Principles of Economics and Management
(PEM)
GTU # 3140709

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Unit-2

Theory of Production and Cost

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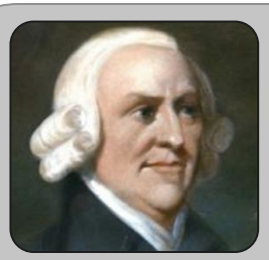
Outline

- Theory of production
  - Production function, meaning
  - Factors of production (meaning and characteristics of land, labour, capital and entrepreneur)
  - Law of variable proportions and law of returns to scale
- Cost
  - Meaning
  - Short run & long run cost
  - Fixed cost, Variable cost, Total cost, Average cost, Marginal cost and Opportunity cost
- Break even analysis
  - Meaning, Explanation, Numerical

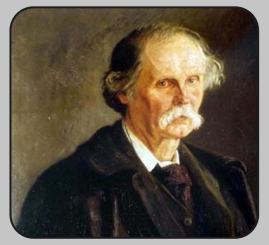
Theory of production

Definition of Production



Adam Smith (1723-1790) defined

"Production is a creation of physical assets."



Alfred Marshall (1723-1790) defined

"Production is a creation of utilities."

Philip Kotler (Born in 1931) defined

"Production is a creation of bundle of satisfaction."

Theory of Production and Three Aspects to Production Processes

- Production theory is the economic process of producing outputs from the inputs.

- Production Process have three different aspects which are:
  1. The quantity of the goods or service produced.
  2. The form of the goods or service created.
  3. The distribution of the goods or service produced.

Utility, Types of Utility and it's Measurement

- "Utility" is referring to the total satisfaction received from consuming the goods or service.
- Types of Utility are:

Form Utility	• Transforms the form of raw materials into marketable goods. E.g. Log of wood converted into a chair
Place Utility	• Products of rural areas fetch higher price in urban areas. E.g. Fruits, vegetables, etc.
Time Utility	• Production in a peak season with low price is stored and marketed in slack season at higher price. E.g. Onion
Possession Utility	• Transfer ownership in a product through buying and selling deals. E.g. Buy and resell

- Measurement of Utility can be done by two different concepts which are:
  1. Cardinal Utility Concept
  2. Ordinal Utility Concept

Cardinal and Ordinal Utility Concept

1. Cardinal Utility Concept
   - It believes that utility is cardinal or quantitative like other mathematical variables (height, weight, etc…)
   - Measuring unit of utility is utils.
   - E.g. Individual gains 20 utils from ice-cream and 10 utils from coffee.
   - Number of difficulties involved in measurement of utility are changes in consumer's mood, taste, preferences etc.
2. Ordinal Utility Concept
   - According to this concept, utility cannot be measured numerically, it can only be ranked as 1, 2, 3 and so on.
   - For instance, an individual prefers ice-cream over the coffee, which implies that utility of ice-cream is given rank 1 and coffee as rank 2.
   - It meets the theoretical requirements of consumer behavior analysis.

Factors of Production

Land

Labor

Capital

Entrepreneur

1. Land

- Land is the economic resource encompassing natural resources found within the economy.
- This resource includes timber, land, fisheries, farms etc.
- Land is a limited resource for any economies.

Source: www.charteredclub.com

Source: www.pakistantoday.com.pk

2. Labor

- Labor represents the human capital available to transform raw materials or natural resources into consumer goods.
- Human capital includes all individuals capable of working in the economy and providing various services to other individuals or businesses.

http://marketbusinessnews.com

3. Capital

- Capital has two economic definitions as a factor of production.
  1. Capital can represent the financial resources which companies use to purchase natural resources like land and other capital goods.
  2. Capital also represents the major physical assets which individuals and companies use when producing goods or services.
- These assets include buildings, production facilities, equipment, vehicles etc.

Source: www.asianage.com

Source: marketbusinessnews.com

4. Entrepreneur

- Entrepreneur is a person who sets up a business and takes financial risks in the hope of profit.
- Entrepreneurs usually have an idea for creating a valuable good or service.

Source: marketbusinessnews.com

Production Function

- Production function relates physical output of a production process to physical inputs.
- It is a mathematical function that relates outputs with the number of inputs.
- Production function: $Q = F(K, L)$
  - Where
  - $Q = quantity\ of\ output$
  - $K = capital$
  - $L = labor$
- For Example
  - Simple Production Function: $Q = K + L$
  - Cobb-Douglas Production Function: $Q = \sqrt{K} \times \sqrt{L}$
  - Leontief Production Function: $Q = Min(K, L)$

Marginal Product

- **Marginal product** of an input (factor of **production**) is the change in **output** resulting from employing **one more unit** of a particular input
- E.g. if a firm's labor is increased from five to six and firm able to produce 10 product more then marginal product is 10.

