LESSON 4

PRICE ELASTICITY OF DEMAND

In the previous chapter, we have studied the law of demand and we have seen that there is an inverse relationship between the quantity demanded and the price of a commodity. A fall in the price of commodity leads to expansion in its quantity demanded while rise in the price of a commodity leads to a contraction in its quantity demanded. For an economist, it is necessary to know the responsiveness of the quantity demanded of a good to change in its price.

Price elasticity of demand

According to Mrs. Joan Robinson price elasticity can be precisely defined as, "The elasticity of demand at any price is the proportional change in amount purchased in response to a small change in price, divided by proportional change in price."

Hence price elasticity measures the change in quantity demanded on change in the price of a good. Elasticity of demand is the measure of the responsiveness to changing prices.

$$\text{Price Elasticity} = \frac{\text{Proportionate change in quantity demanded}}{\text{Proportionate change in price}}$$

OR

$$= \frac{\text{Change in quantity demanded}}{\text{Initial quantity demanded}} \div \frac{\text{Change in Price}}{\text{Initial Price}}$$

Or in symbolic term

$$Ep = \frac{\Delta q}{q} \div \frac{\Delta p}{p} = \frac{\Delta q}{q} \times \frac{p}{\Delta p}$$

$$= \frac{\Delta q}{\Delta p} \times \frac{p}{q}$$

Where Ep = Price elasticity

Δq = Change in quantity demanded

Δp = Change in price

As the change in quantity demanded is in opposite direction to the change in its price, so price elasticity of demand is negative.

Numerical Questions -

1. If there is 10% fall in the price of a good, then it's demand increases from 10 units to 14 units. Calculate the price elasticity of demand.

Ans.-

$$\text{Percentage increase in demand} = \frac{4}{10} \times 100 = 40\%$$

$$\text{Price elasticity of demand (Ep)} = \frac{\text{Percentage change in amount demanded}}{\text{Percentage change in price}}$$

$$\frac{40}{10} = 4$$

2. If the price of good rises from 7 Rs. to 10 Rs. and the demand falls from 6 unit to 4 units. Calculate the price elasticity of demand.

Ans.-

$$\text{Price elasticity of demand} = \frac{\text{Proportional change in quantity demand}}{\text{Proportional change in price}}$$

Proportionate change in Quantity demanded

$$= \frac{4-6}{6} = \frac{-2}{6} = \frac{-1}{3}$$

$$\text{Proportionate change in price} \quad \frac{10-7}{7} = \frac{3}{7}$$

$$\text{Thus price elasticity of demand} \quad = \frac{-1}{3} \div \frac{3}{7}$$

$$= \frac{-1}{3} \times \frac{7}{3} = \frac{-7}{9} = -0.77$$

Types of Price Elasticity of Demand:-

There are five cases of price elasticity of demand-

1. Perfectly elastic (Ep = ∞)
2. Relatively Elastic (Ep > 1)
3. Unitary elastic (Ep = 1)
4. Relatively Inelastic (Ep < 1)
5. Perfectly Inelastic (Ep = 0)

1. Perfectly elastic (Ep = ∞)

A perfectly elastic demand refers to the situation when demand is infinite at the prevailing price. It is a situation where a small rise in price causes the quantity demanded of a commodity to fall to zero and vice versa. Quantity demanded is hypersensitive to changes in price. Under perfect competition the demand curve of a firm is perfectly elastic. Demand is highly responsive towards price.

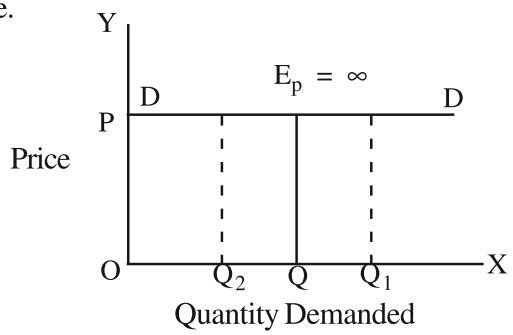


Figure 4.1

In Figure 4.1 it is clear that at the prevailing price OP quantity can be anything OQ, OQ_1, OQ_2. This shows that at constant price the quantity demanded can differ. The demand curve DD is parallel to OX axis.

2. Relatively Elastic (Ep > 1) (More than unitary elastic)

When the proportionate change in quantity demanded is greater than the proportionate change in price then it is a situation of more than unitary elastic.

Generally, the demand of luxury items is relatively elastic. If there is slight decrease in its price, the quantity demanded increases in greater proportion.

