Sem - IV : Economics - Honours.
Compulsory: Mathematical Economics

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Application of Mathematics in Economics:

Elasticity of Demand:

By definition, ~~elasticity is the quan~~ elasticity of demand is the measurement of the quantitative relationship between Price and Demand. It measures the degree of responsiveness of Demand due to some change in its price.

Symbolically:

$$ed = \text{Elasticity of Demand} = (-)\frac{\text{Relative change in Demand}}{\text{Relative change in Price}} \quad \left\{ \frac{P}{Q} \; (-) \right.$$

$$\Rightarrow ed = (-)\frac{\dfrac{\text{Change in Demand}}{\text{Original Demand}}}{\dfrac{\text{change in Price}}{\text{Original Price}}}$$

$$= (-)\frac{\dfrac{\text{Final Demand} - \text{Initial Demand}}{\text{Initial Demand}}}{\dfrac{\text{Final Price} - \text{Initial Price}}{\text{Initial Price}}}$$

$$= (-)\frac{\dfrac{Q_1 - Q}{Q}}{\dfrac{P_1 - P}{P}} = (-)\frac{\dfrac{\Delta Q}{Q}}{\dfrac{\Delta P}{P}}$$

$$= -\frac{\Delta Q}{Q} \times \frac{P}{\Delta P} = (-)\frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

$$ed \text{ at } \bar{P} = \lim_{\Delta P \to 0} \left\{ (-)\frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q} \right\}$$

$$= \lim_{\Delta P \to 0} \frac{\Delta Q}{\Delta P}\left(-\frac{P}{Q}\right)$$

$\Longrightarrow$

$\Rightarrow e_d = (-)\frac{p}{e}\cdot\frac{dD}{dp}$,

Alternatively,

$$|e_d| = \frac{\text{Marginal Function}}{\text{Average Function}}.$$

Illustration:

$x = 25 - 4p + p^2$

$\therefore \frac{dx}{dp} = -4 + 2p$

$\therefore e_x = (-)\frac{p}{x}\cdot\frac{dx}{dp}$.

$= (-)\frac{p}{25-4p+p^2} \times (-4+2p)$

$= \frac{4p - 2p^2}{25-4p+p^2}$ { The numerical estimate of e_x depends upon the given value of p.

Alternatively,

$$|e_x| = \frac{\text{Marginal Function}}{\text{Average Function}}$$

$M.F = \frac{dx}{dp} = -4+2p$.

$AF = \frac{x}{p} = \frac{25-4p+p^2}{p}$

$\Rightarrow$

$$|e_d| = \frac{25-4p+p^2}{p} \times -4+2p$$

$$|e_d| = \frac{-4+2p}{\frac{25-4p+p^2}{p}}$$

$$= \frac{(-4+2p)p}{25-4p+p^2}$$

$$\Rightarrow e_d = \frac{(-)(-4+2p)p}{25-4p+p^2}$$

$$= \frac{4p-2p^2}{25-4p+p^2} \text{ Ans}$$

Relationship among Average Revenue, Marginal Revenue and the Elasticity of Demand:

$$AR = \frac{R}{Q} = \frac{P.Q}{Q} = P.$$

$$MR = \frac{dR}{dQ}.$$

$\because$ $R = P.Q.$

$\therefore$ $MR = \frac{d}{dQ}(P.Q)$

$\Rightarrow$

$\Rightarrow MR = \frac{d}{dQ}(P \cdot Q)$

$= Q \cdot \frac{dP}{dQ} + P \cdot \frac{dQ}{dQ}$.

$= P + Q \cdot \frac{dP}{dQ}$

$= P\left(1 + \frac{Q}{P} \cdot \frac{dP}{dQ}\right)$

$= P\left\{1 - \frac{-1}{\frac{P}{Q} \cdot \frac{dQ}{dP}}\right\}$ $\{+ = - \times -$

$= P\left\{1 - \frac{1}{ed}\right\}$ $\left\{ed = -\frac{P}{Q} \cdot \frac{dQ}{dP}\right.$.

$\frac{MR}{1} = \frac{AR(ed - 1)}{ed} = \frac{ARed - AR}{ed}$,

$ARed - AR = MRed$,

$\Rightarrow ARed - MRed = AR$

$\Rightarrow ed(AR - MR) = AR$

$\Rightarrow ed = \frac{AR}{AR - MR}$. Established