UNIT 3
PRODUCER BEHAVIOUR AND SUPPLY

Basic concepts to be studied under this unit.

Production function: refers to the functional relationship between inputs and output for a given state of technology.

\[ O_x = f(i_1, i_2, \ldots, i_n) \]

Where,
- \( O_x \): output of \( x \) commodity
- \( f \): functional relationship
- \( i_1, i_2, \ldots, i_n \): ‘n’ number of inputs required to produce output of \( x \).

Time period, can be classified as,
1. Very short period or market period
2. Short period / short run
3. Long period / long run

Market period: is that period where supply / output cannot be altered or changed.

Short period / run: is that period where supply / output can be altered / changed by changing only variable factors of production. In other words fixed factors of production remain fixed.

Long period: is that period where all factors of production are changed to bring about changes in output / supply. No factor is fixed.

Difference between short run & long run:

<table>
<thead>
<tr>
<th>Basis</th>
<th>Short Run</th>
<th>Long Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meaning</td>
<td>Only variable factors are changed</td>
<td>All factors are changed</td>
</tr>
<tr>
<td>Price Determination</td>
<td>Demand is active.</td>
<td>Both demand &amp; supply play an important role.</td>
</tr>
<tr>
<td>Classification</td>
<td>Factors are classified as fixed &amp; variable.</td>
<td>All factors are variable.</td>
</tr>
</tbody>
</table>

Fixed factors: These factors remain fixed or cannot be changed in the short run.

Variable factors: These factors are varied to bring about changes in output.

Concept of product: - Refers to volume of goods produced by a firm or an industry during a specific period of time.

Concepts of product:
Total Product- Total quantity of goods produced by a firm / industry during a given period of time with given number of inputs.
Average product = output per unit of variable input.

\[ \text{APP} = \frac{TPP}{\text{units of variable factor}} \]

Average product is also known as average physical product.

Marginal product (MP): refers to addition to the total product, when one more unit of variable factor is employed.

\[ \text{MP}_n = TP_n - TP_{n-1} \]

\[ \text{MP}_n = \text{Marginal product of nth unit of variable factor} \]

\[ TP_n = \text{Total product of n units of variable factor} \]

\[ TP_{n-1} = \text{Total product of (n-1) unit of variable factor}. \]

\[ n=\text{no. of units of variable factor} \]

\[ \text{MP} = \frac{\Delta TP}{\Delta n} \]

We derive TP by summing up MP

\[ TP = \sum \text{MP} \]

**LAW OF VARIABLE PROPORION OR RETURNS TO A VARIABLE FACTOR**

**Statement of law of variable proportion:** In short period, when only one variable factor is increased, keeping other factors constant, the total product (TP) initially increases at an increasing rate, then increases at a decreasing rate and finally TP decreases.

**Explanation of law of variable proportion with a schedule and a diagram**

<table>
<thead>
<tr>
<th>Fixed factor</th>
<th>Variable factor</th>
<th>Total product</th>
<th>Marginal product</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land in acres</td>
<td>Labour</td>
<td>Units</td>
<td>Units</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>I - Increasing returns to a factor</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>15</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>30</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>40</td>
<td>10</td>
<td>II – diminishing returns to a factor</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>45</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>45</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>40</td>
<td>-5</td>
<td>III - Negative returns to a factor</td>
</tr>
</tbody>
</table>
Phase I / Stage I / Increasing returns to a factor.
- TPP increases at an increasing rate
- MPP also increases.

Phase II / Stage II / Diminishing returns to a factor
- TPP increases at decreasing rate
- MPP decreases / falls
- This phase ends when MPP is zero & TPP is maximum

Phase III / Stage III / Negative returns to a factor
- TPP diminishes / decreases
- MPP becomes negative.

Reasons for increasing returns to a factor
- Better utilizations of fixed factor
- Increase in efficiency of variable factor.
- Indivisibility of factors.
- Reasons for diminishing returns to a factor.
- Optimum combination of factors
- Imperfect substitutes.
Reasons for negative returns to a factor

- Limitation of fixed factors
- Poor coordination between variable and fixed factor
- Decrease in efficiency of variable factors.

