

## UNIT II

### THEORY OF PRODUCTION AND COST ANALYSIS

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**Introduction:** The production function expresses a functional relationship between physical inputs and physical outputs of a firm at any particular time period. The output is thus a function of inputs. Mathematically production function can be written as

$$Q = f(L_1, L_2, C, O, T)$$

Where "Q" stands for the quantity of output

L<sub>1</sub>: land

L<sub>2</sub>: labour

C: capital

O: Organization

T=Technology

**Importance:**

1. When inputs are specified in physical units, production function helps to estimate the level of production.
2. It becomes is equates when different combinations of inputs yield the same level of output.
3. It indicates the manner in which the firm can substitute on input for another without altering the total output.
4. When price is taken into consideration, the production function helps to select the least combination of inputs for the desired output.
5. It considers two types' input-output relationships namely 'law of variable proportions' and 'law of returns to scale'. Law of variable propositions explains the pattern of output in the short-run as the units of variable inputs are increased to increase the output. On the other hand law of returns to scale explains the pattern of output in the long run as all the

units of inputs are increased.

6. The production function explains the maximum quantity of output, which can be produced, from any chosen quantities of various inputs or the minimum quantities of various inputs that are required to produce a given quantity of output.

Production function can be fitted to the particular firm or industry or for the economy as a whole. Production function will change with an improvement in technology.

Assumptions:

Production function has the following assumptions.

1. The production function is related to a particular period of time.
2. There is no change in technology.
3. The producer is using the best techniques available.
4. The factors of production are divisible.
5. Production function can be fitted to a short run or to long run.

Cobb-Douglas production function:

Production function of the linear homogeneous type is credited to Juntwicksell and first tested by C. W. Cobb and P. Douglas in 1928. This famous statistical production function is known as Cobb-Douglas production function. Originally the function is applied on the empirical study of the American manufacturing industry. Cobb – Douglas production function takes the following mathematical form

$$P = bL^a C^{1-a}$$

Where P = output

C = Capital

L = Labour

a, 1-a = Elasticity of production

The formula function estimated for the USA by Cobb-Douglas is

$$P = (1.01 L^{0.75} C^{0.25})$$

Assumptions:

It has the following assumptions

1. The function assumes that output is the function of two factors viz. capital and labour.

2. It is a linear homogenous production function of the first degree
3. The function assumes that the logarithm of the total output of the economy is a linear function of the logarithms of the labour force and capital stock.
4. There are constant returns to scale
5. All inputs are homogenous
6. There is perfect competition
7. There is no change in technology

### Long-Run Production Function

#### Law of Variable Proportions:

Law of variable proportions occupies an important place in economic theory. This law examines the production function with one factor variable, keeping the quantities of other factors fixed. In other words, it refers to the input-output relation when output is increased by varying the quantity of one input.

The law of variable proportions or diminishing returns has been stated by various economists in the following manner:

As equal increments of one input are added; the inputs of other productive services being held constant, beyond a certain point the resulting increments of product will decrease, i.e., the marginal products will diminish,” (G. Stigler)

“As the proportion of one factor in a combination of factors is increased, after a point, first the marginal and then the average product of that factor will diminish.” (F. Benham)

#### Assumptions:

The assumptions of the law of variable proportion are given as below:

1. It is assumed that the technique of production should remain constant during production.
2. It operates in the short-run because in the long run, fixed inputs become variable.
3. Some inputs must be kept constant.
4. The various factors are not to be used in rigidly fixed proportions but the law is based upon the possibility of varying proportions. It is also called the law of proportionality.
5. It is assumed that all the units of variable factors of production are homogeneous in amount and quality.
6. It is assumed that labor is a single variable factor.

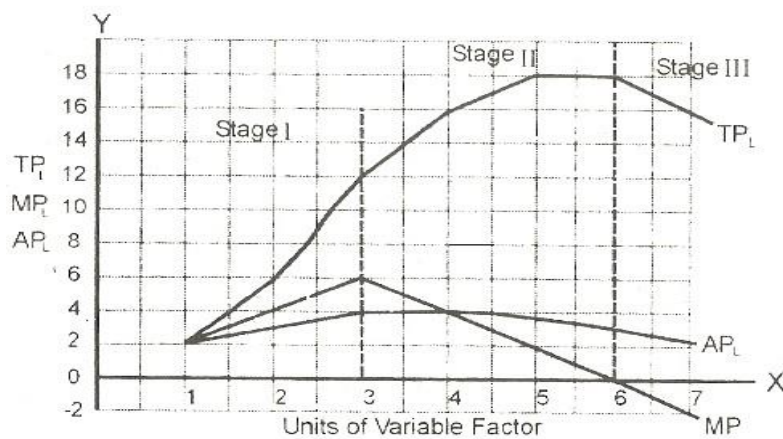
Schedule:

The law of variable proportion is explained with the help of the following schedule:

Units of variable factor (L)	Marginal product ( $MP_L$ )	Total product ( $TP_L$ )	Average product ( $AP_L$ )	Stages
1	2	2	2	I
2	4	6	3	
3	6	12	4	
4	4	16	4	II
5	2	18	3.6	
6	0	18	3	III
7	-2	16	2.28	

In the above schedule, units of variable factor (labor) are employed with other fixed factors of production. The marginal productivity of labor goes on increasing up to the 3rd worker. This is so because the proportion of workers to other fixed factors was at first insufficient. After 3rd worker the marginal productivity goes on falling onwards till it drops down to zero at the 6th unit of labor. The 7th worker is only a cause of obstruction to the others and is responsible in making the marginal productivity negative. The marginal productivity ( $MP_L$ ) and the average productivity ( $AP_L$ ) equalize at 4th worker. Then the  $MP_L$  falls more sharply

## Diagram:



### Three Stages of the Law:

#### 1. First Stage:

First stage starts from point 'O' and ends up to point F. At point F average product is maximum and is equal to marginal product. In this stage, total product increases initially at increasing rate up to point E. between 'E' and 'F' it increases at diminishing rate. Similarly marginal product also increases initially and reaches its maximum at point 'H'. Later on, it begins to diminish and becomes equal to average product at point T. In this stage, marginal product exceeds average product ( $MP > AP$ ).

#### 2. Second Stage:

It begins from the point F. In this stage, total product increases at diminishing rate and is at its maximum at point 'G' correspondingly marginal product diminishes rapidly and becomes 'zero' at point 'C'. Average product is maximum at point 'I' and thereafter it begins to decrease. In this stage, marginal product is less than average product ( $MP < AP$ ).

