Sum of Demands of Chosen periods}}{\text{Number of chosen periods}}$$

c) Weighted Moving Average

In Moving Average Method, weighted given to the selected number of periods is same. This has been refined to include the Weighted Moving Average which allows varying weightages for demands in old periods. Depending upon the age of the period, with-age can be varied:

$$\text{Weighted Moving Average} = W_1D_1 + W_2D_2 + \dots + W_n D_n$$

where W_1, W_2, \dots, W_n are the weightages for the different periods in percentages so that

$$W_1 + W_2 + \dots + W_n = 1$$

This method has the advantage that it allows forecaster to compensate for some known trend in demand or seasonality of demand by carefully fitting appropriate co-efficient of weighted to those periods. The weightages have to be decided by the forecast analysts and this decision is critical to the accuracy of demand forecast.

d) Time Series: Trend analysis or Time series relating to sales represent the past pattern of effective demand for a particular product. The most popular method of analysis of time series is to project the trend of the time series. This method is very simple and inexpensive. The basic assumption is that the trend will persist in future also.

e) Linear Trend: Linear trend is appropriate when the time series reveal a rising trend in sales, in other words there is direct relation between sales and time.

Mathematically:

$$Y = a + bx$$

Y = annual sales

a = constant, intercept value on the graph

b = trend or slope or a constant rate of increase

x = time or unit or no. of years

by the method of Least Squares for above equation to find out the value of a and b are

$$\sum Y = na + b\sum X$$

$$\sum XY = a\sum X + b\sum X^2$$

Illustration 1:

Calculate the trend values by the method of least squares from the data given below and estimate the sales for the year 2017.

Year	2008	2009	2010	2011	2012
Sales of T.V Sales (in'000)	12	18	20	23	27

Solution:

Calculation of Trend values by Least Squares Method

Year (X)	Sales Y	Time deviation (x)	xY	x ²	Trend values Y _c
2008	12	-2	-24	4	13.0
2009	18	-1	-18	1	16.5
2010	20	0	0	0	20.0
2011	23	+1	+23	1	23.5
2012	27	+2	+54	4	27.0
N =5	ΣY=100	Σx=0	ΣxY=35	Σx²=10	

Equation of Straight line = $Y = a + bX$

Since, $\sum x = 0$ value of $a = \frac{\sum Y}{N} = \frac{100}{5} = 20$

Value of $b = \frac{\sum xY}{\sum x^2} = \frac{35}{10} = 3.5$

Equation of straight line $Y_c = a + b(X-2010)$ or $Y_c = 20 + 3.5x$

When $X = 2008$, $Y_c = 20 + (3.5 \times -2) = 13$

When $X = 2009$, $Y_c = 20 + (3.5 \times -1) = 16.5$

When $X = 2010$, $Y_c = 20$

When $X = 2011$, $Y_c = 20 + (3.5 \times 1) = 23.5$

When $X = 2012$, $Y_c = 20 + (3.5 \times 2) = 27.0$

Now for 2017 the value of x would be 7 and $Y_c = 20 + (3.5 \times 7) = 44.5$



Thus the likely sale of T.Vs. in 2017 is 44.5 thousands.

Illustration 2:

Given below are the figures of production (in thousand mounds) of a Sugar factory:

Year	2006	2007	2008	2009	2010	2011	2012
Production (000) mounds	40	45	46	42	47	50	46

Fit a Straight line trend by the Least Squares Method and tabulate the trend.

Solution:

Calculation of trend values by Least square method

Year t	Production (000 mounds) Y	Time deviation(X)	X ²	XY	Trend Values Y _c
2006	40	-3	9	-120	42.035
2007	45	-2	4	-90	43.071
2008	46	-1	1	-46	44.107
2009	42	0	0	0	45.143
2010	47	+1	1	+47	46.179
2011	50	+2	4	+100	47.215
2012	46	+3	9	+138	48.250
N = 7	ΣY=316	(ΣX=0)	Σx²=28	ΣXY= 29	ΣY_c=316

$$Y_c = a + bX = a + b(5-2009)$$

$$a = \frac{\sum Y}{N} = \frac{316}{7} = 45.143$$

$$b = \frac{\sum XY}{\sum X^2} = \frac{29}{28} = 1.036$$

$$Y_c = 45.143 + 1.036X$$

When X = 3, Y_c = 45.143 + (1.036 x - 3) = 42.035, Similarly we can calculate trend values for other years.

Illustration 3:

The following are the annual profits in thousands in a certain business:

Year	2006	2007	2008	2009	2010	2011	2012
Profit (thousands)	60	72	75	65	80	85	95

By the method of least squares fit a straight line. Using that estimate profit for 2016.

Solution:

Fitting Straight line Trend by Least Squares

Year (t)	Profit (000)Y	Time deviation(X)	XY	X ²
2006	60	-3	-180	9
2007	72	-2	-144	4
2008	75	-1	-75	1
2009	65	0	0	0

2010	80	+1	+80	1
2011	85	+2	+170	4
2012	95	+3	+285	9
N =7	ΣY=532	ΣX=0	ΣXY=136	ΣX²=28

The equation of straight line Trend is $Y_c = a + bX$.

Since $X = 0$, $a = \frac{\sum Y}{N}$ and $b = \frac{\sum XY}{\sum X^2}$. Therefore $a = \frac{532}{7} = 76$ and $b = \frac{136}{28} = 4.857$

The equation would be $Y_c = 76 + 4.857 X$

For 2016 the value of X would be +7. Then $Y_{2016} = 76 + (4.857 \times 7) = 76 + 33.99 = 110.99$

Illustration 4:

Calculate the trend values by the method of least squares from the data given below and estimate the sales for the year 2013.

Year	2008	2009	2010	2011	2012
Sales of G.A (₹ in lakhs)	70	74	80	86	90

Solution:

Calculation of Trend values by Least Squares Method

Year (t)	Sales Y	Time deviation(X)	XY	X ²	Trend values Y _c
2008	70	-2	-140	4	69.6
2009	74	-1	-74	1	74.8
2010	80	0	0	0	80.0
2011	86	+1	+86	1	85.2
2012	90	+2	+180	4	90.4
N =5	ΣY=400	Σx=0	ΣxY=52	Σx²=10	ΣY_c=400

Equation of Trend line = $Y_c = a + bX \implies Y_c = a + (t-2010)$

Since $X=0$, $a = \frac{\sum Y}{N} = \frac{400}{5} = 80$

$b = \frac{\sum XY}{\sum X^2} = \frac{52}{10} = 5.2$

The equation of Straight line would be $Y = 80 + 5.2X$. The value of Y when $X = 2013$ or in terms of deviation $X = +5$

$Y_{2013} = 80 + (5.2 \times 5) = 80 + 26 = 106$

Trend value for 2008 = $80 + (2008 - 2009) \times 5.2 = 69.6$

Similarly trend values for 2009, 2010 etc have been calculated.

(ii) Exponential Trend: If the sales are increasing at an increasing rate or at a constant percentage then it would be better to fit an exponential trend.



Mathematically:

$$Y = ab^x$$

Y = annual sales

a = constant, intercept value on the graph

b = trend or slope or a constant rate of increase

x = time or unit or no. of years

f) Regression Analysis: Regression equation establishes the relationship between dependent variable and independent variable, assuming the relationship to be linear. For some commodities independent variable may be only one. But for some products independent variables may more than two. In such a case, multiple regression analysis can be used.

Hence, demand for any product can be estimated at a given value of price.

Simple Regression Equation:

This equation will be form of $Y = a + bx$, for

Independent variable : x

Dependent variable : y

Multiple-Regression Model:

The equation in the case of multiple regression

$$Y = a + b_1x_1 + b_2x_2 + \dots + b_nx_n$$

Independent variables: x_1, x_2, \dots, x_n

Dependent variable : y

Limitations:

1. It is difficult to find out inter-dependence relationship between the variables.
2. Sometimes it may be difficult to identify dependent and independent variable.
3. Indicators are based on historical data. But the relationship cannot be established for the future.

Illustration 5:

Year	2000	2001	2002	2003	2004
Sales(₹ Lakhs)	100	150	100	160	200

Solution:

Using above information find the sales for 2005 by applying regression equation $y = a + bx$.

Year	Sales Y	Time deviations(X) X	Square of deviations X^2	Product of time deviations & sales XY
2000	100	-2	4	-200
2001	150	-1	1	-150
2002	100	0	0	0
2003	160	1	1	160
2004	200	2	4	400
N=5	$\sum Y = 710$	$\sum X = 0$	$\sum X^2 = 10$	$\sum XY = 21$

$$a = \frac{\sum Y}{N} = 710 / 5 = 142$$

$$b = \frac{\sum XY}{\sum X^2} = 210 / 10 = 21$$

$$Y = a + bx$$

$$Y = 142 + 21x$$

2005 sales are: $y = 142 + 21(3) = 142 + 63 = 205$ lakhs.

g) Simultaneous Equation: Establishing relation between two variables with the help of equation, we can estimate demand for a product. These equations are mathematical linear equations to arrive the results.

Example: $4a + 3b = 15$

$$3a + 4b = 20$$

By solving these equations we can find the values of a, b.

Limitations:

1. It is difficult to find out an appropriate equation and relationship between variables.
2. For new products it not suitable, as no past data are available.
3. A few indicators always correctly indicate changes in another variable.

h) Barometric Method: Based on index numbers i.e., economic indicators like Wholesale Price Index (WPI), Consumer Price Index (CPI) estimations will be made. It is also known as leading indicators forecasting. The researcher should try to understand and establish relationship between products and indices.

Limitations:

1. It is difficult to find out an appropriate indicator.
2. For new products it is not suitable, as no past data are available.
3. A few indicators always correctly indicate changes in another variable.
4. Indicators are based on historical data. But the relationship cannot be established for the future.

Conclusion: It is not very easy to estimate demand for a product. Customer's opinions are always volatile or changeable. One should not use a mathematical formula without having knowledge of consumer preference and changing styles, attitudes. It does not present an eternal truth. Though statistical or quantitative techniques are essential in clarifying relationships and provide techniques of analysis, yet they are no substitute for judgemental analysis or qualitative techniques. What is needed is some common sense mean between guessing and too much mathematics.

MARKET

Market for a commodity may be local, regional, national or international. In common parlance 'Market' refers to a place or locality where commodities are bought and sold. In an economic sense, a market is a system by which buyers and sellers bargain for the price of a product and transactions will take place in that system. Market does not limited to a particular place and personal contact between buyers and sellers is also not necessary.

"Market means the whole of any region which buyers and sellers are in such free intercourse with each other, that the price of the same goods tend to equally easily and quickly". – Prof. Cournot

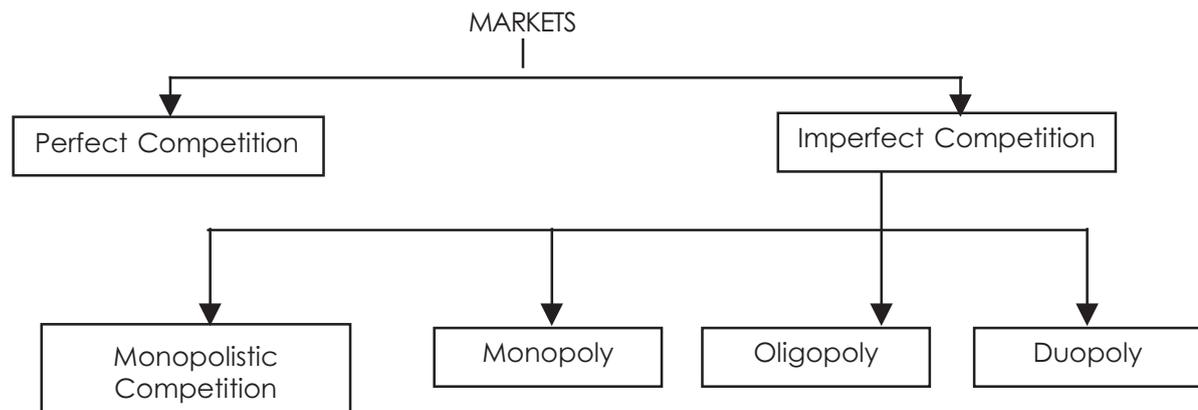
"The word market has been generalized so as to mean any body of persons who are in intimate business relations and carry on extensive transactions in any commodity". – Jevons



Elements of Markets:

1. Sellers and buyer agree to transact at a particular price of a product.
2. Nature of the commodity is known to both parties
3. Price of the product is determined under conditions of the market
4. Competition is depend on the increase in the buyers and seller
5. If there is increase in number buyers, price will increase and it is treated as Seller's market
6. If there is increase in number sellers, price will decrease, it is treated as buyer's market
7. Free communication between the buyers and sellers.
8. Size of the market is not restricted; it may certain city, a region a country or even the entire world.
9. Product is homogenous in case of perfect competition, and the product may be differentiated in case of other markets

Markets can be classified into two broad categories:



PRICE DETERMINATION UNDER PERFECT COMPETITION

Market is a place where buying and selling transactions are under taken. Here it has no reference to a particular place only. Buying and selling transactions may take place from distinct places. On the basis of competition the markets can be classified into two.

Definitions: According to Liff Witch, "Perfect competition is a market in which there are many firms selling identical products with no firm large enough relative to there are many firms selling identical products with no firm large enough relative to the entire market to be able to influence market price".

Mrs. Joan Robinson has defined perfect competition as, "it prevails when the demand for the output of the each product is perfectly elastic".

Features:

1. There must be Large number of Buyers and sellers.
2. In perfect competition, the goods produced by different firms are homogenous or identical.
3. In perfect competition there is free entry and exit of the firms into the industry.
4. The buyers and the sellers must have the knowledge with regard to the prices of various commodities at different supply and demand forces.
5. The factors must be mobilized from those places where they are getting less remuneration to those places where they will get maximum remuneration.

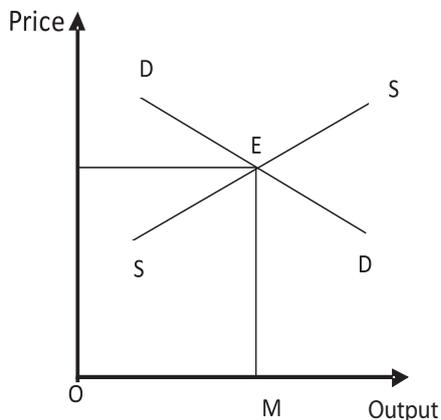
6. All commodities are identical in perfect competition. So the prices of the commodities are also uniform.
7. In order to maintain the uniform price level in perfect competition we should not include the transport cost in the price level.
8. There is a difference between firm and industry under perfect competition. Firm is a production unit and where as industry is a group of firms.

Price determination: Generally price is determined by demand and supply forces. The price is determined at that point where the demand and supply both are equal under perfect competition. The following table explains the price determination under perfect competition.

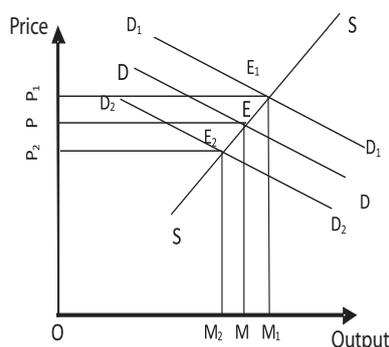
Price	Demand	Supply
5.00	200	600
4.00	300	500
3.00	400	400
2.00	500	300
1.00	600	200

In the above table if the price of the commodity is ₹ 5/- then there is a demand for 200 commodities and supply is 600 commodities. If the price is 1 rupee then there is a demand for 600 commodities and supply reduced to 200 commodities. In the table at ₹ 3/- price level, there is a demand for 400 commodities and the supply is also 400 commodities. Therefore the price is determined as ₹3/-

Diagrammatic Explanation: The price and output determination under perfect competition can be explained with the help of following diagram.



In the diagram on X-axis output and on Y axis the price are determined. DD is the demand curve as SS is the supply curve. Both demand and supply are equal at point E. So, the price is determined as OP and output as OM.



Price determination when demand changes and supply remains constant:

Under perfect competition, if supply being constant the equilibrium price will rise when the demand increases and if the demand decreases then the price will fall down. This can be shown in the diagram.

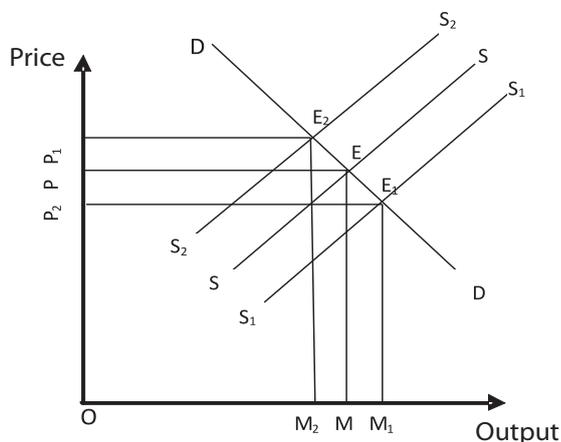
In the diagram DD is the demand curve SS is the supply curve. In the diagram we find supply remains constant. SS is the supply curve. Demand has increased from DD to D₁D₁. This increased demand curve and supply curve both are equal at point E₁. The equilibrium point has

changed from E to E_1 . Therefore the price and output have changed OP to OP_1 and from OM to OM_1 respectively. When the demand decreases from DD to D_2D_2 then supply curve and decreased demand curve both are equal at point E_2 . Therefore the price has decreased from OP to OP_2 and the output also decreased from OM to OM_2 .

Price determination when demand remains constant and supply changes:

If demand is constant, the equilibrium price rise if supply decreases and if supply increases the equilibrium price will fall. This can be explained with the help of diagram.

In the diagram DD is the demand curve SS is the supply curve.

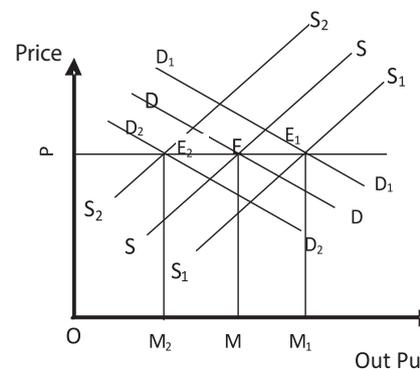


In the diagram when the supply increased from SS to S_1S_1 , then the demand curve and increased supply curve both intersect at point E_1 . So the output has increased from OP to OP_1 . If the supply reduces from SS to S_2S_2 then the decreased supply curve and the demand curve both are equal point E_2 . So the output is decreased from OM to OM_2 and the price has increased from OP to OP_2 .

Price determination when both demand and supply are changed:

Under perfect competition if the demand and supply both are changing in the same direction and in the same rate, then the price may not change. This can be shown in the diagram.

In the diagram on X-axis the output and on Y-axis the price are determined. DD is the demand curve and SS is the supply curve. **The demand and supply are equal** at point E and at the point the price is OP and output is OM . Suppose the demand and supply both have increased from DD to D_1D_1 and SS to S_1S_1 respectively. Now both are equal at point E_1 and at that point the price remains constant. In the same way if demand and supply both have decreased from DD to D_2D_2 and from SS to S_2S_2 respectively.



PRICE DETERMINATION UNDER MONOPOLY:

Mono means "single" and poly means "seller". Therefore monopoly means single seller. In economics, monopoly is said to exist when a firm is the single producer or seller of a product where there are no close substitutes for it. According to M.C. Connel, "Pure or absolute Monopoly exists when a single firm is the sole producer of a product for which there are no close substitutes".

Features:

1. Single producer: Under monopoly there is only one producer or seller. He controls the entire supply of the commodities. Monopoly may be an individual or a partnership or a joint stock company or a state. There is no competition in monopoly market.

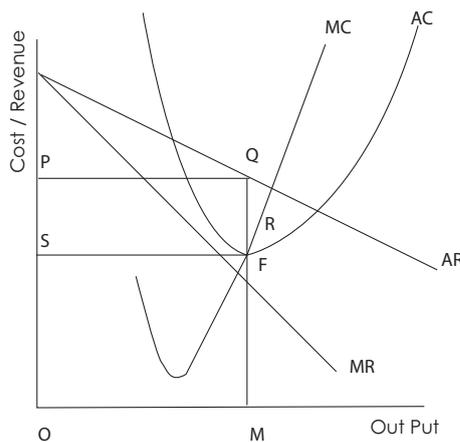
- 2. No close substitutes:** there are "no close substitutes" in monopoly market. There are no other firms produce the similar and nearer commodities for the product of monopoly.
- 3. No difference between Firm and Industry:** Under Monopoly market there is "no difference between firm and industry". There is only one firm and other firms should not produce the similar products which are produced by the monopoly firm. Therefore the firm and industry both are same under monopoly market.
- 4. No free entry:** The monopoly firm can get abnormal profits in the short run as well as in the long run because of strong restrictions on the entry of new firms. If the new firms have freedom to enter the market then the abnormal profits will disappear but in monopoly there is no free entry and therefore the Monopoly firm may get abnormal profits in long run also.
- 5. Monopolist controls only price (or) output:** Under monopoly the producer has controlling power on only price or output. He has no controlling power on both price and output simultaneously.
- 6. Revenue curve falls down from left to right:** In monopoly market the revenue curves are falling down from left to right. If the monopolist wants to sell more he must reduce the price level and if he wants to fix more price he must reduce the output.

PRICE AND OUTPUT DETERMINATION:

The following conditions are essential for the determination of price and output under Monopoly.

1. The main aim of the Monopolist is to get the maximum profits. He must produce the goods to that extent where MC becomes equal to MR. At that level he will get the equilibrium position and maximum profits.
2. If the monopolist increases the supply of commodities then the average revenue and marginal revenue curves fall down from left to right. If he wants to sell more output he must reduce the price level and therefore the revenue curves are falling with the increase of output.
3. Under monopoly the AR is equal to the price, so AR is the demand line.
4. Under monopoly the MR falls more rapidly than the AR
5. The monopoly on AR line which is more than MR and AC. The differences between AC and AR are the amount of abnormal profits.

Diagrammatic Explanation: We can explain the price and output determination under monopoly with the help of following diagram.

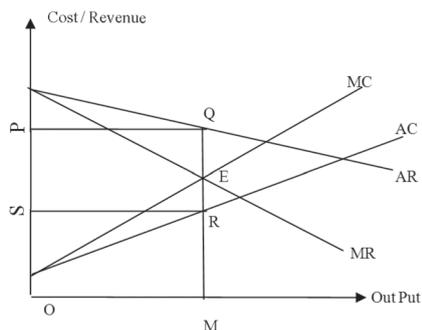


In the diagram on X-axis the output and on Y-axis the costs, Revenue and price are taken. In this diagram MC is the marginal cost curve and AC is the Average cost curve. AR and MR are Average revenue and marginal revenue curves respectively. Under monopoly the output is determined at that point where MC=MR. In the diagram both MC and MR are equal at point E. So the output is determined on AR line. In this diagram the price is OP or OM. The difference between AR and AC is the amount of abnormal profit for one unit. Therefore OR is the unit profit. If we deduct the total cost from the total revenue, we can get the total profit. So $OPQM - OSRM = PQRS = \text{Profit}$.

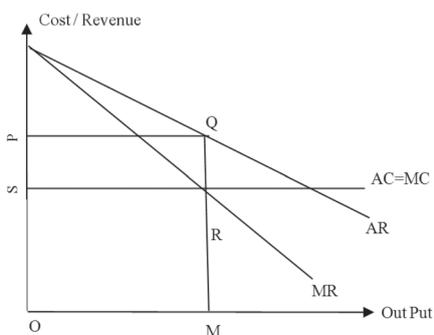
In the above manner the Monopolist gets maximum profits at OP price level and at OM level of output. Beyond or below OM level of output will reduce the amount of profit.

PRICE DETERMINATION WHEN COSTS ARE INCREASING, CONSTANT AND DIMINISHING

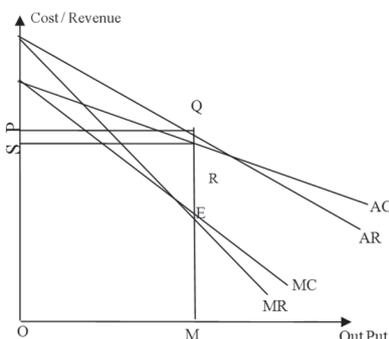
There is a difference between perfect competition and Monopoly. In perfect competition at equilibrium point, the cost curves are at increasing stage, but in Monopoly the cost curves may increase or constant or decrease at equilibrium level. These things can be explained with the help of following diagrams.



In the diagram (a) the cost curves are increasing MC and MR are equal at point E therefore OPQM is the total revenue and OSRM is the total cost. So PQRS is the total amount of profit.



In the diagram (B) the MC and MR equal at point R and the total profit is PQRS. In this diagram MC is constant and therefore it is parallel to X-axis.



In the diagram (C) the cost curves are falling MC curve cuts the MR curve at point E. Therefore the point E is an equilibrium point. OPQM is the total revenue and OSRM is the total cost. Therefore PQRS is the total amount of profit.

Monopoly price and elasticity of demand: The concept of elasticity of demand is more useful in price determination under Monopoly. The main motive of the Monopolist is to get maximum profits. In order to get maximum profits the Monopolist fixes more price in the case of those goods in which there is in elastic demand and less price in the case of those goods in which the demand is elastic one. Therefore monopolist generally fixes the price on the basis of elasticity of demand.

EQUILIBRIUM OF THE FIRM AND INDUSTRY UNDER PERFECT COMPETITION:

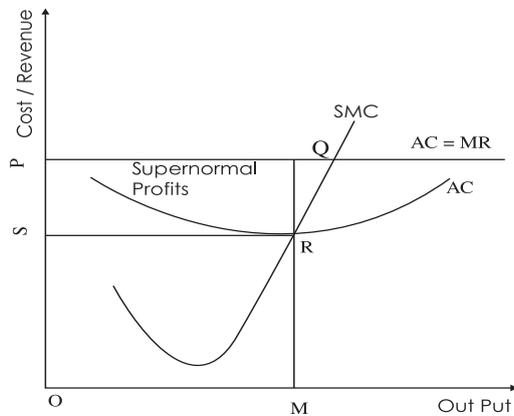
On the basis of competition the markets can be classified into perfect competition and imperfect competition. According to Left Witch, "perfect competition is a market in which there are many firms selling identical products with no firm is large enough relative to the entire market to be able to influence the market price".

According to Mrs. Joan Robinson, "perfect competition prevails when the demand for the output of the each producer is perfectly elastic".

In perfect competition there are large number of buyers and sellers and homogeneous products. In this competition there is a free entry and exit and also perfect market information. The inputs can be freely mobilized. There is a uniform price level. In this competition the transport costs should not be included in the price level.

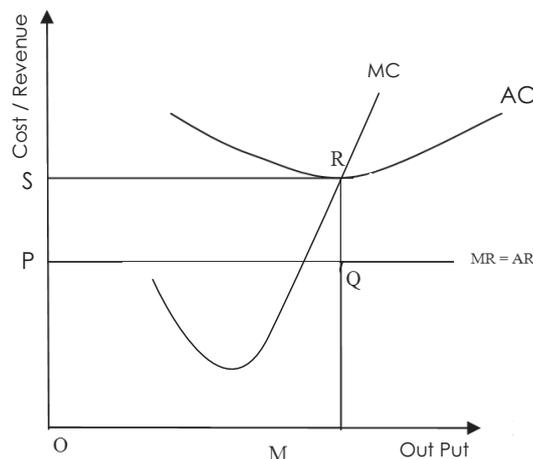
There is difference between firm and industry under perfect competition. Firm is a production unit and where as industry is a group of firms. Equilibrium is a balancing position or resting point.

A firm can get an equilibrium position where it has no desire to increase or decrease its output. At that condition if the firm increase or decrease its output then it will get lesser profits. A consumer is in equilibrium position where he attains maximum satisfaction. The producer gets an equilibrium position if he gets maximum production with the available resources.



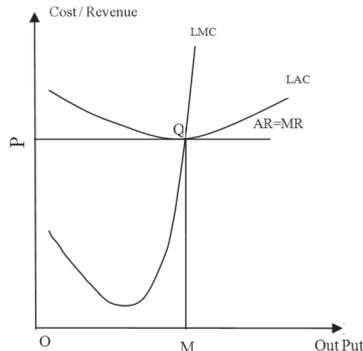
In the (a) diagram on X-axis the output and on Y-axis Cost, Revenue and price are determined. Under perfect competition the average and marginal revenue curves are equal and parallel to X-axis due to uniform price level. In this diagram SMC curve is equal to MR curve at point Q. So at that point the output is determined as OM and the price as OP. The firm is in equilibrium position at point Q when the SMC curve is at rising stage. In this diagram OPQM is the total revenue and OSRM is the total cost. If we deduct the total cost from the total revenue then we get the total profit. Therefore $OPQM - OSRM = PQRS$ (profit).

Equilibrium of the firm under perfect competition: In the short period the firm can get abnormal profits or losses. The following diagram explains how the firm can get abnormal profits and reaches the equilibrium position.



In the diagram on X-axis output and on Y-axis costs, revenue and price are shown. At point Q. SMC and MR are equal and therefore Q is an equilibrium point. At this equilibrium point SAC is more than AR. In this diagram the output is determined as OM and the price as OP. OPQM is the total revenue and OSRM is the total cost. Here the total cost is more than the total revenue. So the firms incur the losses PQRS are the losses.

Long Run Equilibrium: In the long run the firm does not get abnormal profits or losses because of free entry and exit under perfect competition. In the long run both AC and AR become equal and therefore the firm gets only normal profits. This can be explained with the help of following diagram.

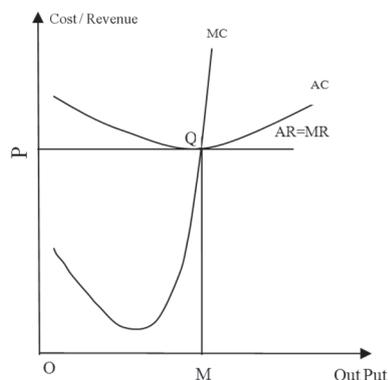


In the diagram on X-axis output and on Y-axis costs, revenue and price are determined. At equilibrium point i.e. at Q LAC and AR both are equal. OPQM is the total revenue and also total cost. Therefore the firm is getting normal profits in the long run.

Equilibrium of the industry under perfect competition: In order to obtain the equilibrium position of the industry under perfect competition the following conditions are essential.

1. The industry gets an equilibrium position where $MC=MR$.
2. All firms in the industry get only normal profits.
3. At equilibrium point the MC, AC, MR and AR are equal.
4. Number of the firms is constant.
5. Possible only in long period.

Diagrammatic Explanation: In the case of the firm there are some possibilities of getting abnormal profits or losses in the short period. But in the case of industry as a whole there is no possibility of getting abnormal profits. The industry gets only normal profits. This can be explained with the help of following diagram.



In the diagram on X-axis the output and on Y-axis costs, revenues and price are shown. The MC and MR become equal at point Q. At that point the MC, MR, AC and AR are equal. The output is determined as OM and the price as OP. OPQM is the total revenue and also total cost. So there are no abnormal profits. The industry is getting only normal profits.

PRICE DISCRIMINATION UNDER MONOPOLY:

Price discrimination means the practice of selling the same commodities at different prices to different buyers. Mrs. Joan Robinson has defined the price discrimination as, "The act of selling the same article produced under single control at different prices to different buyers". This price discrimination is possible only under monopoly.

Kinds of Price Discrimination:

1. **Personal discrimination:** In this case the Monopolist will charge different prices from different customers on the basis of the ability to pay. For example a doctor may charge more fee from a rich patient and less fee from a poor patient for the same services rendered.
2. **Place (or) Local Discrimination:** In this discrimination different prices are charged from different places. The monopolist charges lower price at one place and higher price at another place. Dumping is the best example for local discrimination. In this case the monopolist sells his output with lower price in the foreign market and with higher price in the domestic market.
3. **Trade (or) Use discrimination:** In this the monopolist will charge different prices for different types of uses of the same commodity. For example electricity will be sold at cheaper rate for agricultural purpose and higher price for industrial purpose.

Conditions for Price discriminations: The price discrimination is possible if the following conditions are satisfied.

1. **More than one Market:** There must be two or more than two separate markets otherwise the price discrimination is not possible. Different markets must be essential for charging different prices from different persons.
2. **Different elasticity:** The elasticity of demand in each market must be different. It means that if one market is less elastic than the other it should be elastic. If the elasticity of demand is equal in all markets there will be no scope for price discrimination.

Price and output determination under discriminating monopoly: The main aim of the price discrimination under monopoly is to get maximum profits. The following conditions are essential for getting of maximum profits.

1. The monopolist must fix more price in the case of inelastic demand and lower price in the case of elastic demand.
2. All the marginal revenues in different market must be equal to marginal cost.

Degrees of Price Discrimination:

Prof. A.C.Pigou has distinguished the degrees of price discrimination into 3 on the basis of the degree or extent or price discrimination.

Under the first type of price discrimination the monopolist will not allow any consumer surplus to the consumers. This type of price discrimination is called perfect price discrimination.

Second degree of price discrimination occurs where the monopolist is able to get a part of consumer surplus but not entire consumer surplus.

In this third degree of price discrimination the monopolist divide the customer into two or more classes or groups or market and are divided on the basis of elasticity of demand. This type of discrimination is the most common one.

Importance:

1. There are certain services such as Railways etc., which cannot be provided profitably unless the price discrimination is allowed to take place: uniform price for such services will lead to low incomes or losses to the entrepreneur.
2. If the welfare of the country is required in certain cases the price discrimination is desirable. For example if the doctor charges more fee from rich and less fee from poor, then the public welfare will be increased.
3. With help of price discrimination the government can reduce the inequalities of income and wealth to some extent.
4. If the monopolist fixes higher price in the case of inelastic demand goods and lower price for the elastic demand goods and then the demand and production will not be effected badly.



DIFFERENCE BETWEEN PERFECT COMPETITION AND MONOPOLY:

Perfect competition and monopoly are the two extreme concepts. There are some difference between perfect competition and monopoly. Perfect competition is that one where there are large number of sellers who are producing similar products and where the activity of single seller or buyer may not influence the entire market price. Monopoly is said to be existed when one firm is the sole producer of the product where there are no close substitutes to it.

In perfect competition there are large number of buyers and sellers and also homogeneous products in this competition. There is free entry and exit and also have perfect market information. These factors of production can be freely mobilized. There is a uniform price level. In this competition the transport cost should be included in the price level. There is difference between firm and industry under perfect competition.

In monopoly market there is only single producer and there are no close substitute products. In monopoly there is no difference between firm and industry. The new firm has no right to enter the market. The monopolist has the controlling power either the price or output. Therefore the revenue curves fall down from left to right, if the production is increased.

Differences:

The following are some of the differences between perfect competition and monopoly.

