Elasticity of Demand

4.1 PRICE-ELASTICITY OF DEMAND (Ep)

Changes in quantity demanded of X may show **different degrees of responsiveness** to a change in its price, i.e. when the price of X changes the demand for it may change **either exactly proportionately or more than or less than proportionately** or, at other extremes, the demand may not change at all or even change infinitely. It is this degree of responsiveness of quantity demanded of a commodity to the change in price which is called elasticity of demand, more precisely it is the **Price- elasticity of demand**.

Price- elasticity of demand is the degrees of responsiveness of quantity demanded of commodity X to the change in price of X itself.

$$Ep = \frac{\text{Percentage ChanginQd x}}{\text{Percentage ChanginPx}}$$

Thus, price- elasticity of demand is the ratio of percentage change in quantity demanded of X to percentage change in price of X.

$$Ep = \frac{\%\Delta Qdx}{\%\Delta Px}$$

Mathematically stated:

$$Ed = \frac{\text{\% change in quantity demand of x}}{\text{\% change in price of x}}$$

$$\frac{\dfrac{\text{New quantity demanded - Old quantity demanded}}{\text{Old quantity demanded}} \text{ X 100}}{\dfrac{\text{New price - Old price}}{\text{Old price}} \text{ X 100}}$$

$$= \frac{\Delta D/D}{\Delta P/P}$$

$$\boxed{Ed = \frac{P}{D} x \frac{\Delta D}{\Delta P}}$$

Where P = original price, D = original quantity demanded, P = small change in price, ΔD = small change in quantity demanded.

Besides, since quantity demanded has a negative relationship with price, the elasticity of demand so obtained will have negative sign. To neutralize this negative relation between price and quantity demanded, we attach a minus sign to the formula so as to make Ed as a positive number, or we ignore the negative sign altogether.

$$\therefore \quad Ed = \frac{\text{\% change in quantity demand of x}}{\text{\% change in price of x}}$$

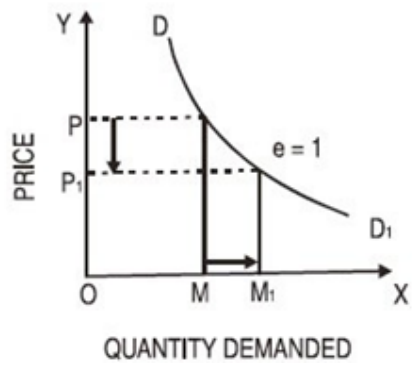
$$= -\frac{P}{D} \times \frac{\triangle D}{\triangle P}$$

FIVE TYPES OF PRICE-ELASTICITIES OF DEMAND

1. **Unit Elastic Demand**: When change in price of X brings about exactly proportionate change in quantity demanded of X the demand is unit elastic or elasticity of demand = 1, e.g. if price falls by 10% then, demand expands by 10%.

$$Ed = \frac{\text{\% change in quantity demand of x}}{\text{\% change in price of x}}$$

$$= \frac{10}{10} = 1$$



2. **Relatively Inelastic Demand**: When change in price brings about less than proportionate change in quantity demanded, then demand is relatively inelastic or Ed is less than 1, e.g. if price falls by 10% and demand rises by 5% then,

$$Ed = \frac{\text{\% change in quantity demand of x}}{\text{\% change in price of x}}$$

$$= \frac{5}{10} = \frac{1}{2} < 1$$

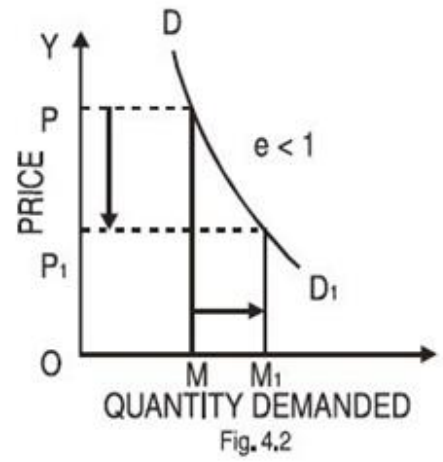
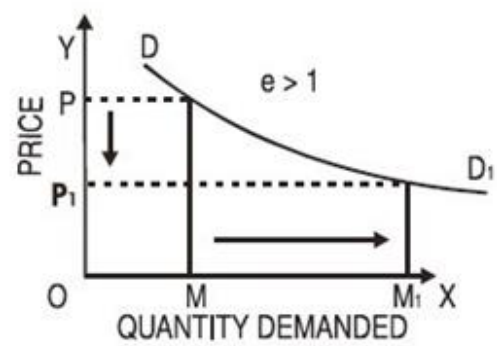