#### 3. Third Stage:

This stage begins beyond point 'G'. Here total product starts diminishing. Average product also declines. Marginal product turns negative. Law of diminishing returns firmly manifests itself. In this stage, no firm will produce anything. This happens because marginal product of the labour becomes negative. The employer will suffer losses by employing more units of labourers. However, of the three stages, a firm will like to produce up to any given point in the second stage only.

Total Product	Marginal Product	Average Product
<b>Stage I</b> First increases at increasing rate then at diminishing rate.	Increases in the beginning then reaches a maximum and begins to decrease.	First increases, continues to increase and becomes maximum.
<b>Stage II</b> Continues to increase at diminishing rate and becomes maximum.	Continues to diminish and becomes equal to zero.	Becomes equal to MP and then begins to diminish.
<b>Stage III</b> Diminishes	Becomes negative.	Continues to diminish but will always be greater than zero.

### Law of Returns to Scale :

In the long run all factors of production are variable. No factor is fixed. Accordingly, the scale of production can be changed by changing the quantity of all factors of production.

#### Definition:

“The term returns to scale refers to the changes in output as all factors change by the same proportion.” Koutsoyiannis

“Returns to scale relates to the behaviour of total output as all inputs are varied and is a long run concept”. Leibhafskey

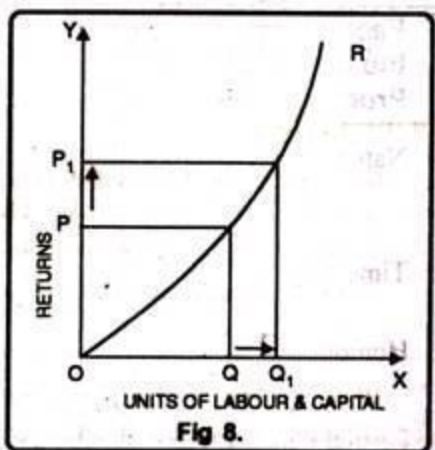
#### Returns to scale are of the following three types:

1. Increasing Returns to scale.
2. Constant Returns to Scale
3. Diminishing Returns to Scale

#### The following three stages of returns to scale:

##### **1. Increasing Returns to Scale:**

Increasing returns to scale or diminishing cost refers to a situation when all factors of production are increased, output increases at a higher rate. It means if all inputs are doubled, output will also increase at the faster rate than double. Hence, it is said to be increasing returns to scale. This increase is due to many reasons like division external economies of scale.

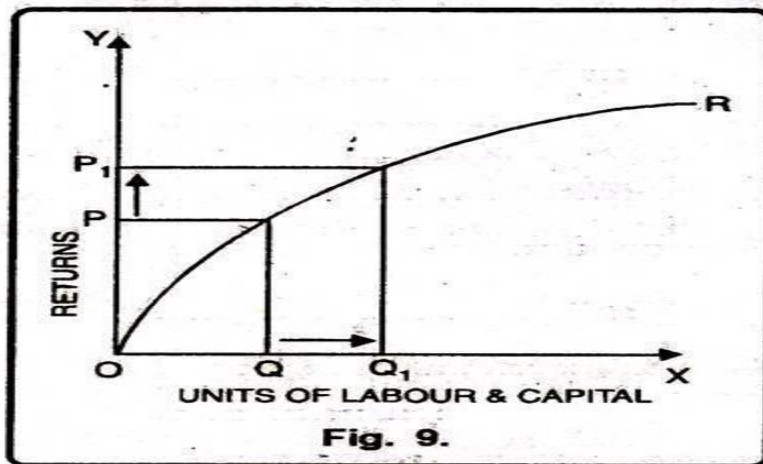


In figure 8, OX axis represents increase in labour and capital while OY axis shows increase in output. When labour and capital increases from Q to  $Q_1$ , output also increases from P to  $P_1$  which is higher than the factors of production i.e. labour and capital.

## 2. Diminishing Returns to Scale:

Diminishing returns or increasing costs refer to that production situation, where if all the factors of production are increased in a given proportion, output increases in a smaller proportion. It means, if inputs are doubled, output will be less than doubled. If 20 percent increase in labour and capital is followed by 10 percent increase in output, then it is an instance of diminishing returns to scale.

The main cause of the operation of diminishing returns to scale is that internal and external economies are less than internal and external diseconomies. It is clear from diagram 9.

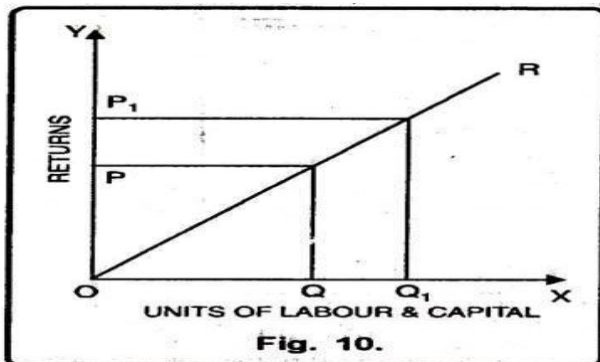


In this diagram 9, diminishing returns to scale has been shown. On OX axis, labour and capital are given while on OY axis, output. When factors of production increase from Q to  $Q_1$  (more quantity) but as a result increase in output, i.e. P to  $P_1$  is less. We see that increase in factors of production is more and increase in production is comparatively less, thus diminishing returns to scale apply.

### 3. Constant Returns to Scale:

Constant returns to scale or constant cost refers to the production situation in which output increases exactly in the same proportion in which factors of production are increased. In simple terms, if factors of production are doubled output will also be doubled.

In this case internal and external economies are exactly equal to internal and external diseconomies. This situation arises when after reaching a certain level of production, economies of scale are balanced by diseconomies of scale. This is known as homogeneous production function. Cobb-Douglas linear homogenous production function is a good example of this kind. This is shown in diagram 10. In figure 10, we see that increase in factors of production i.e. labour and capital are equal to the proportion of output increase. Therefore, the result is constant returns to scale.



### Iso-Quant Curve:

#### **Iso-Quant Curve: Definitions, Assumptions and Properties!**

The term Iso-quant or Iso-product is composed of two words, Iso = equal, quant = quantity or product = output.

Thus it means equal quantity or equal product. Different factors are needed to produce a good. These factors may be substituted for one another.

#### **Definitions:**

According to **Ferguson**, "An isoquant is a curve showing all possible combinations of inputs physically capable of producing a given level of output"

#### **Schedule:**



The concept of isoquant or equal product curve can be better explained with the help Marginal Rate of Technical Substitution.

Combinations	Factor X	Factor Y	Total Output
A	1	14	100 METERS
B	2	10	100 METERS
C	3	7	100 METERS
D	4	5	100 METERS
E	5	4	100 METERS

In the table given above, it is shown that a producer employs two factors of production X and Y for producing an output of 100 meters of cloth. There are five combinations which produce the same level of output (100 meters of cloth).

