

UNIT-III

(Production and Cost Analysis)

MODULE – 4: PRODUCTION ANALYSIS

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4.0: Introduction:

Production analysis relates physical output to physical units of factors of production. In the production process various inputs are transformed in to some form of output. In production analysis, we

study the least cost combination of factor inputs, factor productivities and returns to scale. Managers', while employing resources in the production process, concerned with economic efficiency of production which refers to minimization of cost for a given output level. The efficiency of production process is determined by the proportion in which various inputs are used, the absolute level of each input and productivity of each input.

4.01: Objectives:

The objective of this module is to discuss the input – output relationship in physical terms. After reading this module you will be in a position to understand the:

Meaning of production function

Short run production function

Least cost input combination

4.02: Meaning of production Function:

The functional relationship between physical input and output is called as production function. Production function expresses the technological or engineering relationship between output of a product and inputs employed in its production. In other words, the relationship between the amount of various inputs used in the

production process and the level of output is called production function. It represents the technology involved in the production process. With the help of production function, it is possible to find out number of units of factors of production required to produce a given volume of output. In the same way it is possible to find out the quantity of output that a business firm can produce by employing given quantity of factors of production. Production function describes only efficient levels of output; that is the output associated with each combination of inputs is the maximum output possible, given the existing level of technology. Production function changes as the technology changes.

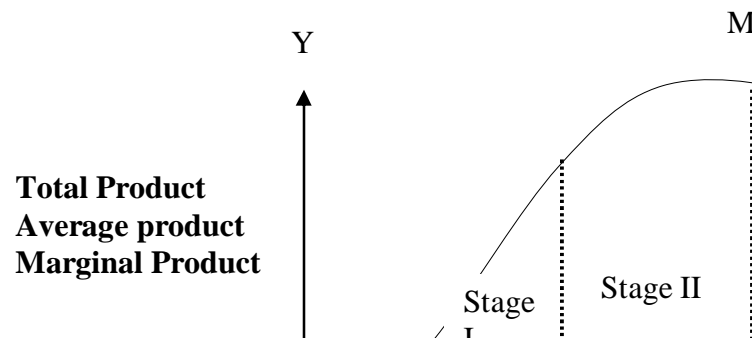
In general we can represent the production function for a firm as $Q = f(K, L)$. Where Q is the total output, K is the fixed capital; L is the variable capital including labour. In the production function Q is the dependent variable and K, L are the independent variables. From the above relationship, it is easy to infer that for a given value of Q , alternative combinations of K and L can be used since labour and capital are substitutes to a limited extent. This implies that, a minimum amount of K and L is absolutely essential for the production of a commodity.

4.03: Short run production analysis:

A business firm cannot make perfect adjustment in fixed factors of production in the short-run. This time period doesn't allow the firm to change fixed factors. It has to continue the production with the given K even in the presence of upward movement in demand. This is a basic constraint under which the firm has to conduct production operations. Firm can increase the output, to meet increased demand, by employing more of variable factors on the given fixed factor. In beginning, as the quantity of variable factors increases, the marginal productivity of variable factors also increases. Therefore the total product increases at an increasing rate. This is called the stage of increasing returns i.e. stage-1. After stage-1, if the firm employs additional units of variable factors, marginal product of variable factors diminishes. As result the total output increases at a decreasing rate. This is called as the law of diminishing returns i.e. stage -2. Beyond this stage if the firm employs variable factors, the marginal product of variable factors will become negative, due to lack of support from given fixed factors. Therefore the firm experiences negative returns in the production process i.e.stage-3. We can understand these three stages with the help of following example.

	Quantity of L		Total Product
	Average Product	Marginal Product	
(Units)	(Units)	(Units)	
	1		3
3	3		
	2		7
3.5	4		
	3		12
4.0	5		
	4		16
4.0	4		
	5		18
3.6	2		
	6		18
3.0	0		
	7		14
2.0	- 4		

GRAPH-1



In the above graph, TPL is the total product of labour, APL is the average product of labour and MPL is the marginal product of labour curve. At point M, TPL reaches to maximum. When total product is the maximum at 6 units of employment of variable factors, the marginal product becomes zero. Corresponding to point M on TPL, MPL curve is cutting the horizontal axis. Beyond 6 units of employment of variable factors, MPL is negative.