Fig. 4.2

3. **Relatively Elastic Demand**: When change in price brings about more than proportionate change in quantity demanded, then demand is relatively elastic or Ed is greater than 1, e.g. if price falls by 10% and the quantity demanded rises by 20% then

$$Ed = \frac{\text{\% change in quantity demand of x}}{\text{\% change in price of x}}$$

$$= \frac{20}{10} = 2 > 1$$



4. **Perfectly Inelastic Demand**: When change in price has no effect on quantity demanded, then demand is perfectly inelastic or Ed is zero, e.g. if price changes by 10% and demand does not change at all then,

$$Ed = \frac{\text{\% change in quantity demand of x}}{\text{\% change in price of x}}$$

$$= \frac{0}{10} = 0$$

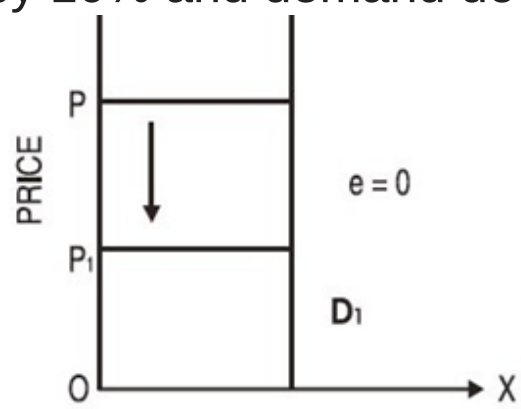
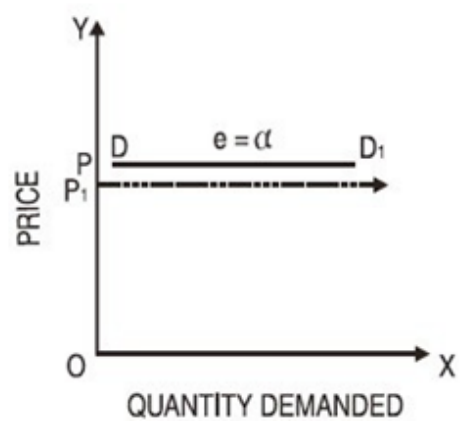


Fig. 4.4

5. **Perfectly Elastic Demand**: When a slight change in price brings about infinite change in the quantity demanded, then demand becomes perfectly elastic. In this case elasticity of demand is infinity.



Attempts have been made earlier to show that different elasticities of demand can be shown by different slopes of demand curve. Elasticity of demand is generally indicated by the steepness of the demand curve; i.e. regular hyperbola indicates unit elasticity of demand; flatter slope indicates more elastic demand etc. It would be improper to conclude anything definite about elasticity of demand by a mere inspection of steepness of a demand curve. The steepness of the demand curves can be compared for their elasticities only if they are drawn on the same scale.

4.2 ARC ELASTICITY OF DEMAND

Although the percentage method is simple yet it is not very reliable; because it is useful only when price changes are infinitesimally small. This is rare. Normally prices do not just change by small amounts. Change in the prices are perceptible e.g price will rise from Re. 1 to Re. 1.25; and will hardly rise from Re.1 to Re. 1.01p. Thus, where price changes are perceptible, say over 10% then instead of percentage or point elasticity methods we use arc elasticity method. The 'arc' represents a segment of the demand curve between the two points under consideration i.e. AB.

