MANAGERIAL ECONOMICS

UNIT-3

Cost Analysis

A production function tells us how much output a firm can produce with its existing plant and equipment. The level of output depends on prices and costs. The most desirable rate of output is the one that maximizes total profit that is the difference between total revenue and total cost.

Entrepreneurs pay for the input factors- Wages for labour, price for raw material, rent for building hired, interest for borrowed money. All these costs are included in the cost of production. The economist's concept of cost of production is different from accounting.

This chapter helps us to understand the basic cost concepts and the cost output relationship in the short and long runs. Having looked at input factors in the previous chapter it is now possible to see how the law of diminishing returns affect short run costs.

Cost Determinants

The cost of production of goods and services depends on various input factors used by the organization and it differs from firm to firm. The major cost determinants are:

1. Level of output: The cost of production varies according to the quantum of output. If the size of production is large then the cost of production will also be more.

2. Price of input factors: A rise in the cost of input factors will increase the total cost of production.

3. Productivities of factors of production: When the productivity of the input factors is high then the cost of production will fall.

4. Size of plant: The cost of production will be low in large plants due to mass production with mechanization.

5. Output stability: The overall cost of production is low when the output is stable over a period of time.

6. Lot size: Larger the size of production per batch then the cost of production will come down because the organizations enjoy economies of scale.

7. Laws of returns: The cost of production will increase if the law of diminishing returns applies in the firm.

8. Levels of capacity utilization: Higher the capacity utilization, lower the cost of production

9. Time period: In the long run cost of production will be stable.

10. Technology: When the organization follows advanced technology in their process then the

cost of production will be low.

11. Experience: over a period of time the experience in production process will help the firm to reduce cost of production.

12. Process of range of products: Higher the range of products produced, lower the cost of production.

13. Supply chain and logistics: Better the logistics and supply chain, lower the cost of production.

14. Government incentives: If the government provides incentives on input factors then the cost of production will be low.

Types Of Costs

There are various classifications of costs based on the nature and the purpose of calculation. But in economics and for accounting purpose the following are the important cost concepts.

Actual cost/ Outlay cost/ Absolute cost / Accounting cost: The cost or expenditure which a firm incurs for producing or acquiring a good or service. (Eg. Raw material cost)

Opportunity cost: The revenue which could have been earned by employing that good or service in some other alternative uses. (Eg. A land owned by the firm does not pay rent. Thus a rent is an income forgone by not letting it out)

Sunk cost: Are retrospective (past) costs that have already been incurred and cannot be recovered.

Historical cost: The price paid for a plant originally at the time of purchase.

Replacement cost: The price that would have to be paid currently for acquiring the same plant.

Incremental cost: Is the addition to costs resulting from a change in the nature of level of business activity. Change in cost caused by a given managerial decision.

Explicit cost: Cost actually paid by the firm. If the factors of production are hired or rented then it is an explicit cost.

Implicit cost: If the factors of production are owned by a firm then its cost is implicit cost.

Book cost: Costs which do not involve any cash payments but a provision is made in the books of accounts in order to include them in the profit and loss account to take tax advantages.

Social cost: Total cost incurred by the society on account of production of a good or service.

Transaction cost: The cost associated with the exchange of goods and services.

Controllable cost: Costs which can be controllable by the executives are called as controllable cost.

Shut down cost: Cost incurred if the firm temporarily stops its operation. These can be saved by continuing business.

Economic costs are related to future. They play a vital role in business decisions as the costs considered in decision - making are usually future costs. They are similar in nature to that of incremental, imputed explicit and opportunity costs.

Determinants Of Short –Run Cost

Fixed cost: Some inputs are used over a period of time for producing more than one batch of goods. The costs incurred in these are called fixed cost. For example amount spent on purchase of equipment, machinery, land and building.

Variable cost: When output has increased the firm spends more on these items. For example the money spent on labour wages, raw material and electricity usage. Variable costs vary according to the output. In the long run all costs become variable.