ACTIVITY -1

1. Spell out the meaning of production function.
2. How many stages are there in the short run production analysis?

What are they?

4.04: Long Run Production Analysis

Long run is a time period where perfect adjustment in all the factors of production is possible. We can understand input –output relationship in the long run with the help of isoquant (IQ) or isoproduct curves.

In the long run a business firm can combine together capital and labour in different proportions to produce the same level of output. By joining together the corresponding points of combinations of capital and labour which yield the same level of output to business firm, we can derive isoquant.

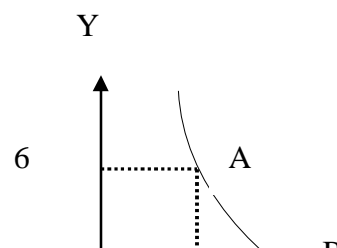
Isoquant schedule:

Labour
Capital
Output
(Units)
(Units)
(Units)

1
6
100
2
4.5
100
3
4.0
100
4
3.7
100
5
3.5
100

According to the above example, a business firm can employ 1 unit of labour + 6 units of capital or any other combination as shown in numerical example, to produce 100 units of output. By plotting the above data on a graph paper and joining together corresponding points, we can derive isoquant.

GRAPH-2



Isoquant is convex to the origin. All points on an isoquant represent the same level of output, though each and every point related to a specific quantity of capital and labour. As the employment of labour increases, the business firm is reducing the employment of capital, to produce same level of output. But the fact is that, as employment of labour increases every time by one unit, the business firm would like to reduce capital in smaller quantities for every successive additional unit increase in labour . This is called the Diminishing Marginal Rate of Technical Substitution of labour for capital. This is equal to the slope of isoquant. The slope of isoquant = $MRTS_{LK}$.

Though the business firm can employ any combination of inputs to produce 100 units of output, there exists difference in cost of employing these combinations. The aim of the business firm is to employ that combination of inputs which minimizes cost to produce 100 units of output. To identify least cost combination of inputs, in addition to isoquant, we have to understand the isocost or factor price line.

Factor price line:

Each and every point on factor price line indicates the different quantities of capital and labour a business can employ actually in the production process, given the prices of capital & labour and the volume of investment at its disposal. Let us assume that the price of capital Rs 20, price of labour Rs 20 and the volume of investment at the disposal of firm is Rs 130. Based on this information we can construct isocost schedule as shown below.

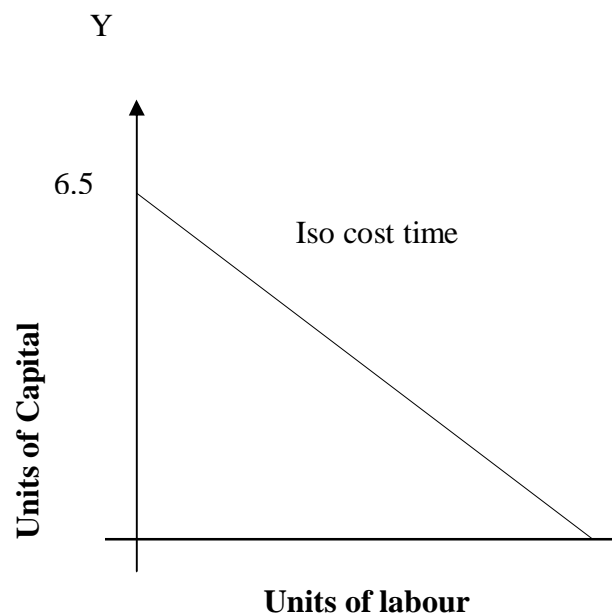
Quantity of labour
Quantity of capital
(Units)
(Units)

0.	0
6. 50	
0.	5
6.00	
1.	0
5. 50	
1.	5
5 .00	
2.	0
4. 50	
2.	5
4. 00	
3.	0
3. 50	
3.	5
3 .00	
4.	0
3. 50	
-	
-	
-	
-	

-	-
6.	5
0.0	

Business firm can employ any one of the combinations shown above. The cost of employing any combination is Rs 130. By plotting the above shown information on a graph paper, and joining together the corresponding points, we can derive the isocost line.