The factor combination A using 1 unit of factor X and 14 units of factor Y produces 100 meters of cloth. The combination B using 2 units of factor X and 10 units of factor Y produces 100 meters of cloth. Similarly combinations C, D and E, employing 3 units of X and 7 units of Y, 4 units of X and 5 units of Y, 5 units of X and 4 units of Y produce 100 units of output, each. The producer, here., is indifferent as to which combination of inputs he uses for producing the same amount of output.

#### Diagram/Graph:

The alternative techniques for producing a given level of output can be plotted on a graph.

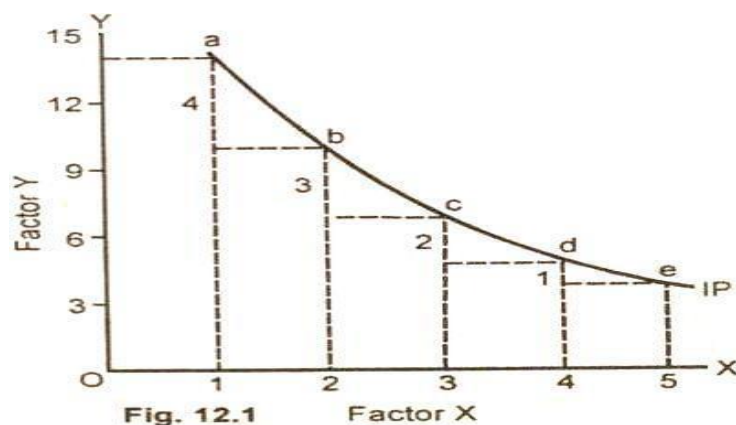


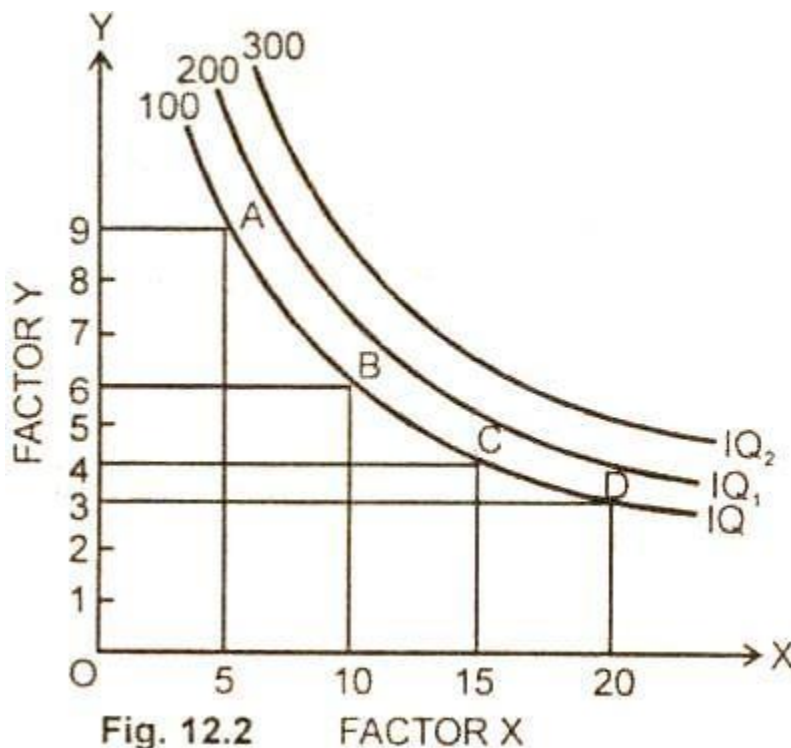
Fig. 12.1

The figure 12.1 shows y the 100 units isoquant plotted to ISO product schedule. The five factor combinations of X and Y are plotted and are shown by points a, b, c, d and e. if we join these points, it forms an 'isoquant'.

#### **Isoquant Map:**

An *isoquant map* shows a set of iso-product curves. Each isoquant represents a different level of output. A higher isoquant shows a higher level of output and a lower isoquant represents a lower level of output.

#### **Diagram/Graph:**



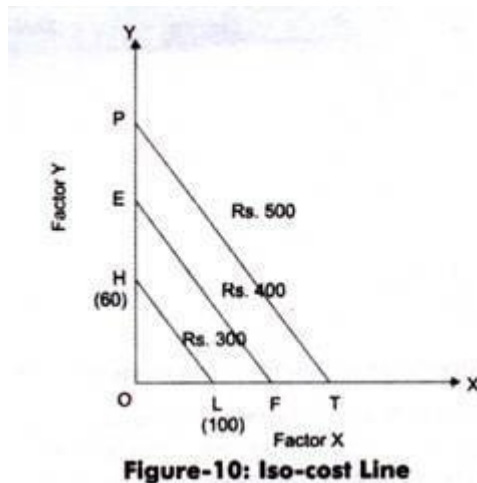
In the figure 12.2, a family of three iso-product curves which produce various level of output is shown. The iso product  $IQ^1$  yields 100 units of output by using quantities of inputs X and Y. So is also the case with isoquant  $IQ^3$  yielding 300 units of output.

We conclude that an isoquant map includes a series, of iso-product curves. Each isoquant represents a different level of output. The higher the isoquant output, the further right will be the isoquant.

#### **Isocost**

In economics an isocost line shows all combinations of inputs which cost the same total amount. Although similar to the budget constraint in consumer theory, the use of the isocost line pertains to cost-minimization in production, as opposed to utility-maximization. For the two production inputs labour and capital, with fixed unit costs of the inputs, the equation of the isocost line is where  $w$  represents the wage rate of labour,  $r$  represents the rental rate of capital,  $K$  is the amount of capital used,  $L$  is the amount of labour used, and  $C$  is the total cost of acquiring those quantities of the two inputs. The absolute value of the slope of the isocost line, with capital plotted vertically and labour plotted horizontally, equals the ratio of unit costs of labour and capital. The slope is: The isocost line is combined with the isoquant map to determine the optimal production point at any given level of output. Specifically, the point of tangency between any isoquant and an isocost line gives the lowest-cost combination of inputs that can produce the level of output associated with that isoquant. Equivalently, it gives the maximum level of output that can be produced for a given total cost of inputs. A line joining tangency points of isoquants and isocosts is called the expansion path.

**In such a case, the iso-cost line is shown in Figure-10:**



As shown in Figure-10, if the producer spends the whole amount of money to purchase X, then he/she can purchase 100 units of X, which is represented by OL. On the other hand, if the producer purchases Y with the whole amount, then he/she would be able to get 60 units, which is represented by OH.