The Law of Variable Proportions

- The law of variable proportions states that
  - "As the quantity of one factor is increased, keeping the other factors fixed, the marginal product of that factor will eventually decline".
- This law describes the input-output relation when the output is increased by varying the quantity of only one input.
- In the short run, some factors of production are fixed like Capital, Land etc. while some other factors are variable like Labor, Raw Materials etc.
- The short run Production Function describes relation between the quantity of variable factor and the quantity of commodity produced.
- Equation of short run production function: $Q = F(L, \overline{K})$
  - $where\ Q = Output,\ L = Labor, and\ K = Capital\ (Bar\ indicates\ that\ it\ is\ Constant)$
- This law is also known as the law of diminishing returns. Because a point will reach, where marginal physical product tends to diminish gradually, if the quantity of a variable factor is increased continuously.

Assumptions of the Law of Variable Proportions

- Only one factor is variable while others are held constant.
- All units of the variable factor are homogeneous.
- There is no change in technology.
- It is possible to vary the proportions in which different inputs are combined.
- It assumes a short-run situation.
- The product is measured in physical units. For example in quintals, tones, etc.

Example - Law of Variable Proportions

No. of Workers	Total Product	Average Product	Marginal Product	Stage

* May not applicable to all business.

Stages of Law of Variable Proportions

1. Increasing Returns
   - It becomes cheaper to produce the additional output.
   - Thus the producer will always expand through this stage.
   - Causes
     - Fixed factor is used more intensively and production increases rapidly.
     - Division of labor and specialization.
     - The fixed factors are indivisible which means that they must be used in a fixed minimum size.

The Best Stage: because it utilizes resources very well.

2. Diminishing Returns
   - This is the stage in which production is feasible and more profitable.
   - In this stage the marginal productivity of labor is positive though, it is diminishing but non-negative.
   - Causes
     - The distortion (disfigurement) in the combination of factors.
     - Control and supervision become difficult.
     - There may be shortage of trained labor or raw material.

3. Negative Marginal Returns
   - It clearly shows the loss so no business like to operate in this stage.

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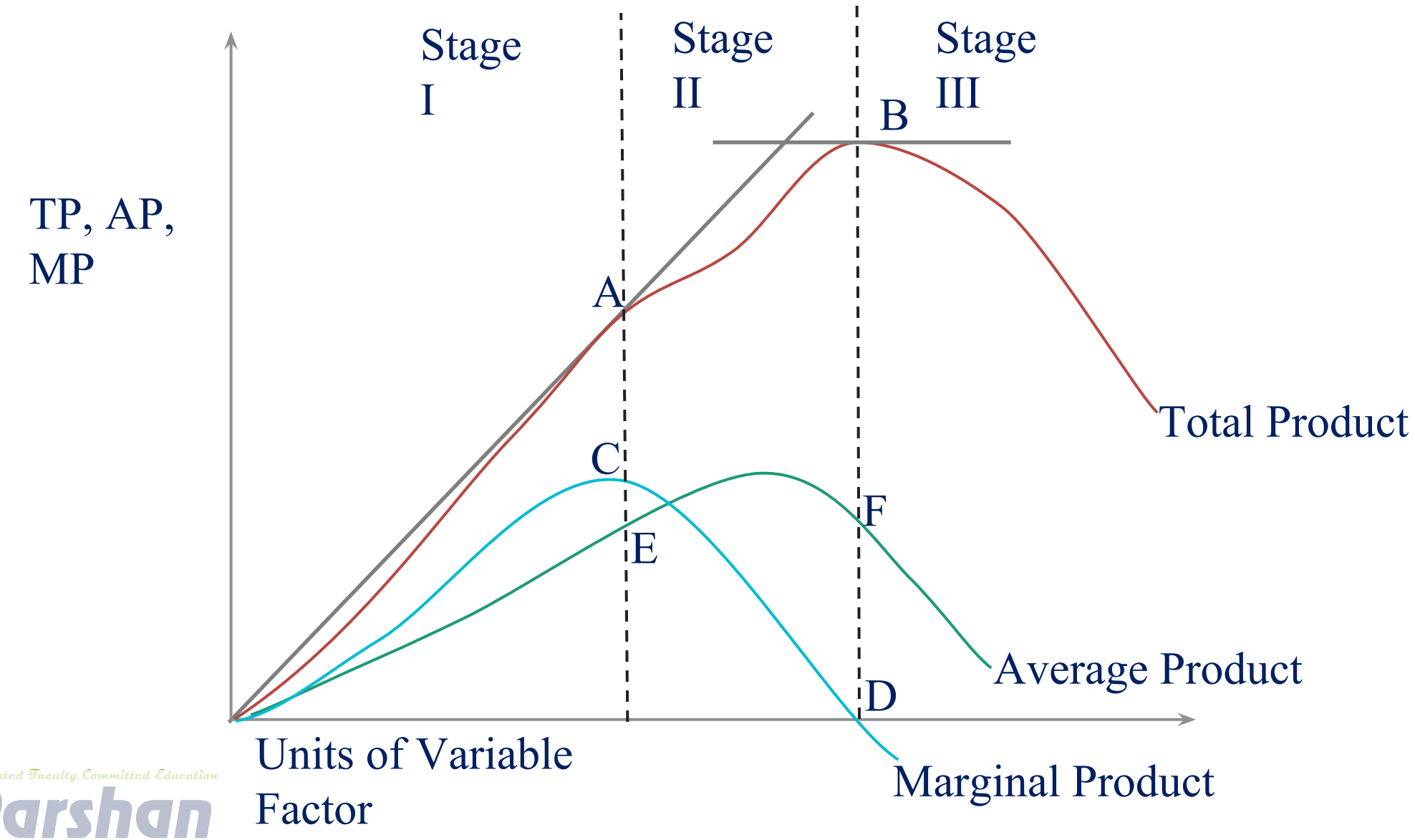

