

Production

Definition :- Production is the organized activity of transforming resources into finished products in the form of goods & services. The objective of production is to satisfy the demand of such transformed resources.

Production function :- Expresses technical relationship between physical inputs & physical output, at any 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 = Quantity of output

F = Functional relationship

between inputs & output.

L_1 = Land

L_2 = Labour

C = Capital

O = Organization

T = Technology

Assumptions :-

1. Production function is related to a particular period of time.
2. There is no change in technology.
3. The producer is using the best technique available.

u. The factors of production are divisible

Importance :-

1. Production function helps to estimate the level of production.
2. Production function input which will yield the same level of output.
3. Production function helps to select the least combination of input for desired output.
4. It is useful to take decisions regarding production department.

Cobb - douglas Production function :-

Cobb & douglas put forth a production function relating output in American manufacturing industry 1899 to 1922 to labour & capital inputs. They used the following formula.

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

where P = total output

L = The index of employment of labour in manufacturing

C = The index of fixed capital in manufacturing

The exponents ' a ' & ' $1-a$ ' are the elasticities of production. These measure the percentage response of output to percentage change in labour & capital respectively.

The formula function estimated for the USA by cobb & douglas is

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

Though Cobb - Douglas production function was based on macro-level study, it has been very useful for interpreting economic results.

Production function with one Variable input

Definition: The law of Variable Proportion explains the input output relation. The change in output due to addition of one variable input & keeping the other factors fixed.

This is a short-term phenomenon. The short run is a period in which at least one input is fixed. It is also called law of diminishing returns (or) law of Variable proportions.

The following hypothetical numerical table illustrates the operations of the law of diminishing returns of input to output again.

		Production Schedule		
Units Variable inputs (n)		Total product	Average Product (AP) Product (TP_n)	Marginal Product (TP_{n-1})
1		20	20	-
2		50	25	30
3		90	30	40
4		120	30	30
5		135	27	15
6		144	29	9
7		147	21	3
8		148	18.5	0
9		148	16.44	-3
10		145	14.5	

Total product is Total number of units of output produced per unit of time by all factor inputs is referred to as a total product. Thus,

$$TP = f(QVF)$$

where, TP = Total products and

QVF = Total of the variable factors

Average product \approx . The average product refers to the total Product Per Unit. of a given variable factor. Thus, by dividing the total product by the Quantity of the Variable factor.

Symbolically $AP = \frac{TP}{QVF}$

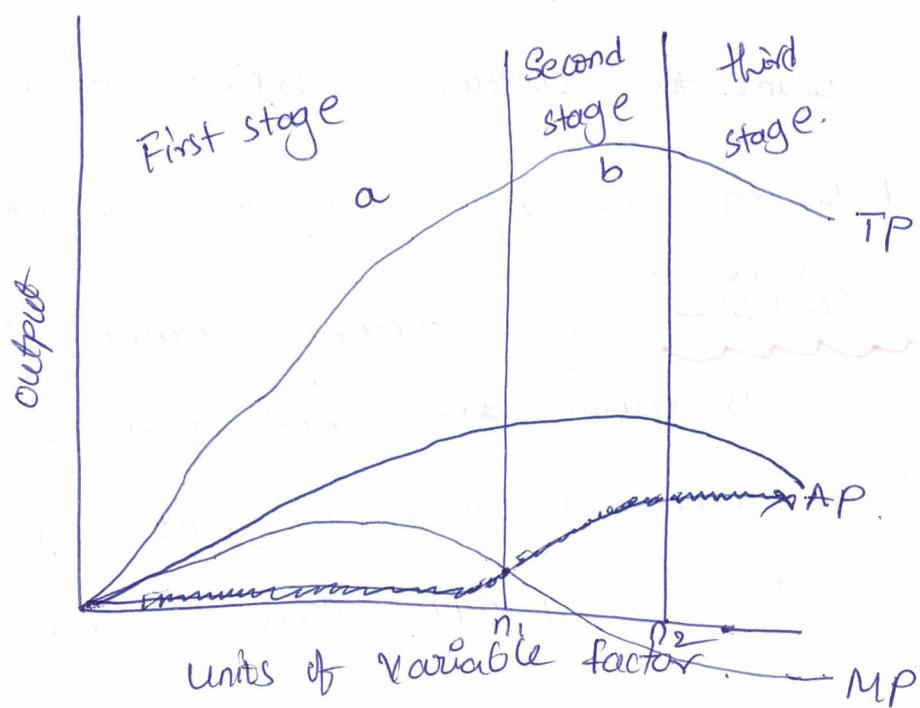
Marginal product \approx The marginal product maybe defined

$$MP_n = TP_n - TP_{n-1}$$

where MP_n , marginal product when 'n' units of Variable

TP = Total output & refers to the number of units Variable factor employed.

Graphical representation of production schedules



Stage I :- Initially the marginal product of the variable input rises, the total product rises at an increasing way.

Stage II :- Leasing a certain point the marginal product being to diminishing

Stage III :- As the marginal product tends to diminish it utility becomes zero & negative there after.

Production function with two inputs & laws of returns
Let us consider a production process that requires two inputs, Capital (C) and Labour (L) to produce a given output (Q). There could be more than two inputs in a real life situation but for simple analysis, we restrict the number of the inputs to two only.

