

Engineering Economics Notes

Chap-2: Cost Concepts &

THE Economic ENVIRONMENT.

- The word 'cost' mean vary in usage. Mostly cost and expense are used interchangeably.

2.2 Cost terminologies:

- Fixed cost: are cost that are independent of output. These are unaffected by change in activity level over feasible range of operations for the capacity or capability available. e.g., taxes, insurance, salaries, licences fees etc.
- Variable costs vary with output. e.g. costs of material, labour, services etc.
- Incremental cost/revenue results from increasing the output of a system by one or more units.

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$$\text{Incremental Cost per unit} = \frac{\text{Variable Cost}}{\text{Units produced}}$$

→ Recurring costs are those that are repetitive and occur when an organisation produces similar goods or services on a continuous basis.

- Variable costs are also recurring.
- A fixed cost that is paid on repeated basis is a recurring cost

→ Non-recurring costs are those that are not repetitive even though the expenditure may be cumulative over a relatively short period of time.

→ Direct costs can be reasonably measured and allocated to a specific output or work activity.

- Indirect costs are those that are difficult to attribute or allocate to a specific output or work activity.
 - Used interchangeably with Overhead cost & burden costs.
- Standard costs are representative costs per unit of output that are established in advance of actual production or service delivery.
 - Standard cost = Direct Labor + Direct material + Factory overhead costs.
- A cost that involves payment of cash is called cash cost (and result in a cash flow).
- A cost that doesn't involve a cash transaction but is reflected only in accounting system is called a noncash / book cost.

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- Sunk cost is the cost that results from the past decision and has no relevance to analyzing future alternatives, costs and revenues.
- Opportunity cost is incurred because of the use of limited resources such that the opportunity to use those resources to monetary advantage in an alternative use is forgone.
- Lifecycle costs refers to summation of all costs, both recurring and non-recurring, related to a product, structure, system or service during its life span.
see graph details in Lec-2, slide-20.
- Operation & Maintenance cost contains most of the recurring cost elements associated with the operation phase of life-cycle.
- disposal cost category includes those non-recurring costs of

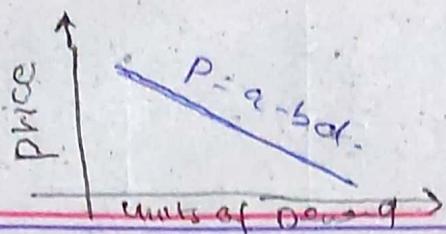
shutting down the operation and the retirement and disposal of assets at the end of life-cycle.

2.3 The General Economic Environment:

- Economics deals with the interactions between people & wealth.
- Consumer goods & services are those products / services that are directly used by people to satisfy their wants.
e.g; food, clothing, houses, cars, ...
- Producer goods & services are used to produce consumer goods and services or other producer goods.
e.g; Factory building and tools, buses ...
 - Amount of the producer goods needed is indirectly related to the amount of consumer goods or services demanded by people.

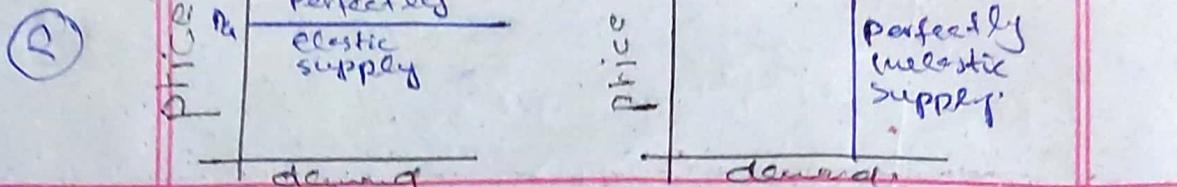
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- Goods & services are produced and desired, because directly or indirectly they have utility, the power to satisfy human wants and needs.
- Utility is measured in term of value / price that must be paid to obtain particular item.
- Good & services may be divided into two types, necessities and luxuries. These terms are relative, for one the necessity may be consider as luxury by another.
- Necessities are basic human requirements
- Luxuries are not basic requirements under given conditions and circumstances.