Stage I
Stage II
Stage III
TP, AP, MP
A
B
C
D
E
F
Total Product
Average Product
Marginal Product
Units of Variable Factor

The Law of Returns to Scale and it's Assumptions

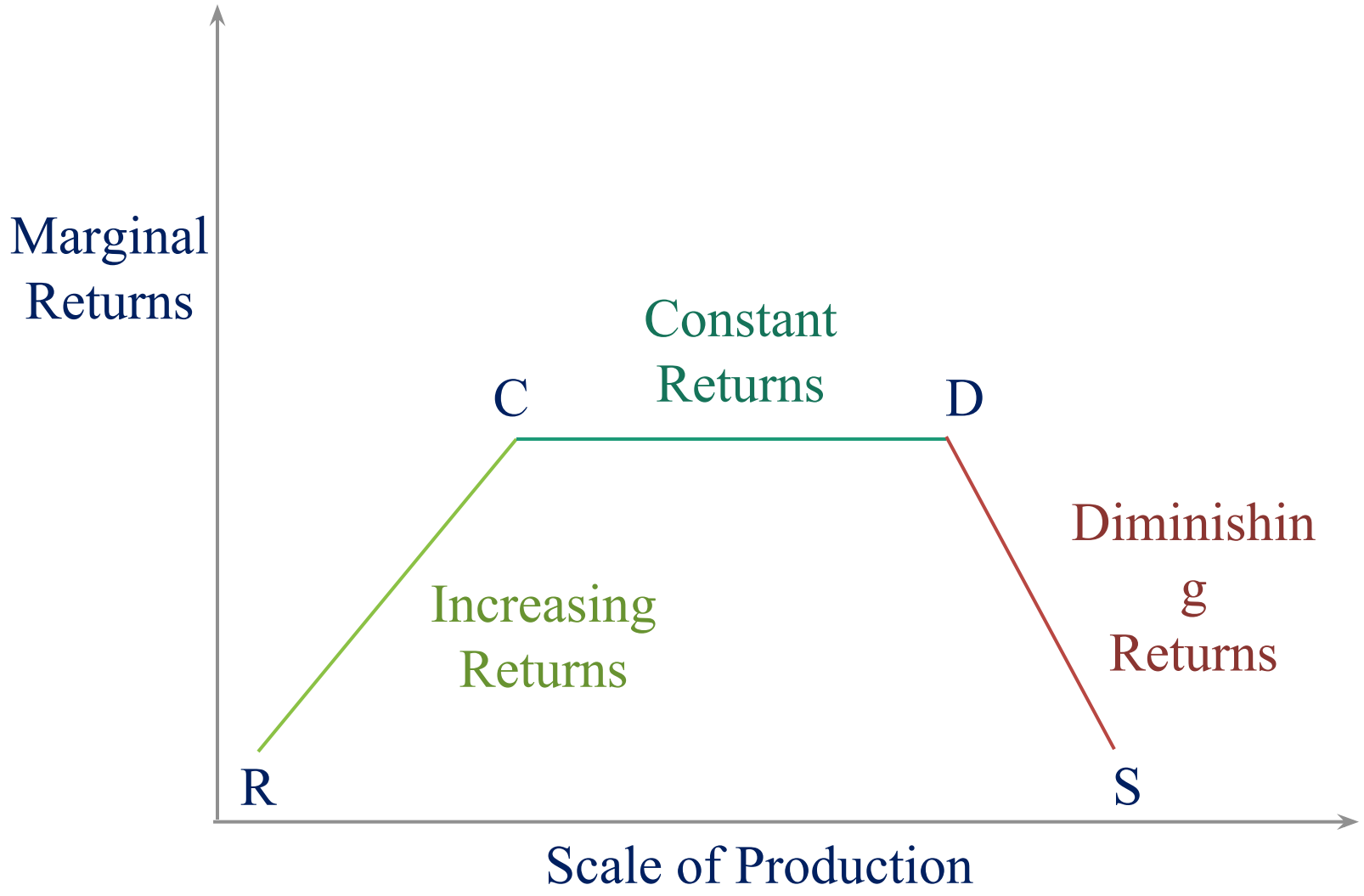
- It describes the relationship between outputs and scale of inputs in the long-run when all the inputs are increased in the same proportion.
- In the words of Prof. Roger Miller
  - "Returns to scale refer to the relationship between changes in output and proportionate changes in all factors of production"
- As demand increases, the firm increases its scale of production.
- Assumptions of The Law of Returns to Scale are:
  - All factors (inputs) are variable but the enterprise is fixed.
  - A worker works with given tools and implements.
  - Technological changes are absent.
  - There is perfect competition.
  - The product is measured in quantities.