1. In perfect competition there is large number of buyers and sellers who are producing homogeneous products therefore the activity of single seller may not influence the market price but in monopoly there is single seller. He controls the entire supply of the commodities. In this there is no competition.
2. In perfect competition the revenue curves are parallel to X-axis and where as in monopoly the revenue curves are falling down from left to right. We can know the nature of revenue curves with the help of following diagrams.
3. In perfect competition because of uniform price level the average revenue and marginal revenue are equal and they are parallel to X-axis but in monopoly the average cost and the marginal revenue curves fall down from left to right. If the monopolist wants to sell more he must reduce the price level and if he wants to fix more price he must reduce the output.
4. Under perfect competition the price is determined at that point where the demand and supply both are equal. In this competition both price and output are determined at equilibrium point. But in monopoly only the output is determined at that level where $MC=MR$.
5. In perfect competition there is a free entry & exit. The new firms may enter the market when the existing firms are getting abnormal profits and leave the market when they are getting losses. But in monopoly the other firms have no freedom to enter the market.

In perfect competition the firm gets an equilibrium position where the marginal cost is at raising stage, if the marginal cost curve fall down there is no possibility of equilibrium between MC and MR. In monopoly market the firm may get an equilibrium position where the MC curve is at raising stage, constant or at falling stage.

6. In perfect competition there is a difference between firm and Industry. Firm is a production unit and where as industry is a group of firms. But under monopoly market, there is no difference between the firm and Industry and both is same.
7. In the short period under perfect competition the firm may get abnormal profits. But in the long run normal profits because of free entry, exit the firm. But in monopoly the firm may get abnormal profits in short period and in long period the firm may get normal profits, because of no free entry.
8. The average cost becomes minimum at equilibrium point under perfect competition. In the case of monopoly AC curve is falling at equilibrium point i.e., point R.
9. In perfect competition the output is more when the price is less and where as in monopoly the output is less and price is more.

- In perfect competition there is no price discrimination. Fixing of different prices to different customers for the same article is said to be price discrimination. The price discrimination is not possible under perfect competition. But in monopoly market there is a possible for price discrimination. Monopolist can fix different prices to different customers for the same commodities.

MONOPOLISTIC COMPETITION (IMPERFECT COMPETITION)

Prof. E.H Chamberline of Harvard University is the founder and the builder of Monopolist competition. It is also sometimes referred as group equilibrium. According to Joe. S.Bain, "Monopolistic competition is found in the industry where there is a large number of small seller selling differentiated but close substitute products".

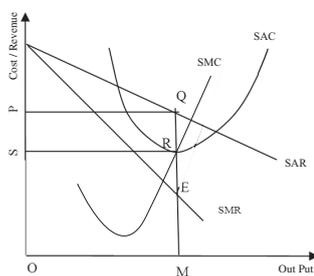
Monopolistic competition is the midway of perfect competition and monopoly. There are some elements of competition and monopoly in this monopolistic competition.

Features:

- Existence of large number of firms:** In monopolist competition there are large number of firms in the market. The output of each firm is very much less in the total output. Because of large number of firms each firm acts independently without bothering about the reaction of rivals.
- Product differentiation:** Product differentiation is another feature of monopolistic competition. Under this monopolist competition products are not homogeneous like in perfect competition and they are not remote substitutes as in monopoly. These products may be close substitutes. For example Colgate tooth paste, close-up etc., product differentiation can be brought about in several ways. The firms may bring about product differentiation by offering supplementary services to the customers or by differentiation the quality of the goods or through advertisements.
- Free entry and Exit:** There is a free entry and exit of the firms in monopolistic competition. The new firms may enter the market or the existence firms may leave the market.
- Excess capacity:** Under monopolistic competition the firms produce the goods upto that level where the average cost is at falling stage. The firms do not produce the output upto that level where the long run average cost is at minimum level. In monopolist competition the amount of output that is produced by the firm is less than the ideal output. This is called excess capacity.
- Selling costs:** The costs on advertisements are commonly called selling costs. According to E.H.Chamberlin selling cost is that cost which shifts the demand curve towards right side. Therefore the selling costs are useful for the increase of demand. The producer spends on selling costs upto that situation where the additional revenue becomes zero. Through publicity and propaganda the firm will popularize the quality of the products. With the help of advertisements the firms may change the tastes of the customers. In a real sense the selling costs will not promote the welfare of the customers.

Short run equilibrium of the firm under monopolistic competition

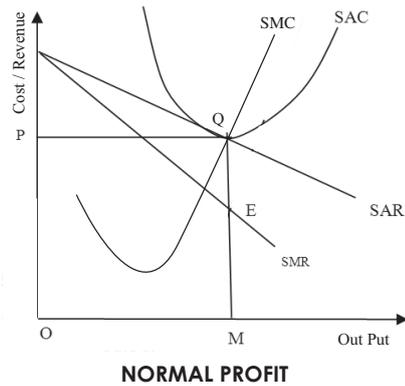
With regard to abnormal profits short run equilibrium of the firm under monopolistic competition is similar to that of a monopoly firm. In order to maximize its profits and for attainment of equilibrium position, the firm must produce the goods upto that level where the marginal cost will become equal to marginal revenue. This can be explained with the help of following diagram.



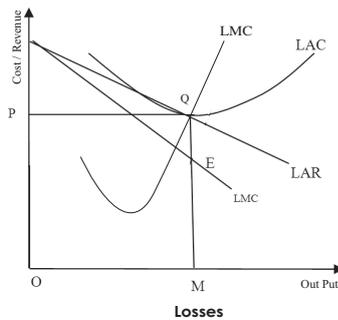
ABNORMAL PROFIT

In this diagram SAR is the short run average revenue curve and also demand line. SMR is the short run marginal revenue curve. SAC is the short run average cost curve and SMC is the short run marginal cost curve, SMC & SMR are equal at point E. Therefore the equilibrium level of output is OM and the price is OP. OPQM is the total revenue and OSRM is the total cost. Therefore QR is the amount of abnormal profit per one unit. PQRS is the total amount of profit.

In the short period it is possible that some firms may get abnormal profits like in the above manner and some other firms may get normal profits or losses like in the following manner.



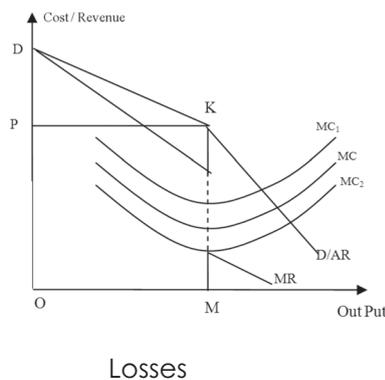
In this diagram A the firm is getting only normal profits which are included in the cost of production. The equilibrium out is OM. At OM output level the price is OP which is also equal to average cost. In the diagram OPQM is the total revenue and total cost. So, the firm is getting only normal profits.



In this diagram B the firm is getting losses. In this diagram at OM output level the price is OP but the unit cost that is average cost is OS. Therefore the firm is getting PS or QR amount of loss. OPQM is the total revenue and OSRM is the total cost. So PQRS is the total amount of loss.

Long Run Equilibrium:

Under monopolistic competition there is a free entry & exit. If the existing firms are getting profits then the new firms may enter the market and if the firms are getting losses then the firms have freedom to leave the market. Therefore in the long run the firms get only normal profits. We can know these things with the help of following diagram.



In this diagram LAC is the long run average cost curve and LMC is the long run average cost curve and LMC is the long run marginal revenue curve and LAR is the long run average revenue curve. The LMC and LMR are equal at point E. So the output is determined as OM and the price is OP. In the diagram average cost is equal to average revenue. So the firm is getting only normal profits in the long run. These normal profits are included in the cost of production.

Difference between perfect competition and Monopolistic competition:

Under perfect competition especially in the long period the firm gets an equilibrium position at that level that the AC is minimum and where as in Monopolistic competition the firm gets an equilibrium position at point Q where the LAC curve is at falling stage. Therefore in monopolistic competition there is an excess capacity.

PRICE DETERMINATION UNDER OLIGOPOLY:

The term oligopoly is derived from two Greek words Oligos means "a few" and pollein which means "to sell". Therefore oligopoly refers to that form of imperfect competition where there will be few sellers are producing either homogeneous products or products which are close substitutes. Oligopoly may also be referred as "Competition among the few".

Features:

- 1. Interdependence:** In Oligopoly market there is an element of interdependence of the firms. The price and output decisions of one firm will affect the other firms.
- 2. Indeterminate demand curve:** No firm in oligopoly can forecast with fair degree of certainty about the nature and position of its demand curve. The firm cannot make an estimation of sales of its products if it reduces its price.
- 3. Element of Monopoly:** In oligopoly market where there are only few firms monopoly element may be prevailed in the market. Each firm controls a large share of the market.
- 4. Importance of selling costs:** Indeterminate demand leads to making of advertisements to make the average revenue more favourable.
- 5. Price rigidity:** The price will be kept unchanged due to fear of realization and the price will tend to inflexible. The reasons for price rigidity are:
 - a) The firms know the ultimate outcome of price change.
 - b) Revised prices further lead to irritation among the consumers.
 - c) To discourage any new firm entering in the field of production.

PRICE DETERMINATION UNDER OLIGOPOLY:

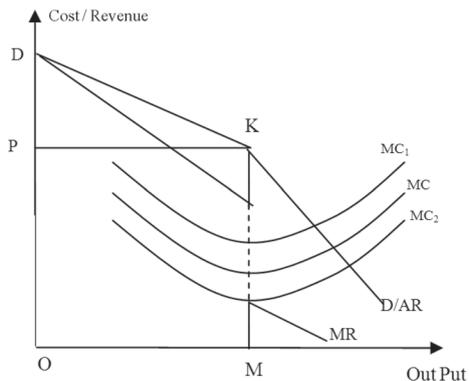
Price can be determined in three ways under oligopoly:

1. Independent pricing;
2. Pricing under collusion;
3. Price Leadership

- 1. Independent pricing:** If there is a product differentiation under oligopoly each firm can act as a monopoly and fixes the price independently. Therefore the firm may determine its price in that way where it gets maximum profits. If there is no product differentiation, it is difficult to know the price determination in accurate manner the firm may compete each other and finally they may fix the common reasonable price which cannot be changed. But this policy independent pricing cannot with stand in the market.
- 2. Pricing Under collusion:** Most of the firms have the opinion that independent price determination leads to uncertainty. To avoid this defect there is a tendency among the oligopoly firm to act collectively by collusion. In this method these firms may make 'cartle' arrangement. The centralized cartle determines the output produce by different firms and the price is also determined which is the most acceptable by all firms. The firms may agree to share the market even though they are producing homogeneous products.
- 3. Price leadership:** If the other firms follow the price which is determined by one firm in oligopoly then we can say that there is a dominant firm or the firm with low costs or well established old firm may take this leadership and fixes the price.

Diagrammatic Explanation: The price & output determination under oligopoly can be explained with the help of following diagram:

The popular method with regard to price and output determination is the method of kinked demand curve.



In this diagram on X-axis the output and on Y-axis costs, Revenue and Price are determined. The demand curve DD₁ has a kink at point K. It is the average revenue curve. The point K divides the demand curve into two parts. DK part of demand curve is elastic one and where as KD₁ part of the demand curve is less elastic.

There is price rigidity at point K because of several reasons. If the particular firm rises its prices the other firms do not follow. Therefore the demand for the particular products will be reduced; on the other hand if the particular firm reduces their prices, other firms follow the price. Therefore no firm has to desire to increase or decrease the price level. So there is price rigidity in oligopoly market. The marginal cost becomes equal to marginal revenue at point E. Therefore the output is determined as OM and the price as OP.

PRICE DETERMINATION UNDER DUOPOLY:

As early as in 1838, a French economist Cournot analyzed a special case of competitive business behaviour with only two firms in an industry. The assumptions are quite strict but considering the time at which this formulation was developed, they cannot be faulted with too much. It is assumed that each member in this two – firm industry produces a homogeneous product, treats the rivals output as given and maximizes profit. We shall illustrate the equilibrium price-volume combination for each firm by taking simple example. The rival firm's output behaviour with respect to one firm's output is called conjectural variation. Cournot assumed a zero conjectural variation.

Assumptions:

1. There are two firms, each owning an artesian mineral water well.
2. Both the firms operate their wells at zero marginal cost
3. Both of them face and demand curve with constant negative slope.
4. Each seller acts on the assumption that his competitor will not reach to his decision to change his output and price.

Suppose, the total industry demand function was:

$$P = 100 - 0.5Q$$

Since the entire output is shared by just two firms, this can well be written as

$$P = 100 - 0.5(Q_1 + Q_2)$$

Firm number 1 for example has a constant cost function represented by

$$C_1 = 5Q_1$$

Firm number II is having an increasing cost function $C_2 = 0.5 Q_2^2$

Firm I's Profit = Total Revenue – Total costs

$$= PQ_1 - 5Q_1$$

$$= [100 - 0.5(Q_1 + Q_2)] Q_1 - 5Q_1$$

$$= 95 Q_1 - 0.5 Q_1 Q_2 - 0.5 Q_1 Q_2$$

The solution of duopoly equilibrium crucially depends on the nature of the reaction function of each duopolist. The equilibrium is reached when the values of Q_1 and Q_2 are such that each firm maximizes its profit, given the output of the other and neither desire to alter the respective output. However, for a common solution,

both the firms must achieve maximum profits and at the same time have no incentive for changing respective output levels. Such a solution is obtained at the intersection point of the two linear reaction functions.

'Duopoly' means two sellers. There are different kinds of 'Duopoly'.

1. Cournot's Solution
2. Edgeworth Model
3. Chamberlin's Model

1. Cournot's Solution:

A.A. Cournot, a French economist was found solution to duopoly pricing in 1838. His model is based on the following assumptions:

1. Total output must be sold out.
2. The two sellers produce and sell a homogeneous product.
3. The number of buyers is large.
4. Each seller knows the demand curve for his product
5. The cost of production is assumed to be zero
6. Each rival's plans of output.
7. Each supplier takes the supply of his rival to be constant.
8. Each accepts the market demand for his product.
9. Each seller aims at maximum revenue *Cournot* assumed that there are two firms each owning a mineral well, and operating with zero costs. They sell output in a market with a straight – line demand curve. Each firm acts on the assumption that its competition will not change its output, and decides its own output so as to maximize profit.

Basing on these assumptions, Cournot's model tells us that each will be supplying exactly equal quantities of the product and the price charged will be same.

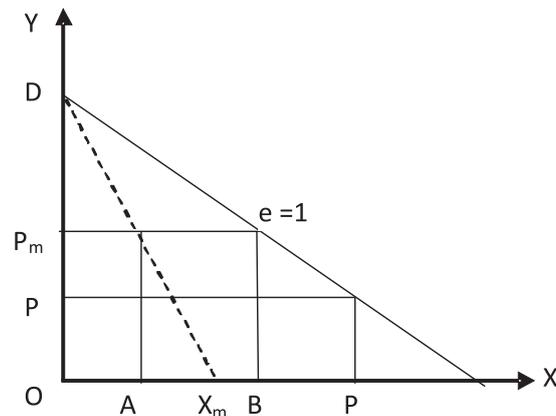
1. Edgeworth's model duopoly pricing:

Edgeworth based his model on the same assumptions of Cournot except that each seller takes his rival's supply constant. Instead Edgeworth assumes that each seller takes the price of his rival constant. According to Edgeworth, there will not be any price stability under duopoly. The price continually varies between competitive and monopolistic levels. According to him, duopoly situation is indeterminate and unstable equilibrium.

2. Chamberlin's Model:

Chamberlin's contribution to the theory of oligopoly consists in his suggestion that a stable equilibrium can be reached with the monopoly price being changed by all firms, if firms recognize their interdependence and act so as to maximize the industry profit.

Chamberlin rejects the assumption of independent action by competitors. He recognizes the mutual dependence of the two sellers put forth a stable equilibrium model. His situation is based on the assumption that each seller is intelligent enough to understand the importance of mutual agreement between the two and that sharing monopoly profits is to the best advantage of both.



1. Firm 'A' – Maximizing output ' OX_m ' and sell it at the monopoly price ' P_m '.
2. Firm 'B' is having 'Quantity' – ' $X_m B$ ' at which B's $MR = MC = 0$
3. Total industry output is OB .
4. 'DD' is demand curve.
5. 'e' – equilibrium price.

Under chamberlin model the market demand is a straight line with negative slope, and production is assumed costless for simplicity.

6.2 GOVERNMENT INTERVENTION AND EFFECT

In modern times the state participation in economic activity can hardly be a matter of disagreement. The free play of economic forces, even in developed capitalist countries, has often meant large unemployment and instability of the system. Hence there is a considerable dilution of the laissez-faire principle and the governments are now called upon to intervene in economic fields which were considered sacrosanct. In developed nations state intervention has been invoked to ensure the economic stability and full employment of productive resources of the country. But the state activity is ore in-evitable in developing countries. Here the state to play a vital and ever expanding role to accelerate process of economic growth. These countries are striving towards the achievement of higher standards of living. In case of under developed nations, the vicious circle of under-developed equilibrium can be broken by a comprehensive government planning of the process of economic development.

In the initial phase, the process of development in developing countries is held up primarily by the lack of the basic social and economic overheads such as schools, technical colleges and research institutes, hospitals and railways, roads, ports, harbours and bridges. Provision of these overheads requires very large investments. Such investments will lead to the creation of external economies, which, in their turn, will provide incentives for the expansion of private enterprise in the field of industry as well as agriculture. Private enterprises will not undertake investments in social overheads, because the returns from them in the form of an increase in the supply of technical skills and higher standards of education and health can be realised only over a long period. Investment in them is not profitable from the standpoint of the private entrepreneurs. Howsoever productive it may be from the broader interest of the society. This indicates the need for direct participation of the government by way of investment in social overheads, so that the rate of development is quickened.

In view of the peculiar circumstances in which politically, socially and economically Indian economy is placed, there is not only a great urgency about economic development but also an infinitely much greater

effort is required to generate the forces of economic growth.

The process of regulated development in India took the shape of democratic planning of the economy. The cornerstone of this process is the "Mixed economy" framework.

Features of a mixed economy are the following:

(i) Individual freedom. In a mixed economy, like any capitalist economy, consumers enjoy the freedom of consumption, producers the freedom of production and workers the freedom of choice of occupation. However, the State imposes restrictions on the production and consumption of commodities and services considered harmful for social welfare and growth.

(ii) Co-existence of public and private sectors. In a mixed economy, the areas of economic activities are demarcated for the public and private sectors by the State: basic industries requiring heavy investment, strategic industries (like defence production) and the activities relating to social welfare and those essential for economic growth belong to public sector. Rest of the industrial activities is open to private sector.

(iii) Planning. Like socialist economies, economic plans (at the national and State levels) are formulated in a mixed economy too. But detailed plans are prepared only for the public sector. For the private sector only the broad targets of production are indicated and creation of new capacities facilitated accordingly. A system of taxes and subsidies is used to encourage private sector to achieve the indicated targets.

(iv) Social welfare. In a mixed economy, the State follows policies which increase social welfare. It spends on provision of social services like education, health, housing for weaker sections, etc. It also imposes progressive rates of direct taxes on incomes and wealth of the people so as to reduce inequalities in the distribution of income and wealth in the society. The State also enacts various labour laws to fix minimum wages, to regulate hours of work and other aspects of working conditions. The State also follows policies to develop backward regions and to increase employment opportunities in the economy.

State regulation of industry has been of an active nature since the inception of the planning process in India. It consisted of two basic dimensions:

(i) The creation and growth of public sector in transport, finance and banking, in certain types of internal and external trade and in the production of key and strategic products, like oil, for the economy.

(ii) Coordination of current economic needs with long-term development targets. For this, economic planning was resorted to for channelising investment and regulating changes in the production structure.

The **intervention of government** in Indian economy can be studied under the following heads:

1. Government as regulator of business;
2. Government as promoter of business;
3. Government as an entrepreneur; and
4. Government as a planner.

It must, however, be well understood that this four-fold classification of government's role is purely for the ease of understanding the State's economic activities. Any one type of role of government is not independent of its other roles—these are integrally connected with one another.

1. **GOVERNMENT AS REGULATOR OF BUSINESS:**

Government regulates the economy through the legal framework. Various legislations have been passed to achieve the various objectives of the economy.

Income Tax Act: to reduce the gap between the rich and Poor, SEBI – To protect the interest of the share holders, Essential Commodities Act – To control prices of essential commodities...etc

Various legislations which have to be complied by business entities in India are

- a) Industrial Development and regulation Act



- b) FEMA
- c) Income Tax
- d) Excise Act
- e) Customs Act,
- f) State level VAT Acts
- g) Factories Act
- h) Companies Act
- i) Other labour and Industrial laws.

2. GOVERNMENT AS PROMOTER OF BUSINESS:

Finance is the crux of the problem of development. We know that the developing countries suffer from scarcity of capital which is the greatest handicap in their economic growth. To mobilise these savings a sound banking system is essential and other financial institutions are required to channelize these savings, into investments and supply credit needs of trade and industry. The government is to see that appropriate financial institutions are set up to meet the requirements of the entrepreneurs

In India, for instance the government took steps to reform the banking system and put it on sound footings. Fourteen major commercial banks were nationalized in 1969 and six more in 1980. In agriculture sector to meet the credit needs of the farmers, NABARD and Land development banks were established. In industrial sector too financial and other institutions were established to promote industrial development. To assist the small scale and cottage industries, several boards were set up such as Cottage industries board, State Financial corporations were setup. To meet the long term financial needs of the large scale industries, industrial finance corporations like IFCI, IDBI, ICICI, etc were setup.

1. GOVERNMENT AS ECONOMIC PLANNER:

The basic challenge before a developing country is to catch up with advanced countries, which is not possible unless these countries are in a position to accelerate the pace of economic growth. This is generally achieved through a process of planned development which amount other things includes. i) Pre-determining the priorities of development; ii) development of suitable links between various sectors and functional areas so that economy can growth in an integrated way, iii) evolving an organizational mechanism for implementation of plans, and iv) a built-in system of review and evaluation of the progress plan.

Planning in India – Objectives and Strategy:

The objectives of planning in India may be grouped into the following broad categories:

- i. Growth of national income and the level of per capital income
- ii. To achieve a planned rate of investment within a given period so as to increase output capacity.
- iii. To reduce in-equalities in the distribution of income and wealth.
- iv. To reduce the concentration of economic power over the productive resources of the economy
- v. To create additional job opportunities.
- vi. To adopt measure to alleviate the three 'bottlenecks' regarded by the planners as being of critical importance, viz., agricultural production, the manufacturing capacity for producers' goods and in the long run as an alternative source of jobs to the unemployed agricultural population.

3. GOVERNMENT AS ENTREPRENEUR:

Public Sector in India:

Public Sector in India was designed to control the “commanding heights” of the economy. Investment in public sector has been undertaken mainly as an instrument of the policy of socialistic pattern of society. There has been a dramatic expansion of the public sector during the planning period. The growing emphasis on public sector is because of the following:

- (1) Many a time, a public enterprise becomes necessary because of the sheer magnitude and size of an enterprise. For example, no private enterprise in India can and would like to provide the capital required for the construction of a dam; only public enterprises have to take up such ventures.
- (2) In certain public utility services, such as power and transport, which require heavy initial investment and which have a long gestation period, only government can wait for the result.
- (3) Only public enterprises can have the consideration of a balanced regional development. The social benefits of providing employment in backward areas are much greater than a similar outlay elsewhere.
- (4) If nature of product/technology necessitates monopoly in supply, it is always good to have monopoly of the State rather than a private firm. This prevents concentration of economic power with private individuals.
- (5) Public enterprises can play a promotional role. They can act as pacesetters for private individuals. For example, it was only after the successful beginning of some plants in the public sector that the private sector came forward for production of fertilizers.
- (6) Public ownership of key economic points, like banks, can exert a healthy influence on the entire economy in respect of prices, geographical distribution, etc.
- (7) The expansion of the public sector has also become necessary for making adequate provision for the infrastructure which is vital for overall industrial growth in the country. It provides better opportunities for expansion of the private sector too. Moreover, the private sector is normally not interested in the development of infrastructure because of the heavy investment, low rate of return and the long gestation period. In the setting up of basic and key industries, like steel and heavy machinery, etc., the public sector has played a most beneficial role since most industries of this type were beyond the capacity of the private sector.

In short, the tremendous growth of public sector in India and persistent emphasis on its importance has been with following objectives in view:

- To initiate and accelerate industrialisation of the country;
- To minimize imbalances in personal, sectoral and regional incomes in the country;
- To tackle the problem of unemployment;
- To forestall and check the growth of monopolistic tendencies in the private sector;
- To create infrastructure for smooth and fast growth; and
- To ensure against economic distortions, often resulting from the operation of free market.
- The type of organisation of these undertakings. There are:

Forms of public sector organisations:

The public sector undertakings can be classified into four kinds, depending on the type of organisation of these undertakings. These are:

- (1) Departmental undertakings:** This category consists of those public sector units which are organised on the pattern of the departments of the government, e.g., the production units of Indian Railways like Chittaranjan Locomotive Works, Integral Coach Factory, and the production units under the Department of Defense Production



(2) Public utilities: These are again departmentally controlled, although some autonomy in their working has been given in certain cases. This category includes undertakings like the railways, ports, posts and telegraphs, power and irrigation works.

(3) Public corporations: This includes those industrial undertakings which are organised as statutory corporations, like Air India International and Indian Airlines Corporation.

(4) Government Companies: The industrial and commercial undertakings mainly, if not wholly, financed by the government. For example, Hindustan Machine Tools, Neyveli Lignite Corporation, Bharat heavy Electrical Limited, etc.

4. GOVERNMENT AS A PLANNER:

Monetary and fiscal policies of a government are also aimed at giving direction to the economy as per the economic priorities. Once a government has decided about the kind of industries (capital or consumer goods), the scale of these industries (large or small – scale), type of industrial ownership (public or private). Domestic or foreign, and the allocation pattern of income between consumption and saving, etc. it develops a scheme of monetary-fiscal-budgetary policies that would help fulfill these objectives. A good mix of these three policies with efficient administrative machinery can create climate for the intended use of resources, pattern of growth in savings and investment and distribution of income. The central bank can mould its monetary policy (money supply and bank rate) to stimulate general industrial growth and revival. Each central budget has a bias in favour of some industries where certain tax concessions and expenditure allocations are done for the revival and growth. Reduction in direct taxes also has a stimulating effect on industry as it results in enhancing demand for the product.

(a) Monetary Policy:

Since the planned development process started in India, the money and credit policy followed by the Reserve Bank of India is based mainly on two considerations: a) to accelerate growth rate, and b) to control and reduce inflationary trends in the economy. Obviously, in a state of fast growing business and industrial activity there is bound to be expansion of currency and credit, but the supply of credit in excess of its need would prove inflationary. The RBI tries to strike a balance between them and in order to draw policy perspectives, it juxtaposes information on indicators like inflation rate, interest rate, BOP position, fiscal deficit, credit flows, etc. This multiple indicator approach lends flexibility for necessary adjustment.

(b) Fiscal Policy or Budgetary Policy:

Fiscal policy or budgetary policy in India is designed to achieve the following objectives:

- i. To achieve rapid economic development;
- ii. To reduce concentration of income and wealth so as to create socialistic pattern of society;
- iii. To achieve plan targets of growth and employment
- iv. To reduce regional imbalances by providing incentive for backward area location of industries, and
- v. To modify industrial structure according to plan frame work by encouraging/discouraging investments in certain industries.

In order to achieve these objectives, the government has followed the policy of formulating its annual budgets and tax provision in such a manner that the desired objectives are fulfilled without creating any noticeable disruption in the existing economic structure. The fiscal policy of the government consists of the following three instruments:

- 1) Policy of taxation,
- 2) Policy of public expenditure, and
- 3) Policy of public debt management.

6.3 BUSINESS AND ECONOMIC FORECASTING

Economic forecasting can be termed as a process of predicting conditions in the economy as a whole or in part. Economic forecasting has many advantages. At the macro level, economic forecasting helps us in estimating the growth of an economy. Economic forecasts assist the Government in taking the steps required to achieve the objective of economic development. For instance, if the forecasts indicate that the economy is growing at a slow pace, then the Government would contemplate making changes in the fiscal and monetary policies so as to raise the growth rate.

Economic forecasting is of vital importance even at the micro level. Firms formulate their strategies based on economic forecasts. For instance, if the forecasts indicate that the economy is growing at a fast pace, then it encourages the businessmen to invest more and improve their profits.

"If the forecasts about demand the cost of inputs, product price, technology etc., that going to plan are seriously in error, then the plan will be of little use and the control phase is likely to break down".

Various economic forecasting techniques are available. They range from simple and relatively inexpensive procedures to methods that are quite complex and expensive. Some of the techniques are quantitative while others are qualitative. It is very difficult to save which one is the best. The best one for a particular task depends on the specific nature of the forecasting problem. Some of the relevant factors to be considered are as follows:

- a) The time into the feature that one must forecast.
- b) Degree of accuracy require
- c) The lead time available before arriving at a decision
- d) The quality of data available for the purpose of the analysis.
- e) The nature of relationships included in the forecasting problem.
- f) The benefits expected from a successful forecast compared to the cost associated with using a particular technique.

Some techniques are quite satisfactory for short run projections such as barrow metric and survey methodology. Others require more lead time and are thus more useful for long forecasting. The forecaster must assess the strengths and weakness of each technique in-order to choose the best technique for his forecasting problem. The forecasting techniques can be broadly categorized into the following:

A. Macro Economic Forecasting:

- a.i) Survey of buyer's intention.
- a.ii) Forecasting Turning points (Barometric Forecasting)
- a.iii) Index Numbers – Composite & Diffusion Indices
- a.iv) Econometric methods.
- a.v) Input-output analysis.
- a.vi) Judgmental forecasting of Macro – Economic Activity

B. Industry Forecasting:

- b.i) Extrapolating the Trend line – Free hand method and least Square Method
- b.ii) Box-Jenkins Methods
- b.iii) Judgmental forecasting at Industry Level



C. Firm's Product:

- c.i) Differential Equations
- c.ii) Correlation analysis
- c.iii) Forecast of Field Sales Personnel
- c.iv) Opinion pooling (Expert opinion)
- c.v) Smoothing Techniques: moving average and exponential smoothing
- c.vi) Constant Growth Rate Projection.

All these methods may now be briefly discussed as below:

i) Survey of buyers intentions:

This method is used for short-term forecasting. This method seeks to “determine whether potential customers intend to buy a certain product or service in the forecasting period. An attempt may be made with this method also to ascertain too many units of a product a customer will buy and at what prices. Some forecasters also make a survey of consumer intentions. Intention surveys are used to judged level of confidence the consumer feels concerning the desirability of spending for consumption in future.

Survey methods are widely used because they provide useful supplementary material in addition to more highly quantitative techniques. In fact, econometric methods which are used for quantitative forecast depend on an underlying stability of the relation between the major demand determinants and the quantity demanded. These quantitative techniques often fail to capture the more emotionally and psychologically based swings in consumer behaviour. But a carefully constructed survey method may clearly reveal this type of information. The longer the forecast period, the greater the chances of error. So this method unlikely to give accurate results for long period.

ii) Forecasting Turning Points - Barometric Forecasting.

Barometric Forecasting is the prediction of turning points in one economic time series through the use of observations on other time series called barometers or indicators. The economists at the national bureau of Economic, Research have classified economic time series into 3 broad categories namely leading indicators, co-incident indicator and lagging indicators. These indicators provide signals or indications of changes in economic activity such as national income, national product, level of employment, rate of inflation etc.

a) Leading Indicators includes twelve indexes. Such as Average work week of production workers, Stock price of 500 common stock, No. of new building permits, change in sensitive materials prices, money supply, Change in total liquid assets.

b) Co-incident indicators include six indexes such as personal income, industrial production, manufacturing and trade sales, employees on non –agricultural payrolls.

c) Lagging Indicators seven indexes such as manufacturing and trade inventories, average prime rate charged by banks, commercial and industrial loans outstanding etc.

These indicators do not always give a clear cut indication of turn in economy activity.

iii) Index Numbers – Composite and Diffusion Indexes:

Composite and diffusion indexes often overcome, atleast partly, the difficulties in barometric forecasting and are also used for forecasting purpose. Composite index are those that measure several aspects of business activity by covering a wide range of economic activities. They are thus quite reliable business cycle indicators. Composite index contains twelve leading, four coincident, and six lagging indicators. The most outstanding of the indexes are: industrial production gross national product, and capacity utilization rate. They are weighted averages of several leading indicators in each group. Large weights are given to

those indicators which do the job of forecasting better than others.

In order to overcome the difficulty arising when some of the 12 leading indicators move up and some move down, another method is used. This is known as the diffusion (pressure) index. Rather than combining 12 leading indicators into a composite index, economists construct a diffusion index which gives the percentage of the 12 leading indicators moving upward. In other words "instead of combining a number of leading indicators into a single standardized index, the methodology consists of noting the percentage of the total number of leading indicators that are rising at a given point of time". As a general rule, barometric forecasting is largely based on composite and diffusion indexes. Not much reliance is placed on individual indicators, except when a firm needs information about expected changes in the market for certain specific goods and services.

The composite and diffusion indexes are no doubt acceptable tools for macro-level forecasting, i.e., for predicting turning points in business cycles. But there are certain shortcomings of this method. Firstly, on various occasions economists forecasted a recession that failed to occur. Secondly, there can be considerable variability in lead time.

iv) Econometric Models:

The statistical methods used in forecasting can be broadly subdivided into two categories namely time series models and econometric models. Econometric model is the use of an explicit structural model that attempts to explain the underlying economic relations. To be more specific if we wish to employ an econometric model to forecast future sales it is necessary to develop a model that incorporates those variables that actually determine the level of sales such as income price of substitutes and prices of complementary etc. In reality different economic variables are found to be interrelated. Therefore, a single equation is grossly inadequate to represent the factors that determine sales.

Suppose that we have found the levels of sales to be estimated fairly accurately by the system of equations sales

$$S_t = -aP_t + bY_t$$

Where

S_t = Sales of Product t

P_t = Price of substitute of t

Y_t = Income of the buyer

Econometric models have the following advantages. Econometric models require analysts to define explicit causal relations. This specification by an explicit model enables the forecaster to search out or identify correlations between normally unrelated variables and may help to make the model more logically consistent and reliable. Secondly, such models permit analysts to consider the sensitivity of the variable to be forecasted, to the changes in the exogenous variables. Lastly, this approach can easily be used for computer simulation.

v) Input-output Forecasting:

Input-output analysis is an attempt to reveal the structural interdependence of the economic system. Input-output analysis for an entire economy is based on an accounting of the flow of goods and services in rupee terms at a particular time. Part of this is an inter-industry flow, goods transferred from an industry to be used in the production processes of other industries, and the remainder flows to an exogenously defined, 'final demand' sector. This sector generally includes households, government, and foreign trade, often lumped together. To be precise, an input-output table shows the purchases by a particular sector from all the other sectors, and sales by the sector to the other sectors. The table below shows a very simple hypothetical input-output table:



Sales by	X	Y	Z	Final Demand	Total Output (₹)
X	-	60	40	100	200
Y	40	-	100	260	400
Z	50	100	-	50	200
Labour	100	240	60	-	410
Total Input	200	400	200	410	1210

If we consider the output of industry X worth ₹ 200, we notice that ₹ 60 worth of X was purchased by industry Y, ₹ 40 worth by industry Z and ₹ 100 worth by final consumers. In a like manner, to produce the output, industry X purchased ₹ 40 worth of output from industry Y, ₹ 50 worth from industry Z, and ₹ 110 of labour services.