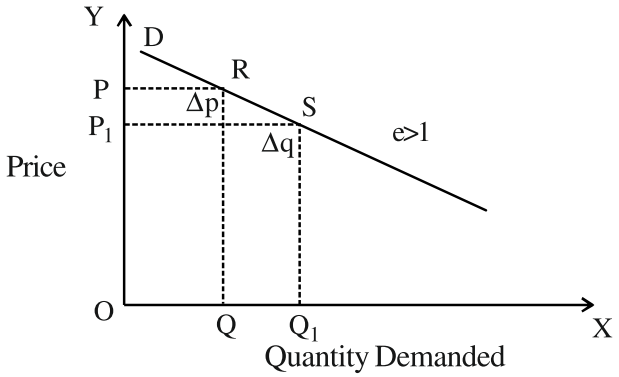


Figure 4.2

In the above figure 4.2 at OP price the quantity demanded is OQ. Thus the total expenditure is OP × OQ = DQRP (Area)

When the price falls to OP_1 then the quantity demanded increases to OQ_1, then the total expenditure is OP × OQ_1 = Area OQ_1 SP_1

Area OQ_1 SP_1 > Area OQRP

This proves that elasticity demand is greater than one. When the total expenditure increases on fall in price and total expenditure decreases with rise in price.

3. Unitary elastic demand (E_p = 1)

When the proportionate change in quantity demanded is equal to the proportionate change in price, then the elasticity is unitary. In this situation, the demand curve is rectangular hyperbola where all the rectangles drawn below it are of equal area. It is the situation when change in price of the commodity is such that the total expenditure of the commodity remains constant.

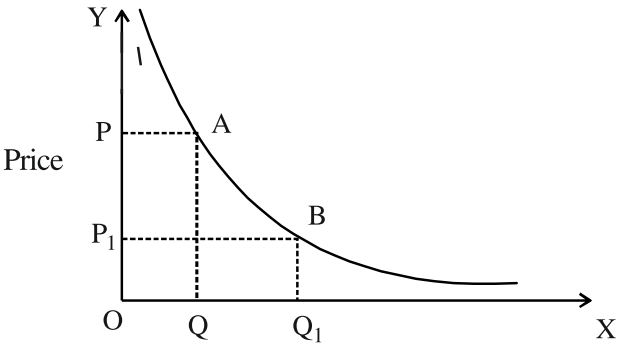


Figure 4.3

In the above fig 4.3 on point A price is OP and quantity demanded is OQ, hence the total expenditure is OP × OQ = Area = OQAP. With the fall in price

to OP_1 the quantity demanded increases to OQ_1 is expenditure on point B = $OP_1 \times OQ_1 = OQ_1\ BP_1$ (Area)

The demand curve is rectangular hyperbola so OQAP = $OQ_1\ BP_1$ i.e. the total amount spent on purchase of commodity at different prices is same.

Thus, the price elasticity of demand on all the points of this demand curve is equal to unit (1).

4. Relatively Inelastic demand (Less then one) ($E_p < 1$)

When the proportionate change in quantity demanded is less than the proportionate change in price then it is the situation of less than unitary elastic demand.

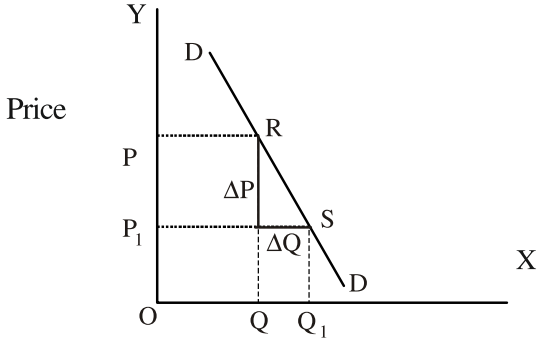


Figure 4.4

In the above figure 4.4 at price OP the quantity demanded is OQ. At point total expenditure is OP × OQ = area OQ RP. When the price falls to OP_1 the quantity demanded increases. Then at points the total expenditure is $OQ_1 \times OP_1$ = Area $OQ_1\ SP_1$

Area $OQ_1\ SP_1$ < OQRP.

This proves that demand is less than unitary elastic when total expenditure on commodity decreases with price falls and increases when price rises.

5. Perfectly inelastic ($E_p = 0$)

When the quantity demanded remains unaffected with the change in price then it is known as perfectly inelastic. In this situation, the demand curve is parallel to Y axis.

In the above fig. 4.5, the quantity demanded is constant at OQ, even with the change in price from OP to OP_1 or OP_2. It is a situation when price elasticity is zero.