Total cost: The market value of all resources used to produce a good or service.

Total Fixed cost: Cost of production remains constant whatever the level of output.

Total Variable cost: Cost of production varies with output.

Average cost: Total cost divided by the level of output.

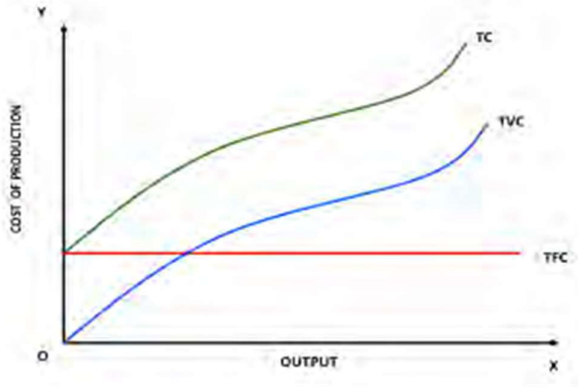
Average variable cost: Variable cost divided by the level of output. **Average fixed cost:** Total fixed cost divided by the level of output. **Marginal cost:** Cost of producing an extra unit of output.

Short Run Cost Output Relationship

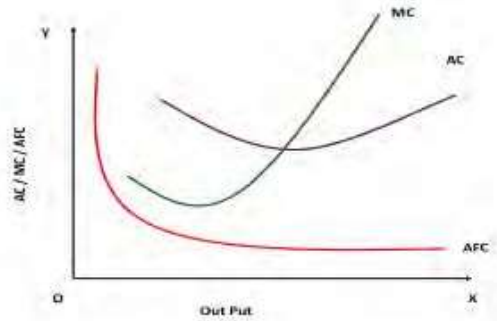
Fixed cost curve is a horizontal line which is parallel to the 'X' axis. This cost is constant with respect to output in the short run. Fixed cost does not change with output. It must be paid even if '0' units of output are produced. For example: if you have purchased a building for the business you have invested capital on building even if there is no production.

Total fixed cost (TFC) consists of various costs incurred on the building, machinery, land, etc.. For example if you have spent Rs. 2 Lakhs and bought machinery and building which is used to produce more than one batch of commodity, then the same cost of Rs. 2 Lakhs is fixed cost for all batches. The total variable costs vary according to the output. Whenever the output increases the firm has to buy more raw materials, use more electricity, labour and other sources therefore the TVC curve is upward sloping. The total cost consists of fixed (TFC) and variable costs (TVC). The TFC of Rs. 2 Lakhs is included with the variable cost throughout the production schedule so the total cost (TC) is above the TVC line.

Graph – Total Cost Curves



Graph – Average Cost Curves



The above set of graphs indicates clearly that the average variable cost curve looks like a boat. Average fixed cost curve declines as output increases and it is a hyperbola to the origin. The Marginal cost curve slopes like a tick mark which declines up to an extent then it starts increasing along with the output. Let us see and understand the nature of each and every curve with an example.

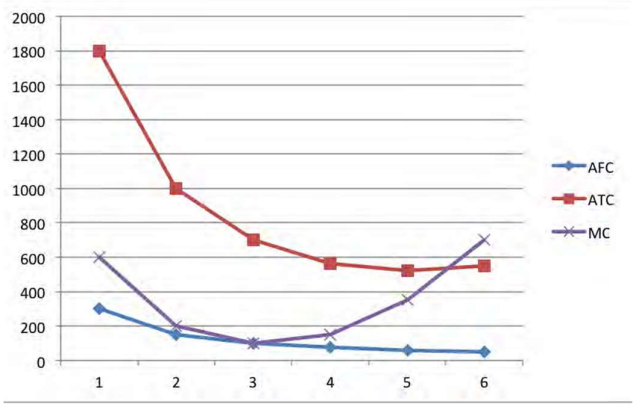
The table and graphs shown below indicates the total costs curves and average cost curves at various output level.

