UNIT-III
(Production and Cost Analysis)
MODULE- 3: COST OUTPUT RELATIONSHIP –II

CONTENTS

3.0: Objectives:

The objective of this module is to discuss average cost and output relationship in the short run and long run. After reading this module you should be able to understand the relationship between:

Average fixed cost and output
Average variable cost and output
Average cost and output in the short run
Long run average cost and output.

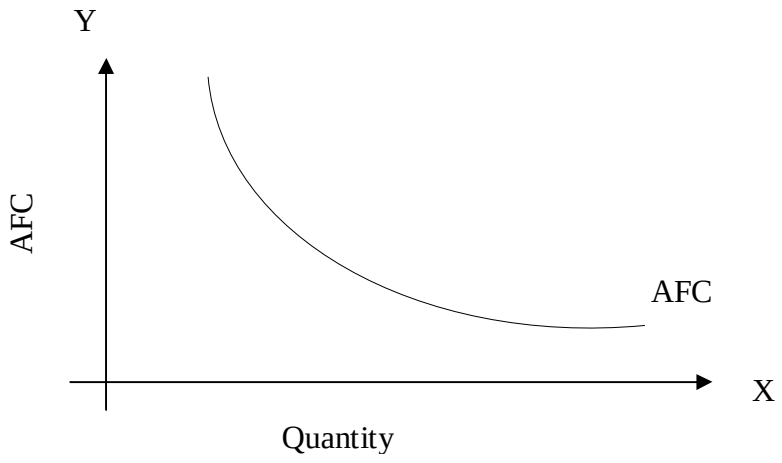
3.01: Average Fixed Cost (AFC) and Output (Q):

Business firm can arrive at average fixed cost i.e. fixed cost per unit, by dividing total fixed cost with the level of output.

$$AFC = \frac{TFC}{Q}.$$

If the TFC is Rs 1000 and the level of output is 100 units, then AFC is Rs.10. The basic feature of AFC is that it decreases continuously as the volume of output increases. This is due to the fact that TFC remains constant in the short-run .

GRAPH-1



3.02: Average Variable Cost (AVC) and Output (Q):

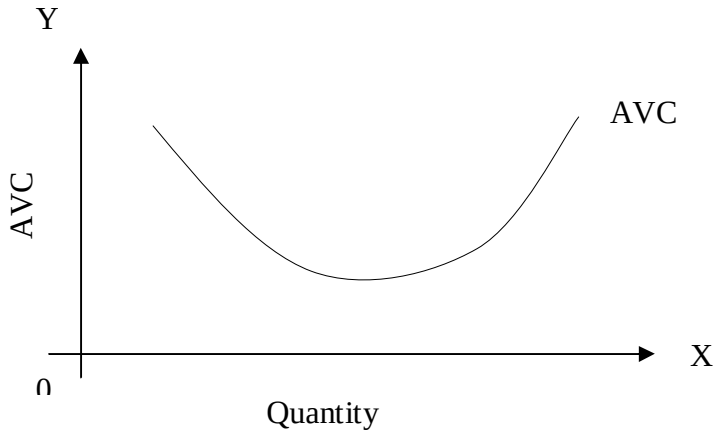
We can arrive at average fixed cost by dividing total variable cost (TVC) with the level of output.

TVC

$$AVC = \frac{\text{-----}}{Q}$$

If the total variable cost of producing 100 units of output is Rs 2000, then the AVC is Rs 20. The basic feature of AVC is that, in the beginning, it decreases as the level of output increases. But after certain level of output, it increases due to diminishing returns experienced by the business firm.