From the above table we can construct another table which shows the corresponding input coefficients:

	X	Y	Z
Producer of Input			
X	-	0.15	0.2
Y	0.2	-	0.5
Z	0.25	0.25	-
L	0.55	0.6	0.3

The table above shows the amount of output that needs to be purchased from the various sectors to produce one unit of output for particular sectors. Thus the first column shows that to obtain ₹ 1 worth of output from industry X requires purchase of ₹ 0.2 worth of output from Y, ₹ 0.25 worth from Z and ₹ 0.55 of labour services.

The answers to our query can be found by solving the three simultaneous equations given below where x, y and z are the output in ₹ From industry X, Y and Z. It is obvious that all three outputs were change due to structural interdependence.

$$x = 0.15y + 0.2z + 120$$

$$y = 0.2x + 0.5z + 260$$

$$z = 0.25x + 0.25y + 50$$

Uses and shortcomings of input-output Forecasting:

Input-out models have various uses and abuses. Prima facie, such models are used by companies to forecast the raw materials, labour power and capital requirements needed to meet a forecasted change in the demand for their products.

However, input-output models are based on two unrealistic assumptions. First input coefficients are assumed to remain fixed and so the possibility of factor-substitution is ruled out. Secondly, the assumption of constant prices of commodities rules out the possibility of substitution in consumption.

Judgmental Forecasting of Macroeconomic Activity:

Some forecasters rely largely, if not entirely, on judgment to derive future values of aggregate economic quantities. Although forecasting is both an art and science, judgmental forecasts represent the last step in the art of forecasting. By using his own knowledge and experience, the forecaster is able to analyze various key sectors in the economy. Forecasts are generated for the key sectors on the basis of such

analysis. In general, the sectors that are evaluated represent the components of GNP so that a forecast of the aggregate of this aggregate economic quantity is obtained by combining the forecasts of the component sectors.

INDUSTRY FORECASTING:

Extrapolating the Trend Line:

The most widely used forecasting technique goes by different names: trend projection, curve fitting, and extrapolation. This is a quantitative technique and is based on the fundamental assumption that future events will follow an established trend observed in the past. However, when there is a significant and unexpected change in one of the underlying trends this approach loses its relevance.

Components of time Series:

A typical time series has the following four major components:

- i) **A Secular trend:** representing the long-term direction, or average movement in the time series.
- ii) **Cyclical fluctuations:** which usually follow variations in the growth of the economy in general, around a long-term, secular trend
- iii) **Seasonal variations:** caused by changes in weather conditions and social habits, such as the need to buy X-mas cards in December and dresses during the festival season (Dewali or Durga Puja).
- iv) **Random or unsystematic variations:** such as wars, revolutions, crop failures, natural calamities, and changes in tastes and preferences of buyers.

Freehand Method: The simplest way to draw a trend line is to use the free-hand method (also known as the eyeball method). By using the method the analyst draws a line through the time series of fluctuations in an attempt to offset the peaks and troughs of the actual data.

The Least Squares Method:

A more satisfactory and accurate method of constructing a straight line trend is by the method of least squares. By using this method, instead of guessing at the trend line, one computes it mathematically. As soon as the trend line is constructed, "the deviations of the actual data from the trend line values when squared will be minimal. In short, they will be less than they would be from any other straight line that could be drawn through the data. This, incidentally, is where the method gets its name". In fact, "deviations squared will be minimum rather than zero, as would be the case if the deviations were not squared, because more emphasis is given to extreme values by the process of squaring".

The formula for calculating straight-line trend by the method of least squares, illustrated in the preceding chapter, is

$$Y_c = a + bX$$

In the above equation $Y_c = a + bX$, there are two unknowns, a and b . We can now solve for the value of these by using the following two normal equations in which time is designated as X and the values in the series by Y .

$$Y = Na + bX$$

$$XY = aX + bY^2$$

These equations can be simplified further by shifting the origin of the series of data in such a fashion that $X = 0$. In other words, instead of starting the time series at the beginning, it can start with a middle value and work the years, both plus and minus, so that $X = 0$.



The Box-Jenkins Method: Prof. Box and Prof Jenkins in their book, *The Time Series Analysis, Forecasting and Control* presented an approach to short-term forecasting. Their approach enables the forecaster to search the relationship that describes movements in time series, by using only past monthly values of particular time series. Unlike regression and econometric techniques which require the forecasters specify the model, the Box Jenkins approach merely starts with tentative specifications which modified and corrected using a rather complicated search technique, until the best specifications for that time series are obtained.

This relatively new approach can only be use for series that are stationary, that is, series they do not have a long term trend. For series that are not stationary, the trend has to be removed by differencing the original time series. The simple type of differencing is the first difference series in which we subtract the proceeding value from each observation of the original series, that is

$$Z_t = Y_t - Y_{t-1}$$

According to this approach any stationary time series can be depicted by one of 3 models.

- 1) Auto regressive model;
- 2) Moving average model and
- 3) Auto-regressive moving average model

Judgmental Forecasting at the Industry Level:

When industry data are not readily available or are inadequately organised (presented) to allow the forecaster to apply statistical techniques of analysis, judgmental forecasts seem to be the preferred choice. This type of situation often occurs in the area of industrial marketing, where industry data, broken down to any degree of detail are often quite inadequate or non-existent.

The Delphi Techniques:

Delphi method is a group process and aims at achieving a 'consensus' of the members. Herein experts in the field of marketing research and demand forecasting are engaged in

- analyzing economic conditions
- carrying out sample surveys of market
- conducting opinion polls

Based on the above, forecast is worked out in following steps:

- i) Coordinator sends out a set of questions in writing to all the experts co-opted on the panel who are requested to write back a brief prediction.
- ii) Written predictions of experts are collated, edited and summarized together by the Coordinator.
- iii) Based on the summary, Coordinator designs a new set of questions and gives them to the same experts who answer back again in writing.
- iv) Coordinator repeats the process of collating, editing and summarizing the responses.
- v) Steps 3 and 4 are repeated by the Coordinator to experts with diverse backgrounds until consensus is reached.

If there is divergence of opinions and hence conclusions, Coordinator has to sort it out through mutual discussions. Coordinator has to have the necessary experience and background as he plays a key role in designing structured 'questionnaires and synthesizing the data.

Direct interaction among experts is not avoided nor is their identity disclosed. Procedure also avoids inter-personnel conflicts nor strong-willed experts are able to dominate the group. This method is also used for technology forecasting.

C. Firm's Product Demand Forecasting:

All business and marketing managers are interested in the future growth of the economy or the demand for the product of a particular industry, of which it is a part. But usually they are more interested in how the changes or growth of the economy will affect their own sales or profits. Usually business managers make use of their knowledge about economic growth, or related data, to predict what probably is going to happen to their future sales. More firms rely on the results of published surveys of expenditure plans of business, consumers and governments.

1. Difference Equations: A method of using time-series data from past years, to predict the sales level for future periods, is that of difference equations, whereby the sales of the current period is found to be a function of the sales of previous periods in the general form:

$$S_t = aS_{t-1} + bS_{t-2} + cS_{t-3} +$$

2. Correlation Analysis: It is a commonly used method of projecting company sales. The process relates an unknown and dependent variable, in this case sales, to a known or independent variable, such as a national or per capital income. On the basis of historical data, a correlation between the two variables can be determined and a line of regression can also be constructed. If official sources give data on the future growth of the independent variable GNP, the line of regression can be extrapolated to determine sales, the unknown variable, in the future.

However, the effectiveness of this method depends on the fulfillment of at least three conditions:

- 1) There must exist a true casual rather than a casual relationship between the two variables;
- 2) The relationship must continue; and 3) data about the independent variable must be available. The forecaster can then compile a table or plot a scatter diagram showing the relationship between the two variables. From these data the forecaster can plot a line of regression using the standard formula $Y_c = a + bX$.

3. Forecast of Field Sales Personnel Expert opinion Forecast: A less sophisticated method of forecasting surveying people who are in a position to know what consumers will probably do in the immediately and near future regarding the purchase of goods and services. A firm may, for instance, arrive at some measure of the future demand for its product or service by interviewing sales people, wholesalers, retailers, jobbers, and other who are very close (i.e., are indirect touch) with the consumer. Pooling information from such informed sources may give the firm some indication about the future sales outlook for its product or service.

4. Opinion Pooling: "Expert opinion forecasts may come from committees within a much larger firm with key personnel making these forecasts". However, such forecasts are to be used with care. By averaging the opinions of the experts who are most knowledgeable about the firm and its products, the firm hopes to arrive at better forecast.

5. Smoothing Techniques:

Some naive forecasting methods are also available. These are known as smoothing techniques which seek to predict future values of a time series on the basis of some average of its past values only. Such techniques prove useful only "when the time series exhibit little trend or seasonal variation but a great deal of irregular or random variations. The irregular or random variations in the time services are then smoothed, and future values are forecasted based on some average of past observations". Two important smoothing techniques are: moving average and exponential smoothing.

a) Moving Averages:

By this method we seek to ensure that the predicted value of a time series in a given period (month, quarter, year, etc.) is more or less equal to the average value of a time series in a number of past periods. For instance, with a three-year moving average, the forecasted value of the time series for the next period is equal to the average value of the time series in the last three periods.



b) Exponential Smoothing:

This technique is often used in conjunction with time-series analysis, especially when the trend and seasonal components in a time series are significant. The basic methodology is like this:

If the forecaster has a time series $(Y_t, Y_{t-1}, \dots, Y_{t-n})$ and seeks to obtain a forecast of Y_{t+1} , he may hypothesize that the best forecast would be an average of previous values of Y . On the basis of the provisional statement or hypothesis, the forecast has the following three options available.

1. He may use a simple mean of all the past data.

so that the forecast of Y_{t+1} is equal to the average of the past $N+1$ values of Y .

2. Alternatively he may use only some of the past data in calculating the simple average. In the extreme case, the forecaster may use only the previous value of Y so that $Y_{t+1} = Y_t$.

Constant Growth Rate Projection:

A common feature of the real world, however, is that sales tend to grow at a constant rate of change rather than at a constant absolute change. Thus if sales of a particular product, say color TV sets, grew at the rate of 5% per annum on the average over the last few year, we can then express the sales function as $S_t = S_0 (1+K)^t$.

Where S_0 is the sale of the base year, k is the average rate of growth of sales per annum and t is the number of periods after the initial period.

Forecasting over the Life Cycle of a Product:

Stage of Life Cycle	Typical Decisions	Forecasting Techniques
1. Product development	Amount of development efforts Business strategies	Panel consensus, Delphi method Historical analysis of comparable products, priority pattern analysis, Input-output analysis
2. Market testing and early development	Optimum facility size, Marketing strategies, including distribution and pricing	Consumer surveys, Tracking and warning systems, Market tests, Experiment designs
3. Rapid growth	Facilities expansion, Marketing Strategies, production planning	Statistical techniques for identifying turning points, Tracking and warning systems, Market surveys, Intention-to-buy surveys
4. Steady state	Promotions, special Pricing, Production Planning, Inventories	Time-Series analysis and projection casual and econometric models, Market surveys for tracking and warning Life cycle analysis.

The types of decisions made over the lifecycle of a product and related forecasting techniques are summarized as follows:

6.4 EMPIRICAL PRODUCTION FUNCTION AND COST ANALYSIS

The relationship between inputs and the resulting outputs is generally summed up in a mathematical form which is called production function. The word function in mathematics means the precise relationship that exists between one dependent variable and many other independent variables. The production function formalizes the relationship between the maximum quantity of output (dependent variable) yielded by a productive process and the quantities of the various inputs used in that process.

The production function shows how a certain amount of inputs will result in the production of a certain amount of output of a commodity. The production function may be expressed as:

$$Q=f(x_1, x_2, x_3, \dots, x_n) \text{ in which}$$

Q is the quantity produced during a given period of time; and x_1, x_2 etc ...are the quantities of different factors used in production .

Traditionally, the production function has been called the law of diminishing returns and has been explained by economists in different ways in last 200 years. We may conveniently study production function as follows:

1. Production function with one variable input,
2. Production function with two variable inputs, and
3. Production function with all inputs.

PRODUCTION FUNCTION WITH ONE VARIABLE INPUT

Law of variable proportions

In economics, the production function with one variable input is illustrated well-known law of variable proportions. The law of variable proportions is one of the fundamental laws of economics. It has also been called as the law of diminishing marginal returns (also sometimes known as law of Diminishing Marginal Productivity)

Law of variable proportion shows the input-output relationship or production function with one factor variable while other factors of production are kept constant.

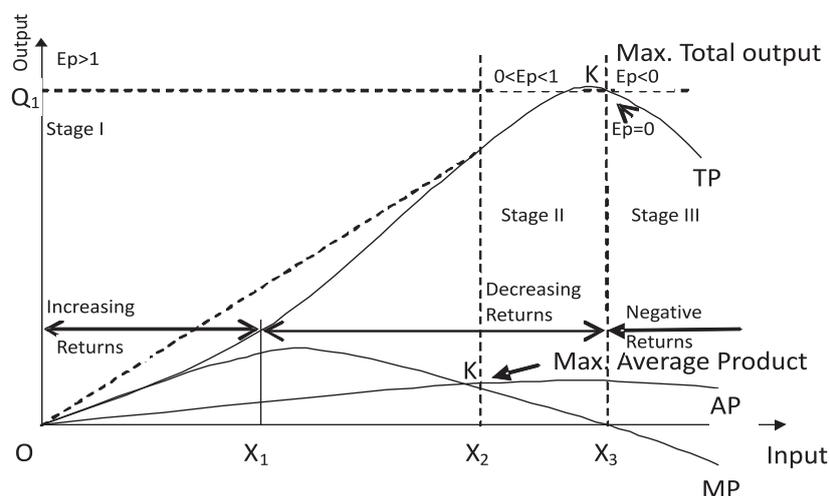
Suppose a farmer has 20 acres of land to cultivate. The land has some fixed investment, i.e., capital on it: a tubewell, a farm house and farm machinery. The amount of land and capital is supposed as fixed factor of production. The farmer can, however, vary the number of men to be employed its cultivation. Labour is thus the variable factor. The change in the number of men will change the output.

Law of Eventually Diminishing Returns, i.e., Marginal Returns only Eventually Declining:

The point worth noting is that the law does not state that each and every increase in the amount of the variable factor employed in the production process will yield diminishing marginal returns. It is possible that initial increases in the amount of variable factor employed in the production process may yield increasing marginal returns. However, in increasing the amount of the variable factor employed, a point will be reached where the marginal increases in total output will begin declining or marginal return will begin declining .

Three stages of production

The total, marginal and average product curves in following diagram demonstrate the law of variable proportions. The figure also shows three stages of production associated with Law of Variable Proportions.



- The total product curve has increased to the maximum point. It has become flat momentarily at that point. Average and marginal product curves also rise. But they start declining much earlier than the average product curve.
- The average product curve starts to decline after reaching the maximum point (P). The MP which started declining earlier and cuts the AP curve at its maximum point (P). It falls at a steeper rate than the AP curve.
- When the TP is at its maximum, MP becomes zero. It cuts the X-axis.
- When the TP curve starts declining, MP is negative. The MP curve lies below X-axis.

The behaviour of TP, AP and MP of variable factor is divided into three stages.

The total product curve is divided into three segments popularly known as three stages of production as under:

Total physical Product (TPP)	Marginal physical Product (MPP)	Average physical Product (APP)
STAGE I Increases at an increasing Rate	Increases, reaches its maximum & then declines till $MR=AP$	Increases & reaches its maximum
STAGE II Increases at a diminishing rate till it reaches maximum	Is diminishing and becomes equal to zero	Starts diminishing
STAGE III Starts declining	Becomes negative	Continues to decline

PRODUCTION FUNCTION WITH TWO VARIABLE INPUTS

Isoquants

To understand a production function with two variable inputs, it is necessary to explain what an isoquant is. An isoquant is also known as Iso-product curve, Equal product curve or a production indifference curve. These curves show the various combinations of two variable inputs resulting in the same level of output. The following table shows how different pairs of labour and capital result in the same output.

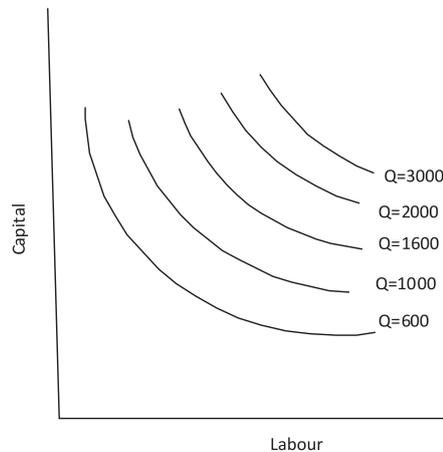
Labour & Capital Inputs in Relation to Output

Labour (units)	Capital(units)	Output(units)
1	5	10
2	3	10
3	2	10
4	1	10
5	0	10

It will be seen that output is the same either by employing 4 Labour + 1 Capital or by 5 Labour + 0 Capital (and so on). This relationship, when shown graphically, results in an isoquant.

Thus, by graphing a production function with two variable inputs, one can derive the isoquant tracing all the combinations of the two factors of production that yield the same output. An isoquant is defined as the curve passing through the plotted points representing all the combinations of the output. The following diagram gives a typical isoquant diagram whereas one moves upward to the right; higher levels of outputs are obtained, using larger quantities of output.

For each level of output there will be a different isoquant. When array of isoquant are represented on a graph, it is called an isoquant map.



Substitutability of Inputs:

An important assumption in the isoquant diagram is that the inputs can be substituted for each other. Let us take a particular combination of X and Y resulting in an output q600 units. By moving along the isoquant q 600, one finds other quantities of the inputs resulting in the same output. Let us suppose that X represents labour and Y, machinery. If the quantity of the labour(X) is reduced, the quantity of machinery (Y) must be increased in order to produce the same output.



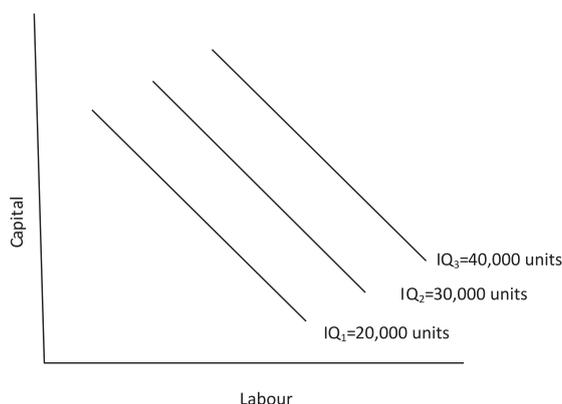
Marginal Rate of Technical Substitution (MRTS):

The Marginal Rate of Technical Substitution refers to the rate at which one input factor is substituted with the other to attain a given level of output. In other words, the lesser unit of one input must be compensated by increasing amounts of the other input to produce the same level of output. Table B presents the ratio of MRTS between the two input factors. Say capital and labour. Five units of decrease in labour are compensated by an increase in 1 unit of capital, resulting in a MRTS of 5:1.

Combinations	Capital (₹ In lakhs)	Labour	Marginal Rate of Technical Substitution (MRTS)
A	1	20	-
B	2	15	5:1
C	3	11	4:1
D	4	8	3:1
E	5	6	2:1
F	6	5	1:1

Functions of Isoquants:

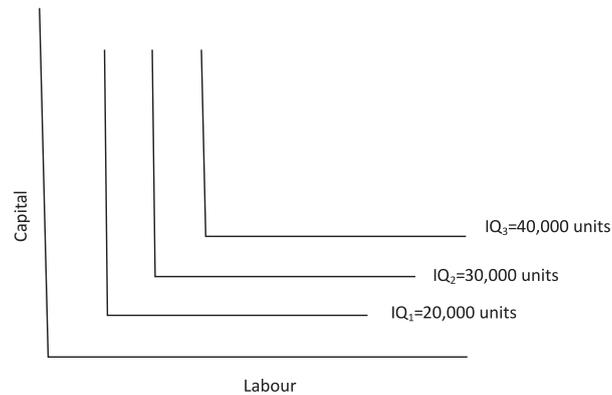
1. Downward sloping: Isoquants are downward sloping curves. This is because increase in one input reduces the other. There is no question of increase in both the inputs to yield a given output. A degree of substitution is assumed between the factors of production. In other words, an isoquant cannot be increased and increase in both the inputs does not yield the same level of output. If it is constant, it means that the output remains constant though the use of one of the factors is increasing, which is not true. Isoquants slope from left to right.



2. Convex to origin: Isoquants are convex to the origin. It is because the input factors are not perfect substitutes. One input factor can be substituted by another input factor in a 'diminishing marginal rate'. If the input factors were perfect substitutes, the isoquant would be a falling straight line.

When the inputs are used in a fixed proportion and substitution of one input for the other cannot take place, the isoquant will be L shaped.

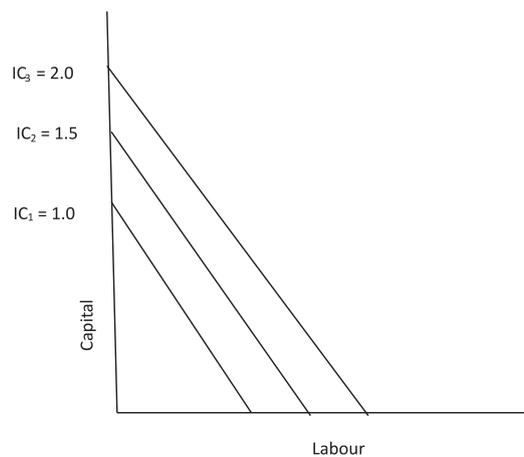
3. Do not intersect: Two isoquants do not intersect. It is because each of these denote a particular level of output. If a manufacturer wants to operate at a higher level of output, he has to switch over to another isoquant with a higher level of output and vice versa.



4. Do not touch axes: The isoquant touches neither X nor Y axis as both inputs is required to produce a given product.

Isocosts:

Isocosts refer to the cost curve that represents the combination of inputs that will cost a producer the same amount of money. In other words, each isocost denotes IQ_2 a particular level of production. If the level of production changes, the total cost changes and, thus the isocost curve moves upwards, and vice versa. The following diagram presents three downward sloping straight line cost curves (assuming that the input prices are fixed, no quantity discounts are available) each costing ₹ 1.0 lakhs, ₹ 1.5 lakh and ₹ 2 lakh for the output levels of 20,000, 30,000 and 40,000 units. (The total cost, as represented by each cost curve, is calculated by multiplying the quantity of each input factor with its respective, is calculated by multiplying the quantity of each input factor with its respective price). Isocosts farther from the origin, for a given input are associated with higher costs. Any change in input prices changes the slope of isocost lines.



Isocosts each representing different levels of total cost

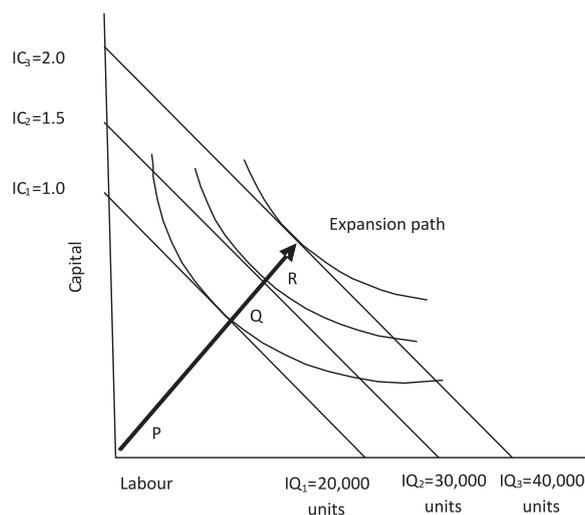
Least-Cost Combination of Inputs:

A manufacturer has to produce at a lower cost to attain a higher profit. Isocosts and isoquants can be used to determine the input usage that minimizes the cost of production.

Where the slope of an isoquant is equal to that of an isocost is the place of the lowest point of cost of production. This can be observed by superimposing the isocosts on isoquant curves. It is evident that the producer can, with a total outlay of ₹ 1.5 lakh, reach the highest isoquant curve IQ_2 . If he wants to reach IQ_3 , he has to bring in additional resources, which is let us assume, not possible. He cannot compromise with IQ_1 , as it means lower output. There is no input combination on IQ_2 other than point Q, which is cheaper than ₹ 1.5 lakh. So the obvious choice for the producer is the Q combination of inputs only on IQ_2 .

The points of tangency P, Q and R on each of the isoquant curves represent the least cost combination of inputs, yielding the maximum level of output. Any output lower or higher than this will result in a higher cost of production.

The substitution of one input for another continues until the producer reaches the point of P, Q or R where the MRTS between the inputs is equal to the ratio between the prices of the inputs. Expansion path refers to the line representing the least cost combination of inputs P, Q, R for different levels of output. Expansion path indicates how production can be expanded along this path if the factor prices are given. The expansion path is also called 'scale line' as it indicates how to adjust the scale of operations as the firm changes its output. The scale line is a ready reckoner to decide on the issues relating to expansion or contraction of output, given the relative prices of inputs.



Least-cost combination of inputs

MRTS = (Change in one input/change in another input)

$$\frac{\Delta K}{\Delta L}$$

Where ΔK is change in capital and ΔL is change in labour

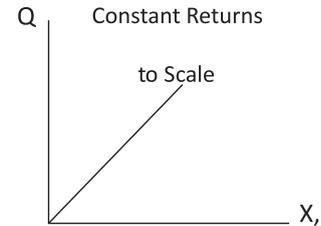
Production functions with two variable inputs:

Production function in a two-input factor setting may look too easy to be useful. It has been a valuable tool for managers to decide what combination of inputs yields a given output at the lowest cost. In case of multiple input factors, quantitative techniques such as optimization techniques and linear programming provide the solution. Computers have further simplified the complexity of production function in a multiple input factor setting.

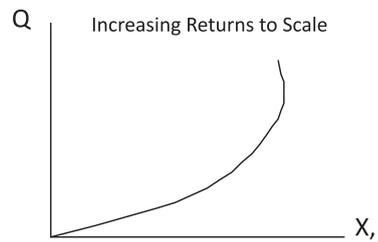
PRODUCTION FUNCTION WITH ALL VARIABLE INPUTS

A closely related question in production economics is how a proportionate increase in all the input factors will affect total production. This is the question of returns to scale and one think of three possible situations:

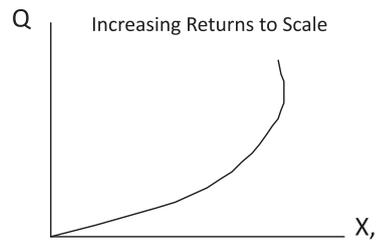
1. If the proportional increase in all inputs is equal to the proportional increase in output, returns to scale are constant. For instance, if a simultaneous doubling of all inputs results in a doubling of production, then returns to scale are constant



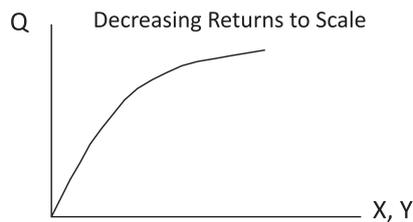
2. If the proportional increase in output is larger than that of the inputs, then we have increasing returns to scale



3. If output increases less than proportionally with input increases, we have decreasing returns to scale.



The most typical situation is for a production function to have first increasing then decreasing returns to scale as shown in the above diagram.



The increasing returns to scale are attributable to specialization. As output increases, specialized labour can be used and efficient, large-scale machinery can be employed in the production process. However, beyond some scale of operations not only are further gains from specialization limited, but also coordination problems may begin to increase costs substantially. When coordination costs more than offset additional benefits of specialisation, decreasing returns to scale begin.

Measurement of production function

Several types of mathematical functions are commonly employed in the measurement of production function but in applied research, four types have had the widest use. These are linear functions, power functions, quadratic functions and cubic functions.



1. Linear Function

A linear production function would take the form:

Total product: $Y = a + bX$

From this function, equation for average product will be:

$$\frac{Y}{x} = \frac{a}{x} + b$$

The equation for the marginal product will be:

$$\frac{\Delta Y}{\Delta x} = b$$

2. Power Function

A power function expresses output, Y, as a function of input X in the form:

$$Y = aX^b$$

Some important special properties of such power functions are:

i) The exponents are the elasticities of production. Thus, in the above function, the exponent b represents the elasticity of production.

ii) The equation is linear in the logarithms, that is, it can be written

$$\log Y = \log a + b \log X$$

When the power function is expressed in logarithmic form as above, the coefficient b represents the elasticity of production.

iii) If one input is increased while all others are held constant, marginal product will decline.

3. Quadratic Production Function

The production may be quadratic, taking the following form:

$$Y = a + bX$$

Where the dependent variable, Y, represents total output and the independent variable, X, denotes input. The small letters are parameters; their probable values of course, are determined by a statistical analysis of the data.

The special properties of the quadratic production function are as under:

i) The minus sign in the last term denotes diminishing marginal returns.

ii) The equation allows for decreasing marginal product but not for both increasing and decreasing marginal products.

iii) The elasticity of production is not constant at all points along the curve as in a power function, but declines with input magnitude.

iv) The equation never allows for an increasing marginal product.

v) When $X = 0$, $Y = a$. This means that there is some output even when no variable input is applied.

vi) The quadratic equation has only one bend as compared with a linear equation which has no bends.

4. Cubic Production Function

The cubic production takes the following form:

$$Y = a + bX + cX^2 - dX^3$$

Some important special properties of a cubic production function are:

- i) It allows for both increasing and decreasing marginal productivity.
- ii) The elasticity of production varies at each point along the curve.
- iii) Marginal productivity decreases at an increasing rate in the later stages.

PRODUCTION FUNCTION AND EMPIRICAL STUDIES

The measurement of production function dates back to a century when certain pioneer studies were made in the field of agriculture. And though economic concepts and statistical techniques have since much advanced, the major work is still in agriculture.

COBB-DOUGLAS Production Function:

A very popular production function which deserves special mention is the Cobb-Douglas function. It relates output in American manufacturing industries from 1899 to 1922 to labour and capital inputs, taking the form:

$$Q = bL^{\alpha}C^{1-\alpha}$$

Where

Q = Total output

L = Index of employment of labour in manufacturing, and

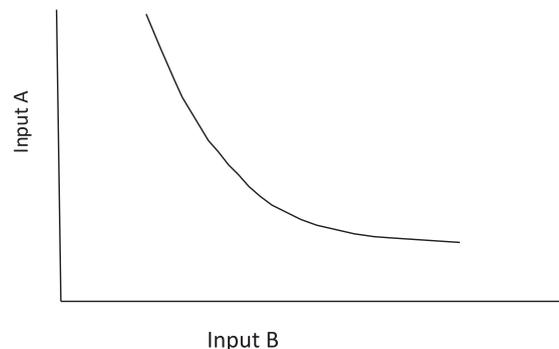
C = Index of fixed capital in manufacturing

The exponents α and $1 - \alpha$ are the elasticities of production that is, α and $1 - \alpha$ measure the percentage response of output to percentage changes in labour and capital respectively. The function estimated for the U.S.A by Cobb and Douglas is:

$$P = 1.01 L^{.75}C^{.25}, R^2 = 0.9409$$

The production function shows that a 1 percent change in labour input, capital remaining constant, is associated with a 0.75 percent change in output. Similarly, a 1 percent change in capital, labour remaining constant, is associated with a 0.25 percent change in output. The coefficient of determination (R^2) means that 94% of the variations on the dependent variable (P) were accounted for by the variations in the independent variables (L and C).

An important point to note is that the Cobb-Douglas function indicates constant returns to scale. That is, if factors of production are each raised by 1 per cent, the output will increase by 1 percent. This indicates that no economies or diseconomies of large scale are evident; on the average, large or small-scale plant may be equally profitable in the U.S. manufacturing industry. In other words, one can assume constant average and marginal production costs for the U.S industries during that period.



The Graph of Cobb-Douglas production function $X = 10A^{0.4} B^{0.6}$ where output $X = 50$.

Managerial Use of Production Functions:

1. The economics of production management takes, as its starting point, the study of the entire group of possible factor combinations that could be used to produce a certain output, within a given state of technology. This type of analysis is carried out through production function.
2. A production function is an expression of the dependent or functional relationships that exists between the inputs of production process and the output that results. Hence it is sometimes known as input-output relations.
3. Of the various types of production function the Cobb-Douglas function is the most celebrated. Because it has certain important properties which are useful for managerial decision making.
4. This study of production function is useful not for its own sake. Because it answers certain questions faced by the management. It enables the management to know beforehand the most profitable decision concerning the employment of resources and the scheduling of the output. It is also useful in deriving a firm's cost function.

CRITICISM:

- 1) Cobb-Douglas production function is criticized because it shows a constant return to scale. But constant returns to scale are not actuality. Industry is either subject to increasing returns or diminishing returns. Due to scarcity and indivisibility of some factors it is not possible to make a proportionate change of all factors. So constant returns are not possible.
- 2) No entrepreneur will like to increase the inputs to have constant returns only. His aim will be to get increasing returns but not constant returns
- 3) Problems arise when this production function is applied to each firm in the industry and to the industry as a whole. This function as applied to each firm may not give the same result as that of the industry.
- 4) It is based on the assumption that factors of production are substitutable and excludes complementary of factors. But, in the short non-complementary of factors is possible. Therefore, it applies more to the long run than the short run.

COST ANALYSIS:

The term cost has a wide variety of meanings. The normal concept of cost most widely used is the 'money cost' of production which relates to the money expenditure of a firm on wages and salaries paid to the labour, payments incurred on machinery and equipment, payment for materials, power, light, fuel transportation etc., payments for rent and insurance and payments to government by way of taxes. Money costs therefore relate to money outlays by a firm or factors of a production which enable the firm to produce and sell a product. Every producer is interested in money costs. Business executives make use of

the cost figures to determine the profitable rent of operation of a plant or department, quotation of price to a customer or to accept a particular order or the purchase of a new machine. Thus cost data are necessary for taking important business decisions. Besides money costs involved, there are other business decisions. Besides money costs involved, there are other implicit costs that are equally important to take decisions on various matters.

