Managerial Economics

Production and Cost Analysis

Introduction

- Next steps after demand analysisare
- Determining level of output based on
  - analysis of input -output relationship in the short runand long run*(Production analysis)*
  - And analysis of costs and output relationship in the short run and long run*(Cost analysis)*

Short run Vs Long Run

- **Short run**is the time period where the firm cannot alter quantities of some of its inputs such as machinery, equipments and technology and**output has to be increased by adding variable input likelabourand raw materials**
- In the**Long run**, No factor of production remains constant in the long run hence,**all inputs are variable**
- Hence, Production function is divided into
  - Production function with one variable input
  - Production function with two variable inputs

Production Analysis

- **Production**is the process by which inputs are combined, transformed, and turned into outputs.

- The production theory stresses on the efficient use of inputs for producing desired output
  - Using minimum input to produce desired output
  - Producing maximum output using the given input

Production function

- Production function is the technical relationship between physical input and physical output
  - *It is always related to a given time period*
  - *It is related to a certain level of technology*
  - *It depends upon relation between inputs*
- ThusProduction functionshowsmaximum quantity of output than can be produced from specified set of inputs in a given period of time with a given level of technology

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- Production Function-

$$Q = f(X_1, X_2 \ldots X_n)$$

- Here, Q is the maximum quantity of output and X1, X2...Xnare quantities of different inputs used in production
- These inputs are various factors of production used

Production Analysis in the Short run: *Production function with one variable input*

- The short run production function shows the maximum output the firm can produce when only one of its inputs can be varied and other inputs remain fixed
- As units of variable inputs increase, the proportion of use between fixed input and variable input changes
- Hence, in the short run production function is governed ***by Law of variable Proportions***

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- Law of Variable proportions states*that other inputs remaining constant, increase in the quantity of the variable factor leads to eventual decline in its average and marginal products*
- Average product is total product(output) divided by unit of variable input used to produce this output
- Marginal product is the addition in total output resulting from addition of the last unit of input when amounts of other inputs are held constant

Example

- Labour and Machinery – Factors of Production
- Labour- Variable factor and Machinery- Fixed factor
- Possibility of substitutinglabourfor Machinery
- Total Product TPL= f (M, L), wheremachinery is Fixed
- Average Product is APL = TP/L
- Marginal Product MPL=ΔTP/ΔL

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Labour(Units)	Total Product (Output)	Marginal Product (Output)	Average Product (Output)	Stages
1	20	-	20	
2	50	30	25	Increasing Returns
3	90	40	30	
4	120	30	30	
5	140	20	28	Diminishing Returns
6	150	10	25	
7	150	0	21.4	
8	130	-20	16.25	Negative Returns
9	100	-30	11.1	

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- Whenlabourisincreased in small units, initially, the output increases but after a certain point there is too muchlabourand productivity oflabourfalls and the marginal product starts falling
  - Assumption is thatlabouris homogeneous
- With increase in variable input,total outputincreases initially at increasing rate and then finally it increases at diminishing rate

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- Hence, there are three stages of Law of Variable proportion
  - Increasing Returns to variable factor*: when additional units oflabourare employed, total output increases at increasing rate so marginal output rises*
  - Diminishing Return to variable factor:*When total output rises but at diminishing rate due to increase inlabour, marginal output falls.*
  - Negative Returns to variable factor:*This is inefficient stage of production and firm should not operate in this stage where with increase inlabourmarginal output becomes negative, total output decreases*

Cost Analysis in the Short run

- After understanding input and output relationship and concept of production function in the short run, the next logical step is analysis of Cost output relationship in the short run

Cost Concept

- Analysis of Costs and Revenues is the central concern of all managerial decisions
- Costs are the charge on revenue and it also forms the basis of price, hence it plays a pivotal role in determining profits of the firm

Types of Costs

- Fixed Cost
- Variable cost
- Total Cost, Average Cost and Marginal Cost

Determinants of Cost

- Prices of Factors of Production
- Productivity of factors of production
- Technological advancement
- Output

