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Module-2

Production and Cost

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- Production Function – Law of variable proportion
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Production

- It the process of transformation of inputs into output.
- Input > Factors of production

Production Function

It is defined as the technical relationship which shows maximum level of output producible fromgiven input

Q = f (La, L, K, O)

Types of Production Function

- Based on the availability of inputs production function has been classified into two1.) The law of Variable Proportion (Short Run)
2.) The law of Fixed Proportion (Long Run)

Variable Proportion

It is the arrangement where the quantity of a single input varies, keeping the quantities of otherinputs constant. It happens in short run due to unavailability of all inputs.

Fixed Proportion

It is the arrangement where the quantities of all inputs are varied in the same proportion. Ithappens in long run.

Basic Production Concepts

Total Product (TP) / Total Physical Product (TPP)

It refers to the total amount of a commodity produced during given period of time with each set ofinputs. It is also known as Total Returns.

Average Product (AP)

It is the output produced using per unit of the variable factor input.

AP = TP / L OR Q / L

(L is the variable factor in most of the cases)

Marginal Product (MP)

It is the addition to the total product from the use of an additional unit of variable factor input

The Law of Variable Proportion

It is also known as Law of Diminishing Returns, Returns to Factor, Short run ProductionFunction.

The law examines the short run relationship between one variable input and output produced, while keeping all other factor inputs constant.

Statement of Law

The law of variable proportion states that as more and more units of a variable factor are applied to a given quantity of a fixed factor, the total product increase at an increasing rate initially, but eventually it will increase at a diminishing rate.

Variable Factor Employed	TP	AP	MP	STAGES
0	-	-	-	-
1	8	8	8	Stage 1 (IRF)
2	20	10	12	Stage 1 (IRF)
3	36	12	16	Stage 1 (IRF)
4	48	12	12	Stage 2 (DRF)
5	55	11	7	Stage 2 (DRF)
6	60	10	5	Stage 2 (DRF)
7	60	8.6	0	Stage 3 (NRF)
8	56	7	-4	Stage 3 (NRF)

STAGE 1 : Increasing Returns to Factor (IRF)

- TP, AP, MP increases at an increasing rate in the initial stage of production.
- This is due to fuller utilization of fixed factors and division labor

STAGE 2: Diminishing Returns to Factor (DRF)

- Most relevant stage in production
- MP falls and TP increases at a diminishing rate
- At the end of second stage, TP reaches max and MP reaches zero
- AP also falls

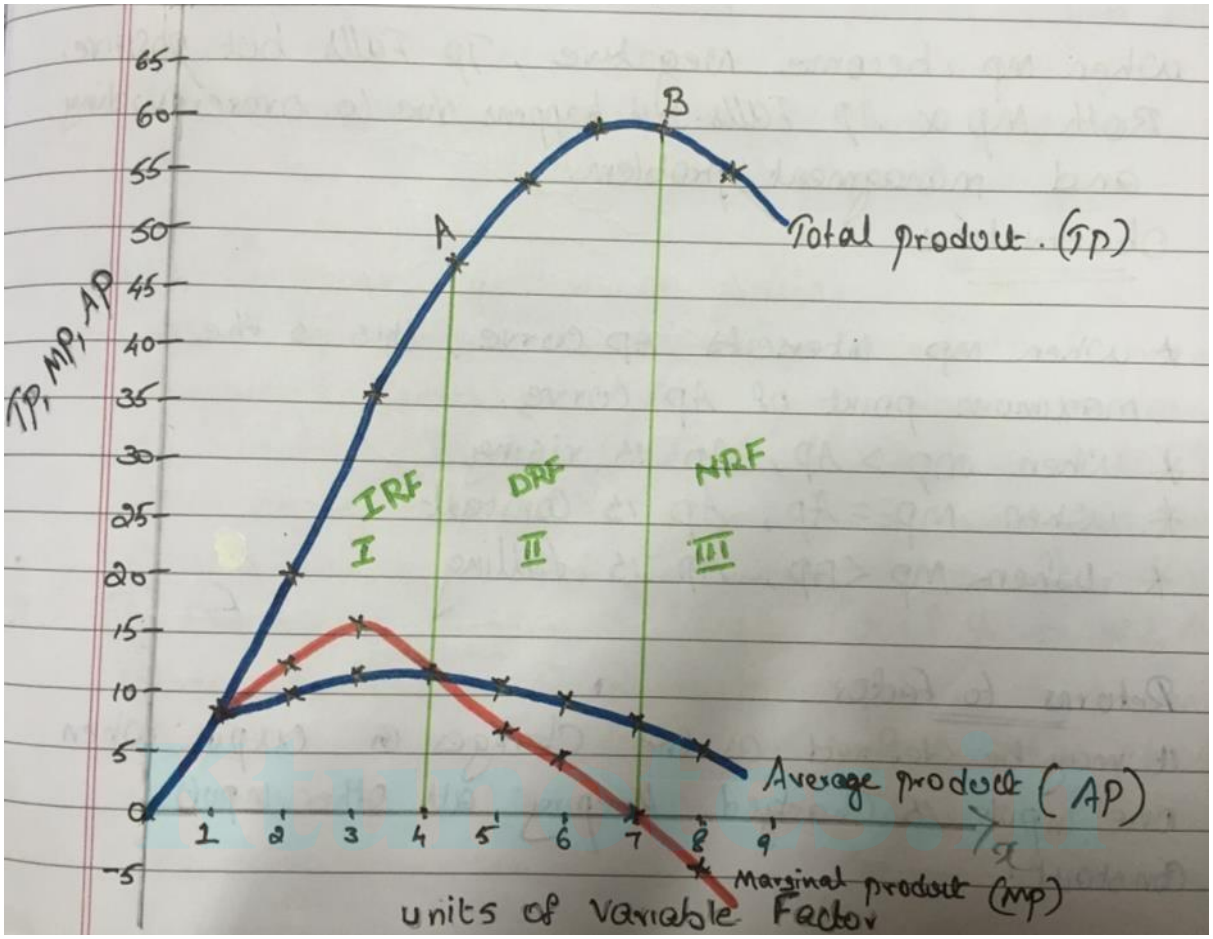
STAGE 3: Negative Returns to Factor (NRF)