Table - Cost Schedule

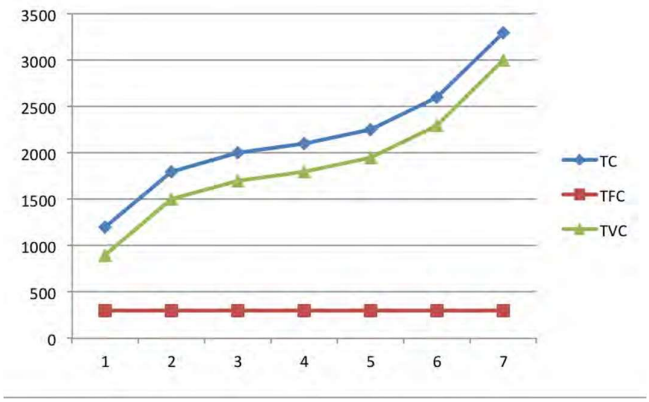
(Rupees in thousands '000)

Output	TC	TFC	TVC	AFC	ATC	AVC	MC
0	v1200	300	-	-	-	-	-
1	1800	300	1500	300	1800	1500	600
2	2000	300	1700	150	1000	850	200
3	2100	300	1800	100	700	600	100
4	2250	300	1950	75	562.5	487.5	150
5	2600	300	2300	60	520	460	350
6	3300	300	3000	50	550	500	700

Graph – Average Cost Curves



Graph – Total Cost Curves



From the above table and set of graphs we can understand that capital is the fixed factor of production and the total fixed cost will be the same Rs. 300,000. The total variable cost will increase as more and more goods are produced. So the total variable cost TVC of producing 1 unit is Rs.1500 000, for 2 units 1700 000 and so on.

Total cost = TFC + TVC for 1 unit TC = 300 + 1500 = 1800.

The marginal cost of producing an extra unit is calculated based on the difference in total cost.

$MC_n = TC_n - TC_{n-1}$

MC2 = TC2 – TC 2-1 = 2000 – 1800 = 200

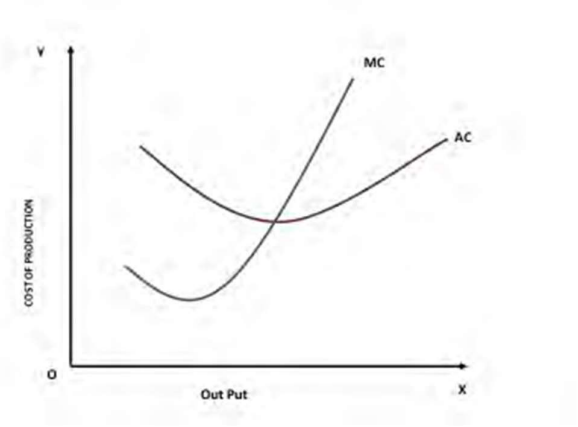
MC for 5^{th} unit = TC of 5^{th} unit minus TC of 4^{th} unit, in our example 2600 – 2250 = 350.

AVC also is calculated in the same manner TVC / output = 2600 / 5 = 460 AFC = TFC / output = 300 / 5 = 60.

Relationship Between Marginal Cost And Average Cost Curve:

The marginal cost and average cost curves are U shaped because of law of diminishing returns. The marginal cost curve cuts the average cost curve and average variable cost curves at their lowest point. Marginal cost curve cuts the average variable cost from below. The AC curve is above the MC curve when AC is falling. The AC curve is below the MC when AC is increasing. The intersecting point indicates that AC=MC and that is the minimum average cost with an optimum output. (No more output can be produced at this average cost without increasing the fixed cost of production)