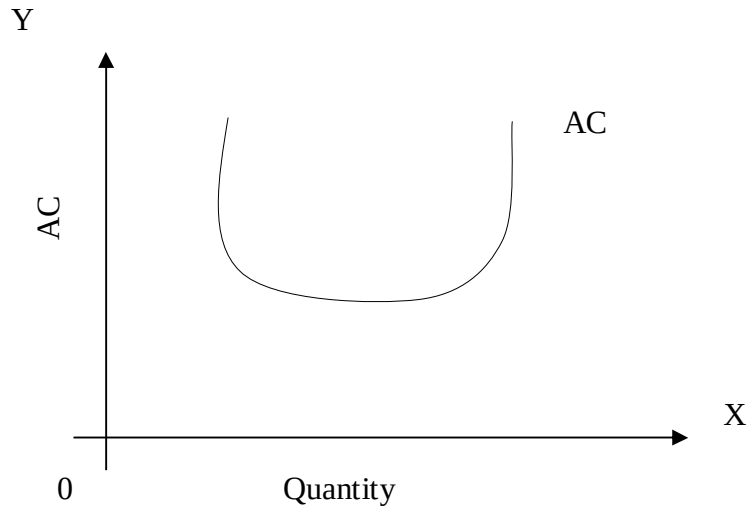
GRAPH-2



3.03: Average Cost (AC) and Output (Q):

We can arrive at average cost by adding together AFC and AVC at any given level of output. For example to produce 100 units of output, the AFC is Rs 10 and the AVC is Rs 20. So that AC is Rs 30. In the beginning as output increases AC decreases. Beyond a level of output as output increases AC decreases.

GRAPH-3



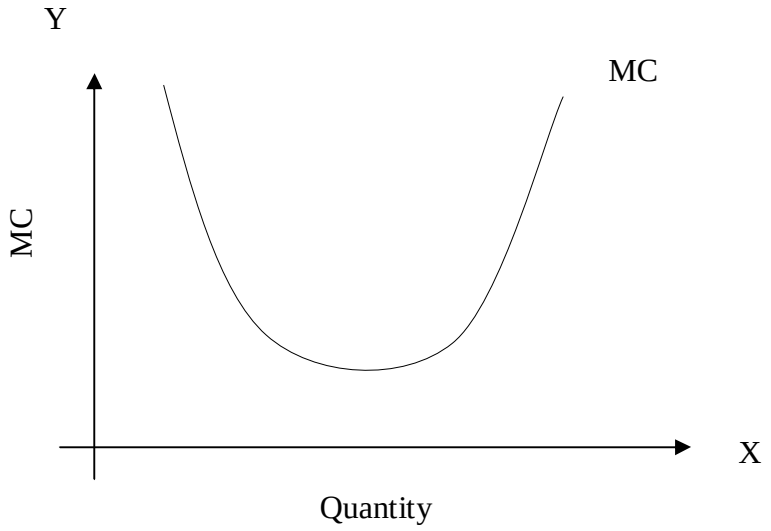
3.04: Marginal Cost (MC):

The change in total cost as a result of an additional one unit increase in output is called marginal cost. In the short marginal cost depends on AVC. We can calculate marginal cost as:

$$MCn = TCn - TCn_{-1}.$$

Here MCn is the marginal cost of n^{th} unit of output. TCn is the total cost of 'n' units of output. TCn_{-1} is the total cost of $n-1$ units of output. For example TCn is Rs 100 where as TCn_{-1} is Rs 87. MCn is Rs 13. In the beginning, as output increases MC decreases. After certain level of output, MC increases. Marginal cost i.e. the cost of producing an additional unit plays an important role in decision making by business firms.