TYPES OF COST:

Actual Cost and Opportunity Cost:

Actual cost is the cost which a firm incurs while producing a commodity and it consists of the cost of raw materials, wages and salaries of labour, rent of business premises, the interest paid on borrowed funds, etc. The actual cost is also called outlay cost or absolute cost.

Opportunity cost is the cost of the best alternative forgone. It is the alternative cost or transfer cost, that is, the return the firm can get from the next best alternative use.

Past Cost and Future Cost:

A distinction is often made between actual costs and future costs. Actual costs or historical costs are records of past cost. Future costs, on the other hand, are based on forecasts. The costs which are relevant for most managerial decisions, which are generally forward looking, are forecasts of future costs. Forecasting of future is required for expense control, projection of future income statements, appraisal of capital expenditures, decision on new projects and on expansion programmes, and price determination.

Original Cost and Replacement Cost:

Original cost, also known as historical cost, refers to the cost of plant, machinery and equipment at the price paid originally by the firm. Replacement cost, on the other hand, refers to the cost the firm would incur when it replaces the plant, machinery and capital equipment at a future date. The difference between the original and replacement costs is the price changes over time.

Suppose a capital assets costs ₹ 50,000 in 1985 and the life of the asset is 10 years. The same asset has to be replaced in 1995 when the price of the new asset is ₹ 65,000. The historical or original cost of the asset is ₹ 50,000 and the replacement cost is ₹ 65,000.

Explicit Cost and Implicit Cost:

The total cost of production of a particular commodity can be said to include "expenditure" or "explicit" cost and "non-expenditure" or "implicit" cost.

Explicit costs are those which are paid by the employer to owners of the factor units, which do not belong to the employer himself. These costs are in the nature of contractual payments of raw materials, interest on borrowed funds, rent on hired land and taxes paid to the government.

Non-expenditure or implicit costs arise when factor units are owned by the employer himself who is not obligated to anyone else in order to obtain these factors. The two non-expenditure costs are depreciation and a normal return on the money capital supplied by the shareholders, in the case of small business units; the wages of the entrepreneur or organiser himself will have to be included in this category.

Expenditure costs are explicit since they are paid to factors outside the firm, while non-expenditure costs are implicit and hence they are imputed costs.

Incremental Cost and Sunk Cost:

A firm may introduce a new product line, add a new machine, replace existing machinery by a better machine, change the method of distribution, and so on. In other words, the firm may want to change or innovate. As a result, there is bound to be a difference between the old cost and the new cost. The differential cost is the additional cost due to a change in the level or nature of business activity. Differential cost is often referred to as incremental cost. It is important to emphasize that differential cost or incremental



cost does not arise when a business is set up afresh but arises only when a change is contemplated in the existing business.

All the past costs may be regarded as sunk costs. As these costs have already been incurred, they are not affected or altered by a change in the level or nature of business activity. It will remain the same whatever be the level or nature of business activity. Accordingly, the management will ignore, sunk cost while evaluating the different alternative policies or changes to be effected.

Out of pocket costs and Book Costs:

Out of pocket costs consist of all current payment to the suppliers of raw materials, wages to workers, interest on capital, etc. All these costs are also explicit costs. Book costs, on the other hand, are costs in the account books of the Depreciation allowances are the best example of book costs. Book costs are implicit costs. While finalizing profit and loss accounts, the company provides for book costs. In fact, all implicit costs are book costs.

Nowadays, many firms adopt the practice of selling their capital assets to leasing companies and buying them back from the latter. In such a case, book cost of depreciation will disappear and will be replaced by out of pocket cost of rent.

The distinction between the two concepts primarily affects the firm's cash position.

SHORT-RUN COST ANALYSIS:

Relation between Short-run Costs and Production Theory:

Short period production is governed by the Law of variable productions because in this period the plant of the firm is fixed and production can be changed only by changing the other inputs. Therefore, costs of the firm in the short run are to be analyzed keeping in view the fact that only the proportions of inputs, not the scale, can be changed.

The Two Types of Short Run Costs:

The short run costs are divided into two types in order to help production and cost analysis. These are:

1. Fixed Costs
2. Variable Costs

1. Fixed Costs.

According to Benham, "*The fixed Costs of a firm are those costs that do not vary with the size of its output*". The best way of defining fixed costs is to say that they are the costs which a firm has to bear even when it is temporarily shut down and thus produces nothing. They are unavoidable contractual costs.

Examples of fixed costs are interest on the investment in plant and equipment, most kinds of insurance premium, property taxes, depreciation and maintenance and the salaries of those people who would not be laid off even in a temporary shutdown.

Fixed costs include the opportunity costs of the owners of the firm as well as normal profits. Marshall referred to fixed costs as supplementary or overheads costs.

2. Variable costs:

Variable costs are those costs which change with changes in the volume of output. These are avoidable, contractual costs. As Benham has said, "*The variable costs of a firm are those costs that do vary with the size of its output*". Marshall called these costs prime costs. Examples of such costs are wages, payments for raw materials, payments for fuel and power, excise taxes, interest on short-term loans, etc.

Average Fixed Cost and Average Variable Costs:

In price theory we need to know the average fixed costs and the average variable costs so that we can compare them directly with the price of the product at which it can be sold in the market. We must know

the behaviour of average fixed cost and the average variable cost as output changes.

Average Fixed Cost:

Average fixed cost is obtained by dividing the total fixed cost of the firm by its output.

$$\text{Average Fixed Cost (AFC)} = \frac{\text{Total Fixed Cost (TFC)}}{\text{Output (Q)}}$$

The fixed costs of a firm are, by definition, constant when output is changed. Therefore, the burden of fixed cost per unit of output will continue to fall as output is increased. Thus, with increasing output the average fixed cost will continue to fall.

Average Variable Cost:

Average variable cost is obtained by dividing the total variable costs by the output of the firm.

$$\text{Average Variable Cost} = \frac{\text{Total variable Cost}}{\text{Output}}$$

The behaviour of average variable cost depends on the behaviour of the average product of the variable factors. We know from our study of the theory of production in the short period that the average product of the variable factors rises at first, remains constant for a while and then starts falling. The shape of the average product curve is an inverted 'U'. Now, cost is just the opposite of productivity. If the average productivity of the variable factors rises, their average variable cost falls. If the average productivity is constant, the AVC is also constant. If the average productivity falls with increased output, the average cost rises. It should be, therefore, clear that the AVC curve must be U-shaped. The AVC falls at first, reaches a minimum and starts rising beyond a point. This should be clear from the table also.

Analytical Importance of the Fixed and Variable Cost Distinction:

In the short period total costs of a firm are broken up into these two types because it is important for price theory. The main points of importance are as under.

1. Decision to shut down the firm.

A producer tries to cover both fixed and variable costs while selling his output. But in the short period due to some reasons price may fall so much that the producer is unable to cover all his costs. Thereby, he suffers a loss. At this time he has to decide whether to continue production or shut down temporarily. In taking this decision, the distinction between fixed costs and variable costs is helpful for him. Fixed costs are those whether the firm has to bear whether it is producing or not. If the firm is shut down it has no variable costs, The maximum loss it can suffer is equal to its fixed costs, Thus the firm will decide to shut down if the price is less than the average variable costs because in such a case its total loss will be greater than its fixed costs. On the opposite, if the price is greater than the average variable costs the firm will be covering a part of its fixed cost also. It will be in the interest of the firm to continue production.

2. Differences in equilibrium conditions of the firm in the short period and the long period.

The distinction is important only for the short period. In the long period all costs are variable and must be covered. This creates a difference between the equilibrium conditions of the firm in the short period and those in the long period. In the short period, the best possible combination of inputs is not obtained because some inputs are fixed and give a fixed cost only the proportion of fixed to variable costs can be changed. Therefore, we find that in the short period, the equilibrium of the firm is given by the condition:

Short period marginal cost = marginal revenue

In the long period, the equilibrium condition is that the long-period marginal cost must equal long period marginal revenue. The short period marginal cost is affected by variable costs only while the long period marginal cost covers both fixed costs and variable costs.



Short-run Average Costs:

In order to find out the profit or loss to a firm at a particular level of output and with given price of the product, we must know the average of the fixed and variable costs combined. It is the average of the total costs of a firm which we must know. We cannot call it 'average total cost' because it seems confusing. Therefore, the name short run average cost or SAC is preferred.

$$SAC = AFC + AVC$$

Since the SAC is obtained from AFC and AVC, the behaviour of SAC with changes in output depends directly on the behaviour of AFC and AVC.

AFC goes on falling as output increases. AVC falls at first, reaches a minimum and then starts rising. In a way, the behaviour of SAC mainly depends upon the behaviour of AVC since AFC is always falling. Therefore, SAC falls at first, reaches a minimum and starts rising as output is increased.

Marginal Cost:

The third important concept in short run cost analysis is that of marginal cost. The addition made to the total cost by the production of one more unit of output is called marginal cost. "*marginal cost is the change in total cost associated with a change in output*". We can, therefore, write

$$\text{Marginal Cost} = \frac{\text{Change in total Costs}}{\text{Change in Output}} = \frac{\Delta TC}{\Delta Q}$$

If the addition of another unit of a commodity increases the total cost from ₹ 190 to ₹ 220, then marginal cost is ₹ 30 (220 – 190). In the short period fixed costs remains constant as output is increased. Therefore, by definitions of fixed costs and marginal cost, there is no relationship between them. Marginal cost is governed only by variable costs which change with changes in output. Therefore, we can write

$$\text{Marginal Cost} = \frac{\Delta TUC}{\Delta Q}$$

Since marginal cost is directly dependent upon, the behaviour of AVC, the behaviour of MC must be derived from the behaviour of AVC alone. We know that the AVC is U-shaped: therefore, the marginal cost curve must also be U-shaped. The MC curve falls at first, reaches a minimum and then starts rising. This should be clear from the table and diagram given below.

Relation between AC and MC:

In price theory, the relationship between AC and MC is of great importance. The whole marginal analysis of product pricing depends upon it. Therefore, the relation between AC and MC must be studied in detail. This relation is better explained with the help of a table and a diagram showing average cost and the related marginal cost.

Relation between Average cost and Marginal Cost

Unit of output	Total cost (₹)	Average Cost (₹)	Marginal Cost (₹)
1	150	150.0	-
2	190	95.0	40
3	220	73.3	30
4	236	59.0	16
5	270	54.0	34
6	324	54.0	54
7	415	59.3	91
8	580	72.5	165

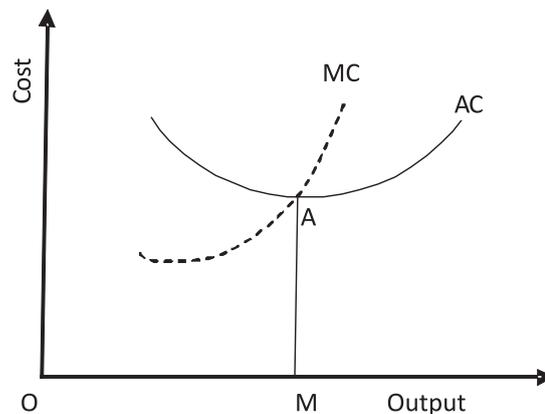
In the table given (vide supra), the following points of relationship between average cost and marginal cost are immediately clear.

1. Both AC and MC are calculated from total cost of production. They are derived from the same source.

$$\text{Average Cost} = \frac{\text{Total Costs}}{\text{Total Output}}$$

$$\text{Marginal cost} = \frac{\text{Change in total Cost}}{\text{Change in a unit of Output}}$$

Average cost shows the inclination of the total cost curve over the output axis. Marginal cost is shown by the slope of the total cost curve at a particular level of output. Both Average cost and Marginal cost can be obtained from the total cost curve.



Relationship between Average Cost and Marginal Cost

2. When average cost is falling, the marginal cost is always lower than the average cost. A common view is that when AC falls, MC falls faster. However, this is not the case throughout. MC reaches a minimum and may then start rising even when the average cost is falling. The only thing to be guaranteed is that the MC lies below AC as long as AC is falling.
3. When AC is rising, MC lies above AC and rises faster than AC, when AC is rising, MC is not only greater than AC, but also rises faster than the AC.
4. The MC curve must cut the AC curve at AC's minimum point. This relationship is derived from the fact that when AC is constant, MC is equal to AC. The Diagram shows the relationship between the AC and MC in a very clear way.

In the curve AC is U-shaped mainly due to the operation of the law of variable proportions in the short period.

The related MC curve is shown dotted. It is also U-shaped. The MC curve intersects the AC curve at the latter's minimum point. The minimum point of the AC curve is that from which the perpendicular to the X-axis is the shortest. In the output OM is produced at the lowest average cost.



Short-run cost function:

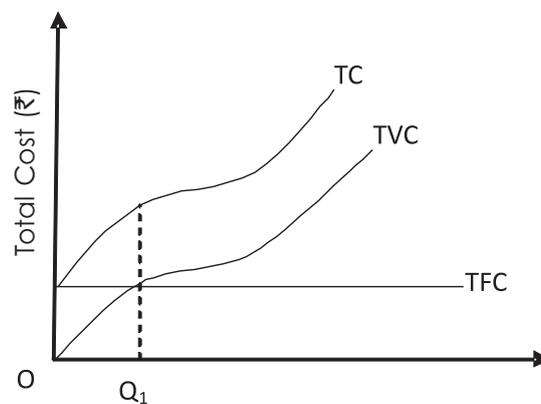
Short-run total cost:

Once money resources of the firm have been invested into buildings, machinery and other fixed assets, their amounts cannot be readily changed. If the firm wants to expand its output, it is possible in the short run only by a change in the rate of utilization of these assets. This results in two kinds of inputs: fixed and variable inputs. Since the fixed inputs do not change with the rate of output, the cost to the firm of these fixed resources is also fixed. On the other hand, cost of those inputs whose quantity can be changed to match the production needs is known as variable cost. Thus:

$$TC = TFC + TVC$$

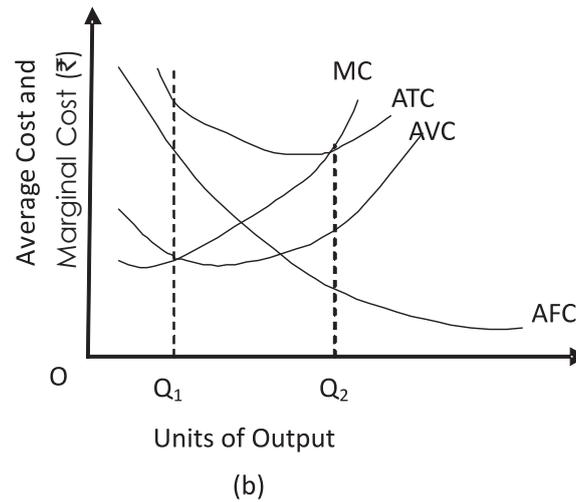
WHERE TC = Total Cost, TFC – Total Fixed Cost and TVC = Total variable cost.

Since fixed costs do not change with output, the TFC curve is a horizontal straight line. TC curves are the lateral summation of the TFC and TVC curves as shown below:



Average and Marginal Cost Curves: In order to arrive at various kinds of decision problems in the short run, we need to understand the behaviour of several cost curves, viz., average fixed cost (AFC), average variable cost (AVC), average total cost (ATC) and marginal cost (MC). We may derive all these costs from the total cost data. If Q represents the level of output, then, $AFC = TFC/Q$, $ATC = TC/Q$ and $MC =$ (for discrete functions) and $MC = d(TC)/dQ$ or $(TVC)/dQ$ (for continuous functions). We may understand these average cost relationships with the help of the following diagram.

Since the TFC remains constant, AFC (which is TFC/Q), continuously declines with increase in Q . This is because as output increases, the total fixed cost gets spread more and more thinly over an increased volume of output. Graphically, the AFC is a rectangular hyperbola, showing the same magnitude (equal to TFC) at all its points.



Short run cost curves

As can be seen from diagram, average variable cost (AVC) declines, reaches a minimum at Q_1 and then starts to increase. Average total cost (ATC) behaves in a similar manner but reaches its minimum at Q_2 units of output. Marginal cost (MC), which is the rate at which total cost changes with the change in output, declines and then starts to increase once Q_1 units of output are produced

The particular relationship between the average cost concept and the marginal cost are depicted as:

- 1) $MC < AVC$, the AVC decline;
- 2) $MC = AVC$, the AVC is at its minimum.
- 3) $MC > AVC$, the AVC is rising.

Exactly, the same relationship holds between MC and ATC. In fact, MC concept is highly useful in decision-making. In deciding whether to produce additional units of output, the relevant cost is marginal cost (i.e., the resultant change in total cost).

The Possible Functional Forms of Cost Function:

The usefulness of any cost function for practical application depends, to a large extent, on appropriateness of the functional form chosen. The choice of a particular function depends upon the correspondence of the economic properties of the function. In economic literature, three functional forms of short-run cost function are popular, viz.,

- 1) Linear,
- 2) Quadratic and
- 3) Cubic.

The most common relationship between total cost and output is cubic (the one that has been discussed so far in this chapter). Let us discuss the mathematical and economic properties of these alternative forms of cost functions:



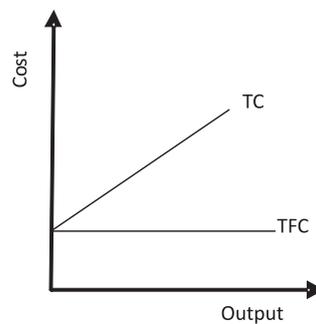
Linear Function:

Mathematical properties of Linear Cost Functions

Functional Form	$Tc = a + bQ$
Average Fixed Cost (AFC)	a/Q
Average Variable Cost (AVC)	b
Average Total Cost (ATC)	$a/Q + b$
Marginal Cost (MC) [= d (TC)/dQ]	b

The graphic presentation of Linear Cost Function:

$$TC = a + bQ$$



The above diagram depicts the following:

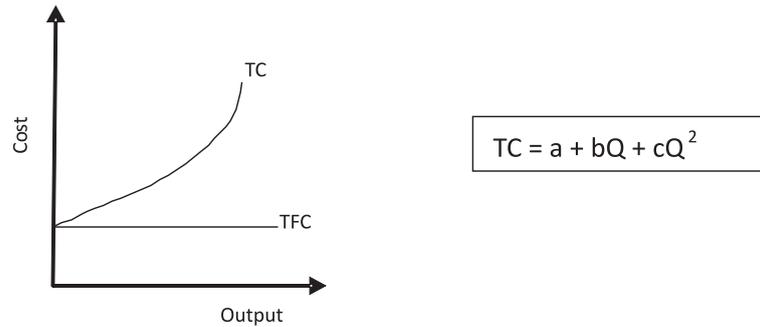
1. Total cost (TC) increases at a constant rate (i.e., firm is experiencing constant returns).
2. Minimum total cost is incurred at zero output level. This minimum equals total fixed cost (TFC).
3. Slope of the total cost function b equals AVC and MC. The horizontal AVC and MC lines denote that average variable cost and marginal cost remain constant as output increases.

Quadratic Function:

Mathematical properties of Quadratic Cost Functions

Functional Form	$TC = a + bQ + cQ^2$
Average Fixed Cost (AFC)	a/Q
Average Variable Cost (AVC)	$b + cQ$
Average Total Cost (ATC)	$a/Q + b + cQ$
Marginal Cost (MC) [=d(TC)/dQ]	$b + 2cQ$

The graphic presentation of Quadratic Cost Functions:



In case of the quadratic cost function

The total cost increases at an increasing rate from the beginning, implying the whole output is produced under conditions of diminishing returns.

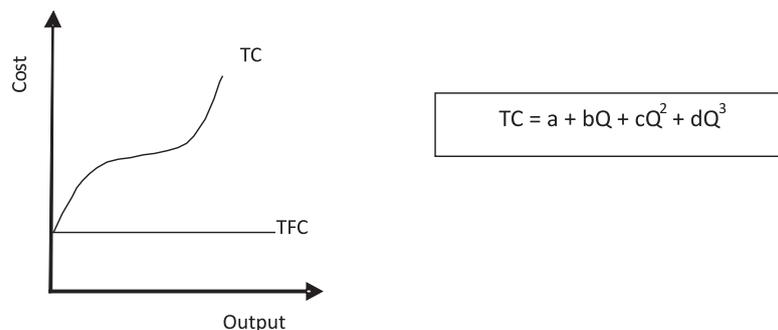
1. Both the AVC and MC increase as soon as the production begins, but the marginal cost increasing at greater rate.
2. MC curve cuts ATC curve at the latter's minimum point.

Cubic Function:

Mathematical properties of Cubic Cost Functions

Functional Form	$TC = a + bQ + cQ^2 + dQ^3$
Average Fixed Cost (AFC)	a/Q
Average Variable Cost (AVC)	$b - cQ + dQ^2$
Average Total Cost (ATC)	$a/Q + b - cQ + dQ^2$
Marginal Cost (MC) [=d(TC)/dQ]	$b - 2cQ + 3dQ^2$

Graphic presentation of Cubic Cost Function:



A cubic cost function demonstrates the following properties:

1. Total cost first increases at a decreasing rate, and later it increases at an increasing rate.

2. As output increases marginal cost falls, reaches a minimum, and then starts to increase. As MC increases it intersects the AC and ATC at their respective minimum points.

LONG RUN COST ANALYSIS:

In the long period, there is adequate time available to change even the fixed factors, in fact, become variable factors in the long period. Consequently, the total fixed cost can be cut down to be considerable extent over a long period, where as in the short period, the fixed cost if absolutely fixed.

Since all factors of production can be used in varied proportions in the long run, it is possible for the firm to alter its scale of operations in accordance with the requirements of output. Long run average cost curve (LAC) is also called **envelope curve**, because it covers all short-run cost curves.

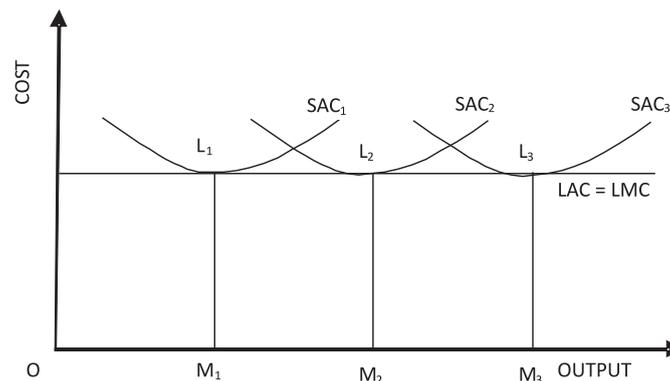
The LAC curve is the envelope of a series of short run average cost curves. If returns to scale are increasing, long-run average cost will be decreasing. If returns to scale are decreasing LAC will be increasing.

Thus firm's long-run average cost function will be:

- Decreasing where returns to scale in production are increasing.
- Constant where returns to scale are constant.
- Increasing where returns to scale are decreasing.

Long-run average Cost Curve under constant returns to scale:

1) When the plant size is expanded, the full capacity production cost (minimum short-run average cost) does not either fall or rise. This is the case shown in following diagram:

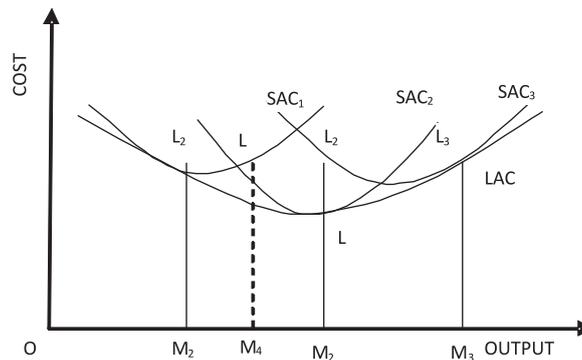


Relationship between Long-Run Average Cost and Short-Run Average Cost Curves under Constant Returns to Scale

The above diagram shows a long period technology with constant returns to scale, that is, in classical language, in this figure, an infinite divisibility of all inputs in the long run is assumed. Therefore, the minimum points of all the short-run average cost curves lie in a straight line. Now, if the firm wants to produce an output OM_1 it will select a plant of the size shown by SAC_1 and produce the output with average cost ML_1 . Therefore, L_1 lies on the long run average cost. Similarly for producing the output OM_2 the firm will make choice for the plant shown in SAC_2 with a point L_2 that lies on the long-run average cost. Similarly L_3 is also on the long-run average cost curve. If we join the points L_1 , L_2 and L_3 we get LAC i.e., the long run average cost curve (or the planning curve as it is also called which is a straight line).

Long-run average cost curve under varying returns to scale:

When the plant size is expanded, the full-capacity production cost falls at first, falls to a minimum and then starts rising as the scale of production is increased further. This is the case shown in following diagram:



**Relationship between short-run Average Cost Curves and
long-run Average Cost Curve under varying Returns to Scale**

The above diagram depicts the case of a firm which has varying returns to scale. Here the LAC curve is different. It is U shaped. SAC_1 , SAC_2 and SAC_3 represent three successively increasing sizes of plant of the firm. Let us assume that SAC_3 represents the size of a plant where full-capacity operation produces output at the lowest possible average cost in the long period. Therefore, point T is the minimum point of the SAC_2 curve as well as that of the long run average cost curve. As we see in figure, long-run average cost curve is touching (tangential to SAC_1 at point L_1 and to SAC_3 at point L_3). Points L_1 , T and L_3 lie on the long-run average cost curve. If we assume here continuities of scale, that is, if we assume here an infinite number of choices of scale of the plant, the long-run average cost curve will be continuous, being tangential to all the conceivable number of short-run average cost curves representing gradually increasing scales of the plant. Thus, if we assume varying returns to scale, as we often believe them to be in theory, and also assume perfectly divisible scale of plant, the long run average cost curve is a U shaped, continuous curve. Of course, the U shape of the LAC is less pronounced than that of the short run average cost curve.

Managerial uses of Cost Functions:

Various important managerial decision are based on estimates of cost curves such as short run choices of rates of output and prices, and long-run decision about numbers, sizes and locations of plants.

Pricing and output decisions are perhaps the most important for a profit-maximising firm. Such decisions must be based on reliable estimates of short-run cost functions.

Capital investment decisions such as plant construction or expansion are long-term decisions and are usually based on estimates of long-run cost functions. Long-run cost functions enable progressive organizations to determine whether or not to make the investment, and what should be optimum size of the plant under the present conditions. Decisions on plant size are largely based on an accurate estimate of demand. However, investment decisions are most complex because demand can shift over time. Moreover, the structure of factors affecting cost may also be expected to shift. These factors make it advisable to build or expand plants in substantial increments of capacity.

It is important to note that past production and cost relationships may not always be relevant to decision about future investments in plant and equipment. Empirical (statistical) estimates may require adjustments to reflect changes in future prices, input combinations, nature of the product, product mix, scale of output, scale of plant, the nature of the conversion process (i.e., conversion of inputs into output) and so forth; all these are expected to affect future costs. Costs of future periods may not behave in the same way as that in the past.



6.5 FACTOR DEMAND AND INPUT DECISION

A profit-maximising firm seeks to produce its optimal level of output at the minimum cost in a given market structure. To achieve this, the manager must decide how much of each input to use in the production process and what price to pay for these inputs.

There are three stages of production. In stage I, the average product of labour, i.e., Total output \div Number of units of labour reaches its maximum. In stage II, both marginal and average product decline, but both are positive. In stage III, the marginal product of labour is negative. Generally the range of production is restricted to stage II. No manager would knowingly employ any input whose marginal product is negative. To be more specific, no manager would hire a labourer if the cost of hiring, i.e., wages and other benefits exceeds the revenue it would get by selling the extra output attributable to that labourer.

Special Features

There are four special features of demand for productive factors as stated below:

1. The demand for a factor is derived demand. i.e., derived from the demand of the commodity which the factor helps to produce. A factor is required to produce something which is in demand. It is not demanded for its own sake.
2. The demand for a factor means joint demand. Only one factor cannot produce a commodity or a service. For example, a machine without labour, material, tools, etc., a workman without tools, drawings; a land without a tiller, cannot give the required output. Hence different factors must be used jointly to produce anything at all.
3. The technology and the direction of its change affect the demand for a factor input and affect the marginal productivity of that input.
4. The demand for inputs is also affected by their relative prices. When inputs are substitutable among themselves, their relative prices help to select the technology to be used by the firm. This, in its turn, determines the demand for inputs. A costlier input has lesser demand.

The demand of a productive factor is dependent on its marginal product. So long an extra unit of a factor contributes more to the firm than it receives from the firm, it is worth using the extra unit of the factor. Let us now define a few terms in this context.

(a) Marginal Product, or Marginal Physical Product (MPR):

The addition to the total output made by employing an extra unit of a factor is known as the marginal physical product of that factor. For example, when the employment of the 10th worker leads to an increase in the output of a commodity, say, X from 500 units to 550 units, the MP of 10th worker is 50 units of output. Since marginal product is measured in physical terms, it is often called marginal physical product (MPR).

(b) Marginal Revenue Product (MRP)

It is the additional revenue the firm makes by selling the output contributed by one additional worker (i.e. the last worker) is sold. Thus it is a rupee measure of the additional output attributable to the effect of the additional worker. Note that MRP can be computed by multiplying MPR by the marginal revenue (MR).

Symbolically it can be written as:

$$\therefore \text{MRP}_{\text{labour}} = \text{MPP}_{\text{labour}} \times \text{MR}_{\text{units}}$$

(c) Value of Marginal Product (VMP)

It measures the addition to revenue due to one unit increase in the quantity of the productive factor. The difference between MRP and VMP lies in the methods of measurement. Hence VMP is determined by multiplying MPR by price (rather than by MR) of the commodity which the factor helps to produce.

$$\text{Hence } \text{VMP}_{\text{labour}} = \text{MPP}_{\text{labour}} \times \text{Price}_{\text{units}}$$

(d) Marginal Resource Cost (MRC)

It is the additional cost to the firm of employing one additional unit of labour. MRC consists of the wage rate and other costs to the firm of employing the additional worker. The difference between MRC and MC is that MRC refers to the variation of costs due to one unit variation in output.

The Behaviour of MRP and MRC

So long as $\text{MRP} > \text{MRC}$ it is profitable to continue employing more labour. The optimum number of units of any variable resource to be used is determined by the relation $\text{MRP} = \text{MRC}$. If $\text{MRP} < \text{MRC}$, production should be stopped and the fewer units of labour is to be employed.

The Behaviour of MRP and VMP

The relationship between the units of variable factor (say labour L) with their MRP and VMP are shown in Table.

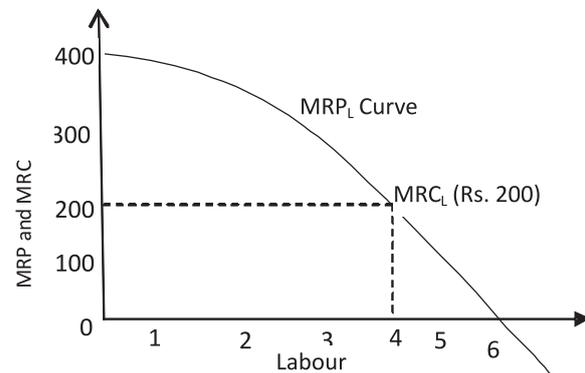
THE MPP AND THE VMP OF THE VARIABLE FACTOR

Units of Variable Factor (L)	Total output of Commodity B, (units) (Q_s)	MPP_L or MP_L	$\text{MRP}_L = (\text{MPP}_L \times \text{MR}_s)$	MR_s	$\text{VMP} = (\text{MPP}_L \times P_s)$ and $(P_s = \text{MR}_s)$	MRC_L ($P_L = 200$)
1	20	20	400	20	400	200
2	37	17	340	20	340	200
3	52	15	300	20	300	200
4	67	10	200	20	200	200
5	67	5	100	20	100	200
6	67	0	0	20	0	200

From Col. (3) we find that MPP_L gradually decreases. This is due to the fact that other factors which are required along with L to produce B are adequate for two units only. Hence any further addition of L does not get the support from other factors which remain fixed. Thus the contribution to output of each extra unit of L becomes smaller than the contribution of the previous unit. Assume that the market for the commodity is perfectly competitive which means that the firm can sell its entire output at a given price (say, $P_b = ₹ 20$). Col (4), i.e. MRP_L also shows the same behaviour as MP_L , i.e., it gradually falls.

If the selling price of the output of a firm remains constant even when the commodity market is perfectly competitive, the price of the commodity becomes equal to its marginal revenue, i.e., MRP equals VMP . In an imperfectly competitive market, when the sale can be increased by reducing the price of the product, $\text{MR} < \text{price of the commodity}$. Thus $\text{VMP} > \text{MRP}$ in an imperfectly competitive market, i.e., VMP overstate the revenue addition made by one extra unit of the variable factor employed in such a situation.

The MRP curve, or demand curve for a factor is actually the firm's demand curve for the variable factor. The maximum price a profit-seeking entrepreneur will be ready to pay for employing one extra unit of the variable factor is the likely contribution to be made to the firm's revenue by the last unit of the factor. The firm's demand curve can be obtained by plotting Col. (4) against Col. (1) of the above table. This is shown in the diagram.

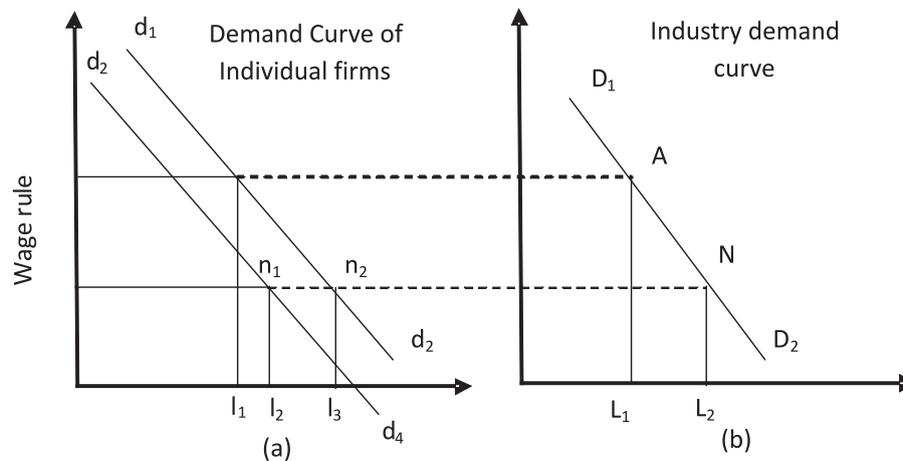


Determination of Optimum Purchase of Labour by a Firm:

The above fig. shows that the optimum level of employment is 4 units of the labour when $MRP_L = MRC_L = ₹ 200$. So long as $MRP_L > MRC_L$, the firm gets the benefit of hiring additional units of labour and production increases. When $MRP_L < MRC_L$ production should be cut back and fewer units of labour are to be employed.