- MP becomes negative, TP falls but remains positive.
- AP remains falling

Observations

- When MP > AP, AP Rises

➢ When MP = AP, AP remains constantWhen
MP < AP, AP falls



- **Economies of scale – internal and external economies**

Economies of scale are cost reductions that occur when companies increase production. The fixed costs, like administration, are spread over more units of production. Sometimes, a company that enjoys economies of scale can negotiate to lower its variable costs, as well.

Definition and Examples of Economies of Scale

Any time a company can decrease costs by increasing the volume of goods they produce, that's an example of an economy of scale.[1] There are several reasons why the costs of production would decrease as volume increases.

For example, by keeping a production line focused on one product, companies may save on the costs associated with swapping out raw materials and tools to produce different products. The most basic examples

are managerial and administrative costs—you don't have to hire more managers just because your workers start producing more items per day.

Diseconomies of Scale

Sometimes a company chases economies of scale so much that it becomes too large. This overgrowth is called a diseconomy of scale. There comes a point at which maximum efficiency has been reached. Any units produced after that will increase production costs per unit, rather than decrease them.

Diseconomies of scale aren't always tied to physical production efficiencies. For example, it might take longer to make decisions, making the company less flexible. Miscommunication could occur, especially if the company becomes global. Acquiring new companies could result in a clash of corporate cultures. This clash will slow progress if they don't learn to manage cultural diversity

How Economies of Scale Work

The specific way an economy of scale works depends on the goods or services being produced. It may be as simple as extending operating hours to get more use out of expensive machinery. Any way that a company can improve the per-unit cost by producing more units, that is how economies of scale work.

Economies of scale not only benefit the organization that produces the goods. Consumers can enjoy lower prices. The economy grows as lower prices stimulate increased demand.

Economies of scale also give a competitive advantage to large entities over smaller ones. The larger the business, non-profit, or government, the lower its per-unit costs.

How to Make Economies of Scale Work for You?

You don't have to be a corporation to benefit from economies of scale. Think of it like how larger families typically buy in bulk. Each box of detergent costs less per wash because you can buy it in bulk. The manufacturer saves on packaging and distribution. It then passes the savings onto you. You also save on travel costs by making fewer trips to the store.

Governments and non-profits can also benefit from economies of scale. These benefits occur whenever an entity produces more, becomes more efficient, and lowers costs as a result.

Economies of Scope

Economies of scope are similar to economies of scale, but they occur when a company branches out into multiple product lines to combine efficiencies and business functions. For example, most newspapers diversified into similar product lines, such as magazines and online news. In other words, economies of scale focus on one product (volume), while economies of scope involve many products (variety).

Types of Economies of Scale

There are two main types of economies of scale: internal and external.

Internal economies are controllable by management because they are internal to the company. External economies depend upon external factors. These factors include the industry, geographic location, or government.