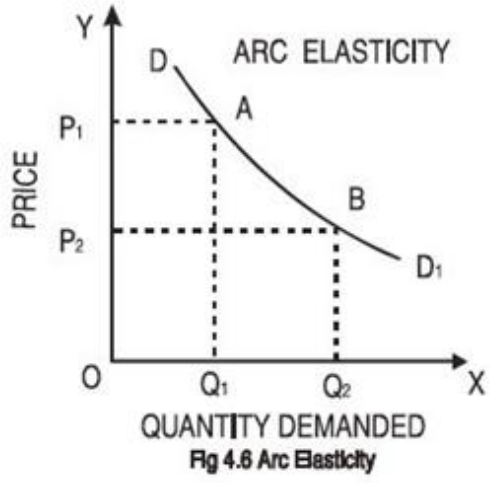


Fig 4.6 Arc Elasticity

Formula for measuring Arc Elasticity of Demand

$$Ed = \frac{\text{Change in Q.D.}}{\text{Original + New Q.D.}} \Big/ \frac{\text{change in price}}{\text{Original + New Price}}$$

$$= \frac{Q2 - Q1}{Q2 + Q1} \div \frac{P2 - P1}{P2 + P1}$$

$$= \frac{Q2 - Q1}{Q2 + Q1} \times \frac{P2 - P1}{P2 + P1}$$

4.3 MARSHALL'S METHOD OF MEASURING ELASTICITY OF DEMAND (Total Revenue or Total Outlay Method)

Here the total revenue or total outlay refers to the product of price and the quantity demanded, i.e. **TR = P X D**.

According to this method:

i) If change in price brings about change in quantity demanded in such a way that total outlay remains the same, then demand is **unit elastic**, e.g.

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Unit Elastic Demand		
Price	**Quantity Demanded**	**Total Outlay**
Rs 60	100 units	Rs 6,000
Rs 50	120 units	Rs 6,000
Rs 40	150 units	Rs 6,000

ii) If change in price brings about a change in the quantity demanded in such a way that the total outlay goes on falling, then demand is relatively inelastic, e.g.

Relatively Inelastic Demand		
Price	**Quantity Demanded**	**Total Outlay**
Rs 60	100 units	Rs 6,000
Rs 50	110 units	Rs 5,500
Rs 40	120 units	Rs 4,800

ii) If change in price brings about a change in the quantity demanded in such a way that the total outlay goes on increasing, then demand is relatively elastic, e.g.

Relatively Elastic Demand		
Price	**Quantity Demanded**	**Total Outlay**
Rs 60	100 units	Rs 6,000
Rs 50	150 units	Rs 7,500
Rs 40	200 units	Rs 8,000

4.1 ELASTICITY AT A GIVEN POINT ON THE DEMAND CURVE

At different points on the same demand curve the elasticity of demand will be different, e.g. let us consider a demand schedule which may tempt us to conclude that at all points on the same demand curve, the elasticity of the demand is the same.