INPUT DEMAND BY A COMPETITIVE INDUSTRY

A competitive firm can change its level of usage of an input if the price of the input changes and hence can change output without affecting fewer the price of the commodity produced. If all firms respond to the price changes of an input simultaneously by changing the level of usage of inputs, the price of the product of the industry changes. As input demand for each firm is derived by holding commodity price constant, input demanded by all firms change when they change their output levels simultaneously, i.e., at the same time.



Derivation of the industry Demand for a Variable Factor

The above fig. shows a typical firm using only labour as a variable input. Let d_1, d_2 be the firm's demand curve for labour at the current market price of the commodity produced. If r_1 is the wage rate, the firm usage l_1 units of labour. Total labour employed by all the firms in the industry (L_1) is shown in the diagram. Hence A is a point on the industry demand curve for labour, D_1, D_2 .

Now if the price of the labour falls from r_1 to r_2 and all other things remain equal, a firm would employ l_3 units of labour and the position is shifted to n_2 on d_1, d_2 curve. Since other things are not equal and all firms increase their inputs, total output increases, i.e., the market supply curve for the commodity is shifted to the right due to the fall in the price of the input. The market price of the commodity falls, MR falls and a firm's MRP (= VMP) curve shifts to the left and the individual firm's demand for labour also falls.

The fall in the individual firm's demand for labour due to fall in commodity price is shown in diagram (a) as a leftward shift of the demand curve for labour from d_1, d_2 to d_3, d_4 . At the wage rate r_2 , n_1 is the equilibrium point, with l_2 units labour. Total labour employed by all the firms of the industry is shown as L_2 units in diagram (b). Several other points like A and N can be generated by changing the market price of the input, i.e., the wage rate. The industry demand curve for labour (the variable input) D_1, D_2 can be obtained by joining these points. The curve is negatively sloped but steeper than that of a firm.

The supply curve of input in the market is positively sloped. Since additional labour must be obtained from other occupations, high prices are to be paid for such additional inputs. Hence the wage rate the firms intend to pay for a particular input is fixed by the supply and the demand for the input in the market.

Thus the wage rate is determined by the supply of and demand for the labour. Any factor which increases (decreases) the demand for labour (or any other input) must increase (decrease) the price that firms must pay for such input.

OUTPUT EFFECT AND INPUT SUBSTITUTION EFFECT

The quantity of an input required in an industry is a function of its own price, the state of technology and the demand for the end product. An input demand curve relates to a single homogenous input and shows the input quantities required at various prices. An input demand curve has downward slope for the following reasons:

(1) An increase in the price of an input results in increase in the firm's marginal cost and shifts the supply curve of its product to the left. Moreover, product price increase leads to a fall the output of the industry. Again lesser inputs are used to produce a smaller output. This decrease in usage of input due to a rise in its price is called the OUTPUT EFFECT.

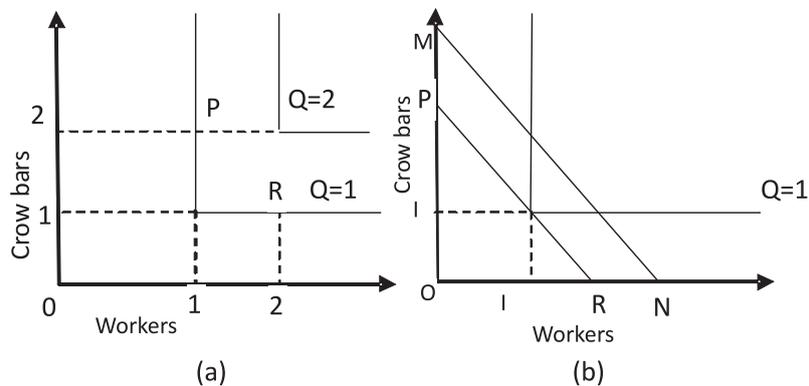
(2) If it is possible to change or vary the proportions of inputs, input price increases may cause firms to substitute expensive inputs by cheaper ones. This change in the usage of inputs is called the input SUBSTITUTION EFFECT.

We may now discuss input demand where input proportions remain fixed.

FIXED INPUT PROPORTIONS

Some production processes need fixed input proportions. For example, six buttons and 1 metre of cloth are required to manufacture a finished good like a shirt. Hence with 60 buttons and 15 metres of cloth, 10 shirts can be produced and 5 metres of cloth will be surplus.

Ditch digging is another example. Suppose in 1 hour a worker can dig a hole with one crowbar and this is the point at the corner of the right angled isoquant.



Right-angled isoquants in a Fixed Proportions Production Function

Diagram (b) shows minimization of operating costs in a fixed proportions production function at the corner of an isoquant.

By giving two crowbars to one worker or by giving one crowbar to two workmen, the digging of hole will not be more than one per hour. Hence there is no chance of substituting one input by another (diagram a).

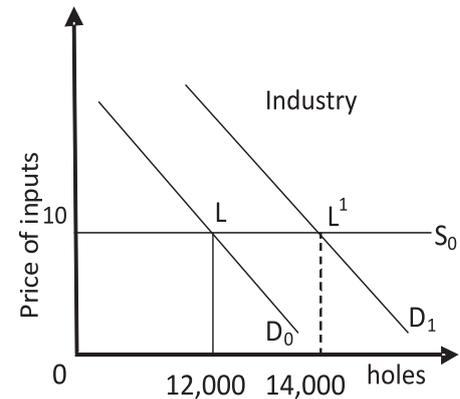
From diagram (b) we find that the cost of digging one hole is minimum at the corner of the isoquant, irrespective of input prices. This point is on the isocost line PR as also on the line MN.

The cost of each hole (MC) equals the cost of hiring a worker for 1 hour (\dot{u}) plus the cost of hiring a crowbar for one hour (P_k). i.e. $MC = \dot{u} + P_k$.

The supply curve of each competitive firm is horizontal at $(\bar{u} + P_k)$ and the industry supply curve at $(\bar{u} + P_k)$ is also horizontal since this is the summation of the individual firms' supply curves.

Now the cost of each hole will be ₹ 10 if wages per hour and the rental for hiring crowbar bar per hour are ₹ 8 and ₹ 2 respectively. At these input prices, the supply curve (S_0) of the hole digging industry is horizontal. See the following Fig.

Point L shows the equilibrium of the competitive hole digging industry. From Fig. we find that 12,000 holes are dug at a cost of ₹ 10 by using 12,000 hours of labour and 12,000 crowbar hours.



The demand for an input depends on the output of the industry, i.e., lesser the output lesser is the demand for an input and vice versa. Hence the demand for an input is derived from the demand for the output of the industry.

The shift of the industry demand curve for the input affects both output and input usage. For example in above Fig., if the demand curve moves to D_1 the new equilibrium will be at L_1 where 14,000 holes are to be dug at a cost of ₹ 10 per hole. The larger output is achieved by using more inputs, i.e., 14,000 hours of labour and 14,000 crowbar hours.

Elasticity of Factor (Derived) Demand

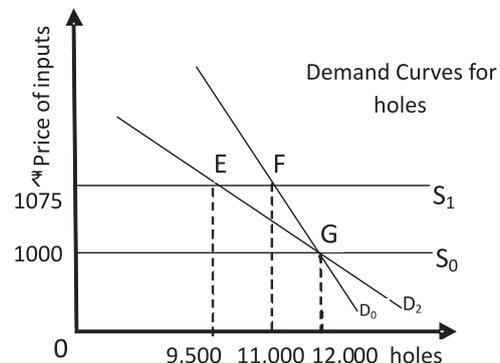


Diagram shows that output falls from 12,000 to 11,000 when the industry supply curve moves from S_0 to S_1 . Under a more elastic demand curve D_2 the fall in output due to shift of the supply curve from S_0 to S_1 is much greater, i.e., from 12,000 to 9,500.

Input prices do affect input usage. In Diagram D_0 is the demand curve for holes dug. The supply curve S_0 shows that at a unit cost of ₹ 10; 1200 holes are dug. When the wage rate rises from ₹ 8 to ₹ 8.75, but the crowbar hiring charges remain constant at ₹ 2, the marginal cost (MC) of firm increases from ₹ 10 to ₹ 10.75. With the new industry supply curve S_1 only 11,000 holes are supplied, and lesser inputs are required, i.e., 11,000 hours of labour and 11,000 crowbar hours. This reduction of inputs owing to the decline in output and rise in input prices is the output effect, discussed earlier.

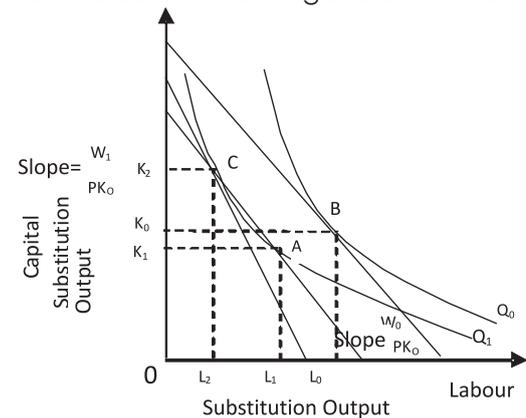
The magnitude of the output effect depends on the elasticity of the demand curve for the output of the whole industry.

In Diagram the elasticity of D_2 is greater than D_0 . When the supply curve moves from S_0 to S_1 there is greater reduction of output under D_2 than under D_0 , i.e., the output effect becomes stronger when the industry faces a more elastic demand for its product.

VARIABLE INPUT PROPORTIONS

Firms prefer to substitute variable inputs when the input prices change provided there isoquants are not right-angled. The net effect of the variation in input prices on the usage of inputs depends on the interaction of output and substitution effects. Let us now study the effects of an increase in the wage rate. The same analysis can also be applied to variations in other input prices.

Diagram shows that due to increase in the wage rate from w_0 to w_1 output declines from Q_0 to Q_1 . The consequent reduction in the usage of labour ($L_1 - L_0$) and that of capital ($K_1 - K_0$) are shown in this figure (point B to A). Finally the substitution effect, i.e., use of less labour ($L_2 - L_1$) and more capital ($K_2 - K_1$) for producing Q_1 units of output, is also shown in the figure (point A to C).



Output Effect and Input Substitution Effect

We have noted earlier that a rise in the wage rate causes a fall in industry output. This may happen, either due to a fall in the number of firms in the industry, or by a reduction of average output of existing firms. Fig shows that at input prices w_0 and PK_0 a firm produces Q_0 units of output with L_0 labour and K_0 capital (point B). Suppose with rise of wage rate to w_1 the firm's output declines to Q_1 . Now only Q_1 units are produced by the firm at the old input prices, with L_1 both labour and K_1 capital (point A). The reduction of output results in the reduction of labour ($L_1 - L_0$) and capital ($K_1 - K_0$) inputs. This is the output effect.

At increased price of labour, Q_1 units of output are obtained with L_2 labour and K_2 capital. Due to substitution effect, less labour ($L_2 - L_1$) and more capital ($K_2 - K_1$) are needed to produce Q_1 units of output (point C).

The substitution and output effects conjointly reduce labour usage. The output effect is more pronounced when the demand for the industry's product is fairly elastic. The substitution effect is more prominent where it is easy to substitute between inputs. Both substitution and output effects account for the downward slope of the demand curve for labour.

A rise in the wage rate causes output to fall. As a result the usage of capital will also fall. But if output remains unchanged (or even falls) the usage of capital may increase if the firm substitutes labour by capital. In Fig. the substitution effect is more pronounced than the output effect and the firm uses more capital and less labour when the wage rate rises. In some other industries the converse is true.

THE FIRM'S MRP RULE

We have already seen that $MRP_K = MPP_K \times MR$ or $MRP_K = MR \times MP_K$ and $MRP_L = MR \times MP_L$.

By combining MRP_K and MRP_L are arrived at two other rules of profit maximisation.

$$1. \quad \frac{MR \times MPL}{MR \times MPL} = \frac{MRPL}{MRPK} = \frac{MPL}{MPK}$$

This condition is satisfied when the isoquant is a tangent to an isocost line and this is the condition of cost minimisation.

$$2. \quad MR = \frac{MRP_K}{MP_K} = \frac{MRP_L}{MP_L}$$

We know from the definition of $MP_L = \frac{\Delta Q}{\Delta L}$, i.e., increase in labour input required to increase output by one unit. Hence $MR \cdot MP_L$, i.e., MR is the expenditure on L which is required to increase the output by one unit with increased L only. A similar explanation can be given for K. The profit - maximizing condition is once again $MR = MC$.



6.6 PRICING POLICIES

INTRODUCTION:

The traditional economic theories of pricing, based on demand and supply are of little use to businessmen in setting prices for their goods. The traditional economists rarely considered the influence exercised by middlemen, rival producers change in Government economic policies, taxation, etc., all of which are really important in price determination.

Under marginal principle of $MC = MR$, price and output are determined on the basic assumption of profit maximization. Some economists – Hall and Hitch of the Oxford University* - rejected the assumption of profit maximization as unrealistic and inapplicable to actual business conditions. In their empirical study of actual business behaviour, Hall and Hitch found that business firms are either ignorant of the concepts of MR and MC or they do not actually calculate MR and MC. Naturally, they do not determine price and output at the point of equality of MR and MC. Besides, business firms are afraid of charging high prices in the short period much above their average costs of production, lest their price policy, resulting in supernormal profits, attract potential competitors to enter the industry and compete away the profits in the long run. High prices and high profit margins may attract public and Government reaction and possible intervention. In other words, in real life, firms would like to avoid entry of rivals and sharing of the market and for this, they would be prepared to forgo supernormal profits in the short period. Often, firms will be interested in getting a large share of the market rather than maximum profit. Sometimes, business firms are influenced by consideration of charging the "right price" with a "just profit margin".

FACTORS INFLUENCING PRICE OF A PRODUCT:

Generally, marketers consider the following factors in setting price:

1. **Target customers:** Price of product is depend on the capacity of buyers to buy at various prices, in other words, influence of price elasticity of demand will be examined.
2. **Cost of the product:** Pricing is primarily based on the, how much it costs to produce and market the product, i.e., both production and distribution cost.
3. **Competition:** Severe competition may indicate a lower price than when there is monopoly or little competition.
4. **The law:** Government authorities place numerous restrictions on pricing activities.
5. **Social responsibility:** Pricing affects many parties, including employees, shareholders and the public at large. These should be considered in pricing.
6. **Market position of the firm:** The position of the market may also influence the pricing decision of the firm. It is only why the different producers of identical products sell their products at different prices.
7. **Distribution channel policy:** The prices of products will also depend up the policy regarding distribution channel The longer the channel, the higher would be the distribution costs and consequently higher the prices.
8. **Price elasticity of Demand:** Price elasticity refers to consequential change in demand due to change in price of the commodity. It is the relative responsiveness to the changes in price. As there an inverse relationship between price and demand for product, the demand will increase with fall in price.
9. **Economic environment:** In recession, prices are reduced to a sizeable extend to maintained the level of turnover. On the other hand, prices are charged higher in boom period to cover the increasing cost of production and distribution

GENERAL OBJECTIVES OF A PRICING POLICY:

Each pricing decision of a firm has generally one of the following objectives:

- To achieve a given rate of return for the entire product line;
- To maintain or increase the existing market share of the firm;
- To maintain at least a particular level of price stability;
- To choose and adopt a price policy which fits into the market conditions faced by the different products in the product line; or
- To aim at discouraging entry of new firms into the industry.

CONSIDERATIONS IN FORMULATING PRICE POLICIES:

The following are the general considerations which must be kept in view while formulating pricing policies:

1. Objectives of the firm:
2. Competitive situations:
3. Promotional policy
4. Price insensibility
5. Manufactures and middlemen interests
6. Pricing reutilization
7. Influence of non-business groups

METHODS OF PRICING:

The main pricing practices can be classified into three broad categories:

1) COST ORIENTED PRICING:

- a) Cost-plus or full Cost Pricing
- b) Target or Rate of Return Pricing
- c) Marginal Cost Pricing

2) COMPETITION-ORIENTED PRICING:

- a) Going Rate Pricing
- b) Trade Association Pricing
- c) Customary Pricing
- d) Price Leadership
- e) Sealed-bid Pricing

3) DEMAND ORIENTED PRICING:

- a) Differential pricing or price discrimination
- b) Perceived Value Pricing

4) PRICING BASED ON OTHER ECONOMIC CONSIDERATIONS, like the:

- a) Administered Pricing
- b) Dual Pricing



5. PRICING POLICIES BASED ON MARKET CONDITIONS:

- a) Perfect competition
- b) Monopoly
- c) Temporary monopoly
- d) Duopoly
- e) Oligopoly
- f) Monopolistic competition.

1. COST ORIENTED PRICE:

a) **Cost – plus pricing:**

Business firms under oligopoly and monopolistic competitive conditions do not determine price and output by comparing marginal cost and marginal revenue but fix prices on the basis of full average cost of production which consists of direct cost or variable cost per unit plus overhead cost of fixed cost per unit plus a margin of normal profit or some satisfactory margin of profit.

In other words:

$$\text{PRICE} = \text{AVC} + \text{AFC} + \text{a profit margin}$$

Now AVC + AFC make up the average cost of production per unit of output and the profit margin added to the average cost is a certain percentage of cost. It is important to note that this profit margin is arbitrary – it may be 10% or 15% or, for that matter, any percentage of profit is known as the mark up.

This approach to price determination is known as full cost pricing or average cost pricing since the firm fixes the price of its product on the basis of covering full cost or average cost; the theory is also known as cost-plus pricing or mark-up pricing.

b) **Marginal Cost Pricing:**

Marginal cost pricing is said to be better than full cost pricing. Under full cost pricing, price is based on total costs comprising fixed and variable costs. Under marginal cost pricing, fixed costs are ignored and pricing is determined on the basis of marginal cost which refers to the cost of producing additional units. The price fixed must cover the marginal cost and total cost-which will have to be covered in the long run. Price based on marginal cost will be much more aggressive than the one based on total cost. Besides, where a firm has large unused capacity, it should explore the possibility of producing and selling more-it should cover the cost of producing the additional units (Marginal cost). The real difficulty is that the management may not always be aware of the concept of marginal cost.

c) **Rate of return (or Target) Pricing:**

It is a refined version of cost-plus pricing. When due to certain reasons, the firm has to revise its prices it needs to ensure that the prices so revised would allow it to maintain either:

- 1. A fixed percentage mark-up over cost;
- 2. Profit as a fixed percentage of total sales; or
- 3. A fixed return on existing investments.

Rate of return price is determined in the following manner:

- Step I. The firm specifies an expected rate of return on investment (expressed as earnings divided by capital invested).
- Step II. To determine a 'normal rate' of output by the firm and then to estimate the 'full cost' on the basis of this normal rate of production.
- Step III. To estimate 'capital turnover' ratio (expressed as invested capital divided by full cost).

Step IV. To multiply capital turnover ratio with the expected rate of return on investment (as found in Step I). This will give us the mark-up percentage.

Step V. To compute Rate of Return (ROR) price, we add up the full cost and the mark-up, i.e., $P = \text{Full Cost} + \text{Mark-up}$

The first four steps can be summarized in the following formula:

$$\text{Mark-up} = \frac{\text{Capital Invested}}{\text{Full Cost}} = \frac{\text{Earnings}}{\text{Capital invested}} = \frac{\text{Earnings}}{\text{Full cost}}$$

2. COMPETITION ORIENTED PRICING:

a) Going Rate Pricing:

Another method of pricing adopted by small firms – which are price followers – is known as going rate pricing. Under this system, a firm sets its price according to the general pricing structure in the industry or according to the price set by the price leader. In a sense, each firm has “monopoly” power over its produce and it can, if it chooses, fix a monopoly price and face all the consequences of monopoly. In practice, however, it prefers the easier and more practical method of choosing price going in the market. It will change its price only when other firms do the same. Such a price policy is useful and safe to a firm under certain circumstances. For instance, the firm may not have an accurate idea of its costs or it may like to play safe and not provoke the larger firm to go for cut-throat competition. Besides, it is difficult for each firm to calculate the full implication of change in costs and prices and it is much better to follow the same pattern of pricing adopted by others. Even a large firm may be satisfied with going rate pricing lest a change in price by it unnecessarily disturbs the whole market. No firm would like to “spoil” the common market by reducing the price.

b) Trade Association pricing:

To avoid uncertainties of pricing decision and the downward pressure on prices which competition exerts, firms frequently come to the express or implied agreements to maintain prices at a similar level. Though express (or, overt) agreements are generally declared as illegal, the firms can easily and safely enter into an implied (or, tacit) collusion. Individual firms, however, may frequently find it worthwhile to break out of any such agreements, but this leads to the following possible alternatives:

i) The price-cut may spark off a price war between the firms which will go on until one or all firms give up the struggle; or

ii) If the firm breaking out of the collusion is able to keep its rivals in the dark about the price-cut, it can gain out of the price-cut only when either the original customers of this firm are unaware or are in some way loyal to this firm. But such situations are generally rare.

c) Customary Pricing:

There are certain goods whose prices tend to be fixed more or less in the minds of consumers-these are known as the “Charm” prices. A good example is the price of most soft drinks in India called by various names of cola. Most or all the soft drinks sell at the price of ₹ 6 or so, customers are accustomed to this price. Change in costs of production – if the change is moderate – will not affect the price, as the firms will not and cannot change the price. Accordingly, a rise in cost of production may probably lead to reduction in quality of the product but not to a rise in price. Likewise, a fall in cost of production may not be accompanied by a decline in price. Pricing in this case may be known as customary pricing.

d) Price leadership:

If often happens that in an industry there is one or many big firms whose cost of production is low and they dominate the industry. In such a situation, the small firms will not like to enter into price war with these big firms. The former may, therefore, follow the price fixed by the leader. For example, Cadbury may be accepted as a leader in the chocolate industry, Hindustan Lever in the soap industry, and so on. Small



firms may change the price only when there is a general change in the cost of production and the price leader has recognized and adjusted his price on that basis. In fact, the price leadership pattern is adopted as a strategy of co-existence – each firm catering to its market.

It is not necessary that the price charged by small firms must equal that charged by the price-leader. There might be some difference in their prices (though it cannot be significant) but any change in the price is always in the same direction for both the price-leader and the followers, and is generally in the same proportion too. As a result, both will have their own markets to cater, thus avoiding diversion of customers.

e) Sealed – bid pricing:

This method is more popular in tenders and contracts. Each contracting firm quotes its price in a sealed cover called 'tender'. All the tenders are opened on a scheduled date and the person, who quotes the lowest price, other things remaining the same, is awarded the contract.

3. DEMAND ORIENTED PRICING:

a) Differential pricing or price discrimination

There are many bases on which the open price discrimination is practiced. These are discussed below.

- **Time Price Differentials:** It is a general practice to use the expression "the demand for a product or service", but it is important to note that demand also has a time dimension. The demand may shift in fairly short-time intervals. For example, demand for telephone facilities is more in the day time rather than at night.
- **Use Price differentials:** Different buyers have different uses of a product or a service. For example railways can be used for long-haul or short-haul freight traffic. Railways can also be used for transporting different types of commodities. Electricity can similarly, be used for industrial or residential purposes.
- **Quality price Differentials:** If the product caters to that group of consumers who are concerned about its quality, then the quality becomes a significant determinant of demand elasticity. The seller has, therefore, to create differences in quality to sell his product. It must be emphasized here that the differences in quality basically depend upon the buyers' understanding of the quality. Sellers use many devices to create quality differences.
- **Quantity Differentials:** When the seller discriminates on the basis of the quantity of purchase, it is known as quantity differentials. Quantity discounts are price concessions based on the size of the lot purchased at one time and delivered at one location. These discounts are thus related to size of a single purchase. The size of the lot purchased is measured in terms of either physical units or monetary units. Sometimes, discounts are according to the trade status, i.e., wholesaler, retailer, jobber, etc.

b) Perceived Value pricing:

Perceived value pricing refers to fixing the price on the basis of a buyer's perception of the value of the product.

4. PRICING BASED ON OTHER ECONOMIC CONSIDERATIONS:

a) Administered prices:

Administered prices are the prices which are fixed and enforced by the government. The term administered prices was introduced by Keynes.

Characteristics of administered prices:

1. They are fixed by Government
2. They are statutory i.e., legally enforced by the government
3. They are regulatory in nature
4. They are meant as corrective measure
5. They are the outcome of the price policy of the Government.

b) Dual Pricing:

Dual pricing is a system in which there are two prices for the same commodity at the same time – one is a controlled price fixed by the Government and the other is a free market price based on conditions of demand and supply. The controlled price is fixed price while the free market price is a fluctuating price. Generally, the Government fixed the prices of a commodity – say, sugar – at a level which will cover the cost of production and permit a reasonable margin of profit. But this controlled price is obviously lower than the free market price because of the existence of excess of demand over supply. The controlled price is mainly for the benefit of lower income groups and it many often be fixed so low that the producers may incur a small margin of loss. The producers are compelled to sell part of their output at the controlled rate to the weaker sections of the community but are permitted to sell the surplus stocks in the market at the free market price which is much higher. This enables the producers to make up their loss in the controlled market or increase their volume of profit. Besides, the general consumers are given a chance to satisfy their demand fully from the market.

c) Shadow Pricing:

The producer has to decide two questions – 1) how much of each product should be produced to maximize profits, 2) What price is worth paying for additional quantities of a scarce resource. To decide the second question “What price is worth paying for additional quantity of a scarce resource”, very often “shadow prices” are used. Shadow prices are not prices obtained by observing the real world. Shadow prices are “imputed values”. The shadow prices show the marginal contribution of the factors of production employed. It is calculated by using the “simplex method”. These imputed values show the increase in profit which would result if an additional unit of that scarce factor is used. The imputed value is the reduction in contribution if that scarce factor is removed.

d) Multiple product pricing:

Now-a-days, multiple production is a common phenomenon. Almost all firms have more than one product in their line of production Pricing of products under those conditions is known as multi-product pricing. The major problem in pricing of multiple products is that each product has a separate demand curve. But all of them are produced under one organisation by interchangeable production facilities, they have only one inseparable marginal cost curve. Hence marginal rule of pricing cannot be applied E.W. Clemens suggests a solution to this problem is – third degree price discrimination under monopoly. As a discriminating monopoly tries to maximize its revenue in all its markets so does a multi-product firm in respect of each its products.

Even the most specialized firms produce a commodity in multiple models, styles and sizes, each so much differentiated from the other that each model or size, each so much differentiated from the other that each model or size product may be considered a different product.

For example:

Refrigerators – 165 liters, 200 liters, 250 liters, single door model, two door model, bottom racks, top racks models etc.

Television sets – 14 inches, 20 inches, 21 inches, 25 inches, 27 inches, color, black & white, remote model, without – remote model, flat screen model digital sound two speakers, four speakers, home theater systems etc.

5. PRICING POLICIES BASED ON MARKET CONDITIONS:

(a) Perfect Competition:

A firm can only sell its product at the market price and nothing above it. In the long run, for an efficient firm, the sales price is just equal to the average cost. Normal profit is made. There is no excess profit.

(b) Monopoly:

Monopolies are almost always nationalized enterprises for which the criterion of maximization of profit is not justifiable. In reality, a firm enjoys monopoly position only because it has succeeded in eliminating or absorbing its competitors. It is therefore probable that, initially, it was better organized and more efficient.



The technical advantages which benefit large firms in certain branches of industry can also neutralize, at least partly, the harmful effects of a monopoly. Finally, "any defacto monopoly must be prepared to defend itself, on the one hand, against the emergence of substitute competitors and, on the other, against the competition of substitute products, which imposes a limitation on its profit realization".

In general, to prevent the entry of new firms, a monopolist must set entry-preventing prices, i.e., it should hold prices at a level which will tend to discourage new firms from entering that particular branch of industry. This presupposes an implicit estimation of production costs of possible competitors, and of the profits which will be required to attract them.

On the contrary, in order to fight the competition of substitute products, a monopoly must establish its price policy on the basis of a demand curve which will actually take those products into account. When the uses of goods produced by a monopoly are many, the degree of monopoly can vary enormously from one use to another. In case of coal, for instance, sales range from the industrial market- in which the fuel oil competition is extremely active – to blast furnace coke market – in which coal enjoys a technical monopoly.

So profit maximization demands that management collect more detailed econometric data in the environment of monopoly, than in that of perfect competition.

(c) Temporary monopoly:

This situation occurs more frequently. A firm invents a new product and places it on the market. For quite some time the demand will remain low, as consumers are not yet aware of the product. The firm will enjoy a de facto monopoly under the protection of its patents. Then, as the product enters into common usage, demand develops rapidly. Additional firms try to enter the market. They develop new production methods. Gradually, prices and production techniques tend to stabilize. So at the end, the market evolves towards an ordinary competitive one.

A firm which invents a new product must determine a strategy relating to prices and production which leads to a maximum effective income. Following J.Dean, we may consider two extreme cases: that of skimming of demand and that of creating a demand market.

(d) Skimming Price Policy:

When the product is new but with a high degree of consumer acceptability, the firm may decide to charge a high mark up and, therefore, charge a high price. The system of charging high prices for new products is known as price skimming for the object is to "skim the cream" from the market. There are many reasons for adopting a high mark-up and, therefore, high initial price:

- i) The demand for the new product is relatively inelastic. The high prices will not stop the new consumers from demanding the product. The new product, novelty, commands a better price. Above all, in the initial stage, there is hence cross elasticity of demand is low.
- ii) If life of the product promises to be a short one, the management may fix a high price so that it can get as much profit as possible and, in as short a period as possible.
- iii) Such an initially high price is also suitable if the firm can divide the market into different segments based on different elasticities. The firm can introduce a cheaper model in the market with lower elasticity.
- iv) High initial price may also be needed in those cases where there is heavy investment of capital and when the costs of introducing a new product are high. The initial price of a transistor radio was ₹ 500 or more (now ₹ 50 or even less); electronic calculators

(e) Duopoly:

This is the case where there are only two firms in an industry. Each duopolist can choose his production in such a way as to maximize his income for a given value of output. Each duopolist has no interest in modifying his behaviour as long as the other does not modify his.

If both duopolists attempt to take one another's reactions into account, the problem is no longer predetermined. Duopoly is often characterized by instability. Duopolists eliminate their competitors through price wars or through agreements. We have already demonstrated that duopolists can assure themselves,

by cooperating, a total income greater than the sum of the revenues that each can insure for himself by non-cooperative behaviour.

(f) Oligopoly:

In oligopolistic situations, entrepreneurs attempt to avoid price wars which are ruinous for the industry. Being aware of the fact that their rivals can do the same, they refrain from seeking to increase their share of the market through price cuts. As a result, oligopoly can attain a certain stability characterized by: a) the 'price leadership' of a firm, b) the reduction of hidden prices, and c) competition in fields other than that of price (like competition in fields other than that of price (like promotion, packaging, etc.) We have already discussed the nature of oligopoly pricing with the help of models.

Now, about the lowering of hidden prices. It can assume various forms. It is contingent upon the customer, upon the size of the order, upon the geographical area and the existence of inferior brands. This policy has the advantage that it precedes adjustments of official prices and in this way contributes to the stability of oligopolists.

Finally, non-price competition is a substitute for price competition. It is much less dangerous because its effects are felt in the long run. So the possibilities of reactions from competition are more limited.

(g) Monopolistic competition:

In this type of market, price policies are extremely varied because of product differentiation. Each firm is faced with a separate demand curve and a market price.

PRICING OF A NEW PRODUCT

Basically, the pricing policy of a new product is the same as that for an established product – viz., the price must cover the full costs in the long run and direct costs or prime costs in the short period.

1. Introduction Stage:

There are two alternative price strategies which a firm introducing a new product can adopt, viz., skimming price policy and penetration pricing policy.

a) Skimming Price Policy:

When the product is new but with a high degree of consumer acceptability, the firm may decide to charge a high mark up and, therefore, charge a high price. The system of charging high prices for new products is known as price skimming for the object is to "skim the cream" from the market. There are many reasons for adopting a high mark-up and, therefore, high initial price:

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- ii) If life of the product promises to be a short one, the management may fix a high price so that it can get as much profit as possible and, in as short a period as possible.
- iii) Such an initially high price is also suitable if the firm can divide the market into different segments based on different elasticity's. The firm can introduce a cheaper model in the market with lower elasticity.
- iv) High initial price may also be needed in those cases where there is heavy investment of capital and when the costs of introducing a new product are high. The initial price of a transistor radio was ₹ 500 or more (now ₹ 50 or even less); electronic calculators used to cost ₹ 1,000 or more, they are now available for ₹ 100 or so.

b) Penetration Price Policy:

Instead of setting a high price, the firm may set a low price for a new product by adding a low mark-up to the full cost. This is done to penetrate the market as quickly as possible. The assumptions behind the low penetration price policy are:



- a) The new product is being introduced in a market which is already served by well-known brands. A low price is necessary to attract gradually consumers who are already accustomed to other brands.
- b) The low price will help to maximize the sales of the product even in the short period.
- c) The low price is set in the market to prevent the entry of new products.

Penetration price policy is preferred to skimming price under three conditions:

In the first place, skimming price offering a high margin will attract many rivals to enter the market. With the entry of powerful rivals into the market, competition will be intensified, price will fall and profits will be competed away in the long run. A firm will prefer a low penetration price if it fears the entry of powerful rivals with plenty of capital and new technology. For a low penetration price, based on extremely low mark-up will be least profitable and potential competitors will not be induced to enter the market.

Secondly, a firm will prefer low penetration price strategy if product differentiation is low and if rival firms can easily imitate the product. In such a case, the objective of the firm to fix low price is to establish a strong market based and build goodwill among consumers and strong consumer loyalty.

Finally, a firm may anticipate that its main product may generate continuing demand for the complementary items. In such a case, the firm will follow penetration pricing for its new product, so that the product as well as its complements will get a wider market.

2. Pricing during Product Maturity stage:

When the product reaches maturity period the firm finds that

- a) Many rivals have already entered the market.
- b) Competition is intense; and
- c) Demand for the product has become more elastic.

Under these conditions, the firm may have to reduce its mark-up and, therefore, the price. In other words, the price of a product in the maturity period will be equal to full cost plus low mark-up.

3. Pricing during Product Decline stage:

In the third stage of the life cycle, the product ultimately becomes a common product. In this period, the competition in the market is severe and the demand for the product is highly elastic. In order to remain in the market, the firm has to charge only a normal mark-up with the full cost.

The Role of Demand in Pricing Decisions:

How a business firm's buyers respond to a change in price is an important consideration, for the eventual effect on sales volume and revenue is determined by the degree of buyer's demand sensitivity to price changes. However, price-setters often miss the following four points:

1. Market Vs Firm Elasticity:

Price elasticity of demand is a measure of the degree to which buyers are sensitive to price changes. In any market characterized by several functionally substitutable products, there are actually two demand schedules: 1) demand for the general product (primary demand) and 2) demand for the firm's specific offering (secondary demand). In general, secondary demand is found to be more price elastic. But a seller may sometimes mistake relatively inelastic market or primary demand as elastic secondary demand.