It can be expressed as capital.

$$Q = f(C, L)$$

where Q = Quantity output, C = Capital, L = Labour.

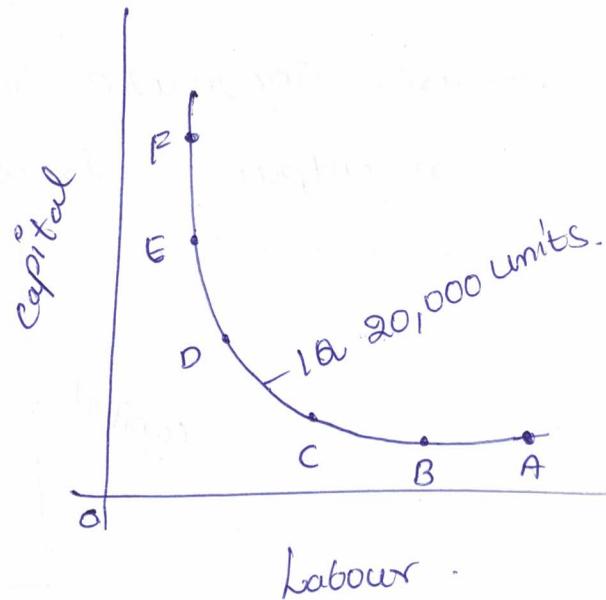
If we want to discuss detail need to understand

The following concept namely isoquants & isocasts

I Iso - ~~casts~~ - quant. 'Iso' means equal, 'quant' means quantity. Isoquant are equal meaning that the quantities through a given isoquant are equal. It is also called "Iso product curve". An isoquant curve

Shows various combination of two input factor such as Capital, Labour, which yield the same level of output
 The Concept of Isoquant is explained below

<u>Combination</u>	<u>Capital</u>	<u>No. of Labour</u>
A	1	20
B	2	15
C	3	11
D	4	8
E	5	6
F	6	5

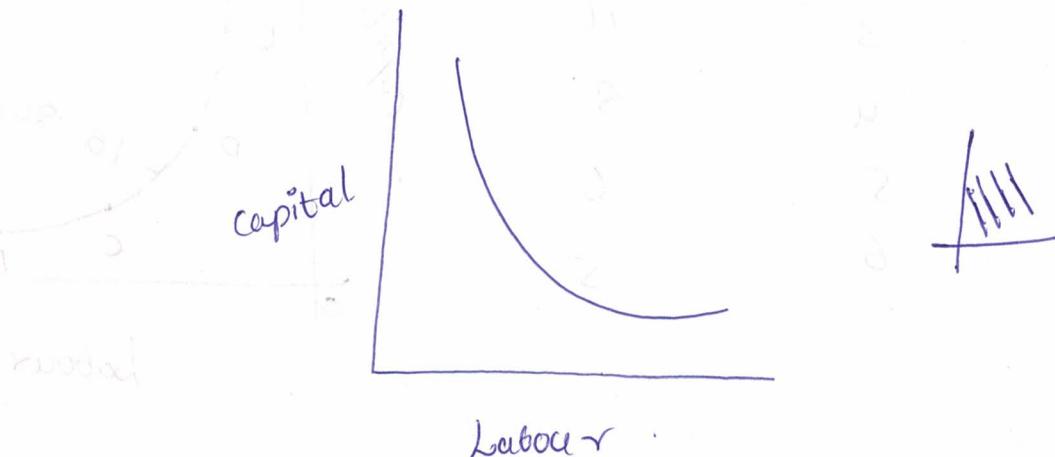


Marginal Rate of Technical Substitution (MRTS)

above table shows the different combination of inputs factors to yield an output of 20,000 units. As the investment goes up the number of output the labour can be reduced. The combination of 6 unit of Capital & 20 units of Labour to produce say 20,000 units of output. All the above combinations of input can be plotted on a graph. The lower all the possible combinations of inputs shown up an isoquant.

Features of Isoquants

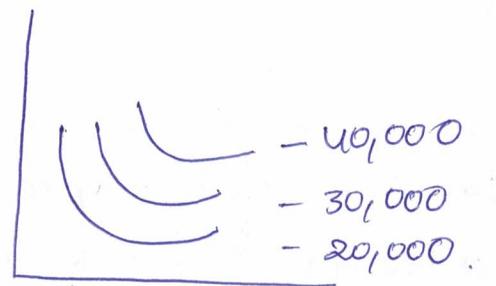
- ① Downward Sloping - Isoquants are downward sloping curves because, if one input increases, the other one reduces. There is no question of pure increase in both the inputs to yield a given output. Isoquants slope from left to right.



- ② Convex to origin - It is because the input factors are not perfect substitutes. One input factor can not be substituted by other input factor in a diminishing marginal rate.