Cost – Output Relationship: Short Run

- In the short run costs are divided into Fixed Cost and Variable Cost as some inputs can not be altered inthe short run
- Short run Cost-Output Relationship explains the behavior of costs with varying levels of output in the short run i.e. for a particular plant site
- It helps to determine cost for different output levels for a given scale of operations

Fixed, Variable and Total Cost

- **Fixed cost** Any cost that does not depend on the firm's level of output. These costs are incurred even if the firm is producing nothing. There are no fixed costs in the long run.
- **Variable cost** A cost that depends on the level of production chosen
- **Total cost (*TC*)** Fixed costs plus variable costs.

Fixed Costs

- FC is the money spent on installation of plant and machinery, fittings and equipment
- Total fixed costs are the total costs per period of time incurred by the firm for fixed inputs

Firms have no control over fixed costs in the short run. For this reason, fixed costs are called sunk costs.

Variable Cost

- Total variable costs are the total costs incurred by the firm for variable inputs such aslabour, raw material etc.
- The total variable cost curve embodies information about both factor or input prices and technology.
- It shows the cost of production using the best available technique at each output level given current factor prices.

Cost schedule of a firm in the short run

Units of output	Total Fixed Cost	Total Variable Cost	Total Cost
0	500	0	500
1	500	50	550
2	500	80	580
3	500	105	605
4	500	129	629
5	500	150	650
6	500	180	680
7	500	225	725
8	500	280	800
9	500	360	860
10	500	450	950
11	500	545	1045
12	500	655	1155

Relationship of Various Costs and Output

- Total fixed cost remains constant with an increase in output
- Total Variable Cost increases with increase in output and it increases in variable proportions
- Uptoa certain output level (5units) it increases with decreasing rate and beyond that level TVC rises at increasing rate
- At low level of output, increases in variable inputs may result in increasing productivity as a result the TVC increases with output but at a decreasing rate

Average Cost and Marginal Cost

- Average Cost= TC/Q

= AFC+AVC

- Average Fixed Cost is total fixed cost divided by output and
- Average Variable Cost is the total variable cost divided by output

Average Cost

Unitsof Output	AFC	AVC	ATC
1	500	50	550
2	250	40	290
3	166	35	201
4	125	32.2	157.2
5	100	**30**	130
6	83	**30**	113
7	71	32.1	103.1
8	62.5	35	97.5
9	55.5	40	95.5
10	50	45	**95**
11	45.5	49.5	**95**
12	41.6	54.6	96.2

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- Average Fixed Cost declines with increase in output
- In case of Average Variable Cost, it decreases with increase in output, but beyond certain point it results in increase in AVC
- For those levels of output where both AFC and AVC decrease, ATC must decrease too, however, ATC reaches its minimum after AVC, because the increases in AVC are offset by decreases in AFC

Marginal Cost

- It Marginal Cost is the addition to total cost resulting from the addition of last unit of output
- Marginal Cost $=\Delta TC/\Delta Q$

  $=\Delta TVC/\Delta Q$, since TFC is constant

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Units	TVC	TC	MC	AVC	ATC
1	50	550	50	50	550
2	80	580	30	40	290
3	105	605	25	35	201
4	129	629	24	32.2	157.2
5	150	650	21	30	130
6	180	680	30	30	113
7	225	725	45	32.1	103.1
8	280	800	55	35	97.5
9	360	860	80	40	95.5
10	450	950	90	45	95
11	545	1045	95	49.5	95
12	655	1155	110	54.6	96.2

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- At low levels of output, MC decreases with increase in output but after reaching the minimum, it goes up with further increases in output

- In the short run, every firm is constrained by some fixed input that leads to diminishing returns to variable inputs and limits its capacity to produce. As a firm approaches that capacity, it becomes increasingly costly to produce successively higher levels of output. Marginal costs ultimately increase with output in the short run.

Reason: Costs have an inverse relationship with Law of Diminishing Marginal Returns