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- A relationship between the price that must be paid to purchase/demand the quantity.
- ~ $P = a - bD$ for $0 \leq D \leq \frac{a}{b}$
 - P: price per unit
 - a: intercept on price axis
 - b: slope, the amount by which demand increases for each unit decrease in P.
 - D: demand
- Similarly $D = \frac{a-P}{b}$
- Consumer can readily forgo the consumption of luxuries if the price is greatly increased, but they find it more difficult to reduce their consumption of true necessities.
- The extent to which price changes influence demand varies according to the elasticity of demand.
- The demand is elastic when a decrease in selling price results in a considerable increase in sales.



→ If a change in selling price produce little or no effect on the demand, the demand is said to be inelastic.

$$\rightarrow \text{Price elasticity of Demand} = \frac{\% \text{ change in Quantitative demanded}}{\% \text{ change in price}} \\ = \% \Delta Q / \% \Delta P$$

$$\text{Price elasticity of supply} = \frac{\% \text{ change in Quantitative Supplied}}{\% \text{ change in the price}} \\ = \% \Delta Q / \% \Delta P$$

- $\cdot PED > PES \Rightarrow \text{Elastic}$
- $PED = PES \Rightarrow \text{unit elastic}$
- $PED < PES \Rightarrow \text{Inelastic}$

2.3.4 Competition:

- Most general economic principles are static for situation in which perfect competition exists.
- Perfect competition occurs in a situation in which any given product is supplied by a large number of vendors and

there is no restriction on additional vendors entering the market.

- Monopoly: a perfect monopoly exists when a unique product or service is available from only a single vendor and that vendor can prevent the entry of all other into the market.
 - During such condition, a buyer is at complete mercy of the vendor in terms of availability and price of the product.
- An oligopoly exists when there are ^{so} few suppliers of the product or service that action by one will almost inevitably result in a similar action by the others.

2.3.5 The total Revenue Function:

- Revenue/gain/income is the total income produced by a given source

- The total revenue (TR) - that will result from a business venture during a given period is the product of the selling price per unit (p) and the number of units sold (D).

- $TR = \text{price} \times \text{demand} = p \cdot D$

$$TR = (a - bD)D \quad \therefore p = a - bD$$

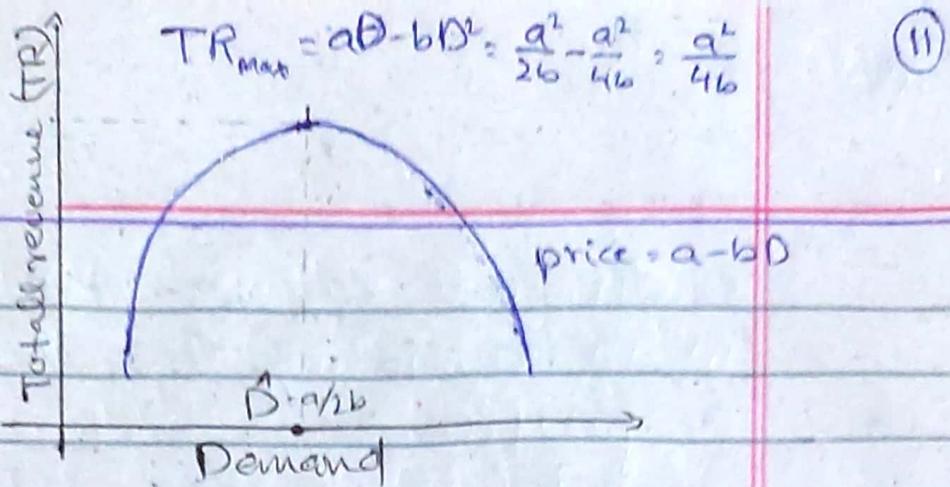
$$TR = aD - bD^2 \quad \text{for } 0 \leq D \leq \frac{a}{b}$$

- The total maximum revenue (TR_{\max}) also would produce maximum profit, can be obtain by solving first derivative and equating it to zero.

$$\frac{d}{dD} TR = a - 2bD = 0$$

$$\hat{D} = \frac{a}{2b}$$

- The derivative of total revenue wrt volume (demand), dTR/dD , which is called incremental or marginal revenue.