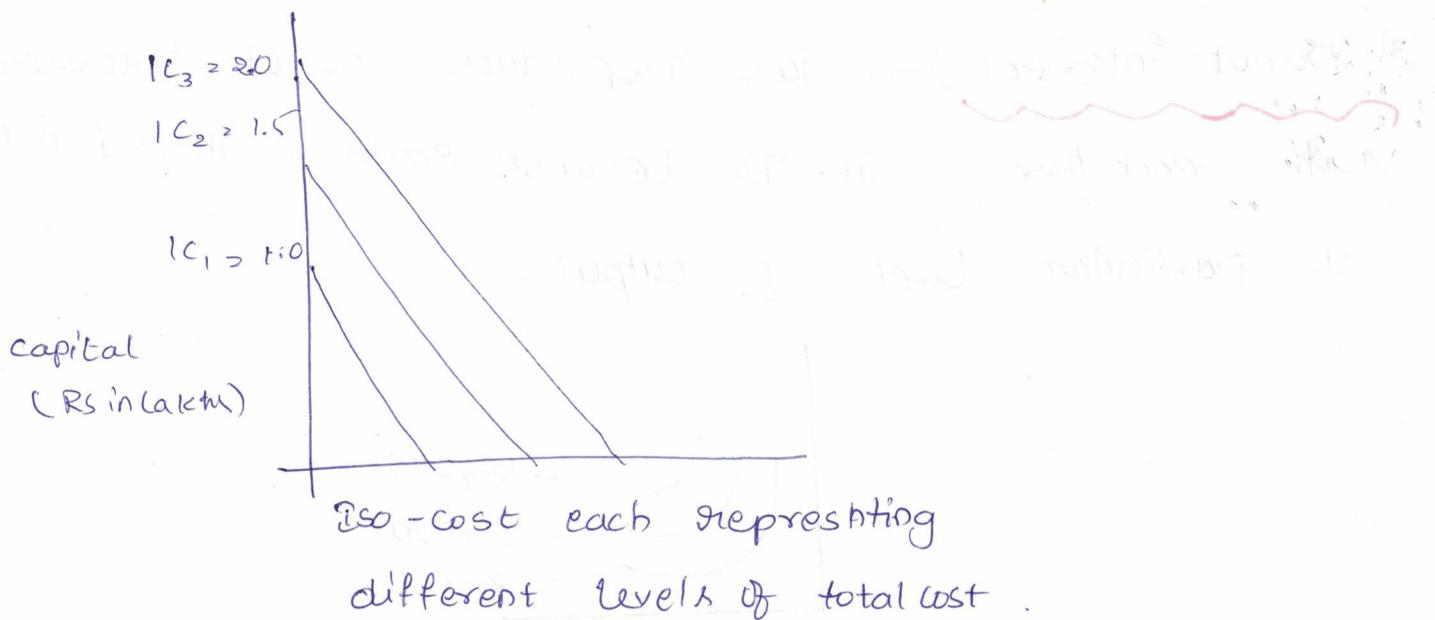


③ Do not intersect Two isoquants do not intersect with each other. It is because, each of them denote a particular level of output.



④ Do not touch axes The isoquant touches neither X-axis nor Y-axis, as both inputs are required to produce a given product.

II Iso-costs. Refers to that cost curve that represent the combination of inputs that will cost the producer the same amount of money. In other words, each isocost denotes a particular level of total cost for a given level of production. If the level of production changes the total cost changes and thus the isocost curve moves upward, and vice versa.



Marginal Rate of technical Substitution (MRTS):

MRTS refers to the at which one input factor is substituted with the other to attain a given level of output. In other words, the lesser units of one input must be compensated by increasing amounts of another input to produce the same level of output.

Combination Capital Labours

(cash in lakhs)

A

20

B

2

15

C

3

11

D

4

8

E

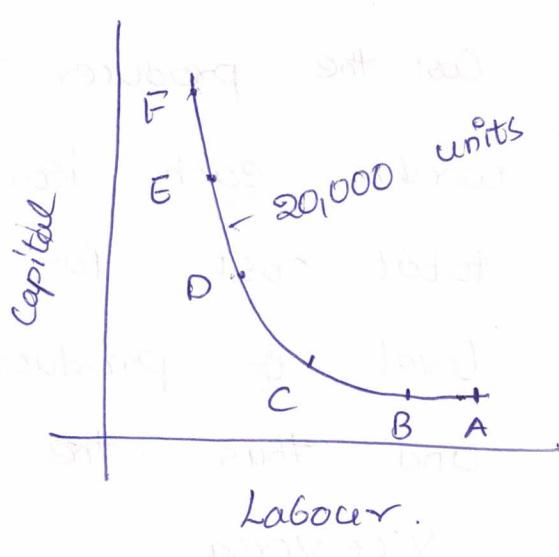
5

6

F

6

5



The above table shows the different combinations of input to yield an amount of 20,000 units of output. As the investment goes up, the number of labourers can be reduced to get same output.

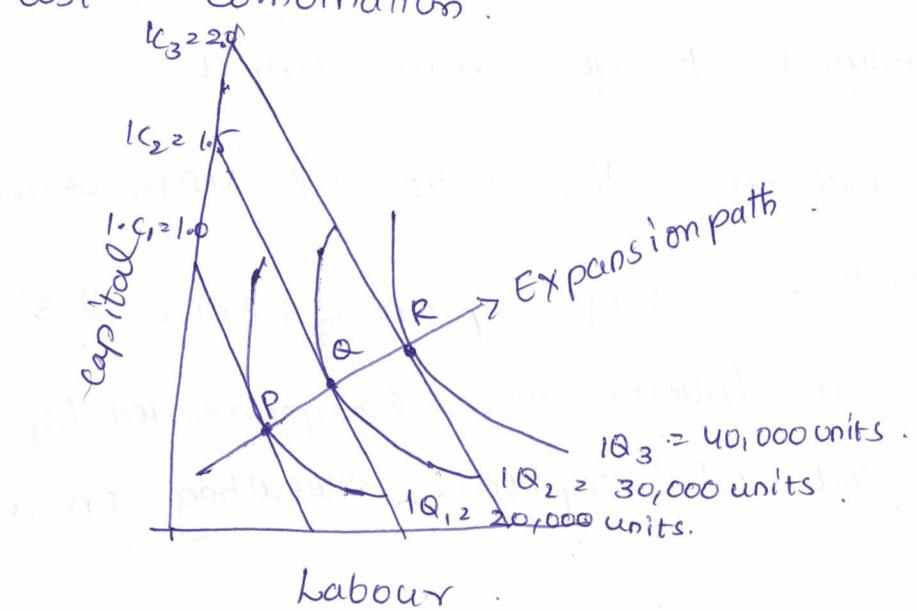
Present the ratio of MRTS between the two inputs factors, say capital & labour. 8.5 units of decrease in labour are compensated by an increase in 1 unit of capital, resulting in a MRTS of 5:1.