Relation between MPP / MP – TPP / TP

- As long as MPP increases TPP increases at an increasing rate
- when MPP decreases TPP increases diminishing rate.
- When MPP is Zero, TPP is maximum
- when MPP is negative, TPP starts decreasing

Short answer questions and Long answer questions

1. What is meant by production?
   Ans: Transformation of Input into Output.

2. What will be MP when TP is maximum?
   Ans: MP will be zero.

3. Define market period, Short run & Long run.
   Ans: Refer time period.

4. Explain the law of variable proportions with the help of a schedule and a diagram
   6 Marks

5. What are the reasons for
   a) Increasing returns to a factor
   b) Diminishing returns to a factor
   c) Negative returns to a factor
   6 Marks

6. Explain the difference between MPP & TPP.
   4 Marks

HOTS

Giving reasons, state whether the following statements are true or false:

1. When there are diminishing returns to a factor, total product always decreases.
   Ans: False, as TPP increases at a decreasing rate when there is diminishing returns to a factor.

2. TPP increases only when MPP increases.
   Ans: False, TPP also increases when MPP decreases but remains positive.

3. Increase in TPP always indicates that there are increasing returns to a factor.
   Ans: False. TPP increases even when there are diminishing returns to a factor.

4. When there are diminishing returns to a factor marginal and total products always fall.
   Ans: False, only MPP falls, not TPP. In case of diminishing returns to a factor TPP increase at diminishing rate.
5. Calculate MP for the following.

<table>
<thead>
<tr>
<th>Variable factor unit</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP unit</td>
<td>0</td>
<td>5</td>
<td>13</td>
<td>23</td>
<td>28</td>
<td>28</td>
<td>24</td>
</tr>
</tbody>
</table>

Ans: -MP: 0 5 8 10 5 0 -4

**COST**

**Cost of production**: Expenditure incurred on various inputs to produce goods and services.

**Cost function**: Functional relationship between cost and output.

\[ C = f(q) \]

Where  
\[ c = \text{cost of production} \]  
\[ q = \text{quantity of product} \]  
\[ f = \text{functional relationship} \]

**Money cost**: Money expenses incurred by a firm for producing a commodity or service.

**Explicit cost**: Actual payment made on hired factors of production. For example, wages paid to the hired labourers, rent paid for hired accommodation, cost of raw material etc.

**Implicit cost**: Cost incurred on the self-owned factors of production.

For example, interest on owners' capital, rent of own building, salary for the services of entrepreneur etc.

**Opportunity cost**: is the cost of next best alternative foregone / sacrificed.

**Fixed cost**: are the cost which are incurred on the fixed factors of production.

These costs remain fixed whatever may be the scale of output. These costs are present even when the output is zero.

These costs are present in short run but disappear in the long run.

**Numerical example of fixed cost**

<table>
<thead>
<tr>
<th>Output</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFC</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

\[ \text{TFC} = \text{Total Fixed Cost} \]
TFC is also called as “overhead cost”, “supplementary cost”, and “unavoidable cost”.

**Total Variable Cost**: TVC or variable cost – are those costs which vary directly with the variation in the output. These costs are incurred on the variable factors of production.

These costs are also called “prime costs”, “Direct cost” or “avoidable cost”.

These costs are zero when output is zero.

Numerical example,

<table>
<thead>
<tr>
<th>Output</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVC</td>
<td>0</td>
<td>10</td>
<td>16</td>
<td>25</td>
<td>38</td>
<td>55</td>
</tr>
</tbody>
</table>

**Diagrammatic presentation of TVC**

**Difference between TVC & TFC**

<table>
<thead>
<tr>
<th>Basis</th>
<th>TVC</th>
<th>TFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meaning</td>
<td>Vary with the level of output</td>
<td>Do not vary with the level of output</td>
</tr>
<tr>
<td>Time period</td>
<td>Can be changed in short period</td>
<td>Remain fixed in short period</td>
</tr>
<tr>
<td>Cost at zero output</td>
<td>Zero</td>
<td>Can never be zero</td>
</tr>
<tr>
<td>Factors of production</td>
<td>Cost incurred on all variable factors</td>
<td>Cost incurred on fixed factors of production</td>
</tr>
<tr>
<td>Shape of the cost curve</td>
<td>Upward slopping</td>
<td>Parallel to x axis</td>
</tr>
</tbody>
</table>
Total cost: is the total expenditure incurred on the factors and non-factor inputs in the production of goods and services.

It is obtained by summing TFC and TVC at various levels of output.