Graph – Relationship Between Average Cost And Marginal Cost

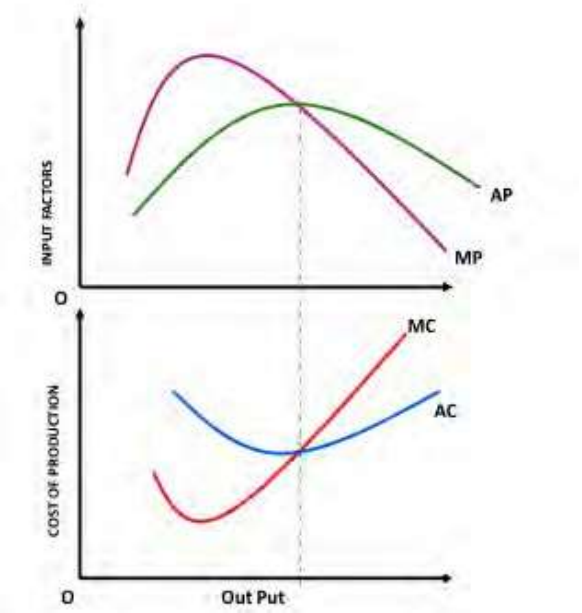


Optimum Output And Minimum Cost

The MC and AC curves are mirror image of the MP and AP curves.
It is presented in the graph below.

All organizations aim for maximum output with minimum cost. To achieve this goal they like to derive the point where optimum output can be produced with the given amount of input factors and with a minimum average cost. In the graph the MP=AP at maximum average production. On the other hand MC = AC at minimum average variable cost. Therefore this is the optimum output to be produced to achieve their managerial goals.

Graph – Optimum Cost And Output

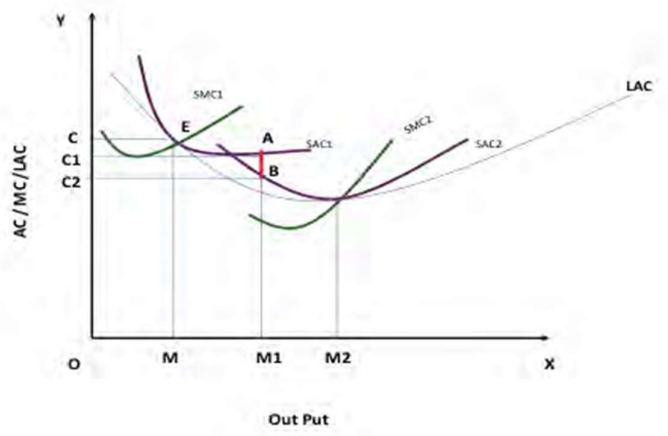


The above set of cost curves explain the cost output relationship in the short period but in the long run there is no fixed cost because all costs vary over a period of time. Therefore in the long run the firm will have only average cost curve that is called as long run average cost curve (LAC). Let us see how the average cost curve is derived in the long run. This LAC also slopes like the short period average cost curve (U shaped) provided the law of diminishing returns prevails. In case the returns to scale are increasing or constant then the LAC curve will have a different slope. It will be a horizontal line, which is parallel to the 'X' axis.

Cost Output Relationship In The Long Run

In the long run costs fall as output increases due to economies of scale, consequently the average cost AC of production falls. Some firms experience diseconomies of scale if the average cost begins to increase. This fall and rise derives a U shaped or boat shaped average cost curve in the long run which is denoted as LAC. The minimum point of the curve is said to be the optimum output in the long run. It is explained graphically in the chart given below.

Graph – Long Run Average Cost Curve



In the long run all factors are variable and the average cost may fall or increase to A, B respectively but all these costs are above the long run cost average cost. LAC is the lower envelope of all the short run average cost curves because it contains them all. At point 'E' the SAC1 and SMC1 intersects each other, in case the organization increases its output from OM to OM1 they have to spend OC1 amount. In case the organization purchases one more machine (increase in fixed cost) then they will get a new set of cost curves SAC2, and SMC2. But the new average cost curve reduces the cost of production from OC1 to OC2.That means they can save the difference of C1C2 which is nothing but AB. Therefore in the long run due to business expansion a firm can reduce their cost of production. During their business life they will meet many combinations of optimum production and minimum cost in different short periods. In the long run due to law of diminishing returns the long run average cost curve LAC also slopes like boat shape.