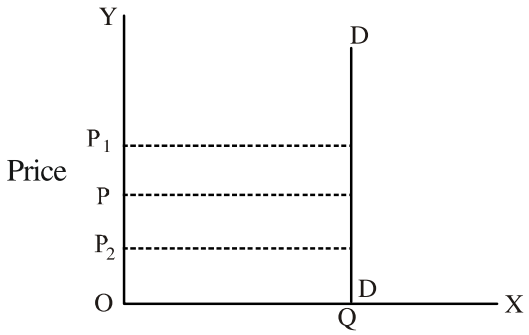


Figure 4.5

Measurement of Price elasticity of demand

Price elasticity of demand can be measured by following methods :-

1. Proportionate or Percentage Method - In this method, the price elasticity of demand is calculated by dividing the proportionate or percentage change in quantity demanded by the proportionate or percentage change in price.

$$E_p = \frac{\text{Proportionate (percentage) change in quantity demand}}{\text{Proportionate (percentage) change in price}}$$

$$E_p = \frac{\text{Change in demand / Initial demand}}{\text{Change in Price / Initial Price}}$$

$$Ep = \frac{\frac{Q_1 - Q}{Q}}{\frac{P_1 - P}{P}} = ed = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

Here E_p = Price elasticity of demand
Q = Initial demand
P = Initial price
Q_1 = New demand
P_1 = New price
ΔQ = Change in demand
ΔP = Change in price

Example - If price of some good is 100 Rs. per kg. then the quantity demanded is 250 grams. When the price falls to Rs. 50 then, the quantity demanded increases to 750 gms. Calculate price elasticity of demand by percentage method.

Answer :- P = 100 Rs P_1 = 50 Rs.

ΔP = 50

Q = 250 Q_1 = 750 gm

ΔQ = 500

$$ed = \frac{\frac{500}{250}}{\frac{50}{100}} = \frac{500}{250} \div \frac{50}{100}$$

$$= \frac{500}{250} \times \frac{100}{50} = 4$$

II. Geometric Method or Point Elasticity

Geometric method measures price elasticity of demand at a point on the demand curve. It is also called point method.

In the Figure 4.6, AB is a straight line demand function. P is the mid point which divides the demand curve in two segments PB (Lower segment) and PA (Upper segment)

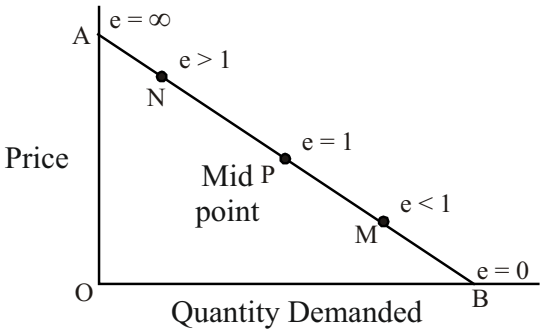


Figure 4.6

Elasticity of demand at point P is the ratio between lower segment (PB) and upper segment (PA)

$$\text{i e} = \quad Ep \text{ (at point P)} = \frac{PB}{PA} = 1$$

As P is the mid point of the demand curve hence, lower segment is equal to upper segment, so the price elasticity at point P = 1

If we have to measure price elasticity at point M between PB segment of AB line then -

$$Ep \text{ (at point M)} = \frac{\text{Lower Segment MB}}{\text{Upper segment MA}} < 1$$

Ep on M point is less than 1.

Price elasticity on point B =

$$Ep \text{ (at point B)} = \frac{\text{LowerSegment0}}{\text{UpperSegmentAB}} = \frac{}{} = 0$$

Price elasticity on point N =

$$Ep \text{ (at point N)} = \frac{\text{LowerSegmentNB}}{\text{UpperSegmentNA}} = \frac{}{} = Ep > 1$$

Price elasticity on point A

Ep = (at point A)

$$= \frac{\text{LowerSegmentBA}}{\text{UpperSegment0}} = \frac{}{} = Ep = \infty$$

III. Total Expenditure Method -

According to this method, price elasticity is calculated on basis of change in total expenditure due to change in price.

Marshall categorised price elasticity of demand in 3 types :-

1. Elastic demand
2. Unitary elastic demand
3. Inelastic demand

1. Elastic demand – If with the fall in price of a commodity total expenditure increases and with rise in its price total expenditure decreases then demand for that commodity is elastic.