Ratio of MRTS between Capital & Labour.

①	②	③	④
A			
B			5:1
C			
D			4:1
E			3:1
F			2:1
			1:1

Least Cost Combinations of Input. The Iso costs & Iso quants can be used to determine the input usage that minimise the cost of production.

where the slope of Isoquant is equal to that of Isocost, there lies the lowest point of cost of production. This can be observed as Least Cost Combination.



Least cost combination of input

It is evident that the producer can, with a total outlay of 1.5 lakh, reach the highest Isoquant Curve which is IQ_2 . If he wants to reach IQ_3 he has to bring additional resources, which is, let us assume, not possible. He can not compromise with IQ_1 , as it means lower output. There is no other input combination on IQ_2 other than point Q, which is cheaper than Rs 1.5 lakhs. So the obvious choice for the producer is a combination of inputs only on IQ_2 .

The points of tangency P, Q & R on each of the Isoquant curves represent the least cost combination of inputs yielding maximum level of output. Any output lower/higher than this will result in higher cost of production.

The Law of Returns to Scale

It refers to the ~~result~~ returns enjoyed by the firm as a result of change in all the inputs are changed simultaneously. There are 3 phases of returns in the long run, which may be separately described as

1) The Law of Increasing returns

2) The Law of Constant returns

3) The Law of decreasing returns.

① The Law of Increasing returns: The Law of increasing returns describes increasing returns to scale. There are increasing returns sales when a given percentage increase in input will lead to a greater relative percentage increased in the result output.

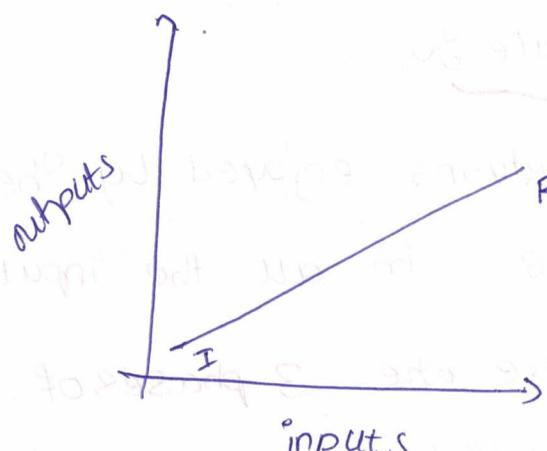
Mathematically we represents

$$\frac{\Delta Q}{Q} > \frac{\Delta F}{F}$$

where $Q =$ output

$F =$ Production factors.

Curve of Law of Increasing returns



Increasing returns maybe attributed to improvement

in large scale operations; divisions of labour,
use of sophisticated machinery better technology etc,

② The Law of Constant returns & The process of
increasing return to scale has ever can not go on

forever it may be followed by constant returns to

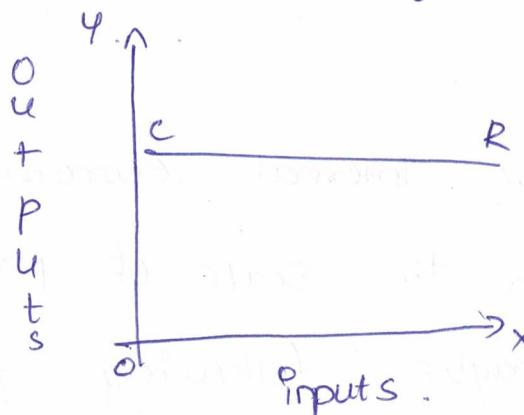
scale. It generally exerts the economic responsibility for increasing returns. when a given percentage increase in inputs leads to the same percentage increase in output.

(8)

Mathematically $\frac{\Delta Q}{Q} = \frac{\Delta F}{F}$

$$\text{Individually, P.F.C} = 1$$

~~↳~~ curve of law of constant returns \Rightarrow

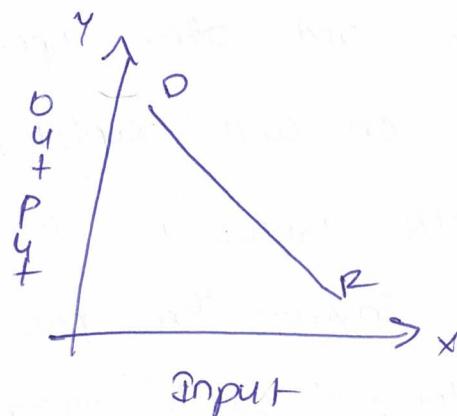


③ The Law of decreasing returns \Rightarrow As the firm expands it may encounter growing dis-economics which are met by virtue of economics of certain factors. decreasing return to scale set in there are decreasing returns to scale.