PRODUCTION FUNCTION

Production is an important economic activity which satisfies the wants and needs of the people. Production function brings out the relationship between inputs used and the resulting output. A firm is an entity that combines and processes resources in order to produce output that will satisfy the consumer's needs. The firm has to decide as to how much to produce and how much input factors (labour and capital) to employ to produce efficiently. This chapter helps to understand the set of conditions for efficient production of an organization.

Factors of production include resource inputs used to produce goods and services. Economist categorise input factors into four major categories such as land, labour, capital and organization.

Land: Land is heterogeneous in nature. The supply of land is fixed and it is a permanent factor of production but it is productive only with the application of capital and labour.

Labour: The supply of labour is inelastic in nature but it differs in productivity and efficiency and it can be improved.

Capital: is a man made factor and is mobile but the supply is elastic.

Organization: the organization plans, , supervises, organizes and controls the business activity and also takes risks.

Production Function

Production function indicates the maximum amount of commodity 'X' to be produced from various combinations of input factors. It decides on the maximum output to be produced from a given level of input, and how much minimum input can be used to get the desired level of output. The production function assumes that the state of technology is fixed. If there is a change in technology then there would be change in production function.

Q = f (Land, Labour, Capital, Organization) Q = f (L, L, C, O)

The production manager's responsibility is that of identifying the right combination of inputs for the decided quantity of output. As a manager ,he has to know the price of the input factors and the budget allocation of the organization. The major objective of any business organization is maximizing the output with minimum cost. To achieve the maximum output the firm has to utilize the input factors efficiently. In the long run, without increasing the fixed factors it is not possible to achieve the goal. Therefore it is necessary to understand the relationship between the input and output in any production process in the short and long run.

Cobb Douglas Production Function:

This is a function that defines the maximum amount of output that can be produced with a given level of inputs. Let us assume that all input factors of production can be grouped into two categories such as labour

(L) and capital (K).The general equilibrium for the production function is Q = f (K, L)

There are various functional forms available to describe production. In general Cobb-Douglas

production function (Quadratic equation) is widely used

$Q = A K^{\alpha} L^{\beta}$

Q = the maximum rate of output for a given rate of capital (K) and labour (L).

Short Run Production Function:

In the short run, some inputs (land, capital) are fixed in quantity. The output depends on how much of other variable inputs are used. For example if we change the variable input namely (labour) the production function shows how much output changes when more labour is used. In the short run producers are faced with the problem that some input factors are fixed. The firms can make the workers work for longer hours and also can buy more raw materials. In that case, labour and raw material are considered as variable input factors. But the number of machines and the size of the building are fixed. Therefore it has its own constraints in producing more goods.

In the long run all input factors are variable. The producer can appoint more workers, purchase more machines and use more raw materials. Initially output per worker will increase up to an extent. This is known as the **Law of Diminishing Returns** or the **Law of Variable Proportion.** To understand the law of diminishing returns it is essential to know the basic concepts of production.

Measures Of Productivity

Total production (TP): the maximum level of output that can be produced with a given amount of input.

Average Production (AP): output produced per unit of input AP = Q/L

Marginal Production (MP): the change in total output produced by the last unit of an input

Marginal production of labour = $\Delta Q / \Delta L$ (i.e. change in the quantity produced to a given change in the labour)

Marginal production of capital = $\Delta Q / \Delta K$ (i.e. change in the quantity produced to a given change in the capital)

Production Function:

A production function, like any other function can be expressed and analysed by any one or more of the three tools namely table, graph and equation. The maximum amounts of output attainable from various alternative combinations of input factors are given in the table.

The production function expressed in tabular form is as follows.