Example - Law of Returns to Scale

Unit	Scale of Production	Total Returns	Marginal Returns	Stage

* May not applicable to all business.

Cont…


Marginal Returns
Constant Returns
C
D
Diminishin g Returns
Increasing Returns
R
S
Scale of Production

Stages of Law of Returns to Scale

1. Increasing Returns to Scale
   - Increase in total output is more than proportional to the increase in all inputs.
   - Causes
     - Indivisibility of Factors
     - Specialization and Division of Labor
     - Internal Economies
     - External Economies
2. Constant Returns to Scale
   - Increase in total output is in exact proportion to the increase in inputs.
   - Causes
     - Internal Economies and Diseconomies
     - External Economies and Diseconomies
     - Divisible Factors

Cont…

3. Diminishing Returns to Scale

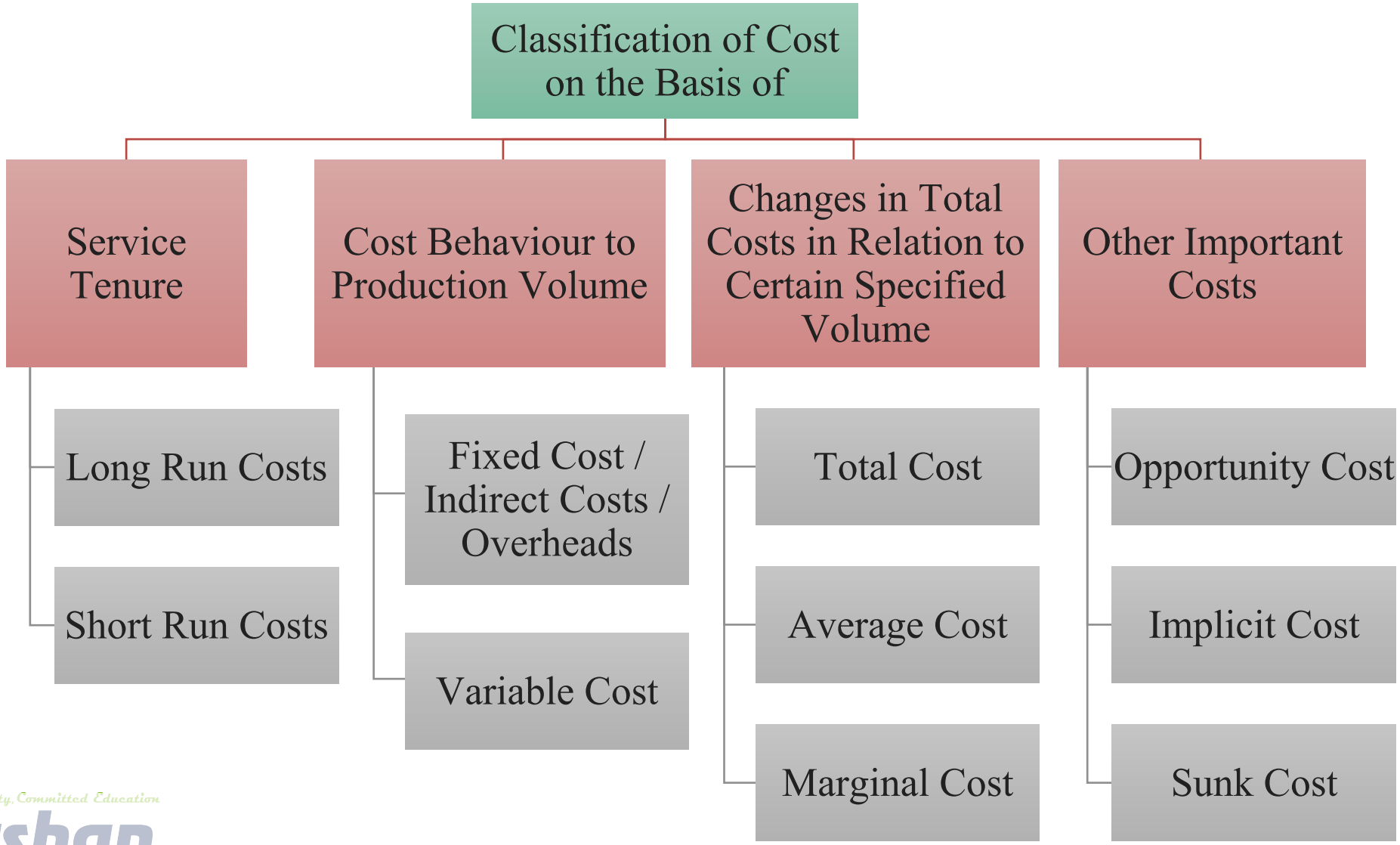
- Increase in output is less than proportional to the increase in inputs.
- Causes
  - Indivisible factors may become inefficient and less productive.
  - Produce problems of supervision and coordination.
  - Large management creates difficulties of control and rigidities.
  - Higher prices or diminishing productivities of the factors.
  - Demand for skilled labor, land, capital, etc. rises.

Cost

Cost

- An amount that has to be paid or given up in order to get something.
- In business, cost is usually a monetary valuation of:
  - Effort
  - Material
  - Resources
  - Time and utilities consumed
  - Risks incurred
  - Opportunity forgone in production
  - Delivery of a good or service

Classification of Cost



Cost on the Basis of Service Tenure

1. Long Run Costs

- Long run costs are accumulated when firms change production levels over time in response to expected economic profits or losses.
- In the long run there are no fixed factors of production.