Internal economies result from a larger volume of production. There are five types of internal economies of scale. You'll typically see them in large organizations.

For example, large companies can buy in bulk. This economy lowers the cost per unit of the materials they need to make their products. They can use the savings to increase profits. Or they can pass the savings to consumers and compete on price.

Technical Economies of Scale

Technical economies of scale result from efficiencies in the production process itself. Manufacturing costs fall 70% to 90% every time the business doubles its output.[3] Larger companies can take advantage of more efficient equipment.

For example, data mining software allows the firm to target profitable market niches. Large shipping companies cut costs by using super-tankers. Finally, large companies achieve technical economies of scale because they learn by doing. They're far ahead of their smaller competition on the learning curve.

Monopoly Power

Monopsony power is when a company buys so much of a product that it can reduce its per-unit costs. For example, Wal-Mart can undercut smaller competitors by wielding its huge buying power.

Managerial Economies of Scale

Managerial economies of scale occur when large firms can afford specialists. They more effectively manage particular areas of the company. For example, a seasoned sales executive has the skill and experience to take care of big orders. They demand a high salary, but they're worth it.

Financial Economies of Scale

Financial economies of scale mean the company has cheaper access to capital. A larger company can get funded from the stock market with an initial public offering. Big firms have higher credit ratings and can offer lower interest rates on their bonds.

Network Economies of Scale

Network economies of scale occur primarily in online businesses. It costs almost nothing to support each additional online customer with existing digital infrastructure. So, any revenue from the new customer is all profit for the business.

External Economies of Scale

A company has external economies of scale if its size creates preferential treatment. That most often occurs with governments.

For example, a state often reduces taxes to attract the companies that provide the most jobs. Big real estate developers convince cities to build roads to support their buildings, and this saves developers on those infrastructure costs. Large companies can also take advantage of joint research with universities to reduce research expenses.

Small companies don't have the leverage to benefit from external economies of scale, but they can band together. Small companies can cluster similar businesses in a small area. That allows them to take advantage of geographic economies of scale. For example, artist lofts, galleries, and restaurants benefit by being together in a downtown art district.

- **Producers equilibrium –Expansion path**

(use diagrams and table from class notes)

- **Iso-quants**: is a curve which shows various combinations of two inputs which give the same level of output. ‘ISO’ means equal and quant means quantity.

- **Iso-Cost line**: shows various combinations of labor and capital (two inputs) that can be purchased for a given expenditure of the firm.

- Least-cost combination or **producer equilibrium**: a producer will be in equilibrium when he is able to produce a given level of output with least cost or when he produces maximum output with a given amount of inputs.

$$\textit{Producers Equilibrium} = \frac{MPL}{MPK} = \frac{PL}{PK}$$

- **Expansion path:** is a line connecting optimal input combinations as the scale of production expands. In other words, it gives the least cost inputs combinations at every level of output. It is a long run concept.

Technical progress and its implications

Technological progress refers to the discovery of new and improved methods of producing goods allowing more output to be produced from the same quantities of factor inputs, capital (K) and labor (L).