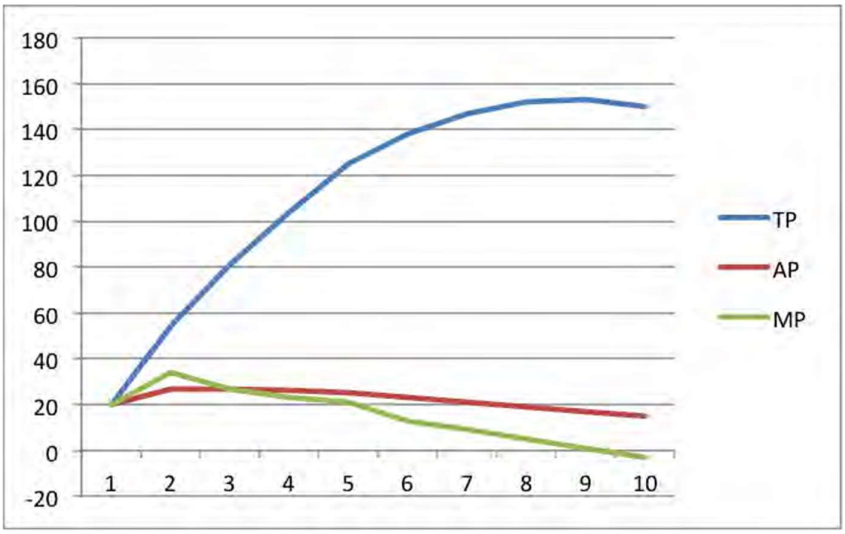
Table - Production Schedule

Labour	TP	AP	MP
1	20	20	0
2	54	27	34
3	81	27	27
4	104	26	23
5	125	25	21
6	138	23	13
7	147	21	9
8	152	19	5
9	153	17	1
10	150	15	-3

The firm has a set of fixed variables. As long with that it increases the labour force from 1 unit to 10 units. The increase in input factor leads to increase in the output up to an extent. After that it start declining. Marginal production increases in the initial period and then it starts declining and it become negative. The firm should stop increasing labour force if the marginal production is zero- that is the maximum output that can be derived with the available fixed factors. The 9^{th} labour does not contribute to any output. In case the firm wants to increase the output beyond 153 units it has to improve its fixed variable. That means purchase of new machinery or building is essential. Therefore the firm understands that the maximum output is 153 units with the given set of input factors.

The graphical representations of the production function are as shown in the following graph.

Graph-Production Curves



The graphical presentations of the values are shown in the graph. The 'X" axis denotes the labour and the 'Y' axis indicates the total production (TP), average production (AP) and marginal production (MP). From the given table and graph we can understand all the three curves in the graph increased in the beginning and the marginal product (MP) first fell, then the average product (AP) finally total production (TP). The marginal production curve MP cuts the AP at its highest point. Total production TP falls when marginal production curve cuts the 'X' axis. The law of diminishing returns states that if increasing quantity of a variable input are combined with fixed, eventually the marginal product and then average product will decline.

When the production function is expressed as an equation it shall be as follows:

$Q = f(Ld, L, K, M, T)$

It can be expressed as $Q = f1, f2, f3, f4, f5 > 0$

Where,

Q = Output in physical units of good X
Ld = Land units employed in the production of Q
L = Labour units employed in the production of Q K = Capital units employed in the production of Q
M = Managerial Units employed in the production of Q T = Technology employed in the production of Q
f = Unspecified function
fi = Partial derivative of Q with respect to ith input.

This equation assumes that output is an increasing function of all inputs.

The Law Of Diminishing Returns

In the combination of input factors when one particular factor is increased continuously without changing other factors the output will increase in a diminishing manner. Let us assume that a person preparing for an examination continuously prepares without any break. The output or the understanding and the coverage of the syllabus will be more in the beginning rather than in the later stages. There is a limit to the extent to which one factor of production can be substituted for another. The total production increases up to an extent and it gets saturated or there won't be any change in the output due to the addition of the input factor and further it leads to negative impact on the output. That means the marginal production declines up to an extent and it reaches zero and becomes negative. The point at which the MP becomes zero is the maximum output of the firm with the given set of input factors. This law is applicable in all human activities and business activities.