If points H and L are joined on X and Y axes respectively, a straight line is obtained, which is called iso-cost line. All the combinations of X and Y that lie on this line, would have the same amount of cost that is Rs. 300. Similarly, other iso-cost lines can be

plotted by taking cost more than Rs. 300, in case the producer is willing to spend more amount of money on production factors.

With the help of isoquant and iso-cost lines, a producer can determine the point at which inputs yield maximum profit by incurring minimum cost. Such a point is termed as producer's equilibrium.

***Least Cost Combination of Inputs:***

The firm may produce a particular quantity of its product at each of the alternative input combinations that lies on the IQ for that quantity. Since the firm's goal is to maximise profit, the optimum input combination for producing a particular quantity of its product would be one that would produce the output at the minimum possible cost.

The optimum input combination in this case is known as the least cost combination of inputs

**Expansion path**

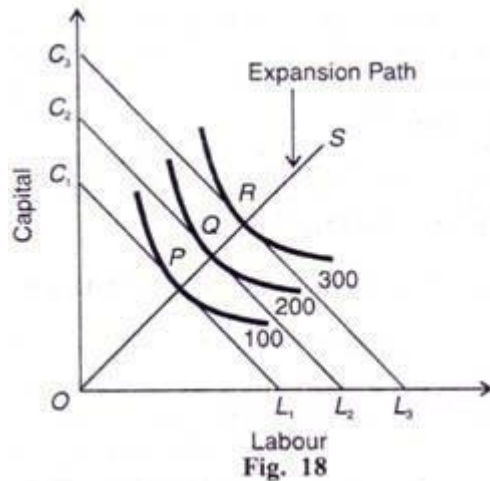
In **economics**, an **expansion path** (also called a **scale line**<sup>[1]</sup>) is a curve in a graph with quantities of two inputs, typically capital and labor, plotted on the axes. The path connects optimal input combinations as the scale of production expands.<sup>[2]</sup> A producer seeking to produce the most units of a product in the cheapest possible way attempts to increase production along the expansion path.<sup>[3]</sup>

Economists Alfred Stonier and **Douglas Hague** defined *expansion path* as "that line which reflects the least cost method of producing different levels of output, when factor prices remain constant."<sup>[4]</sup> The points on an expansion path occur where the firm's **isocost curves**, each showing fixed total input cost, and its **isoquants**, each showing a particular level of output, are **tangent**; each tangency point determines the firm's **conditional factor demands**. As a producer's allowable total cost increases, the firm moves from one of these tangency points to the next; the line joining the tangency points is called the **expansion path**.<sup>[5]</sup>

If an expansion path forms a straight line from the origin, the production technology is considered **homothetic** (or homoethetic).<sup>[6]</sup> In this case, the **ratio** of input usages is always the same regardless of the level of output, and the inputs can be expanded proportionately so as to maintain this optimal ratio as the allowable total cost expands. A **Cobb–Douglas production function** is an example of a production function that has an expansion path which is a straight line through the origin.<sup>[6]</sup>

This is explained in Figure 18, where  $C_1L_1$ ,  $C_2L_2$  and  $C_3L_3$  are the different isocost lines. The line  $C_2L_2$  shows higher total outlay than the line  $C_1L_1$  and  $C_3L_3$  still higher total outlay than the line  $C_2L_2$ . They are shown parallel to each other thereby reflecting constant factor

prices. There are three isoquants 100, 200 and 300 representing successively higher levels of output.



The firm is in equilibrium at point P where the isoquant 100 is tangent to its corresponding isocost line  $C_1L_1$  and similarly the other two isoquants 200 and 300 are tangent to isocost lines  $C_2L_2$  and  $C_3L_3$  respectively at points Q and R. Each point of tangency implies optimal combination of labour and capital that produces an optimal output level. The line OS joining these equilibrium points P, Q and R through the origin is the expansion path of the firm. The firm expands its output along this line keeping factor prices as constant.

#### ECONOMIES OF SCALE

Larger firm is able to reduce its per unit cost of production by linking the various processes of production. Technical economies may also be associated when the large firm is able to utilize all its waste materials for the development of by-products industry. Scope for specialization is also available in a large firm. This increases the productive capacity of the firm and reduces the unit cost of production.

#### **Managerial Economies:**

These economies arise due to better and more elaborate management, which only the large size firms can afford. There may be a separate head for manufacturing, assembling, packing, marketing, general administration etc. Each department is under the charge of an expert. Hence the appointment of experts, division of administration into several departments, functional specialization and scientific co-ordination of various works make the management of the firm most efficient.

#### **Marketing Economies:**

The large firm reaps marketing or commercial economies in buying its requirements and in selling its final products. The large firm generally has a

separate marketing department. It can buy and sell on behalf of the firm, when the market trends are more favorable. In the matter of buying they could enjoy advantages like preferential treatment, transport concessions, cheap credit, prompt delivery and fine relation with dealers. Similarly it sells its products more effectively for a higher margin of profit.

***Financial Economies:***

The large firm is able to secure the necessary finances either for block capital purposes or for working capital needs more easily and cheaply. It can borrow from the public, banks and other financial institutions at relatively cheaper rates. It is in this way that a large firm reaps financial economies.

***Risk bearing Economies:***

The large firm produces many commodities and serves wider areas. It is, therefore, able to absorb any shock for its existence. For example, during business depression, the prices fall for every firm. There is also a possibility for market fluctuations in a particular product of the firm. Under such circumstances the risk-bearing economies or survival economies help the bigger firm to survive business crisis.

***Economies of Research:***

A large firm possesses larger resources and can establish its own research laboratory and employ trained research workers. The firm may even invent new production techniques for increasing its output and reducing cost.

***Economies of welfare:***

A large firm can provide better working conditions in-and out-side the factory. Facilities like subsidized canteens, crèches for the infants, recreation room, cheap houses, educational and medical facilities tend to increase the productive efficiency of the workers, which helps in raising production and reducing costs.

**External Economies.**

Business firm enjoys a number of external economies, which are discussed below:

***Economies of Concentration:***

When an industry is concentrated in a particular area, all the member firms reap some common economies like skilled labour, improved means of transport and communications, banking and financial services, supply of power and benefits from subsidiaries. All these facilities tend to lower the unit cost of production of all the firms in the industry.

***Economies of Information***

The industry can set up an information centre which may publish a journal and pass on information regarding the availability of raw materials, modern

machines, export potentialities and provide other information needed by the firms. It will benefit all firms and reduction in their costs.

***Economies of Welfare:***

An industry is in a better position to provide welfare facilities to the workers. It may get land at concessional rates and procure special facilities from the local bodies for setting up housing colonies for the workers. It may also establish public health care units, educational institutions both general and technical so that a continuous supply of skilled labour is available to the industry. This will help the efficiency of the workers.