Mathematically $\frac{\Delta Q}{Q} < \frac{\Delta F}{F}$

\therefore (Production function of co-efficient) P.F.C < 1

Curve:-



Economies & DisEconomies of Scale:

The economies of scale result because of increase in the scale of production. Alfred Marshall divides the economies of scale into '2' groups: Internal & external

(i) Internal Economies: The internal economies occur as a result of increase in the scale of production.

The internal economies may be following types.

① Managerial

② Marginal Economies: As the firm expands. The firms needs qualified managerial personnel to handle each of its functions: marketing, finance, production, human resources & others in a professional way. Functional Specialisation ensures minimum wastage & lower the cost of production in the longrun.

(ii) Commercial Economies: Transaction of buying & selling raw materials and other operating supplies.

Such as spares & so on will rapid & the volume of each transaction also grows as the firm grows.

There could be cheaper savings in procurement, transportation & storage cost. This will lead to lower cost & increase profit.

⑧ Financial economies There could be a cheaper credit facilities from the financial institutions to meet the capital expenditure.

⑨ Technical economies Increase the scale of production follows when there is sophisticated technology available and the firm is in a position to hire qualified technical manpower to make use of it.

⑩ Risk-bearing economies As there is growth in the size of the firm. There is increase in the risk also. Sharing the risk with the insurance companies is the first priority for any firm.

⑪ Marketing economies As the firm grows larger & large. It can afford to maintain a full-fledged marketing department independently to handle the issues related to design of customer survey, advertising material, promotion campaign and so on.

⑫ Economies of Larger Dimensions. Large scale Production is required to take advantage of bigger size plants and equipment.

① Economies of Research & development - large organisations such as DR. Reddy's Labs, Hindustan Lever. Spend heavily on research & development & bring out several innovative products.

External Economies - External economies refers to all the firms in the industry, because of growth of the industry as a whole. external economies benefit all the firms in the industry as the industry expands. This will lead to low

earning the cost of production & thereby increasing the profitability. The external economies can be

the external economies can be grouped under three types:

① Economies of Concentration

② Economies of R&D

③ Economies of welfare.

Economies of concentration. Because all the firms are located at one place. It is likely that

there is better infrastructure in terms of approach roads, transportation facilities such as railway, and so on.

② Economies of R&D All the firms can pool resources together to finance research and development activities & thus share the benefits of research. There should be common facilities to share journal, newspapers etc., reference material of common interest.

③ Economies of welfare There could be common facilities such as canteen, industrial housing, community hall, schools, colleges, and so on which can be used in common by the employees in the whole industry.

Diseconomies of Scale

Diseconomies are mostly managerial in nature. Problems of planning, coordination, communication and control may become increasingly complex as the firm grows in size resulting in increasing average cost per unit. Some times, the firm may also collapse. E.g. - All inputs increase by 10%, but the production increases by only 5%. Expansion of firm beyond a particular limit may lead to diseconomies of scale. Moreover when the firm is not in a position to respond to the business environment in which it operates, diseconomies are bound to result in.

Short-run and Long-run Production function

Short-run production function refers to that period of time, in which the installation of new plant and machinery to increase the production level is not possible.

Long-run production function :- ~~refers~~ ^{in one}

in which the firm has got sufficient time to install new machinery or capital equipment, instead of increasing the labour units.

Differences b/w Short-run and Long-run PF

<u>Basic comparison</u>	<u>Short-run PF</u>	<u>Long-run PF</u>
1. Meaning	Short-run PF alludes to time period, in which at least one factor of production is fixed.	it connotes the time period in which all factors of production are variable.
2. Law	Law of Variable Proportion	Change in Scale
3. Factor-ratio	Change	Production does not change

4. Scale of production: No change in cost or change in scale of production = scale of production: production.

5. Entry and Exit: There are barriers to entry and firms are free to enter and exit. Firms can shut down but cannot fully recover costs.

Cost - (Definition)

Cost refers to the expenditure incurred to produce an Output or Provide Service. The Cost includes raw-materials, labour and other Expenses which are Useful in Production.

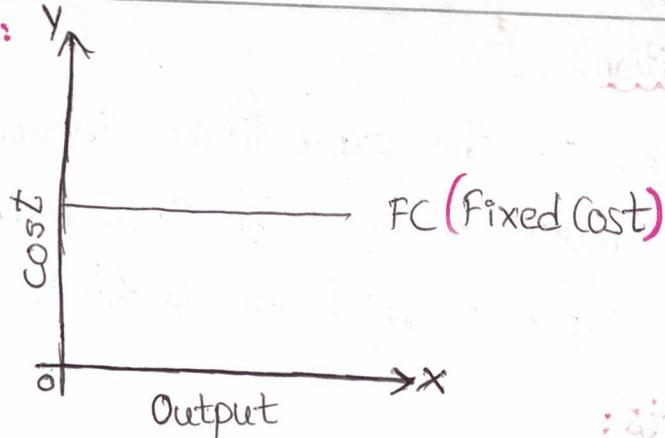
Cost Concepts:* Opportunity Cost Vs Outlay Cost:

- Outlay Cost are also known as actual Cost or Absolute Cost, which are those expenses which are actually incurred by a firm.
- These are the Payments made for labour, Material, plant, Building, Machinery, transportation etc., All the expenses appear in the books of accounts hence based on accounting Cost Concepts.
- Opportunity Cost implies the earnings forgone on the next best alternative had the present Option be undertaken. It means Sacrified Alternative.
- For Eg, A Business man is able to borrow certain amount at 10% to buy a machine, instead of buying the machine he can de-invest the borrowed Fund at say 12%. In this situation the Opportunity Cost is said to be 12% and Outlay Cost is 10%.