For example with two sewing machines and two tailors, a firm can produce a maximum of 14 pairs of curtains per day. The machines are used only from 9 AM to 5 PM and the machines lie idle from 5 pm onwards. Therefore the firm appoints 2 more tailors for the second shift and the production goes up to 28 units. Then adding two more labour to assist these people will increase the output to 30 units. When the firm appoints two more people, then there won't be any change in their production because their Marginal productivity is zero. There is no addition in the total production. That means there is no use of appointing two more

tailors. Therefore, there is a limit for output from a fixed input factors but in the long run purchase of one more sewing machine alone will help the firm to increase the production more than 30 units.

The Law Of Returns To Scale

In the long run the fixed inputs like machinery, building and other factors will change along with the variable factors like labour, raw material etc. With the equal percentage of increase in input factors various combinations of returns occur in an organization.

Returns to scale: the change in percentage output resulting from a percentage change in all the factors of production. They are increasing, constant and diminishing returns to scale.

Increasing returns to scale may arise: if the output of a firm increases more than in proportionate to an increase in all inputs. For example the input factors are increased by 50% but the output has doubled (100%).

Constant returns to scale: when all inputs are increased by a certain percentage the output increases by the same percentage. For example input factors are increased by 50% then the output has also increased by 50 percentages. Let us assume that a laptop consists of 50 components we call it as a set. In case the firm purchases 100 sets they can assemble 100 laptops but it is not possible to produce more than 100 units.

Diminishing returns to scale: when output increases in a smaller proportion than the increase in inputs it is known as diminishing return to scale. For example 50% increment in input factors lead to only 20% increment in the output.

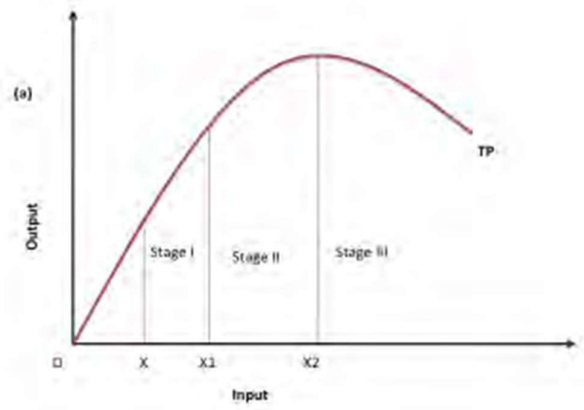
From the graph given below we can see the total production (TP) curve and the marginal production curve (MP) and average production curve (AP). It is classified into three stages; let us understand the stages in terms of returns to scale.

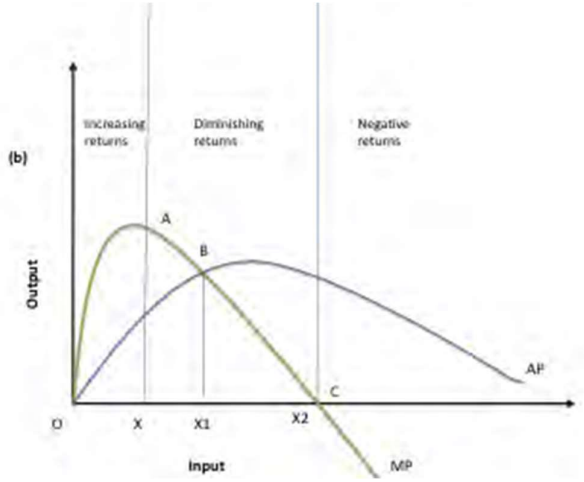
Stage I: The total production increased at an increasing rate. We refer to this as increasing stage where the total product, marginal product and average production are increasing.

Stage II: The total production continues to increase but at a diminishing rate until it reaches the next stage. Marginal product, average product are declining but are positive. The total production is at the maximum level at the end of the second stage with a zero marginal product.

Stage III: In this third stage total production declines and marginal product becomes negative. And the average production also started decline. Which implies that the change in input factors there is a decline in the over all production along with the average and marginal.