2.3.7 Cost, Volume, & Breakeven Point relationships:

- At any demand (D) the total cost is:

$$C_T = C_F + C_V$$

C_T Total C_F fixed C_V variable

- For variable cost per unit (C_V):

$$C_V = (C_V)(D)$$

Then; $[C_T = C_F + C_V D]$

- Break even is the point at which cost and income are equal and there is neither profit nor loss.

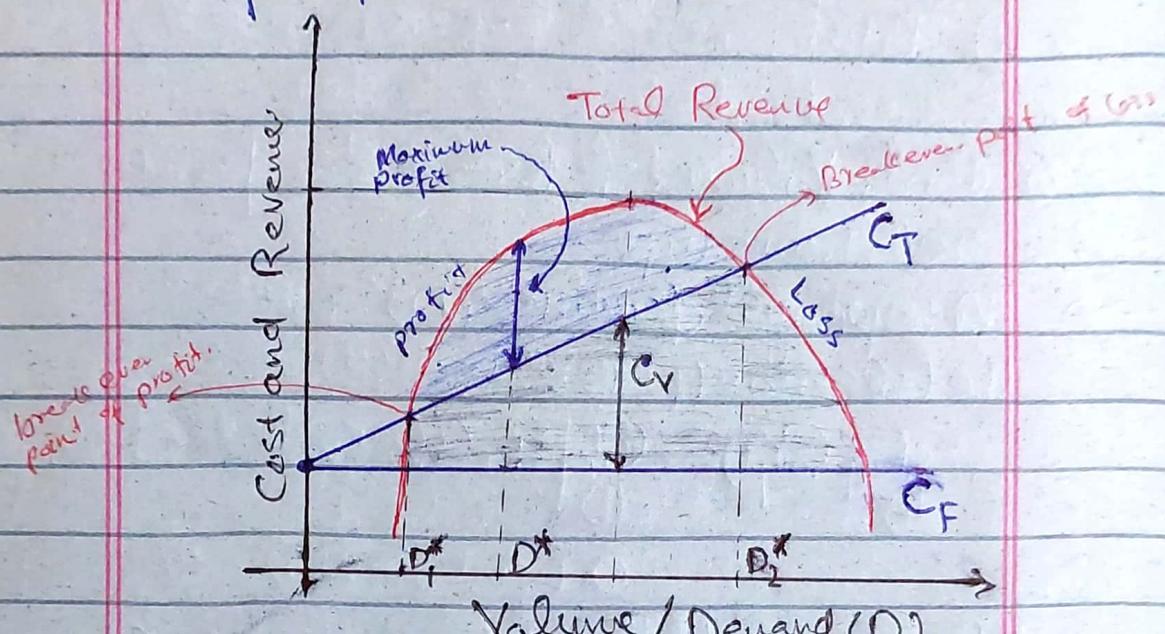
- ~~An increase in demand will result in a profit for the operation at break even point D_1 .~~

- The profit is maximized at a point called optimal Demand D^*

- At break even point D_1 the revenue and cost are again equal but

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additional volume will result in an operating loss instead of a profit.



Combined cost and revenue functions
and break even point as functions of
Volume and Cost

→ At any Volume D , profit is

$$\begin{aligned}\text{profit (loss)} &= TR - CT \\ &= (aD - bD^2) - (C_F + C_V D) \\ &= -C_F + (a - C_V)D - bD^2\end{aligned}$$

for $0 \leq D \leq 96$

→ In order for a profit to occur two conditions must be met

- $a - C_V > 0$; The price per

unit that will result in no demand has to be greater than the variable cost per unit.

ii) Total revenue (TR) must exceed total cost for the period involved.

→ The optimal point (D^*) at which the maximum profit occurs is:

$$\frac{d(\text{Profit})}{dD} = \frac{d}{dD} [-C_F + (a - c_v)D - bD^2] = 0 \\ = 0 + a - c_v - 2bD = 0$$

$$\text{Profit}_{\max} = D^* = \frac{a - c_v}{2b}$$

→ The break-even point occurs when total revenue (TR) = total Cost (C_T)

$$TR = C_T$$

$$aD - bD^2 = C_F + c_v D$$

$$-bD^2 + (a - c)vD - C_F = 0$$

By using quadratic formula

$$D^* = \frac{-(a - c_v) \pm \sqrt{(a - c_v)^2 - 4(-b)(-C_F)}}{2(-b)}$$