2. Demand for buyer's Output:

The Market for buyer's products may actually be price-elastic. So a reduction in price by a firm would raise demand for its product. Hence, manufacturers selling to such buyers, and whose product represents a significant position of these buyers product costs may curtail sales opportunities by eliminating discounts or low margin products.

3. Likelihood of Competitive Entry:

K.B. Monroe has pointed out that "an emphasis on high-price strategies may encourage the entry of competitors when entry barriers are minor and when demand is actually price-elastic. Moreover, continued

high prices or rapidly increasing prices may force buyers to reconsider their need and, perhaps, actively seek out competitive substitutes.

4. Demand Consequences of a Product Line:

Most firms sell a wide variety of products requiring a variety of different marketing strategies. Within a product line there are usually some products that are functional substitutes for each other and some products that are functionally complementary. For example, a photographic product line includes such items as cameras, films, flash bulbs, projectors, screens and other accessories. Because of the demand interrelationships and because there are usually several price-market targets, the product line pricing problem throws a major challenge before the marketing executives.

The Role of costs in pricing Decisions:

Costs play an important role in pricing. Given the selling objectives of a firm, the demand variable provides an upper limit on the pricing discretion the firm enjoys. This limit is the willingness of buyers to purchase a commodity at a stated price on the contrary, the other variable. Affecting profits is cost, which sets a floor to a firm's pricing discretion. If prices are too low in comparison with costs, volume may be high but profit will be almost nil.

In the words of Monroe, "objective cost data are essential for deciding what price to set. Only by determining the difference between costs and price under consideration, and then balancing that margin against the capacity necessary to produce the estimated volume, can the seller determine the value of the product in terms of its contribution to recovering the seller's initial investment". True, the cost aspect of a pricing decision is mainly concerned with ascertaining what costs are relevant to the decision. We shall discover later in this chapter that, when cost-plus methods of pricing are used, and the cost portion of the formula is arbitrarily determined, the resultant price is erroneous in that the pricing formula does not allow for demand or for competition.

It is important for the seller to know the determinants and behaviour of product costs for four major reasons:

1. In order to know when to accelerate cost recovery
2. In order to know how to evaluate a change in selling price;
3. In order to take decision on how to profitably segment a market; and
4. In order to take decision on when to add products or to eliminate products from the product line.

Even so, costs play a limited role in pricing. It is because they indicate "whether the product can be made and sold profitably at any price, but they do not indicate the amount of mark-up or mark-down on cost buyers will accept. Proper costs serve to guide management in the selection of a profitable product mix and to determine how much cost can be incurred without sacrificing profit".

Costs for pricing must deal with the future. Product costs must be based on expected purchase costs of raw materials, wage rates and other expenses to be incurred. In addition, information about development, promotion, and distribution costs is needed. Information on product costs should be regularly gathered to determine whether changes have occurred that may affect the relative profitability of the company. It is planned costs that are relevant, not past costs, since profit planning necessarily deals with the future.

Price Forecasting:

All the methods used for demand forecasting may also be used for forecasting the market price that will exist in the next (or some future) period. We would use some kind of a qualitative forecast. Or, we might use a time-series in which price follows a trend.

However, in practice, we normally use an econometric model to obtain market price forecasts. This requires that we specify and estimate both the market demand and market supply functions.

After estimating these functions, we must obtain the forecasted values for the exogenous variables (e.g., income and prices of inputs.) Inserting those forecasts into our estimated demand and supply functions, we can solve the equations to obtain the price forecast.



TECHNIQUES AND APPLICATIONS OF ECONOMICS

In all this, economics for managerial decision making, we have discussed demand, elasticity of demand, price determination under various markets etc. Further we have also discussed total cost, average cost, marginal cost, marginal revenue etc. Profit maximization, revenue maximization and cost minimization can be made using the following economic techniques, which are useful in taking several managerial decisions.

Problems are worked out and given as illustrations in the following pages relating to all the above concepts for better understanding. Before those illustrations are worked out, the following terminology should be understood by anybody to go further.

- 1) Total Cost (TC) = Fixed Cost (FC) + Variable Cost (VC)

Variable Cost is directly proportional to the number of units produced.

$$\therefore \text{Total Cost} = F + kx = C \text{ (Say)}$$

Where F is the fixed cost and k the constant of proportionality

Total Cost (c) is expressed as a function of output (x) produced i.e. $c = f(x)$ or $c = f(q)$ or $f(u)$.

$$\text{Total cost (c)} = f(x) + k$$

- 2) Average Cost (AC) = $\frac{\text{Total Cost}}{\text{Total number of units produced (Quantity)}} = \frac{c}{x} = \frac{f(x) + k}{x}$

Average Variable Cost (AVC) = $\frac{f(x)}{x}$ as 'k' is fixed cost.

$$\text{Average fixed cost (AVC)} = \frac{k}{x}$$

- 3) Marginal Cost (MC) = Differential Coefficient of total cost w.r.t quantity
 $= \frac{dc}{dx}$

Marginal cost = $\frac{dc}{dx} = f'(x)$ because k's derivative is 0

CASE:

(i) When average cost goes upward, $\frac{d}{dx}\left(\frac{c}{x}\right) > 0$ i.e. $MC > AC$.

(ii) When the average cost curve reaches a minimum point i.e. constant $\frac{d}{dx}\left(\frac{c}{x}\right) = 0$
i.e. $MC = AC$.

(iii) When AC is falling downwards $\frac{d}{dx}\left(\frac{c}{x}\right) < 0$ i.e. $MC < AC$.

** **Prove That The Slope Of Average Cost Curve Is $\frac{1}{x}(MC - AC)$**

PROOF:

Let cost be 'C' and units be 'x'.

$$\text{Then Average cost (say, } y) = \frac{C}{x}$$

To find out the slope, the average cost should be differentiated w.r.to. 'x'.

$$\begin{aligned} \frac{dy}{dx} &= \frac{x \cdot \frac{dy}{dx} - C \cdot 1}{x^2} \\ &= \frac{x \cdot \frac{dy}{dx} - C}{x^2} \\ &= \frac{dc}{x \cdot dx} - \frac{C}{x^2} \end{aligned}$$

$$= \frac{1}{x} \left(\frac{dc}{dx} - \frac{c}{x} \right)$$

$$= \frac{1}{x} (MC - AC) \quad (\text{proved})$$

4) Total Revenue (TR) = Quantity sold selling price per unit of the commodity = $R = px$ where p is the price per unit and x the number of units sold.

5) Average Revenue (AR) = $\frac{\text{Total Revenue}}{\text{Quantity Sold}}$

6) Marginal Revenue (MR) = Differential Coefficient of total Revenue w.r.t quantity = $\frac{dR}{dx}$

7) Profit (P) = Total Revenue (TR) – Total cost (TC)

8) For maximum Profit: Marginal Revenue (MR) = Marginal Cost (MC)

$$\text{Profit} = R - C$$

Marginal profit is the first derivative of profit function.

i.e. where p = profit and x = quantity and marginal profit = $\frac{dR}{dx}$

9) Price Elasticity of Demand.

Price Elasticity of demand is the degree of responsiveness of the demand for a commodity to a change in its price.

$$\text{Price elasticity of demand} = \frac{\frac{\text{Change in quantity demanded}}{\text{Quantity demanded at original price}}}{\frac{\text{Change in price}}{\text{Original price}}} = \frac{\frac{dx}{x}}{\frac{dp}{p}} = \frac{dx}{dp} \div \frac{dp}{p} = 1$$

Where x is the quantity demanded at original price and p is the original price per unit.

It may further be noted that if the price increases, quantity demanded will decrease i.e., Corresponding to any change in price, quantity demanded changes in the opposite direction i.e., $\frac{dx}{dp}$ is always negative. But we take only numerical value and hence ignore the sign.

Price elasticity of demand is denoted by $E_p = - \frac{dp}{p} \div \frac{dp}{p} = \frac{dx}{dp} \div \frac{x}{p}$ (numerically)

**** Show that elasticity of demand = $\frac{AR}{AR - MR}$, where AR and MR are average and marginal revenue respectively at any output.**

Proof:

Total Revenue, (say R) = px , $AR = \frac{R}{x} = \frac{px}{x} = p$

$$MR = \frac{d}{dx} (R) = \frac{d}{dx} (px) = p + x \frac{dp}{dx}$$

$$\text{Now, } \frac{AR}{AR - MR} = \frac{p}{p - p - x \frac{dp}{dx}} = \frac{p}{-x \frac{dp}{dx}} = \frac{p}{x} \times \frac{dx}{dp} = - \frac{dp}{dx} \times \frac{p}{x} = |E_p| \quad (\text{proved})$$

10) If marginal revenue function is given, total revenue function can be found out in the following manner.

We have $MR = \frac{dR}{dx}$

$$\Rightarrow MR = \frac{dR}{dx}$$



$$\Rightarrow MR \, dx = dR$$

integrating with respect to x

$$\int dR = \int MR \, dx$$

$$\Rightarrow R = \int MR \, dx + k, \quad \text{where } r = 2x$$

To find out total cost, when marginal cost is given

$$MC = \frac{dR}{dx}$$

$$\Rightarrow dc = MC \, dx$$

Integrating with respect to x

$$\int dc = \int MC \, dx$$

$$\Rightarrow c = \int MC \, dx + k$$

11) Consumer's surplus

Let y = price; f(x) = demand

$$\text{i.e. } y = f(x)$$

where x_0 , p_0 refers to actuals.

$$\therefore \text{Consumer's surplus} = \int_0^{x_0} f(x) \, dx - x_0 p_0$$

12) Producer's surplus

$$\text{Producer's surplus} = x_0 p_0 - \int_0^{x_0} f(x) \, dx$$

13) Cross demand

If $x_1 = p_1$; $x_2 = p_2$ be the two demand functions of the commodities A & B, then the following results would emerge.

(i) If $\frac{\partial x_1}{\partial p_2}$ and $\frac{\partial x_2}{\partial p_1}$ are < 0 , then the commodities are complementary

(ii) If $\frac{\partial x_1}{\partial p_2}$ and $\frac{\partial x_2}{\partial p_1}$ are > 0 , then the commodities are said to be substitutes or competitive.

(iii) If $\frac{\partial x_1}{\partial p_2} > 0$ (or) $\frac{\partial x_2}{\partial p_1} < 0$ or > 0 , they are said to be unrelated that means no relationship can be established.

ILLUSTRATION: 6

The cost (c) of a firm is given by the function $c = 4x^3 + 9x^2 + 11x + 27$. Find the Average Cost, Marginal Cost, Average Variable Cost, and Average Fixed Cost 'x' being the output.

Solution:

$$C = \text{Total Cost} = 4x^3 + 9x^2 + 11x + 27$$

$$\text{Average Cost} = 4x^2 + 9x + 11 + \frac{27}{x}$$

$$\text{Marginal Cost} = \frac{dc}{dx} = 12x^2 + 18x + 11$$

$$\text{Average Variable Cost} = 4x^2 + 9x + 11$$

$$\text{Average fixed Cost} = \frac{27}{x}$$

ILLUSTRATION: 7

The Average Cost of a firm is given by the function Average Cost = $x^3 + 12x^2 - 11x$, find the Total Cost, Average Variable Cost & Marginal cost.

Solution:

$$\text{Average Cost} = x^3 + 12x^2 - 11x$$

$$\text{Total Cost} = x^4 + 12x^3 - 11x^2$$

$$\text{Marginal Cost} = 4x^3 + 36x^2 - 22x$$

ILLUSTRATION: 8

The cost function of a firm is given by $c = x^3 - 4x^2 + 7x$, find at what level of output Average Cost is minimum and what level will it be.

Solution:

$$\text{Total Cost} = x^3 - 4x^2 + 7x$$

$$\text{Average Cost} = x^2 - 4x + 7$$

In order that average cost is minimum $\frac{dy}{dx} = 0$ and the value of $\frac{dy^2}{dx^2}$

$$\begin{aligned} \text{i.e. } \frac{dy}{dx} &= 2x - 4 = 0 \\ &= x - 2 = 0 \\ \therefore x &= 2 \end{aligned}$$

$\frac{dy^2}{dx^2} = 2$ which is positive so the function will have minimum values.

Minimum:

$$\begin{aligned} \text{Average Cost} &= x^2 - 4x + 7 \\ &= 4 - (4 \times 2) + 7 \\ &= 11 - 8 = 3 \end{aligned}$$

ILLUSTRATION: 9

The Average Cost function (AC) for a certain commodity is given by $AC = 2x - 1 + \frac{50}{x}$ in terms of output x , find the output for which (i) Average cost is increasing (ii) Average cost is decreasing (iii) Find the total cost (iv) Marginal Cost.

Solution:

In order to a function is said to be increasing (or) decreasing its derivation must be zero.

$$\frac{dy}{dx} = 2 - 50x^{-2} = 0$$

$$\Rightarrow 2 - \frac{50}{2x^2} = 0$$

$$\Rightarrow 2x^2 - 50 = 0$$

$$\Rightarrow x^2 - 25 = 0$$

$$\therefore x = \pm 5$$

When $x > 5$ it is increasing

When $x < 5$ it is decreasing



$$\text{Total Cost} = (2x - 1 + \frac{50}{x})x = 2x^2 - x + 50$$

$$\text{Marginal Cost} = \frac{dy}{dx}(2x^2 - x + 50) = 4x - 1$$

ILLUSTRATION: 10

The Cost function of a particular firm $c = \frac{1}{3}x^3 - 5x^2 + 75x + 10$, find at which level, i) The Marginal Cost attains its minimum ii) What is the marginal cost of this level?

Solution:

$$c = \frac{1}{3}x^3 - 5x^2 + 75x + 10$$

$$\text{Marginal Cost} = \frac{dy}{dx}$$

$$= \frac{1}{3}(3x^2) - 5(2x) + 75$$

$$= x^2 - 10x + 75 \text{ (y say)}$$

In order that the MC to be at minimum its 2nd derivative value must be positive

$$\frac{dy}{dx} = 2x - 10 = 0$$

$$\text{or } 2x = 10$$

$$x = 5$$

$$\frac{d^2y}{dx^2} = 2, \text{ which is positive when } x = 5 \text{ MC is minimum}$$

$$\begin{aligned} \therefore \text{Minimum Marginal Cost} &= 5^2 - 10 \times 5 + 75 \\ &= 25 - 50 + 75 = 50 \end{aligned}$$

ILLUSTRATION: 11

The cost function 'c' for the commodity 'q' is given by $C = q^3 - 4q^2 + 6q$ find Average Variable Cost and also find the value of q for which average variable cost is minimum.

Solution:

$$C = q^3 - 4q^2 + 6q$$

$$\text{Average Variable Cost} = q^2 - 4q + 6 - \text{'y' say}$$

$$\Rightarrow \frac{d}{dq}(q^2 - 4q + 6) = 0$$

$$\Rightarrow 2q - 4 = 0$$

$$\therefore q = \frac{4}{2} = 2$$

$$\frac{d^2y}{dx^2} = 2 > 0, \text{ positive}$$

$$\therefore \text{Average Cost is minimum at } q = 2$$

ILLUSTRATION: 12

The cost function 'c' of a firm $= \frac{1}{3}x^3 - x^2 + 5x + 3$, find the level at which the marginal cost and the average variable cost attain their respective minimum.

Solution:

$$C = \frac{1}{3}x^3 - x^2 + 5x + 3$$

$$\begin{aligned} \text{Marginal Cost} &= \frac{dC}{dx} = \frac{1}{3} 3x^2 - 2x + 5 \\ &= x^2 - 2x + 5 \text{ ('y' say)} \end{aligned}$$

$$\frac{dy}{dx} = 2x - 2 = 0$$

$$\therefore x = 1$$

$$\frac{d^2y}{dx^2} = 2, \text{ which is positive}$$

\therefore Marginal cost is minimum value at $x = 1$

$$\text{Average Variable Cost} = \frac{1}{3}x^2 - x + 5 \text{ (y say)}$$

$$\frac{d}{dx} \{\text{Average Variable Cost}\} = \frac{1}{3}x - 1 = 0$$

$$\Rightarrow \frac{2}{3}x = 1$$

$$\therefore x = \frac{3}{2}$$

$$\frac{d^2y}{dx^2} = \frac{2}{3}, \text{ positive}$$

\therefore Average Variable Cost is minimum at output $x = \frac{3}{2}$

ILLUSTRATION: 13

$$\text{Cost} = 300x - 10x^2 + \frac{1}{3}x^3, \text{ Calculate}$$

- i) Output at which Marginal Cost is minimum
- ii) Output at which Average Cost is minimum
- iii) Output at which Marginal Cost = Average Cost.

Solution:

$$\text{i) Marginal Cost} = \frac{dC}{dx} = 300 - 20x + x^2 \text{ (say, y)}$$

In order that MC is minimum first derivate must be equal to zero and 2nd derivate must be positive.

$$\therefore \frac{dy}{dx} = 2x - 20 \Rightarrow 2x = 20$$

$$x = 10$$

$$\frac{dy^2}{dx^2} = 2, \text{ which is positive. It is minimum at } x = 10.$$

$$\text{ii) Average Cost} = 300 - 10x + \frac{1}{3}x^2 \text{ (y say)}$$

$$\frac{dy}{dx} = -10 + \frac{2}{3}x = 0$$

$$\Rightarrow x = 30/2 = 15$$

$$\frac{d^2y}{dx^2} = \frac{2}{3} > 0,$$

\therefore Average Cost is minimum of output at $x = 15$



iii) Output at which Marginal Cost = Average Cost

$$-20x + 10x + x^2 - \frac{1}{3}x^2 = 0$$

$$-10x + \frac{2}{3}x^2 = 0$$

$$\frac{-30x + 2x^2}{3} = 0$$

$$2x^2 - 30x = 0$$

$$2x(x - 30) = 0$$

$$x - 30 = 0$$

$$\therefore x = 15$$

ILLUSTRATION: 14

Cost Function $C = \frac{3}{5}x + \frac{15}{4}$, find

- Cost when output is 5 units
- Average Cost of 10 units
- Marginal cost.

Solution:

$$C = \frac{3}{5}x + \frac{15}{4}$$

i) Cost when output is 5 units

$$= \frac{3}{5} \times 5 + \frac{15}{4} = 3 + \frac{15}{4} = 6.75$$

ii) Average Cost of 10 units

$$\begin{aligned} \text{Average Cost} &= \frac{3}{5} + \frac{15}{4x} \\ &= \frac{3}{5} + \frac{15}{10 \times 4} = \frac{3}{5} + \frac{15}{40} \\ &= \frac{3}{5} + \frac{3}{8} = \frac{24+15}{40} = \frac{39}{40} = 0.975 \end{aligned}$$

iii) Marginal Cost = $\frac{dc}{dx}$

$$= \frac{3}{5} = 0.6$$

ILLUSTRATION: 15

The Revenue function of a firm given by $R = (2200 - 3x)\frac{x}{2}$, find the firm's marginal revenue function.

Solution:

$$R = (2,200 - 3x)\frac{x}{2} = \frac{2,200x}{2} - \frac{3}{2}x^2$$

$$MR = \frac{dc}{dx} = \frac{2,200x}{2} - \frac{3}{2} \times 2x = \frac{2,200x}{2} - 3x = 1100 - 3x$$

ILLUSTRATION: 16

Given $C = x^3 - 10x^2 + 9x$; $R = 12x^2 + 11x - 4$. Find the total profit and hence marginal profits.

Solution:

$$C = x^3 - 10x^2 + 9x$$

$$R = 12x^2 + 11x - 4$$

$$\text{Total Profit} = R - C = 12x^2 + 11x - 4 - x^3 + 10x^2 - 9x$$

$$= -x^3 + 22x^2 + 2x - 4$$

$$= -(x^3 - 22x^2 - 2x + 4) \text{ (Say } P)$$

$$\text{Marginal Profit } \frac{dP}{dx} = (3x^2 - 44x - 2)$$

ILLUSTRATION: 17

A manufacturer can sell "x" items ($x \geq 0$) at a price of $(330 - x)$ each; the cost of producing 'x' items is $\text{₹}x^2 + 10x + 12$. How many items should he sell to make the maximum profit? Also determine the maximum profit.

Solution:

$$\text{Given price (P)} = 330 - x$$

$$\text{Cost (C)} = x^2 + 10x + 12$$

$$\text{Output} = x \geq 0$$

$$\text{Revenue (R)} = P_x = 330x - x^2$$

$$\begin{aligned} \text{Profit} = R - C &= 330x - x^2 - x^2 + 10x - 12 \\ &= 320x - 2x^2 - 12 \text{ (say } y) \end{aligned}$$

In order that maximum profit is attained

$$\frac{dy}{dx} = 0, \text{ and}$$

$$\frac{d^2y}{dx^2} = \text{Positive}$$

$$\frac{dy}{dx} = 320 - 4x = 0$$

$$\Rightarrow -4x = -320$$

$$x = 80$$

$$\frac{d^2y}{dx^2} = -4, \text{ which is negative.}$$

Therefore profit is maximum at $x = 80$ units

$$\begin{aligned} \text{Maximum profit} &= 320(80) - 2(80)^2 - 12 \\ &= 12,788 \end{aligned}$$

ILLUSTRATION: 18

The efficiency (E) of a small manufacturing concern depends on the number of workers (W) and is given by $10E = \frac{-W^3}{40} + 30W - 392$, find the strength of the worker, which give maximum efficiency.



Solution:

$$\text{Given } 10E = \frac{-W^3}{40} + 30W - 392$$

$$\text{Efficiency (E)} = \frac{-W^3}{400} + 3W - \frac{392}{10}$$

$$\frac{de}{dw} = -\frac{1}{400} \times 3W^2 + 3 = 0$$

$$\Rightarrow 3W^2 = 1200$$

$$\Rightarrow W^2 = 400$$

$$\Rightarrow W = 20$$

$$\frac{d^2E}{dw^2} = -\frac{6w}{400}$$

$$\therefore \frac{d^2e}{dw^2} \text{ at } w = 20 = \frac{-6(20)}{400} = \frac{-6}{20} < 0$$

\therefore Maximum efficiency at $w = 20$.

ILLUSTRATION: 19

A firm assumes a cost function $c(x) = x \left(\frac{x^2}{10} + 200 \right)$, x is a monthly output in thousands of units. Its revenue function is given by $R(x) = \left(\frac{2200 - 3x}{2} \right) x$ Find i) If the firm decides to produce 10,000 units per month, the firm's cost and Marginal cost. ii) If the firm decides to produce Marginal cost of 320, the level of output per month, and cost of the firm. iii) The marginal revenue function. iv) If a decision is taken to produce 10,000 units each month, the total revenue and marginal revenue of the firm. v) If the firm produces with a marginal revenue of 1040, the firm's monthly output and monthly revenue. vi) The firm's profit function and marginal profit function. vii) The output required per month to make the marginal profit = 0, and find the profit at this level of output. viii) Find the marginal revenue and the marginal cost at the output obtained in (ix) above comment upon the result.

Solution:

$$C = x \left(\frac{x^2}{10} + 200 \right) = \frac{x^3}{10} + 200x$$

$X =$ '000 units p.m.

$$R = \left(\frac{2200 - 3x}{2} \right) x = \frac{2200x - 3x^2}{2}$$

i) if firm's output – 10,000 units per month.

$$\text{Cost} = 10 \left(\frac{100}{10} + 200 \right) = 2,100$$

$$MC = \frac{dc}{dx} = \frac{3x^2}{10} + 200$$

$$\text{Marginal Cost (at } x = 10) = \frac{3(100)}{10} + 200 = 230$$

ii) i.e., $MC = 320$

$$\frac{3x^2}{10} + 200 = 320$$

$$3x^2 + 2000 = 3,200$$

$$3x^2 = 1200$$

$$x^2 = 400$$

$$\therefore \sqrt{400} = 20$$

$$\therefore \text{Total cost} = \frac{20 \cdot 20 \cdot 20}{10} + 200 \times 20 = 4,800$$

iii) Marginal Revenue

$$= MR = \frac{dr}{dx} = \frac{2200}{2} - \frac{6x}{2}$$

$$= 1100 - 3x$$

iv) Total revenue at $x = 10$

$$\text{is } \frac{2200 \times 10 - 3(100)}{2} = \frac{22000 - 300}{2} = \frac{21700}{2}$$

$$= 10850$$

$$\text{Marginal Revenue} = 1100 - 3 \times 10 = 1070$$

v) Given, $MR = 1040$

$$\text{i.e. } 1100 - 3x = 1040$$

$$-3x = -60$$

$$x = 20$$

$$\text{Monthly Revenue} = \frac{2200 \times 20}{2} - \frac{3 \times 400}{2}$$

$$= 22000 - 600 = 21400$$

vi) Profit = $R - C = \frac{2200x}{2} - \frac{3x^2}{2} - \frac{x^3}{2} - 200x$

$$\text{Marginal Profit} = \frac{-x^3}{10} - \frac{3x^2}{2} + 900x \text{ (say } p)$$

$$= \frac{dp}{dx} = \frac{3x^2}{2} - \frac{6x}{2} + 900$$

vii) $MP = 0$ (given)

$$\frac{-3x^3}{2} - 3x + 900 = 0$$

$$\Rightarrow -3x^2 - 30x + 9000 = 0$$

$$x^2 + 10x - 3000 = 0$$

$$x^2 + 60x - 50x - 3000 = 0$$

$$x(x + 60) - 50(x + 60) = 0$$

$$x(x - 50)(x + 60) = 0$$

$$\therefore x = 50 \text{ or } x = -60$$

$$\text{Profit} = R - C = \frac{2200x}{2} - \frac{3x^2}{2} - \frac{x^3}{2} - 200x$$

$$\text{Profit, at output } x = 50$$

$$= 28750$$

viii) Marginal cost at $x = 50$

$$= \frac{3x^2}{2} + 200 = \frac{3(2500)}{2} + 200 = 950$$

$$\text{Marginal Revenue} = \text{at } x = 50$$

$$1100 - 3x = 1100 - 3 \times 50 = 950$$

Profit will be maximum at $MC = MR$



ILLUSTRATION: 20

A radio manufacturer produces 'x' sets per week at total cost of ₹ $x^2 + 78x + 2500$. He is a monopolist and the demand function for his product is $x = \frac{(600 - P)}{8}$, when the price is 'p' per set show that maximum net revenue is obtained when 29 sets are produced per week what is the monopoly price.

Solution:

$$\text{Cost (C)} = x^2 + 78x + 2500$$

$$\text{Demand (D)} \quad X = (600 - P) / 8$$

$$8x = 600 - P$$

$$\therefore P = 600 - 8x^2$$

Total Revenue per 'x' sets

$$\text{Price } x \text{ i.e., } 600x - 8x^2$$

Maximum revenue is obtains at $MC = MR$

$$\text{Marginal Cost} = \frac{dc}{dx} = 2x + 78 - \text{(i)}$$

$$\text{Marginal Revenue} = \frac{dr}{dx} = 600 - 16x - \text{(ii)}$$

Equity (i) & (ii)

$$2x + 78 = 600 - 16x$$

$$= 18x = 522$$

$$\therefore x = \frac{522}{18} = 29$$

Monopoly price $600 - 8x$

$$600 - 8 \times 29$$

$$= 600 - 232 = 368$$

ILLUSTRATION: 21

The demand function for a particular commodity is $y = 15 e^{-\frac{x}{5}}$, where 'y' is the price per unit and 'x' is the no. of units demanded, determine the price and quantity for which revenue is maximum.

Solution:

$$\text{Demand function } y = 15 e^{-\frac{x}{5}}$$

$$\text{Total Revenue } \text{®} = 15 \times e^{-\frac{x}{5}}$$

$$\text{In order that Revenue is maximum } \frac{dR}{dx} = 0$$

$$\text{And } \frac{d^2R}{dx^2} = \text{negative}$$

$$\frac{dR}{dx} = 15 \left(x \times e^{-\frac{x}{5}} \times \frac{1}{5} + e^{-\frac{x}{5}} \times 1 \right)$$

$$= 15 \left(e^{-\frac{x}{5}} - \frac{x e^{-\frac{x}{5}}}{dx} \right)$$

$$= 15 e^{-\frac{x}{5}} \left(1 - \frac{x}{5} \right) = 0$$

$$= 1 - \frac{x}{5} = 0$$

$$\text{i.e., } 1 - \frac{x}{5}$$

$$\therefore x = 5$$

$$\frac{d^2R}{dx^2} = 15 \left[\frac{x}{25} e^{-x/25} - \frac{e^{-x/5}}{5} - \frac{e^{-x/5}}{5} \right]$$

$$= 15 \left[\frac{x}{25} e^{-x/25} - \frac{2e^{-x/5}}{5} \right]$$

$$\therefore \frac{d^2R}{dx^2} \text{ at } x = 5 = 15 \left[\frac{1}{5e} - \frac{2}{5e} \right] = -ve$$

ILLUSTRATION: 22

$P = \frac{150}{q^2 + 2} - 4$ represents the demand function for a product where 'p' is the price per unit per 'q' units; determine the marginal revenue function.

Solution:

$$P = \frac{150}{q^2 + 2} - 4$$

$$\text{Revenue (R)} = \frac{150}{q^2 + 2} - 4q$$

$$\text{M.R} = \frac{dR}{dq} = \frac{q^2 + 2(150) - 150q \times 2q}{(q^2 + 2)^2} - 4$$

$$= \frac{150q^2 - 300 \times 300q^2}{(q^2 + 2)^2} - 4$$

ILLUSTRATION: 23

A manufacturer can sell 'x' items per month, at price $P = 300 - 2x$. Manufacturer's cost of production ₹ Y of 'x' items is given by $Y = 2x + 1000$. Find no. of items to be produced to yield maximum profit p.m.

Solution:

$$\text{Units} = x$$

$$\text{Price} = 300 - 2x$$

$$\text{Revenue (R)} = Px = 300x - 2x^2$$

$$\text{Cost (C)} = 2x + 1000$$

$$\text{Profit (z)} = 300x - 2x^2 - 2x - 1000$$

$$-2x^2 + 298x - 1000$$

$$\frac{dz}{dx} = -4x + 298 = 0$$

$$-4x = -298$$

$$x = \frac{298}{4} = 74.5$$

$$\frac{d^2z}{dx^2} = -4 \text{ which is Positive}$$

$$\frac{d^2z}{dx^2} = <0$$

Profit is maximum at $x = 74.5$ units

ILLUSTRATION: 24

The price (P) per unit at which company can sell all that it produces is given by the function $P(x) = 300 - 4x$. The cost function is $500 + 28x$, where 'x' is the number of units, find x, so that profit is maximum.



Solution:

$$P = 300 - 4x$$

$$R = P(x) = 300x - 4x^2$$

$$C = 500 + 28x$$

$$P = R - C$$

$$\text{Profit} = 300x - 4x^2 - 500 - 28x$$

$$= -4x^2 + 272x - 500$$

$$\frac{dz}{dx} = -8x + 272 = 0$$

$$-8x = -272$$

$$x = \frac{272}{8} = 34$$

$$\frac{d^2z}{dx^2} = -8, \text{ which is Negative}$$

Profit is maximum at $x = 34$ units.

ILLUSTRATION: 25

If 'n' be the no. of workers employed the average cost of production is given by

$$C = 24n + \left[\frac{3}{2(n-4)} \right] \text{ Show that } n = 4\frac{1}{4} \text{ will make } C \text{ minimum.}$$

Solution:

$$C = 24n + \left[\frac{3}{2(n-4)} \right] = 24n + (n-4)^{-1}$$

$$\frac{dc}{dn} = 24 + \frac{3}{2} \times -1 \times (n-4)^{-2} = 0$$

$$24 - \frac{3}{2} (n-4)^{-2} = 0$$

$$(n-4)^{-2} = 16$$

$$\frac{1}{(n-4)^2} = 16$$

$$(n-4)^2 \cdot 16 = 1$$

$$(n-4)^2 = \frac{1}{16}$$

$$n-4 = \frac{1}{4}$$

$$n = \frac{1}{4} + 4 = 4\frac{1}{4}$$

$$\frac{d^2c}{dx^2} = 0 + \frac{-3}{2} \times -2 (n-4)^{-3}$$

$$= 3 (n-4)^{-3}$$

$$= 3 \left(\frac{17}{4} - 4 \right)^{-3}$$

$$= \frac{1}{\left(\frac{1}{4} \right)^3} \text{ which is Positive}$$

Hence condition is satisfied and cost will be minimum at $n = 4\frac{1}{4}$.

ILLUSTRATION: 26

A firm has revenue function given by $R = 8D$, where R = Gross Revenue and D = Quantity sold, production cost function is given by $C = 15000 + 60 \left(\frac{D}{900}\right)^2$. Find the total profit function and the number of units to be sold to get the maximum profit.

Solution:

$$R = 8D$$

$$C = 15000 + 60 \left(\frac{D}{900}\right)^2$$

$$\text{Profit} = 8D - 15000 - 60 \left(\frac{D}{900}\right)^2$$

To find number of units to get the maximum profit

$$\frac{dp}{dD} = 0 \text{ and } \frac{d^2p}{dD^2} \text{ should be } -ve$$

$$\Rightarrow \frac{dp}{dD} = 8 - \frac{60 \cdot 2D}{810000} = 0$$

$$\Rightarrow 8 - \frac{120D}{810000} = 0$$

$$\Rightarrow 8 - \frac{120D}{810000} = 0$$

$$\therefore D = \frac{27000 \times 8}{4} = 54000$$

$$\frac{d^2p}{dD^2} = \frac{-4}{27000} \text{ which is } -ve$$

P is maximum at $D = 54,000$.

ILLUSTRATION: 27

The total cost function of a firm $C = \frac{x^3}{3} - 5x^2 + 28x + 10$, where C is total cost and ' x ' is the output. A tax @ ₹2/- per unit of output is imposed and the producer adds it to his cost. If the demand function is given by $P = 2530 - 5x$, where ₹' P ' is the price per unit of output, Find the profit maximising output and the price at the level.

Solution:

$$\text{Given (C)} = \frac{x^3}{3} - 5x^2 + 28x + 10 + 2x$$

$$P = 2530 - 5x$$

$$\text{Revenue} = xp = 2530x - 5x^2$$

$$\text{Profit} = 2530x - 5x^2 + 5x^2 - 28x - 10 - \frac{x^3}{3} - 2x$$

$$= -\frac{x^3}{3} - 2502x - 10 - 2x$$

$$\frac{dp}{dx} = \frac{-3x^2}{3} - 2500$$

$$X^2 = 2500$$

$$\therefore x = \sqrt{2500} = 50$$

$$\frac{dp^2}{dx^2} = -2, \text{ which is Negative}$$

\therefore Maximum profit is at $x = 50$ units

$$\text{Price } 2530 - 5 \times 50 = 2280$$



ILLUSTRATION: 28

Find the Elasticity of Demand for the following:

i. $P = \frac{10}{(x+2)^2}$

ii. $P = \frac{4}{(2x+1)^2}$

iii. $x \cdot p^n = K$, where n, k are constant.