- The land, labor, capital goods, and entrepreneurship all vary to reach the long run cost of producing a good or service.
- The long run is a planning and implementation stage for producers.
- They analyze the current and projected state of the market in order to make production decisions.

2. Short Run Costs

- Short run costs are accumulated in real time throughout the production process.
- Fixed costs have no impact of short run costs, only variable costs and revenues affect the short run production.
- The short run costs increase or decrease based on variable cost as well as the rate of production.
- If a firm manages its short run costs well over time, it will be more likely to succeed in reaching the desired long run costs and goals.

Cost on the Basis of Cost Behaviour to Production Volume

1. Fixed Cost / Indirect Costs / Overheads

- In economics, fixed costs are business expenses that are not dependent on the level of goods or services produced.
- They tend to be time-related, such as salaries or rents being paid per month, and are often referred to as overhead costs.
- **Total Fixed Cost**: Total cost for all fixed inputs of the firm per time is called total fixed cost.
- E.g. firm taking land on lease Rs. 1,00,000 per month and borrowed money on interest Rs. 20,000 per month. So total fixed cost per month is Rs. 1,20,000 per month.

2. Variable Cost

- Variable costs are costs that change in proportion to the good or service that a business produces.
- E.g. Assume a business produces cloths. A variable cost of this product would be the direct material, i.e., cloth, and the direct labor.

	1 Garment	2 Garments	3 Garments
Cloth (Direct Materials)	10 ft.	20 ft.	30 ft.
Labor (Direct Labor)	5 hrs	10 hrs	15 hrs

- **Total Variable Cost**: To It varies with output.