***Economies of Disintegration:***

The firms in an industry may also reap the economies of specialization. When an industry expands, it becomes possible to spilt up some of the processes which are taken over by specialist firms. For example, in the cotton textile industry, some firms may specialize in manufacturing thread, others in printing, still others in dyeing, some in long cloth, some in dhotis, some in shirting etc. As a result the efficiency of the firms specializing in different fields increases and the unit cost of production falls.

Thus internal economies depend upon the size of the firm and external economies depend upon the size of the industry.

## **COST ANALYSIS**

Profit is the ultimate aim of any business and the long-run prosperity of a firm depends upon its ability to earn sustained profits. Profits are the difference between selling price and cost of production. In general the selling price is not within the control of a firm but many costs are under its control. The firm should therefore aim at controlling and minimizing cost. Since every business decision involves cost consideration, it is necessary to understand the meaning of various concepts for clear business thinking and application of right kind of costs.

**COST CONCEPTS:**

A managerial economist must have a clear understanding of the different cost concepts for clear business thinking and proper application. The several alternative bases of classifying cost and the relevance of each for different kinds of problems are to be studied. The various relevant concepts of cost are:

***1. Opportunity costs and outlay costs:***

Out lay cost also known as actual costs obsolete costs are those expends which are actually incurred by the firm these are the payments made for labour, material, plant, building, machinery traveling, transporting etc., These are all

those expense item appearing in the books of account, hence based on accounting cost concept.

On the other hand opportunity cost implies the earnings foregone on the next best alternative, has the present option is undertaken. This cost is often measured by assessing the alternative, which has to be scarified if the particular line is followed.

The opportunity cost concept is made use for long-run decisions. This concept is very important in capital expenditure budgeting. This concept is very important in capital expenditure budgeting. The concept is also useful for taking short-run decisions opportunity cost is the cost concept to use when the supply of inputs is strictly limited and when there is an alternative. If there is no alternative, Opportunity cost is zero. The opportunity cost of any action is therefore measured by the value of the most favorable alternative course, which had to be foregoing if that action is taken.

### **2. *Explicit and implicit costs:***

Explicit costs are those expenses that involve cash payments. These are the actual or business costs that appear in the books of accounts. These costs include payment of wages and salaries, payment for raw-materials, interest on borrowed capital funds, rent on hired land, Taxes paid etc.

Implicit costs are the costs of the factor units that are owned by the employer himself. These costs are not actually incurred but would have been incurred in the absence of employment of self – owned factors. The two normal implicit costs are depreciation, interest on capital etc. A decision maker must consider implicit costs too to find out appropriate profitability of alternatives.

### **3. *Historical and Replacement costs:***

Historical cost is the original cost of an asset. Historical cost valuation shows the cost of an asset as the original price paid for the asset acquired in the past. Historical valuation is the basis for financial accounts.

A replacement cost is the price that would have to be paid currently to replace the same asset. During periods of substantial change in the price level, historical valuation gives a poor projection of the future cost intended for managerial decision. A replacement cost is a relevant cost concept when financial statements have to be adjusted for inflation.

### **4. *Short – run and long – run costs:***

Short-run is a period during which the physical capacity of the firm remains fixed. Any increase in output during this period is possible only by using the



existing physical capacity more extensively. So short run cost is that which varies with output when the plant and capital equipment is constant.

Long run costs are those, which vary with output when all inputs are variable including plant and capital equipment. Long-run cost analysis helps to take investment decisions.

**5. Out-of pocket and book costs:**

Out-of pocket costs also known as explicit costs are those costs that involve current cash payment. Book costs also called implicit costs do not require current cash payments. Depreciation, unpaid interest, salary of the owner is examples of book costs.

But the book costs are taken into account in determining the level dividend payable during a period. Both book costs and out-of-pocket costs are considered for all decisions. Book cost is the cost of self-owned factors of production.

**6. Fixed and variable costs:**

Fixed cost is that cost which remains constant for a certain level of output. It is not affected by the changes in the volume of production. But fixed cost per unit decreases, when the production is increased. Fixed cost includes salaries, Rent, Administrative expenses depreciation etc.

Variable is that which varies directly with the variation in output. An increase in total output results in an increase in total variable costs and decrease in total output results in a proportionate decline in the total variable costs. The variable cost per unit will be constant. Ex: Raw materials, labour, direct expenses, etc.

**7. Past and Future costs:**

Past costs also called historical costs are the actual cost incurred and recorded in the book of account these costs are useful only for valuation and not for decision making.

Future costs are costs that are expected to be incurred in the future. They are not actual costs. They are the costs forecasted or estimated with rational methods. Future cost estimate is useful for decision making because decisions are meant for the future.

**8. Traceable and common costs:**

Traceable costs otherwise called direct cost, is one, which can be identified with a product's process or product. Raw material, labour involved in production is examples of traceable cost.

Common costs are the ones that are common and are attributed to a particular process or product. They are incurred collectively for different processes or

different types of products. It cannot be directly identified with any particular process or type of product.

**9. Avoidable and unavoidable costs:**

Avoidable costs are the costs, which can be reduced if the business activities of a concern are curtailed. For example, if some workers can be retrenched with a drop in a product – line, or volume or production the wages of the retrenched workers are escapable costs.

The unavoidable costs are otherwise called sunk costs. There will not be any reduction in this cost even if reduction in business activity is made. For example cost of the ideal machine capacity is unavoidable cost.

**10. Controllable and uncontrollable costs:**

Controllable costs are ones, which can be regulated by the executive who is in charge of it. The concept of controllability of cost varies with levels of management. Direct expenses like material, labour etc. are controllable costs.

Some costs are not directly identifiable with a process of product. They are apportioned to various processes or products in some proportion. This cost varies with the variation in the basis of allocation and is independent of the actions of the executive of that department. These apportioned costs are called uncontrollable costs.

**11. Incremental and sunk costs:**

Incremental cost also known as differential cost is the additional cost due to a change in the level or nature of business activity. The change may be caused by adding a new product, adding new machinery, replacing a machine by a better one etc.

Sunk costs are those which are not altered by any change – They are the costs incurred in the past. This cost is the result of past decision, and cannot be changed by future decisions. Investments in fixed assets are examples of sunk costs.

**12. Total, average and marginal costs:**

Total cost is the total cash payment made for the input needed for production. It may be explicit or implicit. It is the sum total of

the fixed and variable costs. Average cost is the cost per unit of output. It is obtained by dividing the total cost (TC) by the total quantity produced (Q)

$$\text{Average cost} = \text{TC}/\text{Q}$$

Marginal cost is the additional cost incurred to produce an additional unit of output or it is the cost of the marginal unit produced.