Three types

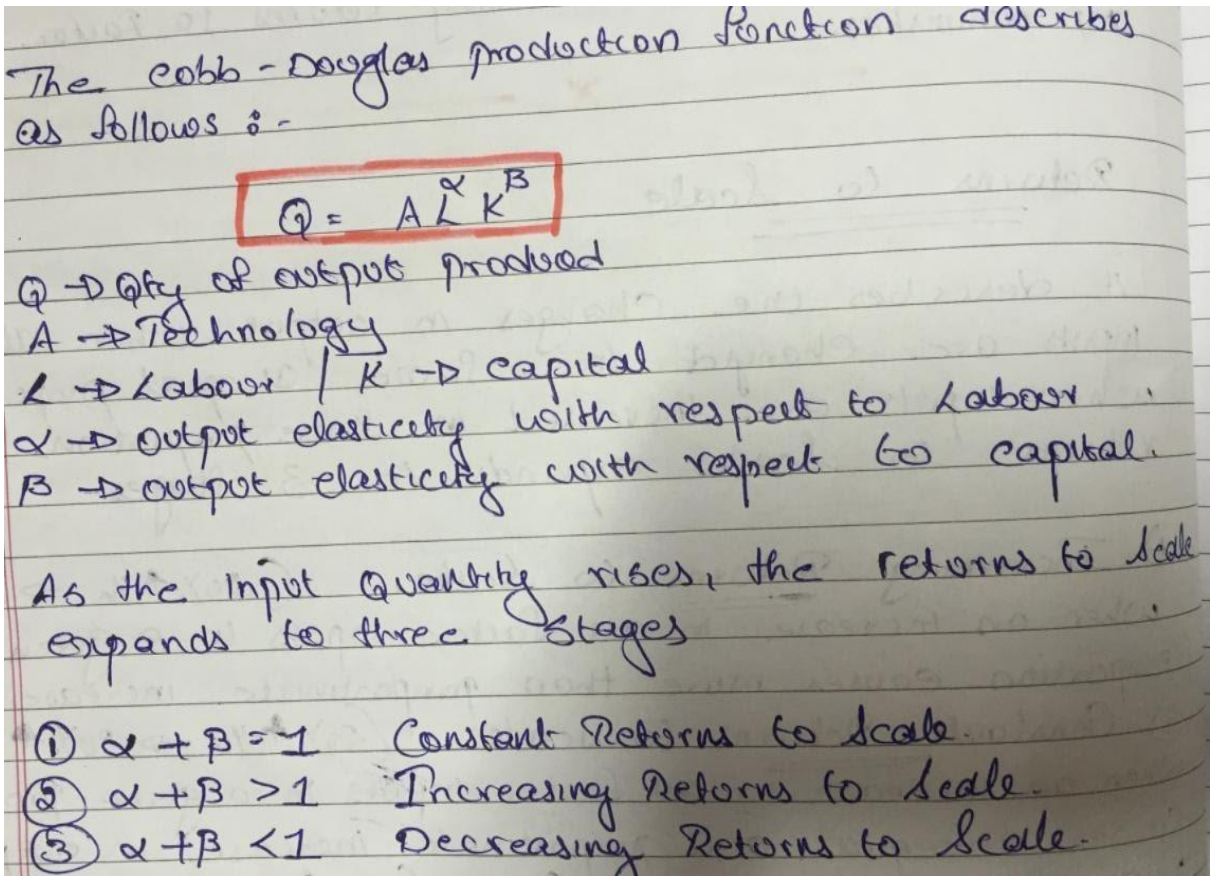
1. Neutral technical progress- Technical progress is said to neutral if changes in the marginal product of labor and capital are same.

2. Labor augmenting technical progress- If the marginal product of labor increases faster than the marginal product of capital.

3. Capital augmenting technical progress- Technical progress is said to be capital augmenting if the marginal product of capital increases faster than the marginal product of labor.

Cobb-Douglas production function

- It was proposed by Wicksell for the first time
- It was statistically tested by Charles.W. Cobb and Paul. H. Douglas in 1928
- They used the data from manufacturing sector of USA for the years 1899 to 1922



- C - D Production function is a homogenous production function
- C - D Production function always exhibits constant returns to scale

α + β = 1

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 thedifference between total revenue and total cost. Entrepreneurs pay for the input factors- Wages for labor, price for rawmaterial, 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.

Cost Concepts

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 theimportant cost concepts.

- **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)
- **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.
- **Economic costs** are related to future. They play a vital role in business decisions asthe costs considered in decision - making are usually future costs. They are similar innature to that of incremental, imputed explicit and opportunity costs
- **Social Cost:** social cost is the sum of private cost and external cost. Private cost is the cost incurred by the producer in the production of a commodity. These are the expense of producer in buying or hiring factor services.

  When a commodity is produced it may cause damages to the environment in the form of air pollution, water pollution etc. These are the external cost and it is met by the society.
- **Sunk Cost**

  Sunk cost is the cost which has already been incurred and cannot be recovered. In other words, it is totally irretrievable.

Determinants of Short –Run Cost

Fixed cost: Some inputs are used over a period of time for producing more than onebatch 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. Forexample, the money spent on labor 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 (TFC or FC): Cost of production remains constant whatever the level of output. Eg: salary, rent

Total Variable cost (TVC or VC): Cost of production varies with output. Eg: Raw materials

Average cost (AC): Total cost divided by the level of output.

AC = TC / Q or TFC + TVC /Q or AFC + AVC

Average variable cost: Variable cost divided by the level of output.

AVC = TVC / Q

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

AFC = TFC / Q

Marginal cost: Cost of producing an extra unit of output.

MC = TC n – TCn– 1

$$\mathbf{MC} = \frac{\Delta\, TC}{\Delta Q}$$

Short Run Cost Output Relationship

Fixed cost curve is a horizontal line which is parallel to the 'X' axis. This costis 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.