Cost on the Basis of Changes in TCs in Relation to Certain Specified Volume

1. Total Cost

- Total cost is sum of total fixed cost and total variable cost.

$$Total\ Cost(TC) = Total\ Fixed\ Cost(TFC) + Total\ Variable\ Cost\ (TVC)$$

2. Average Cost

- Average obtained by dividing the total cost of producing a given volume of a product by the volume of production of that product.

$$Average\ Cost\ (AC) = \frac{Total\ Cost\ (TC)}{Total\ Volume\ Produced\ (TVP)}$$

3. Marginal Cost

- The benefits of mass production can be seen in marginal cost.
- If V1 volume of product is manufactured in X1 cost and it requires X2 cost for producing V1 + 1 volume then the marginal cost of production is X2 – X1 with reference to production volume V1.
- E.g. if 1000 toys are manufactured in Rs. 50000 and 1001 toys requires Rs. 50030 then the marginal cost is Rs. 30 at volume 1000 toys.

Other Important Costs

1. Opportunity Cost

- E.g. if you have Rs. 50000 to invest and have two option share market and real estate.
  - If you selected share market and got Rs, 4000 return in one year.
  - At the same time if you invest it in real estate then it will give Rs. 5000 return
  - Then you have to forget Rs. 1000 due to not selecting real estate.
  - This 1000 is called Opportunity Cost.
- In real practice if alternative (X) is selected from a set of competing alternatives (X, Y), then the corresponding investment in the selected alternative is not available for any other purpose.

2. Implicit Cost

- The implicit cost is to be understood with reference to the explicit cost.
- The explicit cost is certain and fixed like 10% interest on bonds indicates 10% explicit cost.
- If the bonds are issued today at Rs. 92 which are repayable after 1 year with its face value of Rs. 100 then Rs. 8 will become the implicit cost.
- The implicit cost in percentage will be 11.5% i.e. $\frac{Rs.\,92}{Rs.\,8}$.

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3. Sunk Cost

- Sunk costs are such cash outflows incurred currently which cannot be reversed at later stage.
- E.g. are the government stamps duty or registration fee or consultancy fee or project report fee etc.
- After incurring such expenses, if business is not started then such fees cannot be recovered.

Break-Even Analysis

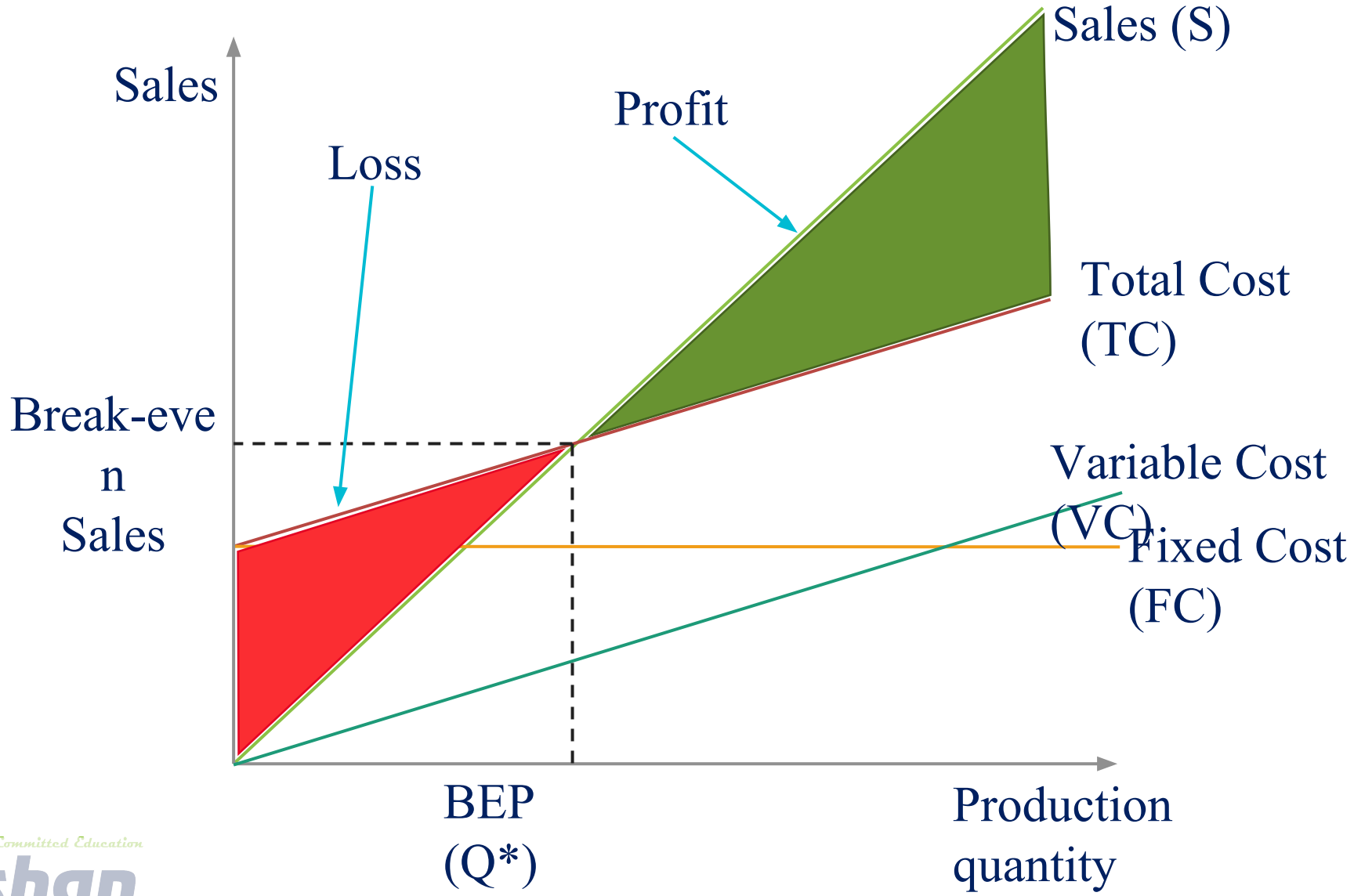
Break-Even Analysis and it's Assumptions