* Fixed Cost Vs Variable Cost:

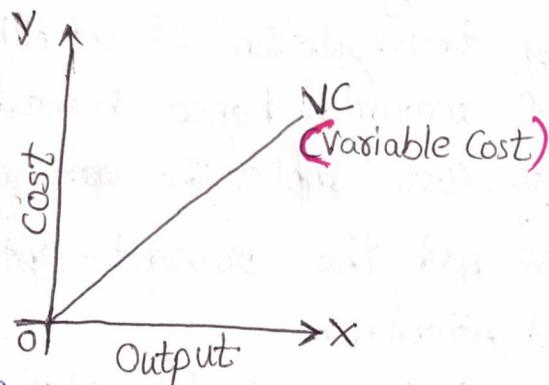
- Fixed Cost is that Cost which remains Constant for certain level of Output.
- It is not effected by the changes in the Volume of Production But Fixed Cost per Unit decreases when the Production is increased.

Ex: Rent of Factory:



- Variable Cost is that which varies directly with the variation in Output.
- An increase in total Output results in an increase in total Variable Cost and decrease in total Output result in a proportionate decrease in the total Variable cost. The Variable Cost per Unit will be Constant.

Ex: Raw - Materials



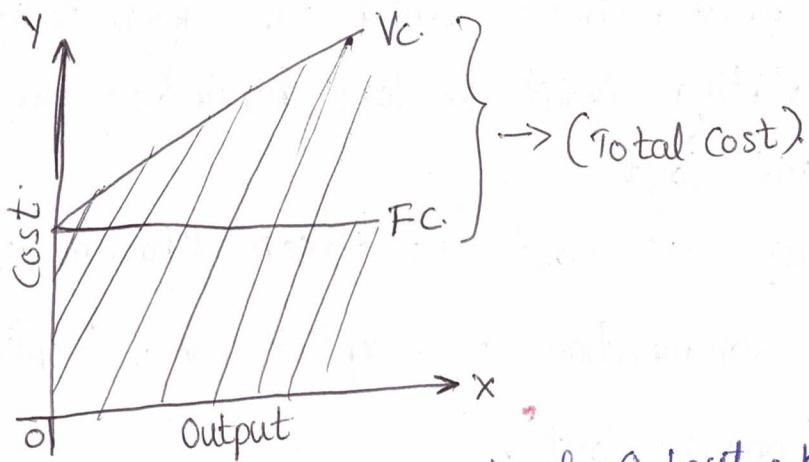
* Explicit Cost & Implicit Cost:

- Explicit Cost is the form of Money Cost. It considers actual Money payments made to factors of production which are not owned by Entrepreneurs. They are wages and salaries, interest paid on the funds borrowed, price of raw materials cost etc., Thus it is one of the Money Cost which records in business books.
- Implicit costs are also called imputed costs. Implicit Costs do not involve payment of cash as they are not actually incurred or spent.
- Implicit Costs are also defined as Payments made to the factors of the production owned by the Entrepreneur and used in the firm. He may also rendered Management Services.

Total Cost, Average Cost and Marginal Cost:

- Total Cost is the total cash payments made for the input needed for production.
- It is the sum of Fixed Cost and Variable Cost. Here,

$$\boxed{\text{Total Cost} = \text{Fixed Cost} + \text{Variable Cost}}$$

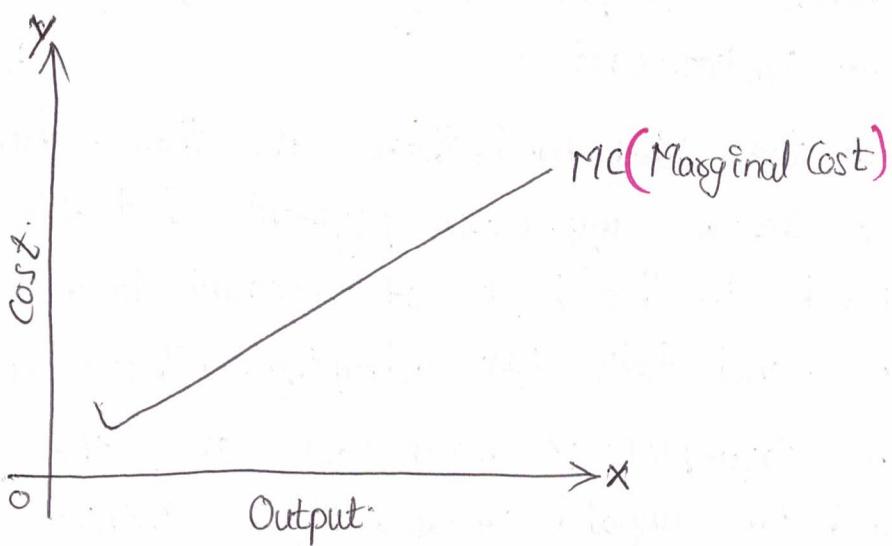


Average Cost is the cost per unit of output. Here,

$$\boxed{\text{Average Cost} = \frac{\text{Total Cost}}{Q}}$$

$\therefore Q = \text{Total Quantity}$.