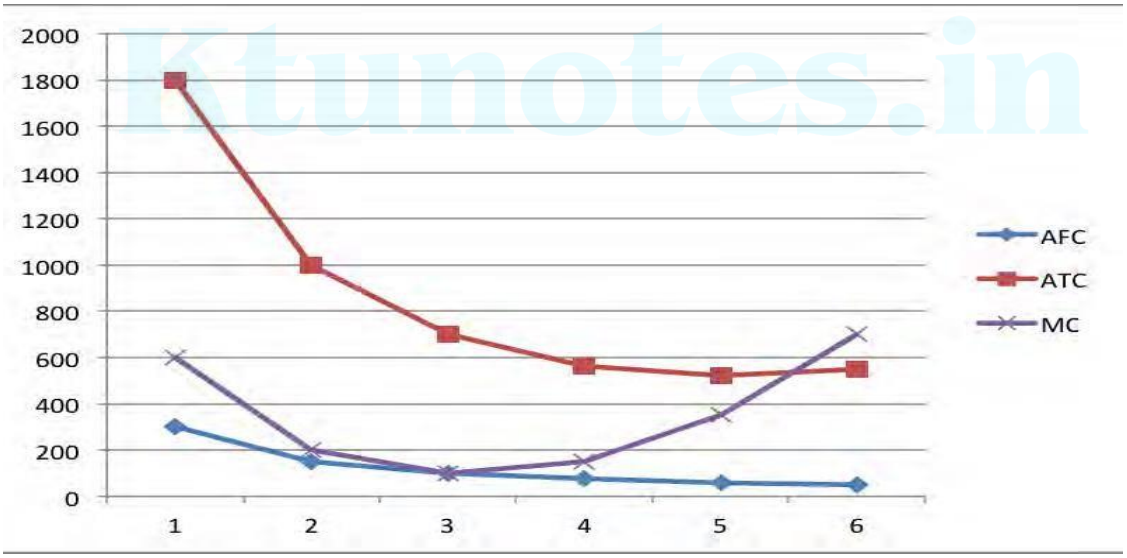
The total variable costs vary according to the output. Whenever the output increases the firm has to buy raw materials, use more electricity, labor and other sources therefore the TVC curve is upward sloping. The total cost consists of fixed (TFC) and variable costs (TVC). The TFC of Rs. 2 Lakhs is included with the variable cost throughout the production schedule so the total cost (TC) is above the TVC line.

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

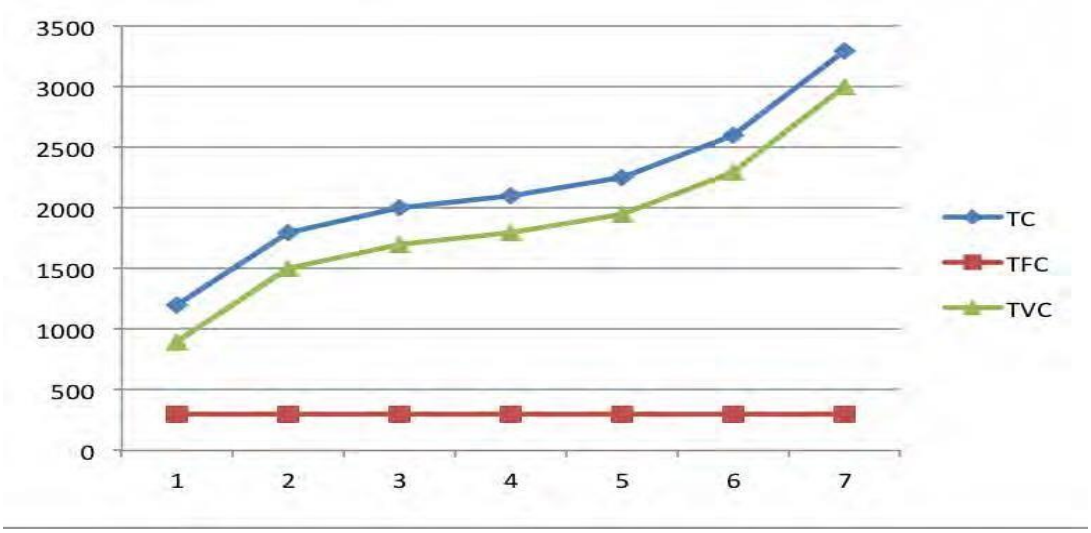
Table –Cost Schedule (Rupees in thousands)

Output	TC	TFC (FC)	TVC (VC)	AFC	ATC (AC)	AVC	MC
0	300	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.

MCn = TCn – TCn-1

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

MC for 5th unit = TC of 5th unit minus TC of 4th 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.