- Break-even analysis is used to find the cut-off production volume (no profit no loss) from where a firm will start receiving profit.
- Production volume less then break-even quantity will put business in loss.
- Assumptions of Break-even analysis are:
  - All costs can be separated into fixed and variable components.
  - Fixed costs will remain constant at all volumes of output.
  - Variable costs will fluctuate in direct proportion to volume of output.
  - Selling price will remain constant.
  - Product-mix will remain unchanged.
  - No opening or closing stock.
  - Productivity per worker will remain unchanged.
  - There will be no change in the general price level.

Break-Even Analysis Equation

- Let,
  - $s = selling\_price\_per\_unit$
  - $v = variable\_cost\_per\_unit$
  - $FC = fixed\_cost\_per\_period$
  - $Q = volume\_of\_production$
- Total sales revenue (S) of the firm is given by the following formula:
  - $S = s * Q$
- Total cost (TC) of the firm for a given production volume is given by:
  - $TC = Total\_variable\_cost + Fixed\_cost$
  - $TC = v * Q + FC$

Break-Even Analysis Graphical Representation



Break-Even Analysis

- Profit is calculated as follows:
  - $Profit = Sales - TC$
  - $Profit = Sales - (Fixed\ cost + Variable\ costs)$
  - $Profit = s * Q - (FC + v * Q)$
- Break-even quantity can be calculated as follows:
  - $Break\ even\ quantity = \frac{Fixed\ Cost}{\frac{Selling\ price}{unit} - \frac{Variable\ cost}{unit}}$
  - $Break\ even\ quantity = \frac{\mathrm{FC}}{\mathrm{s-v}}\ (\text{in units})$
- Break-even sales can be calculated as follows:
  - $Break\ even\ sales = \left(\frac{Fixed\ Cost}{\frac{Selling\ price}{unit} - \frac{Variable\ cost}{unit}}\right) * \left(\frac{Selling\ price}{unit}\right)$
  - $Break\ even\ sales = \frac{\mathrm{FC}}{\mathrm{s-v}} * \mathrm{s}\ (\text{in Rs.})$

Limitation of Break-Even Analysis

- In practice, it may not be possible to achieve a clear-cut division of costs into fixed and variable type.
- It should be noted that fixed costs tend to vary beyond a certain level of activity.
- In practice, variable costs vary with the volume of output, but not necessarily in direct proportions.
- The assumption that selling price remains unchanged gives a straight revenue line which may not be true.
- It assumes that the business conditions may not change which is not true.
- Assumption no change in opening and closing stock of finished product, this is not true in practice.
- Capital employed is an important determinant of the profitability of a concern which break-even analysis does not take into consideration.
- In practice, product mix may not remain unchanged.
- Distribution of fixed cost over a variety of products poses a problem.

Application of Break-Even Analysis

- Determination of selling price which will give the desired profits.
- Fixation of sales volume to cover a given return on capital employed.
- Forecasting costs and profit as a result of change in volume.
- Gives suggestions for shift in sales mix.
- Inter-firm comparison of profitability.
- Determination of costs and revenue at various levels of output.
- It is an aid in management decision-making, forecasting, long-term planning and maintaining profitability.
- It reveals business strength and profit earning capacity of a concern without much difficulty and effort.