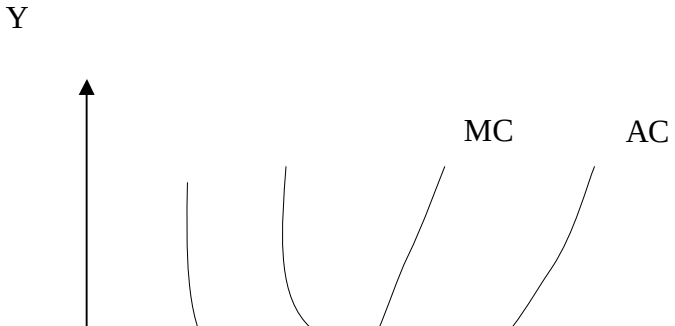
GRAPH-4



3.05: Relationship between AC and MC:

As the volume of output increases AC and MC decrease. But the rate of fall in MC is more than the rate of fall in AC. On the other hand as AC increases MC also increases. But the rate of increase in MC is more than the rate of increase in AC. According to numerical example given in the next page, as output increases from 1 unit to 5units AC decreased from Rs130 to Rs 32.40. On the other hand MC decreased from Rs.30 to Rs.2. When out increased from 8 units to 10 units, AC increased from Rs 32.50 to Rs 40. Where as MC increased from Rs 55 to 75.

GRAPH-5



We can understand the relationship between output and AFC,AVC, AC,MC with the following example.

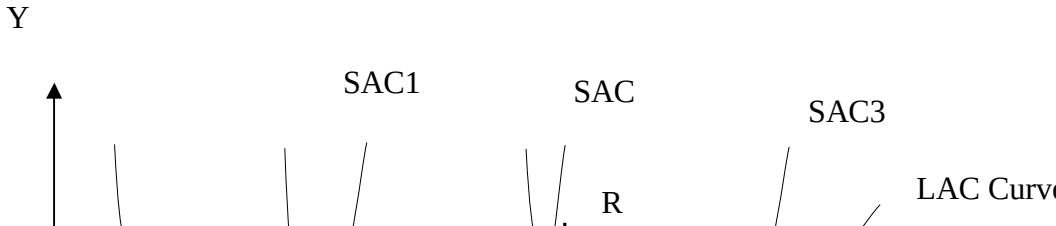
Output	TFC	TVC	TCs	AFC	AVC	AC	MC
0	100	---	100	Infinite	nil	infinite	---
1	100	30	130	100.0	30.0	130.0	30
2	100	45	145	50.0	22.5	72.50	15
3	100	55	155	33.3	18.33	51.63	10

4	100	60	160
25.0	15.0		40.00
5			
5	100	62	162
20.0	12.40		32.40
2			
6	100	78	178
16.66	13.0		29.66
16			
7	100	105	205
14.30	15.0		29.30
27			
8	100	160	260
12.50	20.0		32.50
55			
9	100	225	325
11.10	25.0		36.10
65			
10	100	300	400
10.0	30.0		40.0
75			

3.06: Long run Average Cost (LAC) and Output (Q):

In the long run a business firm can make perfect adjustment in its production capacity through introducing changes in fixed factors of production along with variable factors of production. The shape of long run average cost curve depends on the nature of economies of scale experienced by the business firm. The derivation of LAC curve is shown below.

GRAPH-6



According to the above graph, SAC1, SAC2, SAC3 are short run average cost curves, which represent cost of production or the state of technology in that short period. A firm can produce OQ1 level of output with Q1M average cost in short period -1. If there is increase in the demand for the product, with SAC1 technology the average cost of producing OQ2 is Q2S. If the firm operates in the long run, it can adopt new technology represented by SAC2. With SAC2, firm can produce OQ2 output with average cost Q2N. This is less than Q2S. Firm can expand its output to OQ3 at which the average cost is Q3T. If the firm produces OQ4, with SAC2 technology, the average cost is Q4R. By going advanced technology such as SAC3, it can produce OQ4 with OH average cost. The thick line which touches all the short run average cost curves is known as long run average cost curve (LAC curve). The minimum point of LAC curve is touching the minimum point of SAC2 at point T. This indicates that in the long run a business firm can produce OQ3 volume of output with the minimum average cost Q3T. Since OQ3 level of output corresponds to minimum average cost in the long run, it (OQ3) is called as optimum output. A firm which produces output corresponds to minimum average

cost in the long run is called as an ‘optimum firm’ or most efficient firm. LAC curve also known as planning curve or envelope curve.