A Demand Schedule	
Price of X	**Quantity demanded of X**
100	10
90	20

80	30
70	40
60	50
50	60
40	70
30	80
20	90
10	100

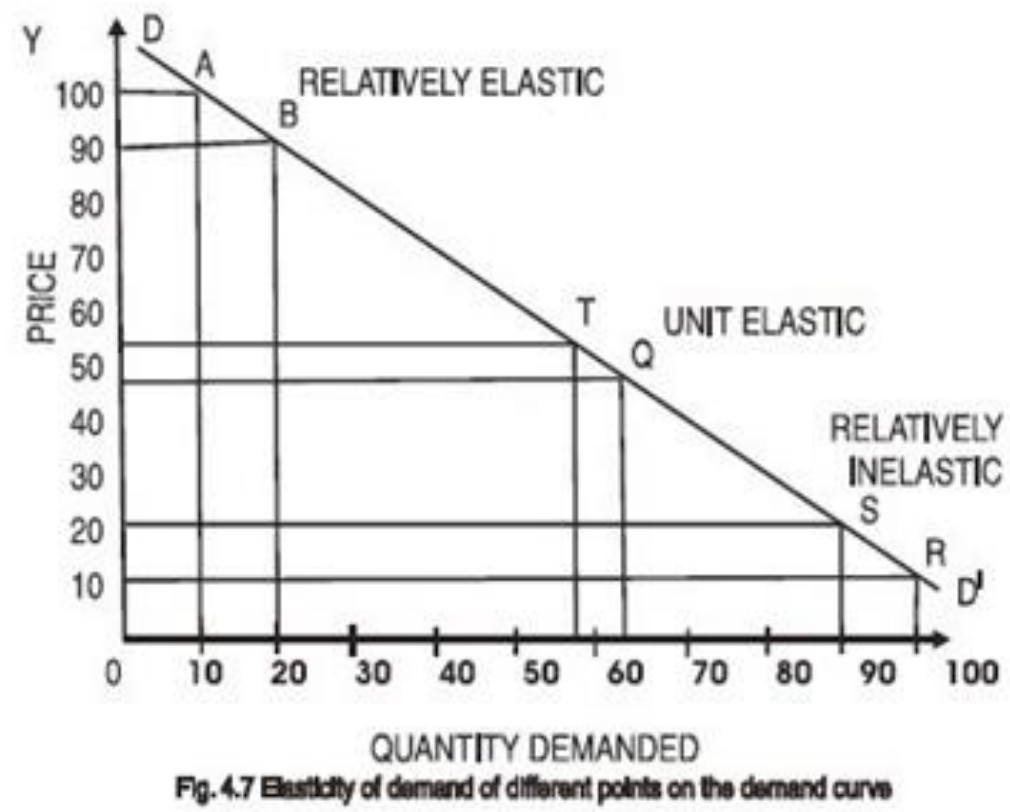

Fig. 4.7 Elasticity of demand of different points on the demand curve

Referring to the above figure, between points A and B, the demand is relatively elastic because % change in price is about 10% from (100 to 90) resulting in 100% change in quantity demanded (since demand changes from 10 to 20). Thus, demand here is relatively elastic. Besides when price changes from 10 to 20, demand changes from 100 to 90. Thus, price between R and S has changed by 100% . Thus, between R and S demand is relatively inelastic. Only at some middle range of prices, demand is unit elastic. Thus, **elasticity of demand is different at different points on the same demand curve**. To be more precise, we can derive a formula to measure the elasticity of demand at a given point on the demand curve.

Let us assume that DD^1 is the given demand curve and that we have to

measure the elasticity of demand at a given point T on the demand curve.

Let us now assume a slight fall in price from OP to OP^{I}; then the demand expands from OM to OM^{I}.

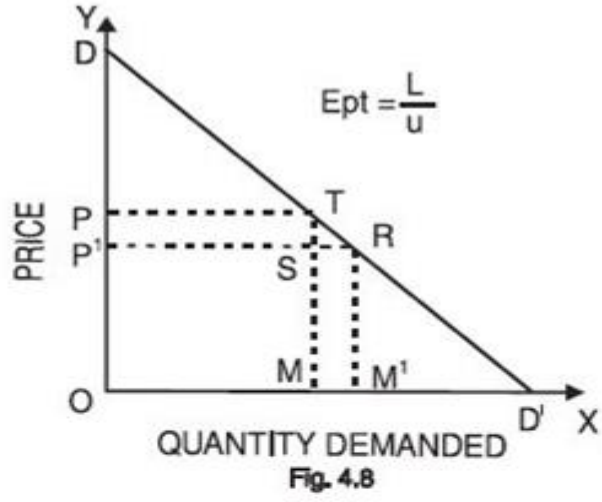

Fig. 4.8

$$\text{Now } Ed = \frac{P}{D} x \frac{\Delta D}{\Delta P} = \frac{OP}{OM} x \frac{MM'}{PP}$$

$$\text{Now } \frac{MM'}{PP} = \frac{SR}{ST} = \frac{MD'}{MT} = \frac{MD'}{OP}$$

$$\therefore Ed \frac{OP}{OM} x \frac{MD'}{OP} = \frac{MD'}{OM} = \frac{MD'}{PT}$$

And since ΔTMD' and TPD are similar

$$\frac{MD'}{PT} = \frac{D'T}{DT}$$

$$\therefore \text{Ed at a point T} = \frac{\text{Lower segment}}{\text{Upper segment}}$$

Let us assume that DD^{I} is a given straight line demand curve intercepting the X- axis at a point D^{I} And Y-axis at point D. If we have to find out the elasticity of demand at any point A on this demand curve then we apply the following formula;