**13. Accounting and Economics costs:**

Accounting costs are the costs recorded for the purpose of preparing the balance sheet and profit and loss statements to meet the legal, financial and tax purpose of the company. The accounting concept is a historical concept and records what has happened in the past.

Economics concept considers future costs and future revenues, which help future planning, and choice, while the accountant describes what has happened, the economics aims at projecting what will happen.

### **COST-OUTPUT RELATIONSHIP**

A proper understanding of the nature and behavior of costs is a must for regulation and control of cost of production. The cost of production depends on money forces and an understanding of the functional relationship of cost to various forces will help us to take various decisions. Output is an important factor, which influences the cost. The cost-output relationship plays an important role in determining the optimum level of production. Knowledge of the cost-output relation helps the manager in cost control, profit prediction, pricing, promotion etc. The relation between cost and its determinants is technically described as the cost function.

$$C = f(S, O, P, T, \dots)$$

Where;

C = Cost (Unit or total cost)

Considering the period the cost function can be classified as (a) short-run cost function and (b) long-run cost function. In economics theory, the short-run is defined as that period during which the physical capacity of the firm is fixed and the output can be increased only by using the existing capacity allows to bring changes in output by physical capacity of the firm.

#### **a. Cost-Output Relation in the short-run:**

The cost concepts made use of in the cost behavior are total cost, Average cost, and marginal cost.

Total cost is the actual money spent to produce a particular quantity of output.

Total cost is the summation of fixed and variable costs.

$$TC = TFC + TVC$$

Up to a certain level of production total fixed cost i.e., the cost of plant, building, equipment etc, remains fixed. But the total variable cost i.e., the cost of labour, raw materials etc., Vary with the variation in output. Average cost is the total cost per unit. It can be found out as follows.

$$\text{—} \quad AC = \frac{TC}{Q}$$

### Q

The total of average fixed cost (TFC/Q) keep coming down as the production is increased and average variable cost (TVC/Q) will remain constant at any level of output.

Marginal cost is the addition to the total cost due to the production of an additional unit of product. It can be arrived at by dividing the change in total cost by the change in total output.

In the short-run there will not be any change in total fixed cost. Hence change in total cost implies change in total variable cost only.

#### Cost – output relations

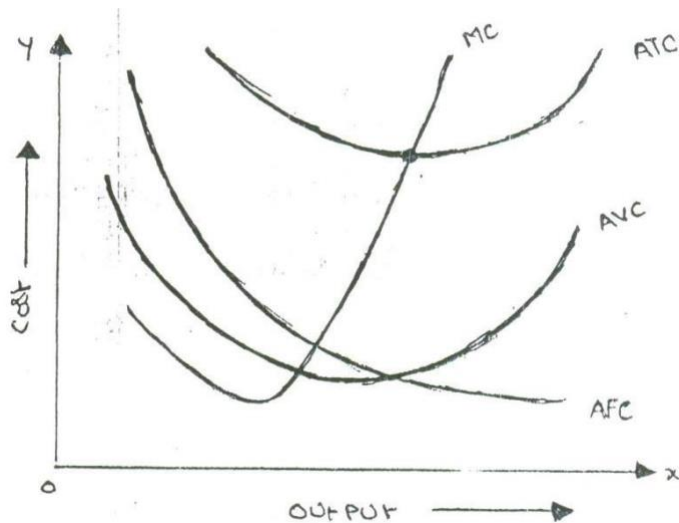
Units of Output Q	Total fixed cost TFC	Total variable cost TVC	Total cost (TFC + TVC) TC	Average variable cost (TVC / Q) AVC	Average fixed cost (TFC / Q) AFC	Average cost (TC/Q) AC	Marginal cost MC
0	-	-	60	-	-	-	-
1	60	20	80	20	60	80	20
2	60	36	96	18	30	48	16
3	60	48	108	16	20	36	12
4	60	64	124	16	15	31	16
5	60	90	150	18	12	30	26
6	60	132	192	22	10	32	42

The above table represents the cost-output relation. The table is prepared on the basis of the law of diminishing marginal returns. The fixed cost Rs. 60 May include rent of factory building, interest on capital, salaries of permanently employed staff, insurance etc. The table shows that fixed cost is same at all levels of output but the average fixed cost, i.e., the fixed cost per unit, falls continuously as the output increases. The expenditure on the variable factors (TVC) is at different rate. If more and more units are produced with a given physical capacity the AVC will fall initially, as per the table declining up to 3<sup>rd</sup> unit, and being constant up to 4<sup>th</sup> unit and then rising. It implies that variable factors produce more efficiently near a firm's optimum capacity than at any other levels of output.

And later rises. But the rise in AC is felt only after the start rising. In the table 'AVC' starts rising from the 5<sup>th</sup> unit onwards whereas the 'AC' starts rising from the 6<sup>th</sup> unit only so long as 'AVC' declines 'AC' also will decline. 'AFC' continues to fall with an increase in Output. When the rise in 'AVC' is more than the decline in 'AFC', the total cost again begin to rise. Thus there will be a stage where the 'AVC', the total cost again begin to rise thus there will be a stage where the 'AVC' may have started rising, yet the 'AC' is still declining because the rise in 'AVC' is less than the drop in 'AFC'.

Thus the table shows an increasing returns or diminishing cost in the first stage and diminishing returns or diminishing cost in the second stage and followed by diminishing returns or increasing cost in the third stage.

The short-run cost-output relationship can be shown graphically as follows.



In the above graph the "AFC" curve continues to fall as output rises an account of its spread over more and more units Output. But AVC curve (i.e. variable cost per unit) first falls and than rises due to the operation of the law of variable proportions. The behavior of "ATC" curve depends upon the behavior of 'AVC' curve and 'AFC' curve. In the initial stage of production both 'AVC' and 'AFC' decline and hence 'ATC' also decline. But after a certain point 'AVC' starts rising. If the rise in variable cost is less than the decline in fixed cost, ATC will still continue to decline otherwise AC begins to rise. Thus the lower end of 'ATC' curve thus turns up and gives it a U-shape. That is why 'ATC' curve are U-shaped. The lowest point in 'ATC' curve indicates the least-cost

combination of inputs. Where the total average cost is the minimum and where the "MC" curve intersects 'AC' curve, it is not the maximum output level rather it is the point where per unit cost of production will be at its lowest.