GRAPH-3

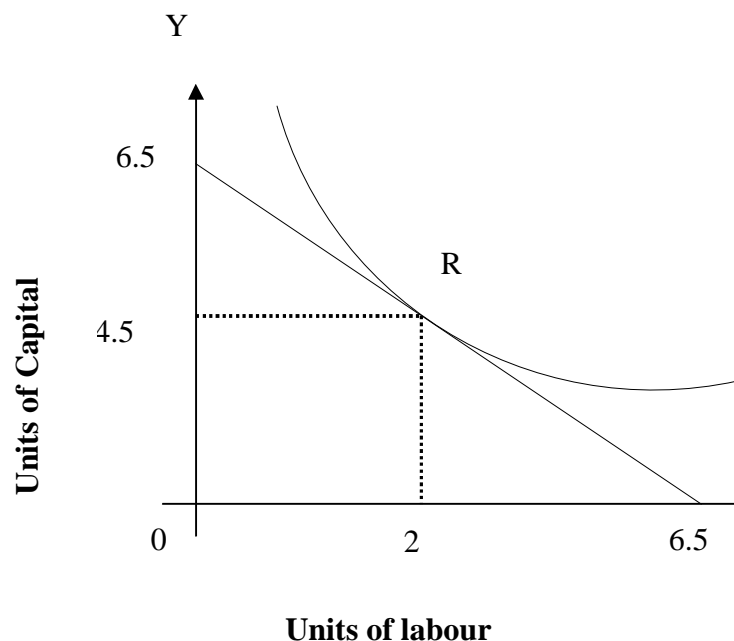


The slope of isocost line represents the relative factor price ratio i.e. the ratio between price of labour to price of capital (P_L / P_K). In other words also we can say that the slope of isocost indicates the ratio between wage rate to rate of profit (w / r).

4.05: The choice of optimum input combination:

The combination of factor inputs that produces maximum output with least cost is called optimum input combination or least cost input combination. A business firm can identify this combination at a point where $MRTS_{LK} = P_L / P_K$. This is possible at a point where isocost is tangent to isoquant.

GRAPH-4



In the above graph at point R isocost line is tangent to isoquant. Therefore the combination of labour and capital that firm would like to employ to produce 100 units of output (2 units of labour + 4 . 5 units of capital. See the isoquant schedule) is same as the combination of labour and capital that firm can actually employ with Rs 130 total investment (2 units of labour + 4 . 5 units of capital. See the isocost schedule). If the firm employs any other combination of labour and capital to produce 100 units of output, its cost on labour and capital will be more than Rs 130. Thus the combination of 2 units of labour + 4. 5 units of capital is the least cost combination or optimum combination. This is also called as optimization of production.

ACTIVITY-2

1. Define isoquant.
2. Define isocost.
3. What is least cost input combination?

4.06: Summary:

Production function represents the relationship between physical input and output. With the help of production function it is possible to find out the quantity of capital and labour required to produce a given level of output. Production function is generally expressed as $Q = f(K, L)$. In the short run, beyond a level of output, firm experiences diminishing returns in the production process due to the given fixed factors of production. In the long run, firm can make perfect adjustment in all the factors of production. Therefore, firm can produce optimum output i.e. the maximum possible output with minimum cost in the long run.

4.07: 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*

4.08: Self Assessment Test:

1. What is production function? Discuss the input- output relationship in the short run.

2. Explain the process of identification of optimum input combination with the help of isoquant and isocost line.