- Marginal Cost is the additional cost incurred to produce an additional unit of output.



Ex: Rent for land and building which are owned by the firm
 Interest on own capital which is invested in the business
 Remuneration for the service rendered by him.

→ In addition to these payments depreciation is allowed factor. Thus

$$\text{Total Cost} = \frac{\text{Fixed cost} + \text{Variable cost}}{\text{Explicit Cost} + \text{Implicit Cost}}$$

→ In brief, costs which are not taken into account while calculating Profit or loss, business position is known as Implicit Cost.

whereas Cost is taken known as Explicit Cost.

→ The combination of Explicit and Implicit also called as "Economic Cost".

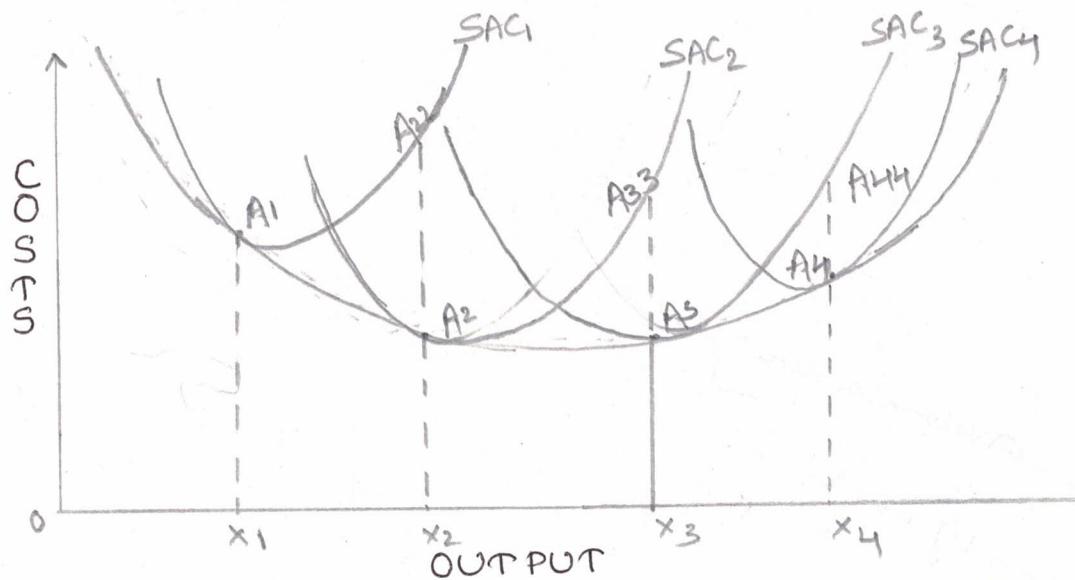
* Out of Pocket Costs **vs** Book Costs:

→ Out-of-Pocket Costs are those expenses which are Current cash payments to outsiders, whereas the book costs do not require these current cash payments.

→ All these explicit costs like payment of rent, wages, salaries, interest, transport charges etc., fall in the category of out of Pocket costs.

→ On the other hand, there are those business costs which do not involve any cash payments but for them a provision is made in the books of account to include them in profit & loss A/c and take tax advantages. These are known as the book-costs.

→ The examples of book costs are the provision for depreciation and for unpaid amount of the interest on the owner's Capital Employed in the firm. In a way these are Imputed costs or the Payments by a firm to itself.



The figure shows how LAC curve envelopes several short-run average cost (SAC) curves. Suppose the firm is producing an output of ox_1 units on a plant of SAC_1 . If it wants to produce ox_2 units of output, either it can operate on SAC_1 by overutilising SAC_1 plant or by acquiring a bigger size plant SAC_2 and operating on it. Long run average cost curve is of great utility for the entrepreneur to make decisions relating to expansion of the size of the firm. It helps to minimise the costs to the advantage of the firm.

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BREAK-EVEN ANALYSIS

Introduction:- It refers to analysis of the break-even point (BEP). It is important because it denotes the minimum volume of production to be undertaken to avoid losses. A firm is said to attain the BEP when its total revenue is equal to total cost ($TR = TC$). It is also called Cost-Volume-Profit analysis.

Definition:-

Break-even analysis is defined as analysis of costs and their possible impact on revenues and volume of sales. It refers to no-fit or no-loss point.