For eg. the price of Bikaneri bhujia is₹ 90 per kg. and demand is₹ 400 Kg., then the total expenditure 90 x 400 =₹ 36000. If the price of Bhujia decreases to₹ 80 per kg. and demand increases by 550 kg., then the total expenditure will be 80 x 550 =₹ 44000. As the total expenditure has increased with fall in price so the price elasticity is more than one (e > 1) hence it is called as elastic demand.

2 Unitary demand - If rise and fall in price of a commodity leaves the total expenditure unaffected then price elasticity of demand is unitary (Ep = 1.) When the price of a water bottle is₹ 10 each and demand is 400 bottles, then total expenditure is 10 x 400 =₹ 4000. If the price falls to₹ 8 per bottle and demand increases to 500 bottles then the total

expenditure is 8 x 500 = ₹ 4000. We see that the total expenditure is unchanged, hence elasticity of demand is equal to one.

3. Inelastic Demand – If fall in price of a commodity causes total expenditure on a commodity to decrease, while on contrary rise in price causes total expenditure on a commodity to increase, then demand for a commodity is inelastic or less than one. For eg. if the price of salt is ₹ 10 per kg and total demand is 100 kg. then total expenditure will be 10 × 100 = ₹ 1000. Now if the price of salt declines to ₹ 8. per kg. the demand for salt at this new price is ₹ 110. Therefore the total expenditure is 8 × 110 = ₹ 880. Here with fall in price, total expenditure, too decreases, so price elasticity is less than one or a inelastic.

Thus to conclude, elastic demand is when change in total expenditure is in the opposite direction to change in price whereas in inelastic demand, change in total expenditure is in the same direction as the change in price in unitary elastic demand.

Change in price causes no change in total expenditure. The main limitation of this method is that we can only find whether elasticity is more. The actual measurement is not possible in a numerical value.

Numerical Question

1. When the price of a good is ₹ 11 per unit, then a consumer purchases 8 units. When the price falls to ₹ 8 per unit, then he buys 11 units. Calculate price elasticity of demand by total expenditure method.

Ans. - According to total expenditure method in Frist situation : Total expenditure = 11×8= ₹ 88

In second situation total expenditure= 8×11

= ₹ 88

In both the situations total expenditure remains the same. Thus elasticity of demand is equal to unitary.

2. Calculate price elasticity of demand through percentage method in following tables:

Price per unit (₹)	Total expenditure (₹)
10	180
9	162

Ans. – We will find out quantity demanded by dividing total expenditure with price

$$q_1 \quad \frac{180}{10} = 18$$

$$q_2 = \frac{162}{9} = 18$$

Here $P_1 = 10,\ Q_1 = 18$

$P_2 = 9,\ Q_2 = 18$

$$Ep = \frac{\frac{0}{18}}{\frac{1}{10}} = \frac{010}{181} \times — = 0 \text{ (Zero)}$$

Arc method -

This method is used to measure the elasticity of demand when there are wide gaps in the data available of price and quantity of a commodity. This method studies a segment or part of the demand curve where the segment lies between two points on the demand curve.

Determinants of price elasticity of demand:-

Price elasticity of demand depends on following factors :-

1. Nature of the commodity :- The price elasticity of demand of necessary goods is inelastic. The consumers cannot decrease their demand even if the prices increases for eg. of food grains and medicines etc. ($E_p < 1$)

The price elasticity of comfortable items is unitary as with the change in price the total expenditure on these goods remains the same. ($E_p = 1$)

Luxury items like air conditioners etc. have greater than unitary elastic demand as change in price causes greater change in their demand.

2. Availability of Substitutes :– If for a commodity, close substitutes are available, its demand tends to be elastic for eg; tea and coffee. If for a commodity, good substitutes are not available, people will have to buy it even when its price rises and therefore its demand would tend to be inelastic for eg. salt & liquor.

3. The number of uses of a commodity :- The greater the number of uses to which a commodity can be put, the greater will be its price elasticity of demand. If price of commodity having several uses increase, its demand will be small and it will be put to most important uses. If price of electricity increases it will be withdrawn from using warm water and cooking food.

4. Importance of goods in consumer's budget- Goods on which consumer spends a very small proportion of his income like match box, safety pins pencil etc, will have an inelastic demand. On the other hand, goods on which the consumer spends a large proportion of his income like car etc, their demand will be relatively elastic.

5. Postponement of use - Demand will be elastic for those commodities whose consumption can be postponed, for instance the demand for construction of a house can be postponed on increase in interest rate of house loans.

6. Habit of consumer - Goods to which a person becomes accustomed or habitual will have inelastic demand like cigarette, tobacco etc. He will not decrease their consumption even if their price increases.