The relationship between 'AVC', 'AFC' and 'ATC' can be summarized up as follows:

- b. If both AFC and 'AVC' fall, 'ATC' will also fall.
- c. When 'AFC' falls and 'AVC' rises
  - i. 'ATC' will fall where the drop in 'AFC' is more than the rise in 'AVC'.
  - ii. 'ATC' remains constant if the drop in 'AFC' = rise in 'AVC'
  - iii. 'ATC' will rise where the drop in 'AFC' is less than the rise in 'AVC'

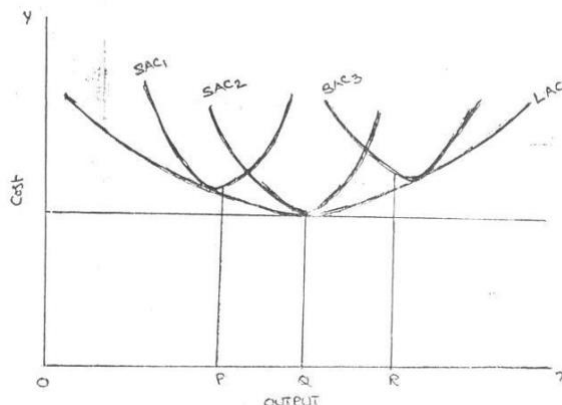
### **b. Cost-output Relationship in the long-run:**

Long run is a period, during which all inputs are variable including the one, which are fixed in the short-run. In the long run a firm can change its output according to its demand. Over a long period, the size of the plant can be changed, unwanted buildings can be sold staff can be increased or reduced. The long run enables the firms to expand and scale of their operation by bringing or purchasing larger quantities of all the inputs. Thus in the long run all factors become variable.

The long-run cost-output relations therefore imply the relationship between the total cost and the total output. In the long-run cost-output relationship is influenced by the law of returns to scale.

In the long run a firm has a number of alternatives in regards to the scale of operations. For each scale of production or plant size, the firm has an appropriate short-run average cost curves. The short-run average cost (SAC) curve applies to only one plant whereas the long-run average cost (LAC) curve takes in to consideration many plants.

The long-run cost-output relationship is shown graphically with the help of "LAC" curve.



To draw on 'LAC' curve we have to start with a number of 'SAC' curves. In the above figure it is assumed that technologically there are only three sizes of plants – small, medium and large, 'SAC', for the small size, 'SAC2' for the medium size plant and 'SAC3' for the large size plant. If the firm wants to produce 'OP' units of output, it will choose the smallest plant. For an output beyond 'OQ' the firm wills optimum for medium size plant. It does not mean that the OQ production is not possible with small plant. Rather it implies that cost of production will be more with small plant compared to the medium plant.

For an output 'OR' the firm will choose the largest plant as the cost of production will be more with medium plant. Thus the firm has a series of 'SAC' curves. The 'LCA' curve drawn will be tangential to the entire family of 'SAC' curves i.e. the 'LAC' curve touches each 'SAC' curve at one point, and thus it is known as envelope curve. It is also known as planning curve as it serves as guide to the entrepreneur in his planning to expand the production in future. With the help of 'LAC' the firm determines the size of plant which yields the lowest average cost of producing a given volume of output it anticipates.

### **BREAKEVEN ANALYSIS**

The study of cost-volume-profit relationship is often referred as BEA. The term BEA is interpreted in two senses. In its narrow sense, it is concerned with finding out BEP; BEP is the point at which total revenue is equal to total cost. It is the point of no profit, no loss. In its broad determine the probable profit at any level of production.

#### **Assumptions:**

1. All costs are classified into two – fixed and variable.
2. Fixed costs remain constant at all levels of output.
3. Variable costs vary proportionally with the volume of output.
4. Selling price per unit remains constant in spite of competition or change in the volume of production.
5. There will be no change in operating efficiency.
6. There will be no change in the general price level.
7. Volume of production is the only factor affecting the cost.
8. Volume of sales and volume of production are equal. Hence there is no unsold stock.

9. There is only one product or in the case of multiple products. Sales mix remains constant.

**Merits:**

1. Information provided by the Break Even Chart can be understood more easily than those contained in the profit and Loss Account and the cost statement.
2. Break Even Chart discloses the relationship between cost, volume and profit. It reveals how changes in profit. So, it helps management indecision-making.
3. It is very useful for forecasting costs and profits long term planning and growth
4. The chart discloses profits at various levels of production.
5. It serves as a useful tool for cost control.
6. It can also be used to study the comparative plant efficiencies of the industry.
7. Analytical Break-even chart present the different elements, in the costs – direct material, direct labour, fixed and variable over heads.

**Demerits:**

1. Break-even chart presents only cost volume profits. It ignores other considerations such as capital amount, marketing aspects and effect of government policy etc., which are necessary in decisionmaking.
2. It is assumed that sales, total cost and fixed cost can be represented as straight lines. In actual practice, this may not be so.
3. It assumes that profit is a function of output. This is not always true. The firm may increase the profit without increasing its output.
4. A major draw back of BEC is its inability to handle production and sale of multiple products.
5. It is difficult to handle selling costs such as advertisement and sale promotion in BEC.
6. It ignores economics of scale in production.
7. Fixed costs do not remain constant in the long run.
8. Semi-variable costs are completely ignored.
9. It assumes production is equal to sale. It is not always true because generally there may be opening stock.



10. When production increases variable cost per unit may not remain constant but may reduce on account of bulk buying etc.
  11. The assumption of static nature of business and economic activities is a well-known defect of BEC.
- 
1. Margin of safety: Margin of safety is the excess of sales over the break even sales. It can be expressed in absolute sales amount or in percentage. It indicates the extent to which the sales can be reduced without resulting in loss. A large margin of safety indicates the soundness of the business.

Margin of safety can be improved by taking the following steps.

1. Increasing production
2. Increasing selling price
3. Reducing the fixed or the variable costs or both
4. Substituting unprofitable product with profitable one.

Present sales – Breakeven sales or Profit

5. Angle of incidence:

This is the angle between sales line and total cost line at the Break-even point. It indicates the profit earning capacity of the concern. Large angle of incidence indicates a high rate of profit; a small angle indicates a low rate of earnings. To improve this angle, contribution should be increased either by raising the selling price and/or by reducing variable cost. It also indicates as to what extent the output and sales price can be changed to attain a desired amount of profit.