Key terms used in Break-even analysis

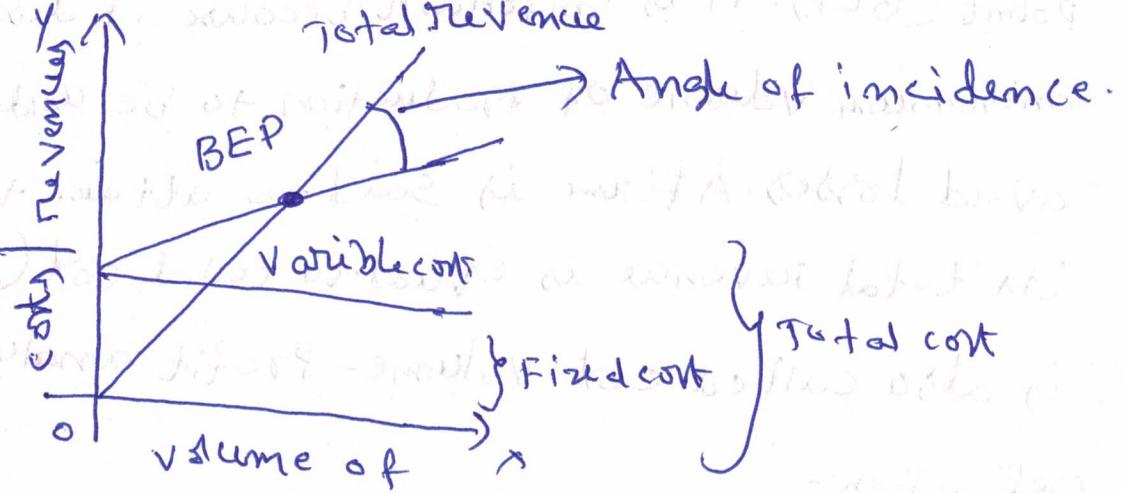
Contribution:- is the difference between selling price and variable cost.

$$\text{contribution} = \text{selling price} - \text{variable cost}$$

Fixed cost + profit

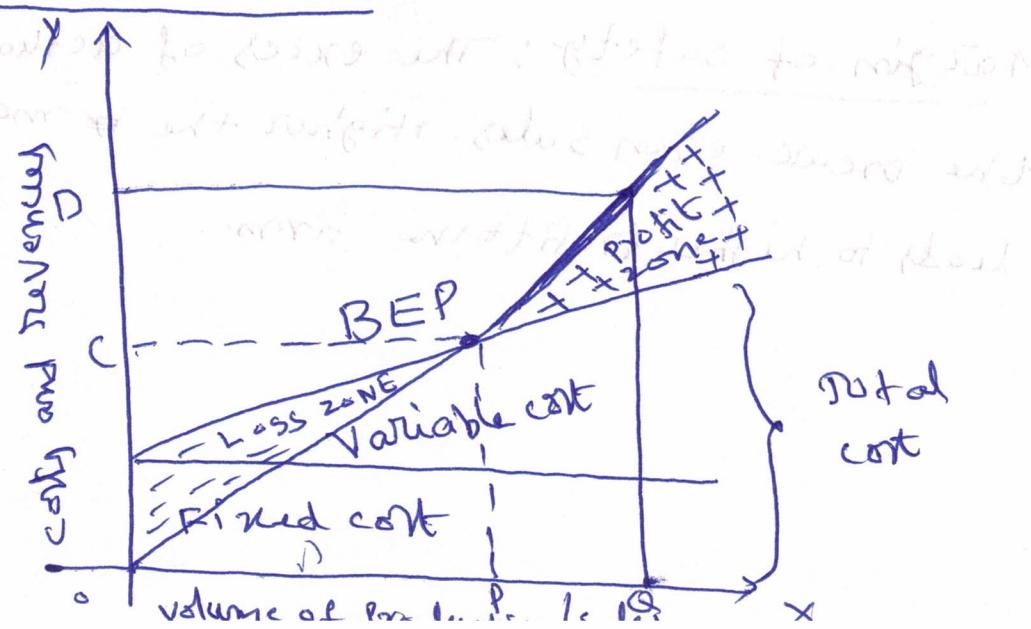
Margin of safety: The excess of actual sales minus the break-even sales. Higher the margin of safety leads to higher profits to the firm.

Angle of incidence:- The angle formed where total cost curve cuts the total revenue curve.



P/V Ratio:- It is popularly known as Profit-volume ratio. The ratio between the contribution and sales.

Break-even chart



Assumptions:

- costs can perfectly be classified into fixed and variable costs with no regard to A - number.
- selling price does not change with volume of changes (it remains fixed. it means it does not consider the price discount).
- All the goods produced are sold. There is no closing stock.
- There is only one product available for sale. in case of multi-product firms, the product mix does not change.
- Significance:
 - To ascertain the profit at a particular level of sales volume / a given capacity of production.
 - To calculate sales required to earn a particular desired level of profit.
 - To compare the product lines, sales areas, methods of sale for individual company.
 - To compare the efficiency of the different firms.
 - To decide whether to add a particular product etc.
 - To decide whether to add a particular product or drop one from the existing product line or drop one from it.
 - To decide to 'make or buy' a spare part.
 - To decide what promotion mix will yield optimum sales.
 - To assess the impact of change in fixed cost, variable cost or selling price on BEP and profit during a given period.

Limitations of BEA:

- BEP is based on fixed cost, variable cost, and total revenue. A change in one variable is going to affect the BEP.
- All costs cannot be classified into fixed cost & variable cost. we have semi-variable costs also.
- In case of multi-product firm, a single chart can not be of any use. series of charts have to be made use of.
- it is based on fixed cost concept and hence holds good only in the short-run.
- Total cost & Total revenue lines are not always straight as shown in the figure. The validity and price discounts are the usual phenomena affecting the total revenue line.
- where the business conditions are volatile, BEP cannot give stable results.