Solution:

(i) $P = \frac{10}{(x+2)^2} = 10(x+2)^{-2}$

Differentiating w.r.to x

$$= \frac{dP}{dD} = 10(-2)(x+2)^{-3} = -20(x+2)^{-3}$$

$$\frac{P}{x} = \frac{10}{x(x+2)^2}$$

$$\text{Elasticity of demand } (E_p) = \frac{dx}{dP} \div \frac{x}{P} = - \left| \frac{dx}{dP} \times \frac{P}{x} \right|$$

$$\frac{dx}{dP} = \frac{1}{20(x+2)^{-2}} = \frac{(x+2)^3}{20}$$

$$\begin{aligned} \frac{dx}{dP} \times \frac{P}{x} &= \frac{(x+2)^3}{20} \times \frac{1}{x(x+2)^2} \\ &= \frac{-(x+2)}{2x} \end{aligned}$$

ii) $P = \frac{4}{(2x+1)^2} = 4(2x+1)^{-2}$

$$\frac{dP}{dx} = 4 \times -2 \times (2x+1)^{-3} = -8(2x+1)^{-3}$$

$$\begin{aligned} \frac{dx}{dP} &= -\frac{1}{8(2x+1)^3} = -\frac{1}{8}(2x+1)^3 = \frac{(2x+1)^3}{8} \\ &= \frac{P}{x} = \frac{4}{x(2x+1)^2} \end{aligned}$$

$$\text{Elasticity of demand } (E_p) = \frac{(2x+1)^3}{8} \times \frac{4}{x(2x+1)^2} = \frac{(2x+1)}{8}$$

iii) $x \times p^n = k$

$$\begin{aligned} x &= \frac{k}{p^n} \\ \frac{x}{p} &= \frac{k}{p^n \times p} = \frac{k}{p^{n+1}} \end{aligned}$$

Differentiating w.r.to x .

$$x \times n.p^{n-1} + p^n \cdot 1 = 0$$

$$\frac{dP}{dx} \cdot xnp^{n-1} + p^n = 0$$

$$= \frac{dP}{dx} \cdot xnp^{n-1} - p^n$$

$$\frac{dx}{dP} = \frac{-pn}{x.n.p^{n-1}} = \frac{-p}{xn}$$

$$\frac{dx}{dP} = \frac{xn}{p}$$

$$\frac{P}{x} = \frac{p^{n+1}}{k}$$

$$E_p = \frac{xn}{p} \times \frac{p^{n+1}}{k}$$

$$= \frac{xn p^n}{k}$$

ILLUSTRATION: 29

The Demand curve for x is given by the equation $P = 24 - \frac{1}{2} \sqrt{q}$, where P and q denote price and quantity respectively. Find the point price elasticity for $P = ₹12/-$.

Solution:

$$\text{Demand } P = 24 - \frac{1}{2} \sqrt{q}$$

$$\frac{dp}{dq} = \frac{1}{2} \times \frac{1}{2\sqrt{q}} = \frac{1}{4\sqrt{q}}$$

$$\frac{dp}{dq} = -4\sqrt{q}$$

$$\begin{aligned} \frac{24}{q} - 2\sqrt{q} &= \frac{(24 - 2\sqrt{q})}{q} = \frac{4(24 - 2\sqrt{64})}{\sqrt{64}} \\ &= \frac{4(24 - 16)}{8} = \frac{8}{2} = 4 \end{aligned}$$

$$EP = \frac{dx}{dp} \times \frac{p}{q} = \frac{-4\sqrt{q}(24 - 2\sqrt{q})}{\sqrt{64}}$$

$$P - 24 = -\frac{1}{2} \sqrt{q}$$

$$= -2(p - 24) = \sqrt{q}$$

$$= -2(12 - 24) = \sqrt{q}$$

$$= -24 + 48 = \sqrt{q}$$

$$\sqrt{q} = 24$$

$$\therefore q = 576$$

ILLUSTRATION: 30

The Demand function is $x = 100 + 4p + 10p^2$, where x is demand for the commodity at price 'p' compute marginal quantity demand, average quantity demand and hence elasticity of demand. At $p = 4$

Solution:

$$X = 100 + 4p + 10P^2$$

$$\text{Marginal quantity demand} = \frac{dx}{dq}$$

$$\frac{dx}{dq} = 4 + 20P \rightarrow (1)$$

$$\text{Average Quantity demand} = \frac{x}{p} = \frac{100}{p} + 4 + 10p \rightarrow (2)$$

$$E_p = \frac{dx}{dq} \times \frac{x}{p} = \frac{4 + 20p}{\frac{100}{p} + 10p + 4} = \frac{(4 - 20p)p}{100 + 10p^2 + 4p}$$

$$\text{at } P = 4$$

$$= \frac{(4 - 80)4}{100 + 160 + 16} = \frac{28}{23}$$

ILLUSTRATION: 31

Find an expression for price elasticity in the case of following demand functions and evaluate it at the price $P = 20$

i. $12Q + 7P = 216$



ii. $Q = 2500 - 8P - 2P^2$

iii. $Q = \frac{64}{p^6}$

iv. $Q = \frac{5p}{(1-3p)^2}$

Solution:

i) $7P = 216 - 12Q$

$$P = \frac{216-12Q}{7} = \frac{1}{7} (216 - 12Q)$$

$$\frac{dp}{dQ} = \frac{1}{7} \times -12 = \frac{-12}{7} = \frac{dp}{dQ} = \frac{-7}{12}$$

$$\frac{p}{Q} = \frac{1}{7} \left(\frac{216}{Q} - 12 \right)$$

$$E_p = \left[\frac{-7}{12} \times \left(\frac{216}{Q} - 12 \right) \right]$$

$$E_p = \left[\frac{-1}{12} \times \left(\frac{216-Q}{Q} \right) \right]$$

$$12Q = 216 - (7 \times 20) = 216 - 140 = 76$$

$$Q = \frac{76}{12} = 6 \frac{1}{3}$$

$$E_p = \text{at } P = 20$$

$$E_p = \frac{1}{12} \left[\frac{216 - 12 \times \frac{76}{12}}{\frac{76}{12}} \right]$$

$$= \frac{1}{12} \left(\frac{140 \times 12}{76} \right) \frac{140}{76} = \frac{1.8}{19}$$

ii) $Q = 2,500 - 8p - 2p^2$

$$\frac{dQ}{dp} \text{ at } p=20 = -8 - 4p = -8 - 80 = -88$$

$$\frac{Q}{p} = \frac{2500}{p} - 8 - 2P$$

$$= 125 - 8 - 40 = 77$$

$$\frac{Q}{p} = \frac{1}{77}$$

$$E_p = 88 \times \frac{1}{77} = \frac{8}{7}$$

iii) $Q = \frac{64}{p^6} \quad \frac{dQ}{dp} = \frac{64 \times -6}{p^7}$

$$\frac{Q}{p} = \frac{64}{p^7} \Rightarrow \frac{p}{Q} = \frac{p^7}{64}$$

$$E_p = \frac{64 \times 6}{p^7} \times \frac{p^7}{64} = 6$$

iv) $Q = \frac{5p}{(1-3p)^2}$

$$\frac{dQ}{dp} = \frac{(1-3P)^2 \cdot 5 - 5P \times 2(1-3P) \cdot -3}{(1-3P)^4}$$

$$\frac{5(1-3P)^2 + 30P(1-3P)}{(1-3P)^4} = \frac{5(1-3P) + 30P}{(1-3P)^3}$$

$$\frac{Q}{P} = \frac{5}{(1-3P)^2} = \frac{P}{Q} = \frac{(1-3P)^2}{5}$$

$$E_p = \frac{5(1-3P) + 30P}{(1-3P)^3} \times \frac{(1-3P)^2}{5}$$

$$= \frac{5 - 15P + 30P}{5(1-3P)} = \frac{1 - 3P + 6P}{1 - 3P} = \frac{1 + 3P}{1 - 3P}$$

$$= \frac{1 + 60}{1 - 60} = \frac{61}{-59}$$

ILLUSTRATION: 32

The total revenue from sale of 'x' units is given by the equation $R = 100x - 2x^2$, calculate the point price elasticity of demand, when marginal revenue is 20.

Solution:

$$R = 100x - 2x^2$$

$$\text{Price} = 100 - 2x$$

$$MR = \frac{dR}{dx} = 100 - 4x$$

$$\frac{P}{x} = \frac{100}{x} - 2$$

$$\frac{dp}{dx} = -2 = \frac{dx}{dp} = \frac{1}{2}$$

$$E_p = \frac{1}{2} \times \left(\frac{100}{x} - 2 \right)$$

$$= \frac{50}{x} - 1$$

$$= \frac{50}{20} - 1$$

$$\frac{5}{2} - 1$$

$$\frac{5-2}{2} = \frac{3}{2}$$

$$100 - 4x = 20$$

$$4x = 80$$

$$X = 20$$

ILLUSTRATION: 33

Prove that the elasticity of demand for the following is constant $x = 3(p^{-2})$, Where P and X are the price & quantity demanded respectively.

Solution:

$$E_p = - \left| \frac{dx}{dp} \times \frac{P}{x} \right|$$

Differentiate w.r.to 'x'

$$\Rightarrow 1 = 3 (-2 \cdot p^{-3}) \frac{dp}{dx}$$

$$\Rightarrow 1 = -6p^{-3} \cdot \frac{dp}{dx}$$



$$\Rightarrow \frac{dp}{dx} = \frac{p^3}{6}$$

$$\therefore \frac{dx}{dp} = \frac{6}{p^3} \quad \text{– Equation (1)}$$

$$\text{Now } \frac{x}{p} = \frac{3}{p^3}$$

$$\Rightarrow \frac{p}{x} = \frac{p^3}{3} \quad \text{– Equation (2)}$$

From equations (1) & (2)

$$\therefore E_p \frac{dx}{dp} = \frac{p}{x}$$

$$= \frac{6}{p^3} \times \frac{p^3}{6}$$

$$= 2 \text{ (proved)}$$

ILLUSTRATION: 34

The total cost (C) and the total revenue (R) of a firm are given $C(x) = x^3 + 60x^2 + 8x$; $R(x) = 3x^3 - 3x^2 + 656x$, x being output determine, the output for which the firm gets maximum profit. Also obtain the maximum profit.

Solution:

$$C = x^3 + 60x^2 + 8x$$

$$R = 3x^3 - 3x^2 + 656x$$

$$\text{Profit} = 3x^3 - 3x^2 + 656x - x^3 - 60x^2 - 8x$$

$$= 2x^3 - 63x^2 + 648x = (p)$$

Derivative w.r.to x

$$\frac{dp}{dx} = 6x^2 - 126x + 648 = 0$$

$$x^2 - 21x + 108 = 0$$

$$x^2 - 9x - 12x + 108 = 0$$

$$x(x - 9) - 12(x - 9) = 0$$

$$(x - 12)(x - 9) = 0 \quad x = 12 \text{ or } 9$$

$$\frac{d^2p}{dx^2} = 2x - 21$$

$$\text{at } x = 9$$

$$\frac{d^2p}{dx^2} = 18 - 21 = -3 < 0$$

\therefore P is maximum at $x = 9$

$$\text{at } x = 12$$

$$\frac{d^2p}{dx^2} = 24 - 21 = 3 > 0$$

\therefore P is minimum at $x = 12$

$$P = 2x^3 - 63x^2 + 648x$$

$$\text{at } x = 9$$

$$\text{Profit } P = 2(9)^3 - 63(9)^2 + 648(9)$$

$$7292 - 63 \times 81 - 648 \times 9 = 2187$$

ILLUSTRATION: 35

A monopolist has demand curve $x = 106 - 2p$ and average cost curve $(AC) = 5 + x/50$. The total revenue is $(R) = xp$, determine the most profitable output and maximum profit.

Solution:

$$x = 106 - 2p \Rightarrow x - 106 = -2p$$

$$P = \frac{x - 106}{-2} = \frac{106 - x}{2}$$

$$R = \frac{106x - x^2}{2}$$

$$\text{Total Cost} = 5x + \frac{x^2}{50}$$

$$\text{Profit} = \frac{106x - x^2}{2} - 5x - \frac{x^2}{50}$$

$$\frac{dp}{dx} = \frac{(106x - 2x)}{2} - 5 - \frac{2x}{50} = 0$$

$$\frac{dp}{dx} = 53 - x - 5 - \frac{2x}{50} = 0$$

$$48 = x \left(1 + \frac{1}{25}\right)$$

$$X = \frac{1200}{26}$$

$$\frac{d^2p}{dx^2} = \frac{-26}{25} < 0$$

$$\therefore P \text{ is maximum at } x = \frac{1200}{26}$$

ILLUSTRATION: 36

The total cost function of a manufacturing firm is given by $C = 2x^3 - x^2 + 3x + 5$ and the Marginal Revenue = $8 - 3x$, X = output, determine the most profitable output of the firm.

Solution:

$$C = 2x^3 - x^2 + 3x + 5$$

$$\text{M.R.} = 8 - 3x$$

$$\text{M.C} = \frac{dc}{dx} = 6x^2 - 2x + 3$$

Profit maximum at $MC = MR$

$$6x^2 - 2x + 3 = 8 - 3x$$

$$6x^2 + x - 5 = 0$$

$$6x^2 + 6x - 5x - 5 = 0$$

$$6x(x + 1) - 5(x + 1) = 0$$

$$(x + 1)(6x - 5) = 0$$

$$X = -1, 6x - 5 = 0$$

$$x = \frac{5}{6}$$

ILLUSTRATION: 37

A company is planning to market a new model of a doll. Rather than setting the selling price of the doll based only on production cost estimation management polls the retailers of the doll to see



how many dolls they will buy for various prices. From this survey, it is determined at the unit demand function (the relationship between the amount 'x' each retailer would buy and the price he would pay) is $x = 30,000 - 1500P$. The fixed cost of the production of the dolls are found to be ₹28,000/- and cost of Material & labour to produce each doll is estimated to be ₹ 8/-per unit. What price should the company charge retailer in order to obtain a maximum profit? Also find the maximum profit.

Solution:

$$x = 30000 - 1500P$$

$$x - 30000 = -1500P$$

$$\therefore P = \frac{30000 - x}{1500}$$

$$\text{Revenue} = \frac{30000x - x^2}{1500}$$

$$C = 8x + 28000$$

$$\text{Profit} = \frac{30000x - x^2}{1500} - 8x - 28000$$

$$\frac{dc}{dx} = \frac{1}{1500} (30000 - 2x) - 8 = 0$$

$$= 30000 - 2x - 12000 = 0$$

$$-2x = -18000$$

$$x = \frac{18000}{2} = 9000$$

$$\frac{d^2p}{dx^2} = -2, \text{ which is Negative}$$

$$= \frac{30000 \times 9000 - 9000^2}{1500} - 72,000 - 28000$$

$$180000 - \frac{810000}{15} - 72,000 - 28000$$

ILLUSTRATION: 38

Assume that for a closed economy $E = C + I + G$; Where E= total expenditure on consumption goods, I = Exp. on Investment goods and G = Govt. Spending. For equilibrium, we must have $E = Y$, Y being total income received.

For a certain Economy, it is given that $C = 15 + 0.9Y$, where $I = 20 + 0.05Y$ and $G = 25$. Find the equilibrium values of Y, C and I. How will these change, if there is no Government spending.

Solution:

$$E = 15 + .9Y + 20 + .05Y + 25$$

$$E = 60 + .95Y = (1)$$

$$\text{As given } E = Y = 60 + .95Y$$

$$0.05Y = 60$$

$$\therefore Y = \frac{60}{.05} = 1200$$

$$C = 15 + 0.9 \times 1200 = 1095$$

$$I = 20 + 0.05 \times 1200 = 80$$

When there is no government spending.

$$\begin{aligned}
 Y &= 35 + .95Y \\
 &= .05Y = 35 \\
 \therefore Y &= \frac{35}{.05} = 700 \\
 C &= 15 + 630 = 645 \\
 I &= 20 + 35 = 55
 \end{aligned}$$

ILLUSTRATION: 39

A demand function of an item is $P = 8/(x+1) - 2$ and supply function is $P = (x+3)/2$, determine the equilibrium price and consumer's surplus.

Solution:

$$\begin{aligned}
 \text{Equilibrium price} &= \text{Demand} = \text{Supply} \\
 &= \frac{8}{x+1} - 2 = \frac{x+3}{2} \\
 &= \frac{8-2(x+1)}{x+1} = \frac{x+3}{2} \\
 &= (8-2x-2)2 = (x+3)(x+1) \\
 16 - 4x - 4 &= x^2 + 4x + 3 \\
 -x^2 - 8x + 9 &= 0 \\
 x^2 + 8x - 9 &= 0 \\
 x^2 - x + 9x - 9 &= 0 \\
 x(x-1) + 9(x-1) &= 0 \\
 (x-1)(x+9) &= 0 \\
 x = 1, x = -9 \\
 \text{Price} &= \frac{1+3}{2} = \frac{4}{2} = 2 \\
 \text{Consumer's surplus} &= \int_0^1 \left(\frac{8}{x+1} - 2 \right) dx - 2 \times 1 \\
 &= \int_2^4 [8 \log(x+1) - 2x] - 2 \\
 &= [8 \cdot \log 2 - 2] - 2 \\
 &= 8 \log 2 - 4
 \end{aligned}$$

ILLUSTRATION: 40

The demand function for a particular brand of pocket calculator is stated below, $P = 75 - 0.3Q - 0.05Q^2$, Find the consumer's surplus at a quantity of 15 calculators.

Solution:

$$\begin{aligned}
 \text{Price} &= 75 - 0.30 \cdot 15 - 0.05 (15^2) \\
 &= 75 - 4.5 - 0.5 \cdot 225 \\
 &= 75 - 15.75 = 59.25 \\
 \text{Consumer's surplus} &= \int_0^{15} (75 - 0.3Q - 0.05Q^2) dQ - (59.25 \times 15) \\
 &= \int_0^{15} \left(75Q - \frac{0.3Q^2}{2} - \frac{0.5Q^2}{2} \right) - (59.75 \times 15)
 \end{aligned}$$



$$\begin{aligned} &= [(1125 - 33.75 - 56.25) - 0] - 888.75 \\ &= 1035 - 888.75 \\ &= 146.25 \end{aligned}$$

ILLUSTRATION: 41

The demand and supply function under perfect competition are $Y = 16 - x^2$ and $Y = 2(x^2 + 2)$ respectively. Find the market price, consumer's surplus and producer's surplus.

Solution:

Under perfect competition market price is: demand = supply i.e.

$$16 - x^2 - 2x^2 - 4 = 0$$

$$-3x^2 + 12 = 0$$

$$-3x^2 = -12$$

$$\therefore x^2 = 12/3$$

$$x = \sqrt{\frac{12}{3}} = 2 \text{ units}$$

Consumer's surplus =

$$= \int_0^2 (16 - x^2) dx - (12 \times 2)$$

$$= \int_0^2 \left(16x - \frac{x^3}{3}\right)$$

$$= 32 - \frac{8}{3} - 24$$

$$= 5 \frac{1}{3}$$

Producer's surplus =

$$= 2 \times 12 \int_0^2 2(x^2 + 2) dx$$

$$= 24 - \int_0^2 \left(\frac{2x^3}{3} + 4x\right)$$

$$= 32 - \frac{16}{3} - 8 - 0$$

$$= 32 - \frac{16}{3}$$

$$= 26 \frac{2}{3}$$

ILLUSTRATION: 42

The demand function is $Y = 85 - 4x - x^2$, 'y' is the price and 'x' is the quantity demand. Find the consumer's surplus for $Y = 64$.

Solution:

$$\text{Quantity is } 85 - 4x - x^2 = 64$$

$$\Rightarrow -x^2 - 4x + 21 = 0$$

$$\Rightarrow x^2 + 4x - 21 = 0$$

$$\Rightarrow x^2 + 7x - 3x - 21 = 0$$

$$\Rightarrow x(x + 7) - 3(x + 7) = 0$$

$$\Rightarrow (x - 3)(x + 7) = 0$$

$\therefore x = 3$ or $x = -7$, not acceptable

Consumer's surplus =

$$= \int_0^3 (85 - 4x - x^2) dx - (3 \times 64)$$

$$= \left[85x - \frac{4x^2}{2} - \frac{x^3}{3} \right]_0^3 - 192$$

$$= 255 - 18 - 9 - 192$$

$$= 36$$

ILLUSTRATION: 43

Find whether the following commodities are complementary or competitive (or) substitutes, where P_1 , P_2 and X_1 , X_2 are prices and quantities respectively of the two commodities.

i. $x_1 = P_1^{-1.7} \cdot P_2^{0.8}$; $x_2 = P_1^{0.5} \cdot P_2^{-2}$

ii. $x_1 = \frac{4x^3}{P_1^2 P_2}$; $x_2 = \frac{16}{P_1 P_2^2}$

iii. $x_1 = P_1^{-8} \cdot P_2^{1.2}$; $x_2 = P_1^{0.2} \cdot P_2^{0.6}$

iv. $x_1 = P_1^{-1.1} \cdot P_2^{0.3}$; $x_2 = P_1^{0.2} \cdot P_2^{0.6}$

v. $x_1 = 1 - 2P_1 + P_2$; $x_2 = 5 - 2P_1 - 3P_2$

vi. $x_1 = \frac{P_2^{0.6}}{P_1^{1.5}}$; $x_2 = \frac{P_1^{0.1}}{P_2^{0.1}}$

Solution:

(i) $x_1 = P_1^{-1.7} \cdot P_2^{0.8}$; $x_2 = P_1^{0.5} \cdot P_2^{-2}$

Differentiate partially x_1 w.r.to p_2

$$\begin{aligned} \frac{\partial x_1}{\partial p_2} &= P_1^{-1.7} (0.8) P_2^{0.2} \\ &= \frac{0.8}{P_1^{1.7} \times P_2^{0.2}} \quad \text{which is greater than zero} \end{aligned}$$

Again differentiating partially x_2 w.r.to p_1

$$\begin{aligned} \frac{\partial x_2}{\partial p_1} &= P_1^{-1.7} (0.5) P_1^{-0.5} \\ &= \frac{0.5}{P_2^{0.2} \cdot P_1^{0.5}} \quad \text{which is greater than zero} \end{aligned}$$

Hence the commodities are substitutes.

(ii) $x_1 = \frac{4x^3}{P_1^2 P_2}$; $x_2 = \frac{16}{P_1 P_2^2}$

Partially differentiating x_1 w.r.to p_2

$$\frac{\partial x_1}{\partial p_2} = P_1^{-1.7} = \frac{-4}{P_1^2 \cdot P_2^2} \quad \text{which is less than zero}$$

Again partially differentiating x_2 w.r.to p_1

$$\frac{\partial x_2}{\partial p_1} = P_1^{-1.7} = \frac{-16}{P_1^2 \cdot P_2^2} \quad \text{which is also less than zero}$$



Therefore, commodities are complementary.

$$(iii) \quad x_1 = P_1^{-0.8} \cdot P_2^{1.2}; \quad x_2 = P_1^{0.2} \cdot P_2^{0.6}$$

Differentiating partially x_1 w.r.to p_2

$$\frac{\partial x_1}{\partial p_2} = P_1^{-0.8} (1.2) P_2^{-0.4} \quad \text{which is greater than zero}$$

Similarly differentiating partially x_2 w.r.to p_1

$$\begin{aligned} \frac{\partial x_2}{\partial p_1} &= P_2^{0.6} (0.2) P_1^{-0.8} \\ &= \frac{(0.2) P_2^{0.6}}{P_1^{0.8}} \quad \text{which is greater than zero} \end{aligned}$$

Therefore the commodities are substitutes.

$$(iv) \quad x_1 = P_1^{-1.1} \cdot P_2^{0.3}; \quad x_2 = P_1^{0.2} \cdot P_2^{0.6}$$

Differentiate partially x_1 w.r.to p_2

$$\frac{\partial x_1}{\partial p_2} = \frac{P_1^{-1.1} (0.3)}{P_2^{0.7}} = \frac{(0.3)}{P_1^{1.1} \cdot P_2^{0.7}} \quad \text{which is greater than zero.}$$

Similarly differentiate partially x_2 w.r.to p_1

$$\frac{\partial x_2}{\partial p_1} = P_2^{0.6} (0.2) P_1^{-0.8} = \frac{(0.2) P_2^{0.6}}{P_1^{0.8}} \quad \text{which is also greater than zero.}$$

Therefore, the commodities are substitutes.

$$(v) \quad x_1 = 1 - 2P_1 + P_2; \quad x_2 = 5 - 2P_1 - 3P_2$$

Differentiating partially x_1 w.r.to p_2

$$\frac{\partial x_1}{\partial p_2} = 1, \quad \text{which is greater than zero.}$$

Similarly, differentiating partially x_2 w.r.to p_1

$$\frac{\partial x_2}{\partial p_1} = -2, \quad \text{which is less than zero.}$$

Therefore, the relationship between the commodities cannot be established.

$$(vi) \quad x_1 = \frac{P_2^{0.6}}{P_1^{1.5}}; \quad x_2 = \frac{P_1^{0.1}}{P_2^{0.1}}$$

Differentiating partially x_1 w.r.to p_2

$$\begin{aligned} \frac{\partial x_1}{\partial p_2} &= \frac{1}{P_1^{1.5}} (0.6) P_2^{-0.4} \\ &= \frac{(0.6)}{P_1^{1.5} \cdot P_2^{0.4}} \quad \text{which is greater than zero.} \end{aligned}$$

Similarly, differentiating partially x_2 w.r.to p_1

$$\begin{aligned} \frac{\partial x_2}{\partial p_1} &= \frac{1}{P_1^{0.1}} \cdot \frac{1}{P_1^{0.9}} \\ &= \frac{0.1}{P_2^{0.1} \cdot P_1^{0.9}} \quad \text{which is greater than zero.} \end{aligned}$$

Therefore, the commodities are substitutes.

LINEAR PROGRAMMING:

In practice linear programming has proved to be one of the most widely used technique of managerial decision making in business, industry and numerous other fields. Linear programming is extensively used to solve a variety of managerial problems. In each of these applications, the general objective is to find minimum cost, maximum profit in the time period under consideration. It is necessary to satisfy all demand requirements without violating any of the constraints. Few examples of industrial applications are as follows:

- (a) Product Mix-Problem.
- (b) Minimisation of cost.
- (c) Maximisation of profits.
- (d) Maximisation of revenue. etc.

Some of the illustrations are given here under to help the management for taking the above managerial decisions.

ILLUSTRATION: 44

Formulate Linear programming model for the following problem and solve the problem using simplex method.

A company sells two types of products, one is Super and the other is Delux. The Super contains 2 units of chemical A and 4 units of chemical B per jar and the Delux contains 3 units of each of the chemicals A and B per carton. The Super is sold for ₹3 per jar and the Delux is sold for ₹4 per carton. A customer requires at least 90 units of chemical A and at least 120 units of the chemical B for his business. How many of each type of Super should the customer purchase to minimize the cost while meeting his requirements?

	Products		Required Units
	Super	Delux	
Chemical A	2	3	90
Chemical B	4	3	120
Cost	3/-	4/-	

Let x_1 be the no. of liters of Super.

Let x_2 be the no. of kilograms of Delux.

Objective Function:

Min. $Z = 3x_1 + 4x_2$

Subject to constraints:

$2x_1 + 3x_2 \geq 90$

$4x_1 + 3x_2 \geq 120$

And $x_1, x_2 \geq 0$

$2x_1 + 3x_2 - x_3 + A_1 = 90$

$4x_1 + 3x_2 - x_4 + A_2 = 120$

ILLUSTRATION: 45

A Company produces the products P, Q and R from three raw materials A, B and C. One unit of product P requires 2 units of A and 3 units of B. A unit of product Q requires 2 units of B and 5 units of C and one unit of product R requires 3 units of A, 2 unit of B and 4 units of C. The Company has 8 units of material



A, 10 units of B and 15 units of C available to it. Profits/unit of products P, Q and R are ₹3, ₹5 and ₹4 respectively.

- Formulate the problem mathematically,
- How many units of each product should be produced to maximize profit?
- Write the Dual problem.

Solution:

Raw Materials	P	Q	R	Available units
A	2	-	3	8
B	3	2	2	10
C	-	5	4	15

Profits 3/- 5/- 4/-

Let x_1 be the no. of units of P

Let x_2 be the no. of units of Q

Let x_3 be the no. of units of R

Objective function: Max. $Z = 3x_1 + 5x_2 + 4x_3$

Subject to constraints:

$$2x_1 + 3x_2 \leq 8$$

$$3x_1 + 2x_2 + 2x_3 \leq 10$$

$$5x_2 + 4x_3 \leq 15$$

And $x_1, x_2, x_3 \geq 0$.

Primal

$$\text{Max. } Z = 3x_1 + 5x_2 + 4x_3$$

Subject to

$$2x_1 + 3x_2 \leq 8$$

$$3x_1 + 2x_2 + 2x_3 \leq 10$$

$$5x_2 + 4x_3 \leq 15$$

And $x_1, x_2, x_3 \geq 0$

Dual

$$\text{Min. } Z = 8y_1 + 10y_2 + 15y_3$$

Subject to

$$2y_1 + 3y_2 \geq 3$$

$$3y_1 + 2y_2 + 5y_3 \geq 5$$

$$2y_2 + 4y_3 \geq 4$$

And $y_1, y_2, y_3 \geq 0$

$$2x_1 + 3x_2 + S_1 = 8$$

$$3x_1 + 2x_2 + 2x_3 + S_2 = 10$$

$$5x_2 + 4x_3 + S_3 = 15$$

$$\text{Max } Z = 3x_1 + 5x_2 + 4x_3 + 0.S_1 + 0.S_2 + 0.S_3$$

ILLUSTRATION: 46

A Chemical Company produces two compounds A and B. The following table gives the units of ingredients C and D per kg of compounds A and B as well as minimum requirements of C and D and costs/kg of A and B. Using the simplex method, find the quantities of A and B which would give a supply of C and D at a minimum cost.

		Table Compound		Minimum requirement
		A	B	
Ingredient	C	1	2	80
	D	3	1	75
Cost per kg.		4	6	

Solution:

Let x_1 be the no. of units of A

Let x_2 be the no. of units of B

Objective function: $\text{Min. } Z = 4x_1 + 6x_2$

Subject to Constraints:

$$x_1 + 2x_2 \geq 80$$

$$3x_1 + x_2 \geq 75$$

And $x_1, x_2 \geq 0$

$$x_1 + 2x_2 - x_3 + A_1 = 80$$

$$3x_1 + x_2 - x_4 + A_2 = 75$$

$$\text{Max. } Z = 4x_1 + 6x_2 - 0.x_3 - 0.x_4 - M.A_1 - M.A_2$$

$$x_1, x_2, x_3, x_4, A_1, A_2 \geq 0.$$

ILLUSTRATION: 47

A company possesses two manufacturing plants each of which can produce three products X, Y and Z from a common raw material. However, the proportions in which the products are produced are different in each plant and so are the plant's operating costs per hour. Data on production per hour costs are given below, together with current orders on hand for each product.

	Product			Operating cost/ hour in ₹
	X	Y	Z	
Plant A	2	4	3	9
Plant B	4	3	2	10
Orders on hand	50	24	60	

You are required to use the simplex method to find the number of production hours needed to fulfill the orders on hand at minimum cost.

Interpret the main features of the final solution.

**Solution:**

Let a be no. of hours of plant A in use

Let β be no. of hours of plant B in use

Objective function: $\text{Min } Z = 9a + 10\beta$

Subject to constraints:

$$2a + 4\beta \geq 50$$

$$4a + 3\beta \geq 24$$

$$3a + 2\beta \geq 60$$

$$\text{And } a, \beta \geq 0$$

ILLUSTRATION: 48

Four Products A,B,C and D have ₹ 5, ₹ 7, ₹ 3 and ₹ 0 profitability respectively. First type of material (limited supply of 800 kgs.) is required by A,B,C and D at 4 kgs., 3 kgs, 3 kgs., 8 kgs, and 2 kgs. respectively per unit.

Second type of material has a limited supply of 300 kgs. And is for A,B,C and D at 1 kg, 2 kgs, 0 kgs, and 1 kg per unit. Supply of the other type of materials consumed is not limited. Machine hrs. available are 500 hours and the requirements are 8,5,0 and 4 hours for A,B,C and D each per unit.

Labour hours are limited to 900 hours and requirements are 3,2,1 and 5 hours for A,B,C and D respectively.

How should the firm approach so as to maximize its profitability? Formulate this as a linear programming problem. You are not required to solve the LPP.

Solution:

Let 'x' be the no. of units of product A

Let 'y' be the no. of units of product B

Let 'p' be the no. of units of product C

Let 'z' be the no. of units of product D

Objective function Maximize $Z = 5x + 7y + 3p + 9z$

	A	B	C	D	Supply in Kgs.
I type material	4	3	8	2	800
II type material	1	2	0	1	300
Machine	8	5	0	4	500
Labour	3	2	1	5	900
Profit	5	7	3	9	

Subject to constraints

$$4x + 3y + 8p + 2z \leq 800$$

$$x + 2y + 0 + z \leq 300$$

$$8x + 5y + 0 + 4z \leq 500$$

$$3x + 2y + p + 5z \leq 900 \text{ and}$$

$$x, y, p, z \geq 0.$$

Illustration 49

1. K Ltd. sells output in a perfectly competitive market. The average variable cost function K Ltd. is

$$AVC = 300 - 40Q + 2Q^2$$

K Ltd has an obligation to pay ₹ 500 irrespective of the output produced.

What is the price below which K Ltd. has to shut down its operation in the short run?

Solution:

A firm has to shut down its operation, if the price is less than average variable cost.

Under perfect competition

$$P = MR$$

i.e. Price is equal to marginal revenue. The firm will continue its operation under the short run so long as price is at least equal to average variable cost.

Thus the equilibrium price which the firm will shut down is the minimum AVC i.e. the average variable cost.

$$AVC = 300 - 40Q + 2Q^2$$

AVC is minimum where $\frac{d(AVC)}{dQ} = 0$

$$\text{i.e. } \frac{d(AVC)}{dQ} = -40 + 4Q = 0$$

i.e. $Q = 10$ units.

when the firm is producing 10 units,

$$\begin{aligned} AVC &= 300 - 40Q + 2Q^2 \\ &= 300 - 40(10) + 2(10)^2 \\ &= 300 - 400 + 200 = 100 \end{aligned}$$

If the price falls below ₹ 100 the firm has to shut down its operation under short run.

Illustration 50

J Ltd is operating in a perfectly competitive market. The price elasticity of demand and supply of the product estimated to be 3 and 2 respectively. The equilibrium price of the product is ₹ 100. If the government imposes a specific tax of ₹ 10 per unit, what will be the new equilibrium price?