Long Run Cost

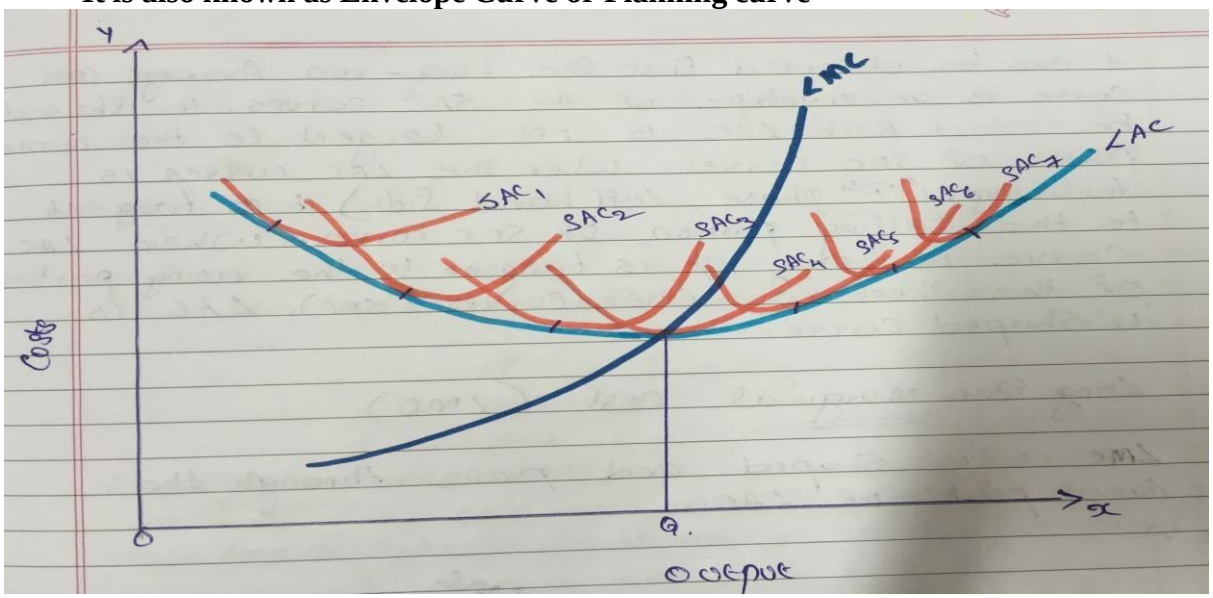
- In long run all costs varies
- There is no fixed cost in long run

Long Run Average Cost (LAC)

- LAC is derived from short run AC
- LAC is termed as the collection of SAC

Long Run Average Cost (LAC)

It is also known as Envelope Curve or Planning curve



Revenue

- Revenue means receipts from sale of output by a firm in a given period

Total Revenue (TR)

- It is the total amount of money received by a firm from the sale of goods and services during a certain period

  TR = Q x P i.e PQ

  Q = Quantity/Outpu

  tP = Price

Average Revenue (AR)

- AR = TR/Q
- P x Q / Q = P

i.e. AR = P

Marginal Revenue (MR)

It is the addition to total revenue from the sale of an additional unit of outputMR = TR n - TR n-1

MR = d(TR) / d(Q)

Break Even Analysis

- It is method used to study the relationship between TC and TR
- Breakeven point (BEP) is used to understand this relationship
- BEP is the point where TC equals to TR. No profit, no loss (zero profit)

BEP: TR = TC

Profit / Loss = TR – TC

Profit / Loss = (PxQ) – (TFC + TVC)

BEP = TFC / P – AVC

(BEP means breakeven point or quantity)