In economics, the production function with one variable input is illustrated with the well known law of variable proportions. (below graph) it shows the input-output relationship or production function with one factor variable while other factors of production are kept constant. To understand a production function with two variable inputs, it is necessary know the concept **iso-quant or iso-product curve.**

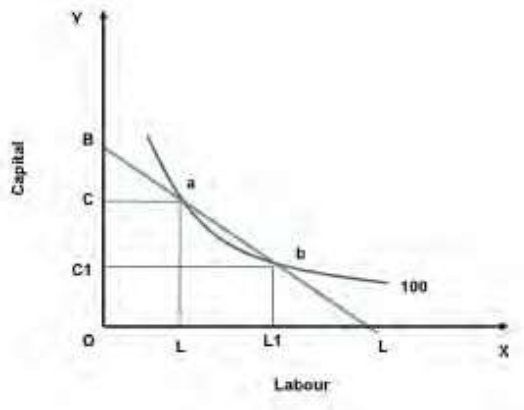

(a)
Output
TP
Stage I
Stage II
Stage III
O
X
X1
X2
Input


(b)
Increasing returns
Diminishing returns
Negative returns
Output
A
B
AP
C
O
X
X1
X2
Input
MP

ISO-Quants

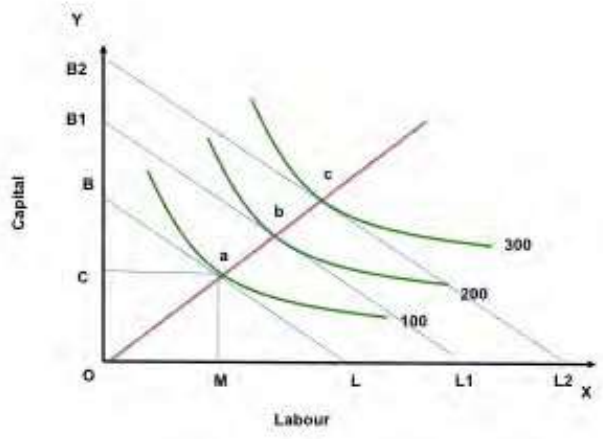
To understand the production function with two variable inputs, iso-quant curve is used. These curves show the various combinations of two variable inputs resulting in the same level of output. The shape of an Iso-quant reflects the ease with which a producer can substitute among inputs while maintaining the same level of output. From the graph we can understand that the iso-quant curve indicates various combinations of capital and labour usage to produce 100 units of motor pumps. The points a, b or any point in the curve indicates the same quantum of production. If the production increases to 200 or 300 units definitely the input usage will also increase therefore the new iso-quant curve for 200 units (Q1) is shifted upwards. Various iso-quant curves presented in a graph is called as iso- quant map.

Iso-cost: different combination of inputs that can be purchased at a given expenditure level.



The above graph explains clearly that the iso quant curve for 100 units of motor consists of 'n' number of input combinations to produce the same quantity. For example at 'a' to produce 100 units of motors the firm uses OC amount of capital and OL amount of labour ie., more capital and less labour force. At 'b' OC1 amount of capital and OL1 labour force is used to produce the same that means more labour and less capital.

Optimal input combination: The points of tangency between iso quant and iso cost curves depict optimal input combination at different activity levels.



Expansion path: Optimal input combinations as the scale of production expand. From the graph it is clear that the optimum combination is selected based on the tangency point of iso cost (budget line) and iso- quant ie., a, b respectively. The point 'a' indicates that to produce 100 units of motor the best combination of capital and labour are OC and OM which is within the budget. Over a period of time a firm will face various optimum levels if we connect all points we derive expansion path of a firm.

Managerial Uses Of Production Function:

Production functions are logical and useful. Production analysis can be used as aids in decision making because they can give guidance to obtain the maximum output from a given set of inputs and how to obtain a given output from the minimum aggregation of inputs. The complex production functions with large numbers of inputs and outputs are analyzed with the help of computer based programmes.