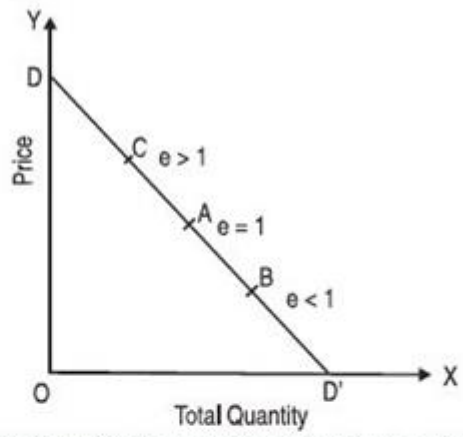

Fig 4.9 Point Elasticity of Demand when Demand Curve is a Straight Line

$$\text{Ed at Point A} = \frac{D'A}{DA}$$

Let us assume that the length of DD' is 8 cms.

$$\text{Then Ed at Point A} = \frac{D'A}{DA} = \frac{4}{4} = 1$$

$$\text{Ed at Point B} = \frac{D'B}{DB} = \frac{2}{6} = \frac{1}{3} < 1$$

$$\text{Ed at Point C} = \frac{D'C}{DC} = \frac{2}{6} = \frac{1}{3} > 1$$

Thus at lower range of prices demand becomes less and less elastic.

4.4 INCOME ELASTICITY OF DEMAND (Ey)

Income- elasticity of demand is the degree of responsiveness of quantity demanded of any commodity X to the change in consumer's income. It is expressed as the ratio of percentage change in quantity demanded of commodity X to percentage change in income. While measuring income elasticity of demand, all influences on demand other than income are held constant. The formula for income elasticity of demand is:

$$Ey = \frac{\text{Percentage change in quantity demand of x}}{\text{Percentage change in Income}}$$

$$Ey = \frac{\%\ \text{of}\ \Delta Qdx}{\%\ \Delta \text{Income}}$$

$$= \frac{\dfrac{\text{New Qdx - Old Qdx}}{\text{Old Qdx}} \times 100}{\dfrac{\text{New Income - Old Income}}{\text{Old Income}} \times 100}$$

$$\therefore Ey = \frac{\dfrac{\Delta Q}{Q}}{\dfrac{\Delta Y}{Y}} = \frac{\Delta Q}{Q} \times \frac{Y}{\Delta Y}$$

$$\therefore \boxed{Ey = \frac{Y}{Q} \times \frac{\Delta Q}{\Delta Y}}$$

Where Y = original income; Q = original demand
Y= change in income, Δ Q= change in demand

There is the possibility that as the income of the consumer changes, his demand for a commodity may change either in the **same direction** or in the opposite direction or a change in his income **may have no effect at all on demand** for that commodity.

Income- elasticity may be either **positive or negative or zero**.

i) **Positive Income Elasticity: If change in income brings about change in demand for a commodity in the same direction then income elasticity of demand with respect to that good is positive**. i.e. when income rises and demand for the good also expands and with a fall in income, the demand for that good also falls then income elasticity of demand is positive. **This happens in case of normal goods.** Thus goods having positive income elasticity of demand are normal goods.

ii) **Negative Income Elasticity: If change in consumer's income brings about change in demand for a commodity in the opposite direction then income elasticity of demand is negative**. i.e. when income rises and the consumer demands less of a particular good or with a reduction in income more units of that good are demanded then income elasticity of demand is negative. This occurs in case of inferior goods. Therefore, in

case of inferior good the income elasticity of demand is negative i.e. less than zero.

iii) **Zero Income Elasticity of Demand: If change in income of the consumer has no effect on demand for the commodity, then the**

income elasticity of demand is zero. The income may rise or fall but if it does not have any influence on demand then the Income Elasticity of demand is zero. E.g. our income may change but if our demand for salt is not affected due to change in income then income elasticity of demand for salt will be zero.