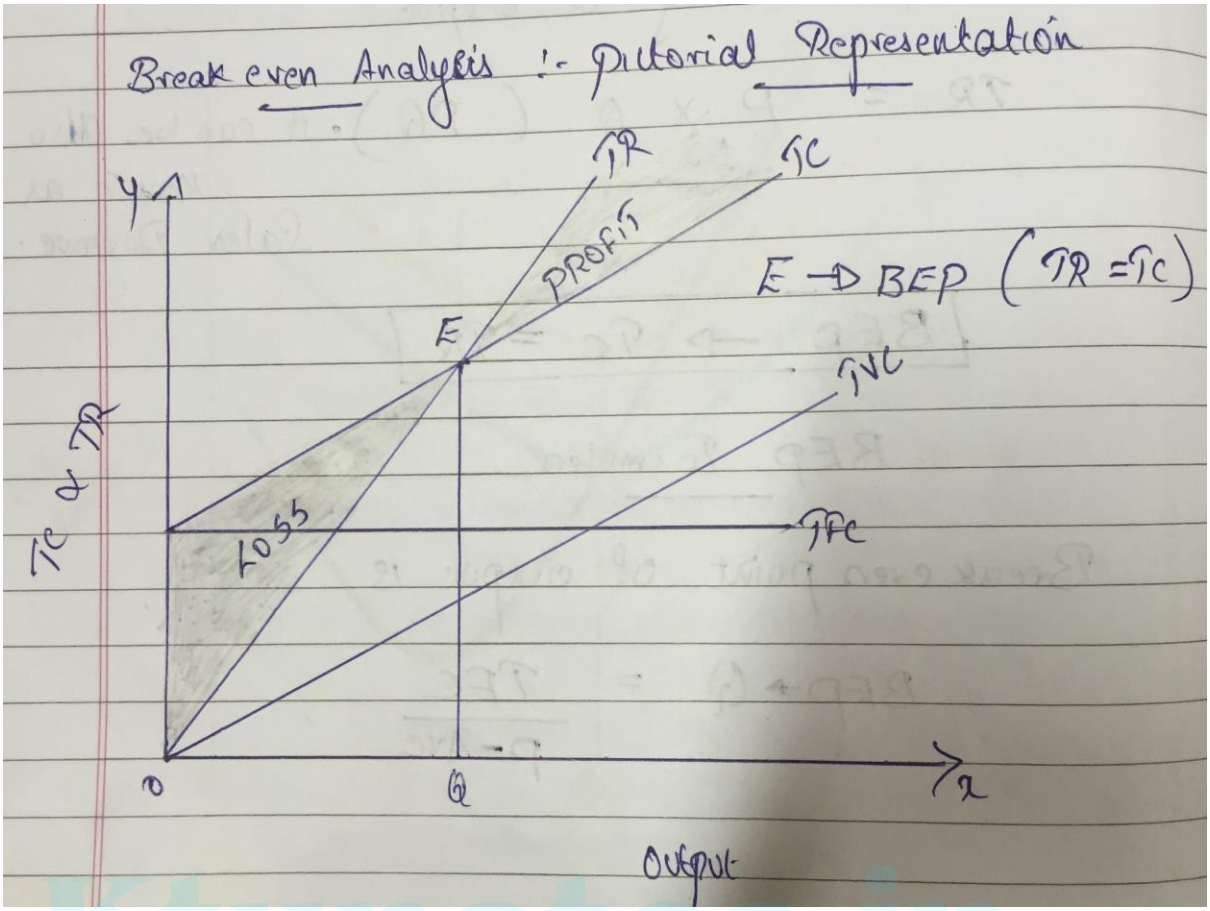
NOTE:

1.) At BEP, it is zero profit

2.) when no of units sold is lesser than BEP, it is loss

3.) when no of units sold is greater than BEP, it is profit

Break even Analysis :- pictorial Representation



Observations

TC > TR, it is

Loss

TC < TR, it is

Profit

TC = TR, No Profit, No Loss (BEP)

Margin of Safety

Margin of safety is how much output or sales level can fall before a businessreach it's BEP

Margin of Safety = Excess of Sales/Actual sales – BEP

Uses of Break-Even Analysis:

It helps in the determination of selling price which will give the desired profits.

It helps in the fixation of sales volume to cover a given return on capital employed.

It helps in forecasting costs and profit as a result of change in volume.

It gives suggestions for shift in sales mix.

It helps in making inter-firm comparison of profitability.

It helps in determination of costs and revenue at various levels of output.

It is an aid in management decision-making (e.g., make or buy, introducing a product etc.), forecasting, long-term planning and maintaining profitability.

It reveals business strength and profit earning capacity of a concern without much difficulty and effort.

LIMITATIONS OF BREAK EVEN ANALYSIS

1. Break-even analysis is based on the assumption that all costs and expenses can be clearly separated into fixed and variable components. In practice, however, it may not be possible to achieve a clear-cut division of costs into fixed and variable types.

2. It assumes that fixed costs remain constant at all levels of activity. It should be noted that fixed costs tend to vary beyond a certain level of activity.

3. It assumes that variable costs vary proportionately with the volume of output. In practice, they move, no doubt, in sympathy with volume of output, but not necessarily in direct proportions.

4. The assumption that selling price remains unchanged gives a straight revenue line which may not be true. Selling price of a product depends upon certain factors like market demand and supply, competition etc., so it, too, hardly remains constant.

5. The assumption that only one product is produced or that product mix will remain unchanged is difficult to find in practice.