7. Time period - Time also influences the demand of commodity. Demand is inelastic in short period as compared to long period. The longer the period of time, the greater is the ease to consumer, who can change his habits and substitute one good for another.

The above study has dealt with price elasticity of demand in detail. Beside this, there are other types of demand elasticity also like income elasticity, cross elasticity and substitution elasticity of demand.

The concept of elastity of demand is of much practical importance. It helps in determination of price in various markets, price determination of factors of production, in formulation of government policies and helps in analysing the problems of international trade.

Important points

- The responsiveness of quantity demanded to the change in its price is known as price elasticity of demand It is negative as there is inverse relationship between price and the quantity demanded of a good.
- Types of price elasticity of demand-

1. Perfectly elastic Ep = $\propto$

   Demand is infinite at specific price and with slight rise in price the demand becomes zero.

2. Elastic demand Ep > 1

   Percentage change in quantity demanded is greater than percentage change in price.

3. Unit elasticity Ep = 1

   Percentage change in quantity demanded is equal to percentage change in price.

4. Relatively Inelastic demand Ep < 1

   Percentage change in quantity demanded is less to than percentage change in price.

5. Perfectly inelastic Ep = 0

   When there is no change in quantity demanded with change in price.

- Measurement of price elasticity of demand-

a) Percentage Method :-

$$E_p = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

b) Point Method :-

$$Ep = \frac{\text{Lower Segment of demand curve}}{\text{Upper Segment of demand curve}}$$

c) Total expenditure Method :-

According to this method price elasticity is measured on the basis of change in total expenditure due to change in price.

1. If with the fall in price of a good total expenditure increases and with rise in its price total expenditure decreases then demand is elastic.
2. If rise and fall in prices bring no change in total expenditure then elasticity of demand is unitary.
3. If with the fall in price total expenditure decreases and with rise in its price, total expenditure increases, then demand is inelastic or less than unitory.

Factors affecting price elasticity

1. Nature of good.
2. Availability of substitute goods.
3. Different uses of goods.

4. The proportion of consumer income spent.
5. Habit of consumer.
6. Time Period.

Exercise Questions

Objective Type Questions :-

1. If there is no change in the quantity demanded of a good with the change in its price then the demand will be –

   A. Perfectly inelastic C. Unitary.

   C. Infinite D. Perfectly Elastic

2. What will be the effect on consumer's total expenditure, due to rise in price, in case of an inelastic demand -

   A. Constant B. Zero

   C. Increases D. decreases

3. The formula for price elasticity according to geometric method is –

   A. $\frac{\text{Lower segment of demand curve}}{\text{Upper segment of demand curve}}$

   B. $\frac{\text{Upper segment of demand curve}}{\text{Lower segment of demand curve}}$

   C. $\frac{\Delta q/q}{\Delta p/p}$ D. $\frac{\Delta p/p}{\Delta q/q}$

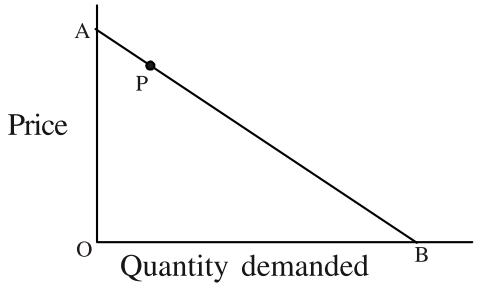
4. If there is 10% rise in the price of samosa, and is 10% decrese in its demand, then demand for samosa will be –

   A. Unitary elastic B. Zero elastic

   C. More than Unitary elastic

   D. Less than Unitary elastic

5. Find the price elasticity of demand on point P by point method -



   A. Relatively elastic B. Unitary elastic

   C. Relatively inelastic D. Zero

Very Short Answer Type Questions :-

1. Define price elasticity of demand.
2. What will be the elasticity of demand if demand curve is parallel to X axis ?
3. What will be the price elasticity at the midpoint of demand curve?
4. Why is the demand of water inelastic?
5. What is the formula of price elasticity of demand according to geometric method?

Short Answer Type Questions :-

1. Explain two factors determining price elasticity of demand.
2. Explain perfectly inelastic demand and perfectly elastic demand with the help of a figure.
3. How do we measure price elasticity of demand according to percentage method?

Essay Type Questions :-

1. Explain the various types of price elasticity of demand with the help of a figure.
2. Explain the various methods of measuring price elasticity of demand.
3. Explain in detail the various factors determining the price elasticity of demand.

Answer Table

1	2	3	4	5
A	C	A	A	A