**Relation between TC, TFC and TVC**

1. TFC is horizontal to x axis.
2. TC and TVC are inversely, S shaped (they rise initially at a decreasing rate, then at a constant rate & finally at an increasing rate) due to law of variable proportions.
3. At zero level of output TC is equal to TFC.
4. TC and TVC curves parallel to each other.

$$\text{TC} = \text{TFC} + \text{TVC}$$

$$\text{TFC} = \text{TC} - \text{TVC}$$

$$\text{TVC} = \text{TC} - \text{TFC}$$

**Average cost**: are the “cost per unit” of output produced.

Average fixed cost is the per unit fixed cost of production.

$$\text{AFC} = \frac{\text{TFC}}{\text{output}}$$

AFC declines with every increase in output. It’s a rectangular hyperbola. It goes very close to x axis but never touches the x axis as TFC can never be zero.

Average variable cost is the cost per unit of the variable cost of production.

$$\text{AVC} = \frac{\text{TVC}}{\text{output}}$$

AVC falls with every increase in output initially. Once the optimum level of output is reached AVC starts rising.

Average total cost (ATC) or Average cost (AC): refers to the per unit total cost of production.

$$\text{ATC} = \frac{\text{TC}}{\text{output}}$$

$$\text{AC} = \text{AFC} + \text{AVC}$$
Phases of AC

I phase: When both AFC and AVC fall, AC also fall.
II phase: When AFC continues to fall, AVC remaining constant AC falls till it reaches minimum.
III phase: AC rises when rise in AVC is more than fall in AVC.

**Important observations of AC, AVC & AFC**

1. AC curve always lie above AVC (because AC includes AVC & AFC at all levels of output).
2. AVC reaches its minimum point at an output level lower than that of AC because when AVC is at its minimum AC is still falling because of fall in AFC.
3. As output increases, the gap between AC and AVC curves decreases but they never intersect.

**Marginal cost**: refers to the addition made to total cost when an additional unit of output is produced.

\[ MC_n = \text{TC}_n - \text{TC}_{n-1} \]

\[ MC = \Delta TC / \Delta Q \]

Note: MC is not affected by TFC.

**Relationship between AC and MC**

- Both AC & MC are derived from TC
- Both AC & MC are “U” shaped (Law of variable proportion)
- When AC is falling MC also falls & lies below AC curve.
- When AC is rising MC also rises & lies above AC
- MC cuts AC at its minimum where MC = AC

**Important formulae at a glance**

1. \[ \text{TFC} = \text{TC} - \text{TVC} \text{ or } \text{TFC} = \text{AFC} \times \text{output} \text{ or } \text{TFC} = \text{TC} \text{ at 0 output}. \]
2. \[ \text{TVC} = \text{TC} - \text{TFC} \text{ or } \text{TVC} = \text{AVC} \times \text{output} \text{ or } \text{TVC} = \Sigma \text{MC} \]
3. \[ \text{TC} = \text{TVC} + \text{TFC} \text{ or } \text{TC} = \text{AC} \times \text{output} \text{ or } \text{TC} = \Sigma \text{MC} + \text{TFC} \]
4. \[ \text{MC}_n = \text{TC}_n - \text{TC}_{n-1} \text{ or } \text{MC}_n = \text{TVC}_n - \text{TVC}_{n-1} \]
5. \[ \text{AFC} = \text{TFC} / \text{Output} \text{ or } \text{AFC} = \text{AC} - \text{AVC} \text{ or } \text{ATC} - \text{AVC} \]
6. \[ \text{AVC} = \text{TVC} / \text{Output} \text{ or } \text{AVC} = \text{AC} - \text{AFC} \]
7. \[ \text{AC} = \text{TC} / \text{Output} \text{ or } \text{AC} = \text{AVC} + \text{AFC} \]
Short answers and Long Answer questions:
1. What is cost of production?
2. Define cost function.
3. What are money costs?
4. Distinguish between explicit and implicit costs.
5. How do you define an opportunity cost?
6. What difference you find between fixed and variable costs?
7. Why the fixed cost curve is a horizontal straight line to the X axis?
8. Why variable costs are are variable?
9. What is average cost? How do you derive it?
10. Explain AVC, AFC & ATC and explain the relationship between these costs.
11. Explain the relationship TC, TFC & TVC.
12. With a diagram describe the various phases of AC.
13. Bring out the relationship between AC & MC

**HOTS**
1. Why AFC curve never touches ‘x’ axis though lies very close to x axis?
   Ans: - Because TFC can never be zero.
2. Why AVC and AFC always lie below AC?
   Ans: - AC is the summation of AVC & AFC so AC always lies above AVC & AFC.
3. Why TVC curve start from origin?
   Ans: - TVC is zero at zero level of output.
4. When TVC is zero at zero level of output, what happens to TFC or Why TFC is not zero at zero level of output?
   Ans: - Fixed cost are to be incurred even at zero level of output.