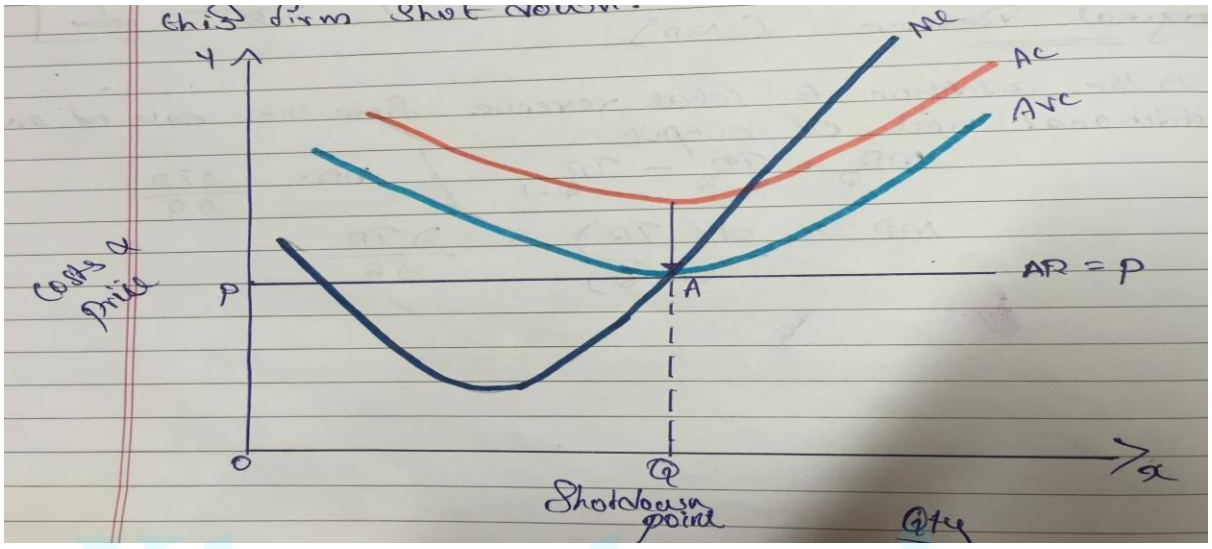
6. Apportionment of fixed cost over a variety of products poses a problem.

Shut Down Point

A shut down point is a point where the firm experience no benefit in continuingoperations or productions.

Shutdown point is defining as that point where the market price of the product isequal to the AVC in the short run

Pictorial representation of shut down point



Model Questions

a) What is break-even analysis? (2)

b) Suppose a Company produces batteries and its fixed cost is Rs. 50,000/-. If variable expense per battery is Rs.3/- and price of battery is Rs 8/- estimate

i. Break-even level of output. (3)

ii Number of batteries to be produced to get a total profit of Rs. 25000/- (3)iii What is the margin of safety if the planned sales is 12000 batteries? (2)

5. a) Distinguish between fixed cost and variable cost. (3)

b) In a firm if AVC<P<AC, will the firm shut down or continue to produce? Givereason. (3)

Where, P – Price AVC – Average variable cost AC – Average cost

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5. a) (i) Calculate Break even quantity from the following data

Fixed Cost: Rs. 25,000; Average Variable Cost: Rs. 12; Selling price Rs.17

ii) What will be the Break-Even Quantity, if selling price increases by Rs.3?

b) What are the limitation of Breakeven analysis?

Previous Year Questions

1. Distinguish between explicit and implicit cost.(3)
2. What is shut down point? (3)
3. Describe production function.(3)
4. State any three properties of an isoquant(3)

5. a. State the law of variable proportion. Examine its three stages of production with the help of a diagram. (10)
5. b. Briefly explain any four types of internal economies from large scale production. (4)

6. a. Draw a break-even chart and explain break-even point. Suppose a firm's fixed cost is Rs 50000 and they sell their product at a price of Rs.l00 per unit. If the average variable cost per unit of output is Rs. 50, estimate break even output if they sell 1500 units what will be the profit and margin of safety?(10)
6. b. The Cobb-Douglas production function is given as Q: A K^0.5 L^0.5, if the amount of capital (K) is 100 units, the amount of labour (L) is 64 units and A is 2. calculate total product and marginal product of capital (4)

7. a. State and explain the law of variable proportion (7)
7. b. What are isoquants? Describe its characteristics (7)

8. a. With the help of a diagram, explain producer's equilibrium and expansion path (7)
8. b. Explain break even analysis with the help of a diagram. What are its uses? (7)