## I. Multiple Choice Questions:

<b>SNO.</b>	
<b>1</b>	The ratio of input to output is called _____. (a) <b>production</b> (b)consumption (c)Iso quant (d)productivity
<b>2</b>	The product indifference curve is also called _____. Isocost <b>(b) Isoquant</b> (c)Isocurve(d) Economic of scale
<b>3</b>	The cost of the best alternative foregone is called _____. <b>rtunity cost</b> (b)marginal cost (c)average cost (d)total cost
<b>4</b>	ess of actual production over and above the break-even point of production is called _____. (a)BEP <b>(b)contribution</b> (c) angle of incidence (d)margin of safety
<b>5</b>	f the point at which the revenue of the business equals cost _____. )margin of safety <b>(b)BEP</b> (c)equilibrium point (d)contribution
<b>6</b>	Which of the following refers to the expenditure incurred to produce a particular product or service? (a) profit (b)price (c)capital <b>(d)cost</b>
<b>7</b>	Factory rent is the example of _____. <b>fixed cost</b> (b)varial cost(c)sunk cost(d)book cost
<b>8</b>	Raw material is the example of _____. (a)fixed cost <b>(b)variable cost</b> (c)sunk cost(d)book cost
<b>9</b>	Profit = _____. (a)selling price – variable cost <b>(b)contribution+fixed cost</b> (c)contribution-fixed cost (d)BEP
<b>10</b>	Depreciation is the example of _____. (a)fixed cost(b)variable cost (c)sunk cost <b>(d)book cost</b>
<b>11</b>	Which of the following is not a factor of production (a)land <b>(b)profit</b> (c) labour (d)capital
<b>12</b>	ssifies the economies of scale? (a)Paul. A. Samuelson (b) Prof. Lionel Robbins (c) Adam Smith <b>(d)Alfred Marshal</b>
<b>13</b>	of the following is not a synonym for “no profit –no loss” P(b)Break even analysis P analysis <b>(d)Marginal costing</b>
<b>14</b>	Selling price minus variable cost is called _____. atio <b>(b) Contribution</b> (c) Margin of safety (d) Angle of incidence

15	Managerial economics are the part of (a)external economics (b) internal economics(c) both A&B (d) None
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## 2 Marks Questions and Answers

### 1) Define production function and write formula for production function?

a) Production function is defined as a technical relationship between a given set of inputs and the possible output from it. It is a function that defines the maximum amount of output that can be produced with a given set of output

$$Q=f(L_1, L_2, C, O, T) \text{ (LAND, LABOUR, CAPITAL, ORGANIZATION, TECHNOLOGY)}$$

### 2) Meaning of Isoquant?

a) Isoquant refers to the curve throughout which equal quantity is obtained from several combinations of inputs underlying it.

### 3) Meaning of Isocost?

a) Isocost refers to that cost curve which represents the combination of inputs that will cost the firm the same amount of money.

### 4) Explain Cobb – Douglas production function?

a) Cobb and Douglas formulated a production function, in the context of USA, which revealed constant returns to scale. There were no economies or diseconomies resulting from large scale production. According to Cobb and Douglas

$$P=bL^aC^{1-a}$$

P=total output

L=the index of employment of labour in manufacturing

a, a-1 are the elasticities of production

### 5) MRTS.

a) 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

$$\text{MRTS} = \frac{\text{Change in one input, say, capital}}{\text{Change in another input, say, labour}}$$

### 6) Define cost?

a) Cost is defined as the sacrifice made to acquire some benefit. Cost is the expenditure incurred to produce a particular product or service

### 7) Explain about BEA point?

A) Break even analysis refers to analysis of the breakeven point. The BEP is defined as no profit or no loss point. In another words, it points out how much minimum is to be produced to see the profits.  $BEP = (TR = TC)$

**8) What is the meaning of laws of returns?**

a) Laws of returns to scale, refers to the returns enjoyed by the firm as a result of change in all the inputs. There are three returns

a) Laws of increasing returns to scale

b) Laws of constant returns to scale

c) Laws of decreasing returns to scale

**9) Explain about internal economies of scale?**

a) Internal economies refer to the economies in production costs which accrue to the firm alone when it expands its output. The internal economies occur as a result of increase in the scale of production.

**10) Explain about external economies of scale?**

a) External economies refer to all the firms in the industry, because of growth of the industry as a whole or because of growth of ancillary industries. External economies benefit all the firms in the industry as the industry expands

**11) Explain explicit cost and implicit cost?**

a) Explicit costs are those expenses that involve cash payments. These are the actual or business costs that appear in the books of accounts. These costs include payment of wages and salaries

Implicit costs are the costs of the factor units that are owned by the employer himself. These costs are not actually incurred but would have been incurred in the absence of employment of self – owned factors.

**12) Explain out of pocket cost and book cost?**

a) Out-of pocket costs also known as explicit costs are those costs that involve current cash payment. Book costs also called implicit costs do not require current cash payments. But the book costs are taken into account in determining the level dividend payable during a period.

**13) Explain fixed cost and variable cost**

a) Fixed cost is that cost which remains constant for a certain level to output. It is not affected by the changes in the volume of production. But fixed cost per unit decrease, when the production is increased. Fixed cost includes salaries, Rent, Administrative expenses depreciations etc.

Variable is that which varies directly with the variation is output. An increase in total output results in an increase in total variable costs and decrease in total output results in a proportionate decline in

the total variable costs. The variable cost per unit will be constant. Ex: Raw materials, labour, direct expenses, etc.

**14) write formulas of breakeven point ?**

1. Break Even point (Units) =  $\frac{\text{Fixed Expenses}}{\text{Contribution per unit}}$
2. Break Even point (In Rupees) =  $\frac{\text{Fixed expenses}}{\text{Contribution}} \times \text{sales}$

**15) what is diseconomies of scale?**

a) Internal and external diseconomies are the limits to large-scale production. It is possible that expansion of a firm's output may lead to rise in costs and thus result diseconomies instead of economies.

**16) what are the merits of BEA**

A) Information provided by the Break Even Chart can be understood more easily than those contained in the profit and Loss Account and the cost statement. AND Break Even Chart discloses the relationship between cost, volume and profit. It reveals how changes in profit. So, it helps management in decision-making.

**17) What are demerits of BEA**

1. Break-even chart presents only cost volume profits. It ignores other considerations such as capital amount, marketing aspects and effect of government policy etc., which are necessary in decision making.
2. It is assumed that sales, total cost and fixed cost can be represented as straight lines. In actual practice, this may not be so.
3. It assumes that profit is a function of output. This is not always true. The firm may increase the profit without increasing its output.

**18) what is the meaning of contribution ?**

a) Contribution is the difference between sales and variable costs and it contributed towards fixed costs and profit.

$$\text{Contribution} = \text{Sales} - \text{Variable cost}$$

$$\text{Contribution} = \text{Fixed Cost} + \text{Profit.}$$

**19) what is margin of safety ?**

a) Margin of safety is the excess of sales over the break even sales. It can be expressed in absolute sales amount or in percentage. The formula for the margin of safety is

$$\text{Present sales} - \text{Break even sales} \quad \text{or} \quad \frac{\text{Profit}}{\text{P. V. ratio}}$$



20) what is angle of incidence ?

a) This is the angle between sales line and total cost line at the Break-even point. It indicates the profit earning capacity of the concern.