**Revenue**

Revenue: - Money received by a firm from the sale of a given output in the market.

Total Revenue: Total sale receipts or receipts from the sale of given output.
\[ TR = \text{Quantity sold} \times \text{Price} \] (or) \[ output \text{ sold} \times \text{price} \]

Average Revenue: Revenue or Receipt received per unit of output sold.

- \[ AR = \frac{TR}{Output \text{ sold}} \]
- AR and price are the same.
- \[ TR = \text{Quantity sold} \times \text{price or output sold} \times \text{price} \]
- \[ AR = \frac{(output \times \text{quantity} \times \text{price})}{Output/ \text{quantity}} \]
- AR= price

AR and demand curve are the same. Shows the various quantities demanded at various prices.
Marginal Revenue: Additional revenue earned by the seller by selling an additional unit of output.

- \( \text{MR}_n = \text{TR}_n - \text{TR}_{n-1} \)
- \( \text{MR}_n = \frac{\Delta \text{TR}_n}{\Delta Q} \)
- \( \text{TR} = \sum \text{MR} \)

Relationship between AR and MR (when price remains constant or perfect competition)

Under perfect competition, the sellers are price takers. Single price prevails in the market. Since all the goods are homogeneous and are sold at the same price \( \text{AR} = \text{MR} \). As a result AR and MR curve will be horizontal straight line parallel to OX axis. (When price is constant or perfect competition)

Relation between TR and MR (When price remains constant or in perfect competition)

When there exists single price, the seller can sell any quantity at that price, the total revenue increases at a constant rate (MR is horizontal to X axis)
Relationships between AR and MR under monopoly and monopolistic competition (Price changes or under imperfect competition)

- AR and MR curves will be downward sloping in both the market forms.
- AR lies above MR.
- AR can never be negative.
- AR curve is less elastic in monopoly market form because of no substitutes.
- AR curve is more elastic in monopolistic market because of the presence of substitutes.

Relationship between TR and MR. (When price falls with the increase in sale of output)

- Under imperfect market AR will be downward sloping – which shows that more units can be sold only at a less price.
- MR falls with every fall in AR / price and lies below AR curve.
- TR increases as long as MR is positive.
- TR falls when MR is negative.
- TR will be maximum when MR is zero.
Break-even point: It’s that point where TR = TC. or AR=AC. Firm will be earning normal profit.

Shut down point: A situation when a firm is able to cover only variable costs or TR = TVC

Formulae at a glance:

- TR = price or AR × Output sold or TR = ∑ MR
- AR (price) = TR ÷ units sold
- MR_n = MR_n – MR_{n-1}

HOTS

1. Can MR be negative or zero.
Ans:- Yes, MR can be zero or negative.

2. If all units are sold at same price how will it affect AR and MR?
Ans:- AR and MR will be equal at levels of output

3. What is price line?
Ans:- Price line is nothing but AR line and is horizontal to X-axis in perfect competition.

4. Can TR be a horizontal Straight line?
Ans:- Yes, when MR is zero.

5. What do you mean by revenue?
6. Explain the concept of revenue (TR, AR and MR)
7. Define AR
8. Prove that AR = price
9. Prove that AR is nothing but demand curve
10. Explain the relationships between AR and MR when price is constant and when price falls.
11. Explain the relationships between TR and MR when price is constant.
12. What is break-even point? Explain with a diagram.
13. When the situation of ‘shut – down’ point arises for a firm?
14. What happens to TR when a) MR is increasing, b) decreasing but remains positive and c) MR is negative?
    Ans:-  a) TR increases at an increasing rate.
            b) TR increases at a diminishing rate.
            c) TR decreases.
15. Why AR is more elastic in monopolistic competition than monopoly?
    Ans:- Monopolistic competition market has close substitutes. Monopoly market does not have close substitutes.
16. Why TR is 45° angle in perfect competition market?
    Ans:- In perfect competition market the goods are sold at the same price so AR= MR and the TR increases at a constant rate.
17. Can there be Break-even point with AR = AC
    Ans:- Yes there can be breakeven point with AR=AC.