3.07: Cost functions and Estimation of AFC, AVC, AC, and MC:

Linear cost function:

Y = a+ b X. In this function Y is the total cost, ‘a’ is the total fixed cost and b X is the total variable cost.

$$AFC = \frac{a}{X}$$

$$AVC = \frac{b\,X}{X} = b$$

$$AC = \frac{a}{X} + \frac{b\,X}{X}$$

NOTE-1

$$AC = \frac{a}{X} + b$$

$$MC = \frac{\delta Y}{\delta X} = b$$

Given the estimated cost function Y = 100 + 20X, at 100 units of output
Y i.e total cost = Rs 2100, TFC = Rs 100, TVC = Rs 2000
AFC = Rs 1, AVC =20, MC = Rs 20, AC = Rs 21

Quadratic cost function

Y = $a + bX + C X^2$

AC = $\frac{Y}{X} = \frac{a}{X} + \frac{bX}{X} + \frac{CX^2}{X}$

$= \frac{a}{X} + b + CX$

AFC = $\frac{a}{X}$

AVC = b + CX

MC = $\frac{\partial Y}{\partial X}$ = b+2CX

Given the estimated cost function Y = 5000 + 250X + 1 X^2, at 100 units of output

Y = Rs 40,000
AFC = Rs 50
AVC = Rs 350
AC = Rs 400
MC = Rs 450

Cubic cost function:

$Y = a + bX - C X^2 + dX^3$

AC = $\frac{Y}{X} = \frac{a}{X} + \frac{bX}{X} - \frac{CX^2}{X} + \frac{dX^3}{X}$

AFC = $\frac{a}{x}$

AVC = $b - CX + dX^2$

MC = $\frac{\delta Y}{\delta X}$ = $b-2cx+3dx^2$

Given the cost function $Y=18+30X-10X^2+x^3$, at 100 units of output

Y = Rs 903018
AC = Rs 9030.18
AFC = Rs 0.18
AVC = Rs 9030
MC = Rs 31970

Cost Forecasting

Based on the estimated cost functions, we can forecast the TC, AC, AFC, and MC at different levels of output
Given the linear cost function
Y = 100+20X, it is possible to forecast Y at different levels of output.
For example

Output(X) (Units)	Total Cost (Rs)
100	2100
200	4100
300	6100
400	8100
500	
10100	

In the same way using quadratic and cubic cost functions, it is possible to forecast total cost, AFC, AVC, AC and MC at different levels of output.

ACTIVITY-1

1. Given the estimated cost function $Y = 6000 + 200\ X - 0.\ 2\ X^2$, estimate the TC, AFC, AVC, MC at the level of output 200 units and 300 units. Observe, is there any change in average cost structure as a result of increase in output.

3.09: Summary:

In this module an attempt has been made to discuss the cost output relationship in terms of AC, AFC,AVC, MC AND LAC. As output increases, AFC decreases continuously. AFC curve is a rectangular hyperbola. As output increases, in the beginning AVC decreases. Beyond a level of output AVC increases. AC also decreases in the beginning. Later on it takes an upward movement. MC also decreases in the beginning and later on it increases. AVC, AC, MC curves are 'U' shaped. LAC curve shows the nature of average cost in the long run. It is possible to have an idea about optimum firm with the help of LAC curve. Managers' generally use different cost functions based on data availability, to estimate cost output relationship and to forecast the cost of production corresponding to different level of planned output.

3.10: References:

1. P.L.Mehta : *Managerial Economics- Analysis,Problems and Cases.*
2. Dominick Salvatore : *Managerial Economics in a global economy*
3. R.L Varshney and Maheswari : *Managerial Economics.*

4. H.Craig Petersen and Cris Lewis: *Managerial Economics*

3.11: Self assessment test:

1. Discuss the relationship between output and AFC, AVC, AC, MC in the short run.