Solution

Distribution of tax burden between buyers and sellers is in ratio of elasticity of supply to elasticity of demand.

Thus tax burden borne by the buyer = ₹ 10 × $\frac{2}{5}$ = ₹ 4.

if the tax burden borne by buyer is ₹ 4, new equilibrium price will be $100 + 4 = ₹ 104$

Illustration 51

The total cost function for a monopolist is given by

$$TC = 900 + 40Q^2$$

The demand function for the good produced by the monopolist is given by

$$2Q = 48 - 0.08P$$

What will be the profit maximising price

**Solution:**

demand function is given by

$$2Q = 48 - 0.08 P$$

$$\text{or, } 2Q - 48 = -0.08 P$$

$$\text{or, } 48 - 2Q = 0.08 P$$

$$\text{or, } P = 600 - 25Q$$

$$TR = PQ$$

$$= 600Q - 25Q^2$$

TC is given by ,

$$TC = 900 + 40 Q^2$$

The first order condition for profit maximisation is $MR = MC$

$$TR = 600Q - 25Q^2$$

$$MR = \frac{dTR}{dQ} = 600 - 50Q$$

$$MC = \frac{d(TC)}{dQ} = 80Q$$

For maximising profit

$$MR = MC$$

$$\text{i.e. } 600 - 50Q = 80Q$$

$$Q = \frac{600}{130} = 4.6 \text{ units}$$

Equilibrium Price =

$$P = 600 - 25 Q = 600 - 25(4.6)$$

$$= 600 - 115$$

$$= ₹ 485$$

i.e. profit maximising price is ₹ 485

Illustration 52

S Ltd a monopolist aims at profit maximisation. The fixed cost of the firm is ₹ 200 and the average variable cost of the firm is constant at ₹ 30 per unit. S Ltd sells goods in west bengal and Kerala . The estimated demand function for the goods in west bengal and Kerala are

$$P_w = 40 - 2.5 Q_w$$

$$P_k = 120 - 10 Q_k$$

If price discrimination is practiced by S Ltd. ,What will be the profit maximising output?

Solution:

When price discrimination is practiced profit maximising condition is

$$MR_w = MC \dots (1)$$

$$MR_k = MC \dots\dots (2)$$

Now, $P_w = 40 - 2.5 Q_w$

$$TR_w = 40 Q_w - 2.5 Q_w^2$$

$$MR_w = 40 - 5Q_w$$

and $P_k = 120 - 10 Q_k$

$$TR_k = 120Q_k - 10Q_k^2$$

$$MR_k = 120 - 20 Q_k$$

Since average variable cost is constant at ₹ 30 per unit ,then

$$MC = 30$$

$$40 - 5Q_w = 30$$

$$Q_w = 2 \text{ units}$$

$$\& 120 - 20 Q_k = 30$$

i.e. $Q_k = \frac{90}{20} = 4.5 \text{ units}$

Thus profit maximising output in west bengal will be 2 units and in kerala will be 4.5 units.

Thus profit maximising output for the monopolist = 2 + 4.5 = 6.5 units.

Illustration 53

The total cost function of a monopolist is given by

$$C = 50 + 40x = 50 + 40 (x_1 + x_2)$$

The total demand is given by

$$P = 100 - 2x$$

The demand function of the segmented market are

$$P_1 = 80 - 2.5x_1$$

$$P_2 = 180 - 10 x_2$$

If the price discrimination is practised by the monopolist , what will be the equilibrium output in each segment and what will be the price ?

Prove that the market with the higher elasticity will have the lower price.

Solution

The firm aims at the maximisation of profit .

$$\pi = R_1 + R_2 - C$$

$$R_1 = P_1x_1 = (80 - 2.5x_1)x_1$$

$$= 80 x_1 - 2.5x_1^2$$

$$MR_1 = 80 - 5x_1 \dots\dots\dots(1)$$

$$R_2 = P_2x_2 = (180 - 10x_2) x_2$$

$$= 180x_2 - 10x_2^2$$

$$MR_2 = 180 - 20x_2 \dots\dots\dots(2)$$

$$C = 50 + 40x$$



$$= 50 + 40(x_1 + x_2)$$
$$MC = \frac{dc}{dx_1} = \frac{dc}{dx_2} = \frac{dc}{dx} = 40 \dots\dots\dots(3)$$

Then, equating (1) & (3)

$$80 - 5x_1 = 40$$

$$x = 8$$

and, equating (2) & (3)

$$180 - 20x_2 = 40$$

$$x_2 = 7$$

Total output = $8 + 7 = 15$ units

$$P_1 = 80 - 2.5x_1 = ₹ 60$$

$$P_2 = 180 - x_2 = ₹ 110$$

The elasticities are

$$e_1 = \frac{dx_1}{dp_1} \cdot \frac{p_1}{x_1}$$

$$\text{Now } P_1 = 80 - 2.5x_1$$

$$x_1 = 32 - 0.4 P_1$$

$$\frac{dx_1}{dp_1} = 0.4$$

$$\text{then } e_1 = 0.4 \times \frac{60}{8} = 3$$

$$\text{Similarly } e_2 = \frac{dx_2}{dp_2} \cdot \frac{p_2}{x_2} = 1.57$$

Thus $e_1 > e_2$ and accordingly $p_1 < p_2$

i.e. market with the higher elasticity will have the lower price.

ADDITIONAL READING

(1) THE CONCEPT OF REVENUE

Total revenue is the total sale proceeds of a firm by selling a commodity at a given price. If a firm sells 2 units of a commodity at ₹ 18, total revenue is $2 \times 18 = ₹ 36$.

Average Revenue (AR) is the average receipts from the sale of certain units of the commodity. It is found out by dividing the total revenue by the number of units sold.

$$R = P \times Q$$

$$\therefore AR = R/Q = P \times Q/Q = P$$

$$\text{And } P = f(Q)$$

Marginal revenue (MR) is the addition to total revenue as a result of a small increase in the sale of a firm. Algebraically, MR is the addition to R by selling $n + 1$ units instead of n units. $MR = dR/dQ$, where d represents a change

(2) RELATIONSHIP BETWEEN AR, MR AND ELASTICITY

AR, MR, and Elasticity*

However, the true relationship between the AR, MR and elasticity

* The mathematical relationship between AR, MR and elasticity can be worked out as follows. We know that $R = PQ$.

$$MR = \frac{dR}{dQ}$$

$$MR = \frac{dR}{dQ} = \frac{d}{dQ} (PQ)$$

$$= P \frac{dQ}{dQ} + Q \frac{dP}{dQ}$$

$$= P + Q \frac{dP}{dQ}$$

$$MR = P \left(1 + \frac{Q}{P} \cdot \frac{dP}{dQ} \right)$$

$$\text{Elasticity of demand } E = -\frac{P}{Q} \cdot \frac{dQ}{dP}$$

$$\text{or } -\frac{1}{E} = -\frac{Q}{P} \cdot \frac{dP}{dQ}$$

Therefore, (i) can be written as

$$MR = P \left(1 - \frac{1}{E} \right) \quad \left[\because \frac{Q}{P} \cdot \frac{dP}{dQ} = -\frac{1}{E} \right]$$

$$\text{But } P = AR$$

$$MR = AR \left(1 - \frac{1}{E} \right)$$

$$1 - \frac{1}{E} = \frac{MR}{AR}$$

$$-\frac{1}{E} = \frac{MR}{AR} - 1$$

$$\frac{1}{E} = 1 - \frac{MR}{AR}$$

$$\frac{1}{E} = \frac{AR - MR}{AR}$$

$$E = \frac{AR}{AR - MR}$$



$\therefore E = \frac{AR}{AR-MR}$ (Where E is elasticity, AR average revenue and MR marginal revenue.)

By solving, we have, $EA - EM = A$ [Considering $AR = A$, $MR = M$]

$$EA - A = EM$$

$$A(E - 1) = EM$$

$$A = \frac{EM}{E-1}$$

$$\therefore A = M \frac{E}{E-1}$$

Similarly, marginal revenue can be known

By solving $E(A - M) = A$

$$EA - EM = A$$

$$EA - A = EM$$

Or $EM = EA - A$

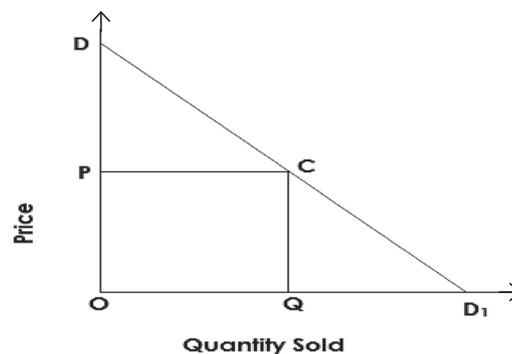
$$\therefore M = \frac{EA - A}{E}$$

$$M = \frac{A(E-1)}{E}$$

$$\therefore M = A \frac{(E-1)}{E}$$

(3) RELATIONSHIP BETWEEN PRICE ELASTICITY AND SALES REVENUE

The proper estimation of price elasticity is of great significance for business decision making. A firm's Revenue changes as a result of the change in price. Total revenue (TR) earned from sales by a firm is obtained by multiplying average unit price with the total quantity sold, i.e., $TR = P \times Q$.



In the total revenue obtained from OQ quantity sold at OP price is OPCQ. Here, three things are clear:

- (1) If the demand Price is elastic, with an increase in price, There is a large fall in sales so that the total revenue decreases. On the other hand, if the price falls, the sales increase so much that the total revenue rises.
- (2) If the elasticity of demand is equal to unity, there is no change in total revenue earned from sales even with the change in price. From example, with the fall in price by 5%, the sales will increase by 5% whereby the total revenue will remain unchanged.

- 3) If the demand price is inelastic, the sales will fall with the increase in price but the total revenue will rise. On the other hand, with the fall in price, the sales will increase but the total revenue will fall.

In general, unity elasticity is not found in practice. When price changes in a certain ratio, the sales normally change in a high or low ratio.

Thus, if the management wants to increase sales, it has to reduce the price. But if the reduction in price is compensated by the additional sales, the total revenue will increase or remain the same. Similarly, the management can raise the price of product for increasing revenue. But if the fall in revenue as a result of sales reduction is not compensated by the increased price, the total revenue will fall. Hence, the effect of a change in price on the sales determines the effect of the change in price on total revenue. Moreover, the firm often remains in a fix as to whether the sales should increase or decrease. In such a situation, the concept of the marginal revenue is decisive.

(4) ELASTICITY OF COST

If output (Q) is produced at a total cost (T), the cost function is $T=f(Q)$. The elasticity of total cost is the ratio of the proportional change in total cost to the proportional change in output. It may be written as

$$k = \frac{dT}{T} \div \frac{dQ}{Q} = \frac{dT}{T} \times \frac{Q}{dQ} = \frac{dT}{dQ} \cdot \frac{Q}{T} = \frac{dT}{T} \div \frac{T}{Q} = \frac{MC}{AC}$$

Thus, cost elasticity (k) is equal to the ratio of marginal cost (dT/dQ) to average cost (T/Q). it follows

from this that if $MC \geq AC, k \geq 1$. It means that when $MC > AC, k > 1$, as shown by the area right to point

E in Figure 1. It is the case of decreasing returns. When $MC = AC, k = 1$, it is the point E where the MC curve cuts the AC curve from below in the figure. It is the case of constant returns. When $MC < AC, k < 1$, shown as the area to the left of point E in the figure, where the MC curve is falling and is below the AC curve. It is the case of increasing returns.

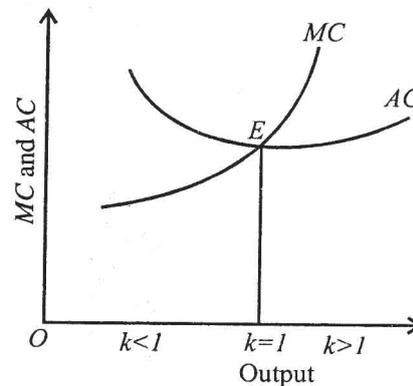


Fig. 1

Since the average cost and the marginal cost are derived from the total cost in relation to the output, the shapes of the AC curve and the MC curve can also be checked from the shape of the total cost curve. If P is the point on the total cost curve at a given output Q, then the average cost is to be read off as the gradient of OP and the marginal cost as the tangent at P. This is shown in Figure 17. The figure, further, reveals that the elasticity of total cost increases continuously with increases in output from less than unity elasticity is less than unity for small outputs, and finally, it is greater than unity for large outputs. In other words, if we taken $k = 1$ at some definite level of output, $Q = \alpha$, then $K < 1$ for outputs $Q < \alpha$, and $k > 1$ for outputs $Q > \alpha$. This is illustrated in Figure 2.

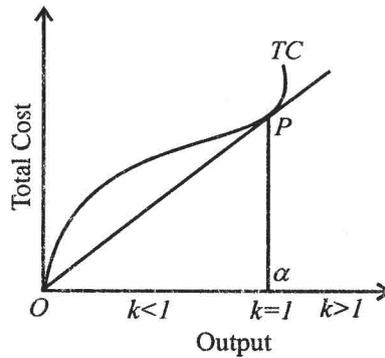


Fig. 2

Elasticity of Average Cost. The elasticity of total cost is given by k or $E(T) = \frac{dT}{dQ} \cdot \frac{Q}{T}$ and average cost is T/Q . Therefore, replacing T by T/Q .

$$\begin{aligned}
 E(T/Q) &= \frac{d(T/Q)}{dQ} \cdot \frac{Q}{T/Q} \\
 &= \frac{d}{dQ} \cdot (T/Q) \cdot \frac{Q^2}{T} \\
 &= \frac{Q^2}{T} \cdot \left(\frac{Q \frac{dT}{dQ} - T}{Q^2} \right) \\
 &= \frac{Q^2}{T} \cdot \frac{1}{Q^2} (Q \frac{dT}{dQ} - T) \\
 &= \frac{Q}{T} \cdot \frac{dT}{dQ} - 1 = K - 1
 \end{aligned}$$

Elasticity of Marginal Cost. As we know, the elasticity of total cost is given by $E(T) = \frac{dT}{dQ} \cdot \frac{Q}{T}$. Therefore, the marginal cost is (dT/dQ) . Replacing T by dT/dQ .

$$\begin{aligned}
 E\left(\frac{dT}{dQ}\right) &= \frac{(dT/dQ)}{dQ} \cdot \frac{Q}{(dT/dQ)} \\
 &= \frac{d}{dQ} (dT/dQ) \cdot \frac{Q}{(dT/dQ)} \quad \dots\dots\dots(1)
 \end{aligned}$$

Since K is given by,

$$K = Q/T \cdot dT/dQ \text{ or } Tk/Q = dT/dQ \quad \dots\dots\dots(2)$$

Submitting the value of (2) in (1), we get

$$E\left(\frac{dT}{dQ}\right) = \frac{d}{dQ} \left(\frac{dT}{dQ} \right) \frac{Q^2}{T_k}$$

(5) CONCEPT OF ELASTICITY OF SUBSTITUTION

The elasticity of substitution is defined as the percentage change in the capital - labour ratio, divided by the percentage change in the rate of technical substitution.

$$\sigma = \frac{\text{percentage change in } K/L}{\text{percentage change in } MRS}$$

$$\text{or } \sigma = \frac{d(K/L)(K/L)}{d(MRS)/(MRS)}$$

The principle of marginal rate of substitution is based on the production function where two factors can be substituted in variable proportion in such a way as to produce a constant level of output .

The elasticity of substitution is a pure number independent of the units of measurement of K & L, since both the numerator and the denominator are measured in the same units.

The factor intensity of any process is measured by the slope of the line through the origin representing the particular process. Thus the factor intensity is the capital – labour ratio. In figure 3 process P_1 is more capital intensive than process P_2 . Clearly

$$\frac{K_1}{L_1} > \frac{K_2}{L_2}$$

The upper part of the isoquant includes more capital – intensive processes. The lower part of the isoquant includes more labour – intensive techniques.

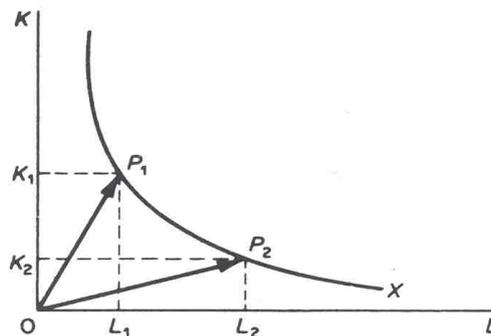


Figure 3

Example

Let us illustrate the above concepts with a specific form of production function, namely the Cobb-Douglas production function. This form is the most popular in applied research, because it is easiest to handle mathematically.

The Cobb-Douglas function is of the form

$$X = b_0 \cdot L^{b_1} \cdot K^{b_2}$$

1. The marginal product of factors

(a) The MP_L

$$MP_L = \frac{\partial X}{\partial L} = b_1 \cdot b_0 \cdot L^{b_1-1} \cdot K^{b_2}$$



$$= b_1 (b_0 \cdot L^{b_1} \cdot K^{b_2}) L^{-1}$$
$$= b_1 \cdot \frac{X}{L} = b_1 (AP_L)$$

Where AP_L = the average product of labour

(b) Similarly

$$MP_K = b_2 \cdot \frac{X}{K} = b_2 (AP_K)$$

2. The marginal rate of substitution

$$MRS_{L,K} = \frac{\partial X / \partial L}{\partial X / \partial K} = \frac{b_1 \left(\frac{X}{L} \right)}{b_2 \left(\frac{X}{K} \right)} = \frac{b_1 \cdot K}{b_2 \cdot L}$$

3. The elasticity of substitution

$$\sigma = \frac{d(K/L)(K/L)}{d(MRS)/(MRS)} = 1$$

Proof

Substitute the MRS and obtain

$$\sigma = \frac{d(K/L)(K/L)}{d\left(\frac{b_1 \cdot K}{b_2 \cdot L}\right) / \left(\frac{b_1}{b_2}\right)\left(\frac{K}{L}\right)} = 1$$
$$= \frac{d\left(\frac{K}{L}\right)\left(\frac{b_1}{b_2}\right)}{\left(\frac{b_1}{b_2}\right)d\left(\frac{K}{L}\right)} = 1$$

Given that b_1/b_2 is constant and does not affect the derivative.

(4) Factor Intensity

In a Cobb-Douglas function factor intensity is measured by the ratio b_1/b_2 . The higher this ratio the more labour intensive the technique. Similarly, the lower the ratio, the more capital intensive the technique

(5) The efficiency of production

The efficiency in the organization of the factors of production is measured by the coefficient b_0 . Intuitively it is clear that if two firms have the same K, L, b_1 and b_2 and still produce different quantities of output, the difference can be due to the superior organization and entrepreneurship of one of the firms, which results in different efficiencies. The more efficient firm will have a larger b_0 than the less efficient one.

(6) The returns to scale

This concept will be developed in the next section, since it refers to the long-run analysis of production. We state that in Cobb-Douglas function, the returns to scale are measured by the sum of the coefficients $b_1 + b_2$.

(7) The role of costs in pricing decision

Cost plays an important role in pricing decision. Most firms rely on full cost uniformation reports when setting prices. Decisions to add a new product or to drop an existing product from the portfolio of Products usually have significant implication for a firm's Cost Structure. Cost information is used in

pricing decision and the manner in which it is used depends on industrial structure and the time frame involved in the pricing decision.

Pricing Decision — A simplified analysis

The demand Q is represented as a decreasing linear function of the price. i.e. $Q = a - bP$.

Total Cost, C expressed in terms of fixed and variable cost components

i.e. $C = f + VQ$

Where f is the fixed cost, v is the variable cost per unit and Q is the Quantity produced in units. The total revenue R is given by the Price (P) multiplied by the Quantity sold.

$TR = PQ = P(a - bP)$

The profit is measured as the difference between the revenue and the cost

Thus, $\pi = TR - C$

$= PQ - (f + VQ)$

$= P(a - bP) - [f + v(a - bP)]$

$= aP - bP^2 - f - av + bvP.$

To find profit maximising price P , we set the first condition of profit maximization

$$\frac{dTR}{dP} = a - 2bP + bv = 0.$$

The equation implies

$$P = \frac{(a + bv)}{2b}$$

The simple economic analysis suggests that the pricing decision depends on cost structure.

(8) Concept of maximization of profit under different market structure

Mathematical derivation of the equilibrium of the firm

The firm aims at the maximization of its profit

$\Pi = R - C$

Where $\Pi =$ profit

$R =$ total revenue

$C =$ total cost

Clearly $R = f_1(X)$ and $C = f_2(X)$, given the price P .

(a) The first-order condition for the maximization of a function is that its first derivative (with respect to X in our case) be equal to zero. Differentiating the total-profit function and equating to zero we obtain

$$\frac{\partial \pi}{\partial x} = \frac{\partial^2 R}{\partial x^2} - \frac{\partial^2 C}{\partial x^2}$$

Or

$$\frac{\partial R}{\partial x} = \frac{\partial C}{\partial x}$$

The term $\partial R/\partial X$ is the slope of the total revenue curve, that is, the marginal revenue. The term $\partial C/\partial X$ is the slope of the total cost curve, or the marginal cost. Thus the first-order condition for profit maximization is

$$MR = MC$$



Given that $MC > 0$, MR must also be positive at equilibrium. Since $MR = P$ the first-order condition may be written as $MC = P$.

- (b) The second-order condition for a maximum requires that the second derivative of the function be negative (implying that after its highest point the curve turns downwards). The second derivative of the total-profit function is

$$\frac{\partial^2 \pi}{\partial x^2} = \frac{\partial^2 R}{\partial x^2} - \frac{\partial^2 C}{\partial x^2}$$

This must be negative if the function has been maximized, that is

$$\frac{\partial^2 R}{\partial x^2} - \frac{\partial^2 C}{\partial x^2} < 0$$

Which yields the condition

$$\frac{\partial^2 R}{\partial x^2} = \frac{\partial^2 C}{\partial x^2}$$

But $\partial^2 R / \partial x^2$ is the slope of the MR curve and $\partial^2 C / \partial x^2$ is the slope of the MC curve. Hence the second-order condition may verbally be written as follows.

(slope of MR) < (slope of MC)

Thus the MC must have a steeper slope than the MR curve or the MC must cut the MR curve from below.

(9) Price discrimination

– Mathematical Analysis

Mathematical derivation of the equilibrium position of the price discriminating monopolist.

Given the total demand of the monopolist

$$P = f(Q)$$

Assume that demand curves of the segmented market

$$P_1 = f_1(Q_1) \text{ and } P_2 = f_2(Q_2)$$

The cost of the firm is

$$C = f(Q) = f(Q_1 + Q_2)$$

The firm aims at the maximisation of profit

$$\pi = R_1 + R_2 - C$$

The first order condition of profit maximisation requires

$$\frac{\partial \pi}{\partial Q_1} = 0 \text{ and } \frac{\partial \pi}{\partial Q_2} = 0$$

$$\therefore \frac{\partial \pi}{\partial Q_1} = \frac{\partial R_1}{\partial Q_1} - \frac{\partial C_1}{\partial Q_1} = 0$$

$$\text{or, } MR_1 - MC_1 = 0$$

$$\text{i.e. } MR_1 = MC_1$$

$$\text{similarly, } \frac{\partial R_2}{\partial Q_2} - \frac{\partial C_2}{\partial Q_2} = 0$$

$$\text{or, } MR_2 - MC_2 = 0 \implies MR_2 = MC_2$$

$$\text{But } MC = MC_1 = MC_2 = \frac{dC}{dQ}$$

$$\text{Therefore, } MR_1 = MR_2 = MC$$

i.e equilibrium is reached when

$$MR_1 = MR_2$$

Second order condition for price discrimination ,

$$\frac{\partial^2 R_1}{\partial Q_1^2} < \frac{\partial^2 C}{\partial Q^2}$$

$$\text{and } \frac{\partial^2 R_2}{\partial Q_2^2} < \frac{\partial^2 C}{\partial Q^2}$$

i.e. MR in each market must be increasing less rapidly than the MC for the output as whole.

(b) Price Discrimination and the price Elasticity of Demand:-

$$TR = PQ$$

$$\begin{aligned} MR &= \frac{d(TR)}{dQ} = P \frac{dQ}{dQ} + Q \frac{dP}{dQ} \\ &= P + Q \cdot \frac{dP}{dQ} \\ &= P \left(1 + \frac{Q}{P} \cdot \frac{dP}{dQ} \right) \\ &= P \left(1 - \frac{1}{e} \right) \end{aligned}$$

where TR = Total Revenue

MR = Marginal Revenue

e = elasticity of demand

In case of price discrimination ,we have

$$MR_1 = P_1 \left(1 - \frac{1}{e_1} \right)$$

$$MR_2 = P_2 \left(1 - \frac{1}{e_2} \right)$$

and $MR_1 = MR_2$

Therefore,

$$P_1 \left(1 - \frac{1}{e_1} \right) = P_2 \left(1 - \frac{1}{e_2} \right)$$

$$\frac{P_1}{P_2} = \frac{\left(1 - \frac{1}{e_2} \right)}{\left(1 - \frac{1}{e_1} \right)}$$

This is obvious from the above equation ,

if $e_1 = e_2$, then $P_1 = P_2$

This means when elasticities are the same , price discrimination is not profitable,

if $|e_1| > |e_2| \implies P_1 < P_2$

ie the market with the higher elasticity will have the lower price .

(10) Economies of scale

Economies of scale are factors that cause the average cost of producing something to fall as the volume of its output increases. Hence it might cost ₹ 5000 to produce 100 copies of a magazine but only ₹ 7500 to produce 1000 copies. The average cost in this case has fallen from ₹ 50 to ₹ 75 a copy because the main elements of cost in producing a magazine (editorial and design) are unrelated to the number of magazines produced.



Economies of scale were the main drivers of corporate gigantism in the 20th century. They were fundamental to Henry Ford's revolutionary assembly line, and they continue to be the spur to many mergers and acquisitions today.

There are two types of economies of scale:

- **Internal:** These are cost savings that accrue to a firm regardless of the industry, market or environment in which it operates.
- **External:** These are economies that benefit a firm because of the way in which its industry is organized.

Internal economic of scale arise in a number of areas. For example, it is easier for large firms to carry the over heads of sophisticated research and development (R & D). In the pharmaceuticals industry R & D is crucial. Yet the cost of discovering the next blockbuster drug is enormous and increasing. Several of the mergers between pharmaceuticals companies in recent years have been driven by the companies' desire to spread their R & D expenditure across a greater volume of sales.

Economies of scale, however, have a dark side, called diseconomies of scale. The larger an organization becomes in order to reap economies of scale, the more complex it has to be manage and run such scale. This complexity incurs a cost, and eventually this cost may come to outweigh the saving gained from greater scale. In other words, economies of scale cannot be gleaned forever.

(11) Laws of return to scale : long-run analysis of production

In the long run expansion of output may be achieved by varying all factors . In the long run all factors are variable. The laws of returns to scale refer to the effects of scale relationships.

In the long run output may be increased by changing all factors by the same proportion or by different proportions .Traditional theory of production concentrates on the first case, that is , the study of output as all inputs change by the same proportion .The term return to scale refers to change in output as all factors change by the same proportion .

Suppose we start from an initial level of inputs and output

$$X_0 = f(L,K)$$

and we increase all the factors by the same proportion k.We will clearly obtain a new level of output X^* , higher than the original level X_0 ,

$$X^* = f(kL,kK)$$

if X^* increases by the same proportion k as the inputs , we say that there are constant returns to scale.

If X^* increases less than proportionally with the increase in the factors, we have decreasing returns to scale .

If X^* increases more than proportionally with the increase in the factors ,we have increasing returns to scale.

(12) Relationship between marginal cost and average cost:-

The relationship between the MC and AC curves becomes clearer with the use of simple calculus .Given $C = zX$,where $z = f(X)$. The MC is

$$\frac{\partial C}{\partial X} = \frac{\partial (zX)}{\partial X}$$

Applying the rule of differentiation of 'a' function of a function ' ' (which states that if $y = uv$,

where $u = f_1(x)$ and $v = f_2(x)$, then $\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$, we obtain

$$MC = \frac{\partial C}{\partial X} = z \frac{\partial X}{\partial X} + X \frac{\partial z}{\partial X}$$

or

$$MC = AC + (X) (\text{Slope of AC})$$

Given that $AC > 0$ and $X > 0$, the following results emerge :

- (a) if (slope of AC) < 0 , then $MC < AC$
- (b) if (slope of AC) > 0, then $MC > AC$
- (c) if (slope of AC) = 0, then $MC = AC$

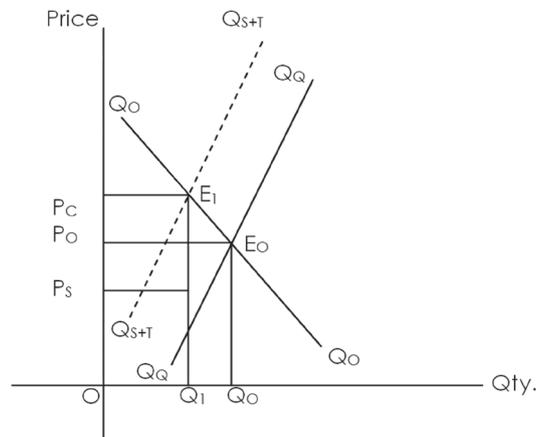
The slope of the AC becomes zero at the minimum point of this curve (given that on theoretical grounds the AC curve is U- shaped). Hence $MC = AC$ at the minimum point of the average cost curve .

(13) Government intervention

– Taxation and its impact Taxes and Subsidies may affect market prices. The manner in which they do so may depend on the price elasticity of demand and supply and market structure. When the supply curve is more inelastic than the demand curve, producers bear more of the tax and receive more of the subsidy than consumers. Where the demand curve is more inelastic than the supply curve the consumers bear more of the tax and receive more of the subsidy than producers.

Let P be the price paid by the consumer of a product produced. Let Q be the quantity produced and consumed. Let t be the excise tax levied by the Government.

The impact of tax on price demands on the price elasticity of demand and supply.



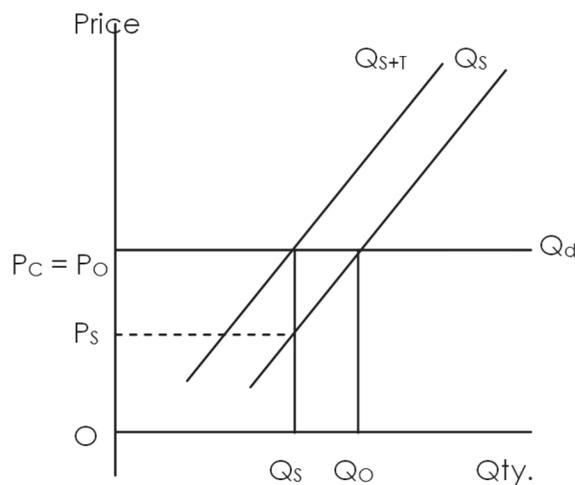
Case I

Tax Shared by buyers and sellers.

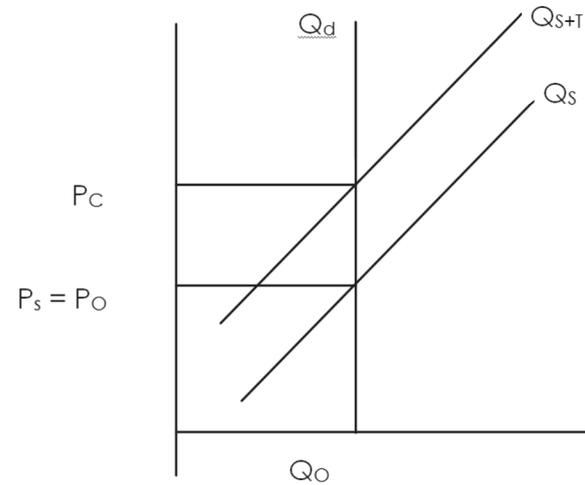
Here original demand curve is Q_0 and supply curve is Q_s . after imposition of tax, original supply curve shifts to the left exactly by amount of the tax. The new supply curve is Q_{s+t} . The new equilibrium price is OP_c in the price paid by the consumer and OP_s is the price received by the seller after deducting tax, i.e., the tax is shared by consumers and producers. The actual impact of the duty depends on the elasticity of demand and supply of the commodity being taxed.

The following points may be noted

- (i) The more elastic (inelastic) the demand; the lower (greater) the proportion of the tax to be paid to the consumer. If demand curve is completely elastic (in parallel to X axis as depicted in Case II). The consumers pay no tax and the entire burden is on the seller. On the other hand if demand curve is completely inelastic, the producer bears on the (as depicted in Case III) in the entire burden is on the consumer.

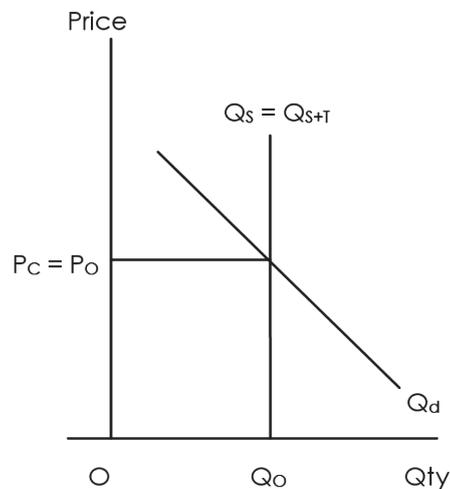


Case II

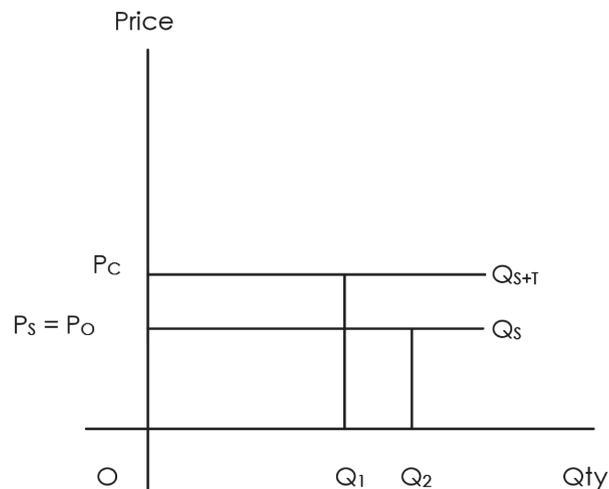


Case III

- (ii) The more elastic (inelastic) the supply, the less (or greater) the proportion of the tax to be paid by the seller, if supply is completely inelastic (as depicted in Case IV), the consumer pays no tax in the entire burden is on the seller) and if supply curve is completely elastic the producer pays no tax



Case IV



Case V

i.e., if Cost Accountants have information about elasticity of demand and supply of the concerned product, they will be able to analyze the effect of changes in tax policies and plan accordingly. However, it is not always possible to make perfect estimate of price elasticity of demand and supply.



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