4.5 CROSS-ELASTICITY OF DEMAND (Ex)

Very often we find that goods are so **inter-related** that a change in demand for one good will also have some influence on demand for some other good, especially if it is a substitute or a complimentary good. **The degree of responsiveness of quantity demanded of B to the change in price of A is the cross-elasticity of demand.**

Thus cross elasticity of demand is defined as the measure of degree of responsiveness of quantity demanded of B to the change in price of A.

$$\therefore \; Ex = \frac{\text{Percentage change in } Q_{dB}}{\text{Percentage change in } P_A}$$

$$\text{Thus, } Ex = \frac{\%\text{ change in } Q_{dB}}{\%\text{ change in } P_A}$$

$$= \frac{\dfrac{\text{New } Q_{dB} - \text{Old } Q_{dB}}{\text{Old } Q_{dB}} \times 100}{\dfrac{\text{New } P_A - \text{Old } P_A}{\text{Old } P_A} \times 100}$$

$$= \frac{\Delta Q_{BA}}{Q_B} \cdot \frac{\Delta P_A}{P_A} = \frac{\Delta_A}{B} \times \frac{\Delta}{A}$$

$$\therefore \; \boxed{Ex = \frac{P_{AB}}{Q_{BB}} \times \frac{\Delta Q}{\Delta P}}$$

Where; P_A = original price of A; Q_B = original quantity of B
ΔP_A = change in price of A ; ΔQ_B = change in quantity of B

Cross elasticity of demand may be either positive or negative or zero.

i) **Positive Cross elasticity of demand**: If the two commodities A and B are so related that change in price of A brings about change in demand for B in the same direction then cross elasticity of demand is positive. This

happens in case of substitutes.

ii) **Negative Cross elasticity of demand**: If change in price of one commodity brings about change in demand for another commodity in opposite direction then cross elasticity of demand is negative. In case of complementary goods the cross elasticity of demand is negative.

iii) **Zero Cross elasticity of demand**: If the two goods are such that demand fro them is not at all inter-related then obviously any change in price of one good will have no effect on demand for the other. In such cases when change in price of A has no effect on demand for Z then cross elasticity of demand is zero. Thus in case of unrelated goods, say salt and pen, the cross elasticity of demand is zero.

4.6 USES OF THE CONCEPT OF ELASTICITY OF DEMAND

1. **Fixation of Price**: The concept of elasticity of demand is useful to the monopolist in formulating a suitable price-policy. He can charge a higher price if the demand for his product is relatively inelastic.

2. **Formulation of Tax Policy**: The concept of elasticity of demand is useful to the Government in formulating an appropriate tax policy. Taxes cannot be levied heavily on commodities, the demand for which is elastic or else when the seller tries to shift the burden of tax over to the buyers by charging higher prices, the buyers may immediately reduce the demand for the product itself and hence the Government may not be able to raise adequate revenue from taxes on such commodities. Hence necessities are covered under the Tax-net. Demand for necessities is inelastic. Therefore even when price is raised due to the tax the consumers will continue to buy and the Government is assured of some amount of revenue.

3. **Factor-Pricing**: The concept of elasticity of demand is also useful in determining factor-prices. Those factors, the demand for whose services is inelastic command higher rewards in the factor market, e.g. we can well observe that the demand for highly skilled and specialized labour, say air-pilots, is relatively inelastic and hence they command higher wages.

4. **Policy of Devaluation**: The concept of elasticity of demand is to be carefully applied when the Government is planning to undertake the measure of devaluation of currency. Devaluation means reducing the value of our currency in terms of foreign currency. This measure is resorted to in order to overcome disequilibrium situation in country's Balance of Payments. Through devaluation it is expected that the country's exports will rise and its imports will decline. But if our demand for foreign goods is inelastic, we will continue to import goods from abroad and thus our Balance of Payments will become more unfavourable. Therefore, before the Government takes the decision to devalue the currency it must study our elasticity of demand for foreign goods and foreigners elasticity of demand for our goods.

5. **Policy Of Nationalisation**: The concept of elasticity of demand is also useful in formulating the policy of nationalization. The Government tries to take over or nationalize those utility concerns, the demand for whose

products and services is inelastic. If such concerns are left in hands of a private sector then the producers would fix exhorbitant prices and thereby exploit the consumers. Thus to safeguard the interest of the consumers the Government feels it fit to nationalize such industries.