Contribution

- The contribution is the difference between the sales and the variable cost.
  - $Contribution = Sales - Variable\ costs$
  - $\frac{Contribution}{unit} = \frac{Selling\ price}{unit} - \frac{Variable\ cost}{unit}$

Margin of Safety (M.S.)

- Margin of Safety is the sales over and above the break-even sales.
- It can be calculated by two methods and one can be derived from other.
- Method I:
  - $M.S. = \frac{Profit}{Contribution} * sales$
- Method II derived from method I:
  - $M.S. = \frac{Profit}{Contribution} * sales$
  - $M.S. = \frac{s*Q-(FC+v*Q)}{Sales-Variable\ costs} * sales$
  - $M.S. = \frac{s*Q-(FC+v*Q)}{(s*Q)-(v*Q)} * (s * Q)$
  - $M.S. = \frac{(s*Q-v*Q-FC)}{(s*Q)-(v*Q)} * (s * Q)$
  - $M.S. = \frac{(s*Q-v*Q)-(FC)}{(s*Q)-(v*Q)} * (s * Q)$
  - $M.S. = (s * Q) - \frac{FC}{s-v} * s$
  - $M.S. = Sales - Break\ even\ sales$
- Now M.S. as a percent of sales:
  - $M.S.\ as\ a\ percent\ of\ sales = \frac{M.S.}{Sales} * 100$

Margin of Safety (M.S.) Example 1

- Alpha Associates has the following details:
  - Fixed cost = Rs. 20,00,000
  - Variable cost per unit = Rs. 100
  - Selling price per unit = Rs. 200
- Find
  - The break-even sales quantity
  - The break-even sales
  - If the actual product quantity is 60,000 find
    - contribution;
    - margin of safety by all methods and
    - margin of safety as a percent of sales.

Margin of Safety (M.S.) Example 1 Solution

- Fixed cost (FC) = Rs. 20, 00,000
- Variable cost per unit (v) = Rs. 100
- Selling price per unit (s) = Rs. 200

$$\text{Break even quantity} = \frac{\text{FC}}{\text{s} - \text{v}} = \frac{20{,}00{,}000}{200 - 100} = 20{,}000\ units$$

$$\text{Break even sales} = \frac{\text{FC}}{\text{s} - \text{v}} * \text{s} = \frac{20{,}00{,}000}{200 - 100} * 200 = 40{,}00{,}000$$

$$\text{Contribution} = \text{Sales} - \text{Variable costs} = \text{s} * \text{Q} - \text{v} * \text{Q}$$
$$\text{Contribution} = 200 * 60{,}000 - 100 * 60{,}000$$
$$\text{Contribution} = 60{,}00{,}000$$

Cont…

- Margin of safety Method I

$$M.S. = \frac{\text{Profit}}{\text{Contribution}} * \text{sales}$$

$$M.S. = \frac{\text{Sales} - (FC + v * Q)}{\text{Contribution}} * \text{sales}$$

$$M.S. = \frac{60{,}000 * 200 - (20{,}00{,}000 + 100 * 60{,}000)}{60{,}00{,}000} * 1{,}20{,}00{,}000$$

$$M.S. = 80{,}00{,}000$$

Cont…

- Margin of safety Method II

$$M.S. = \text{Sales} - \text{Break even sales}$$

$$M.S. = 60{,}000 * 200 - 40{,}00{,}000 = 80{,}00{,}000$$

- Margin of safety as a percent of sales

$$M.S. \text{ as a percent of sales} = \frac{M.S.}{\text{Sales}} * 100$$

$$M.S. \text{ as a percent of sales} = \frac{80{,}00{,}000}{1{,}20{,}00{,}000} * 100 = 67\%$$

Margin of Safety (M.S.) Example 2

- ABC Associates has the following details:
  - Fixed cost = Rs. 30,00,000
  - Variable cost per unit = Rs. 200
  - Selling price per unit = Rs. 350
- Find
  - The break-even sales quantity
  - The break-even sales
  - If the actual product quantity is 80,000, find
    - contribution;
    - margin of safety by all methods and
    - margin of safety as a percent of sales.

GTU Questions

1. Write a detailed note on ‘Break Even Analysis’ with diagram.
2. Explain the law of variable praportion with suitable example.
3. Explain various types of costs with suitable examples.
4. Define the term production and explain factors affecting industrial production.

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Thank You

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