Elasticity of Demand

Concept of Elasticity of Demand:

The law of demand indicates the direction of change in quantity demanded to a change in price.

It states that when price falls, demand rises. But how much the quantity demanded rises (or falls) following a certain fall (or rise) in prices cannot be known from the law of demand. That is to say, how much quantity demanded changes following a change in the price of a commodity can be known from the concept of elasticity of demand?

In Fig. 2.41, we have drawn two demand curves for good X and good Y. Both these curves are negative sloping. Let us assume that prices of both goods X and Y are P_{X1} and P_{Y1} (note that $P_{X1} = P_{Y1}$). At price OP_{X1}, a consumer demands OX_1 and, at price OP_{Y1}, OY_1 is demanded.

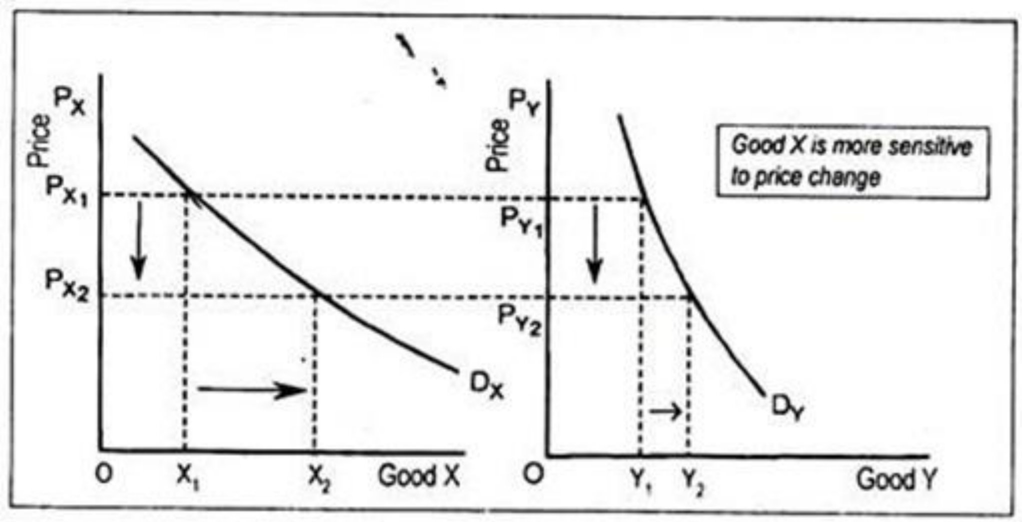


Fig. 2.41: Responsiveness of Product Demand

Now if prices of both X and Y decline by an identical amount to $OP_{X2}$and OP_{Y2}, quantity demanded for X and Y rises from OX_1 to OX_2 and from OY_1 to OY_2, respectively. But the change in quantity demanded for good X is greater than the change in quantity demanded for good Y. This means that good X is more sensitive or responsive to a change in its price than good Y. This is called elasticity of demand.

By elasticity of demand, we normally mean price elasticity of demand. (Price) elasticity of demand measures the degree of responsiveness of quantity demanded following a change in own price of the commodity, holding money income and prices of related goods constant.

(Price) elasticity of demand is the relative difference in the dependent variable (here, quantity) divided by the relative difference in independent variable (here, price). Alternatively, it is defined as the absolute value of the ratio of percentage change in price. Thus, the elasticity of demand is a relative concept.

The formula for calculating elasticity of demand is:

E_P = proportional changes in quantity demanded/proportional changes in price
= % changes in quantity demanded/changes in price

$E_P = |\Delta Q/Q/\Delta P/P| = |\Delta Q/\Delta P.P/Q|$
The vertical lines in the formula denote that we take the absolute value of the ratio and ΔP and ΔQ denote the changes in price and quantity. Since both price and quantity move in opposite direction, $E_P$must always be a negative number. Normally, we drop the negative sign and take the absolute value of E_P by taking **'mod'** (or use negative sign by dropping vertical lines).

Or absolute value, denoted by ||, turns the negative number into a positive one. Thus, E_P = |- 5%/2%| = 2.51 = 2.5. Price elasticity is a pure number, independent of units of measure. The percentage will be the same whether we measure quantity demanded in numbers or kilograms or liters.

Types of Own (Price) Elasticity of Demand:

For all types of commodities, the rate of change of quantity demanded to a change in own price is not uniform. For some commodities, demand is said to be more responsive to price changes compared to other commodities. That is why there are various types of elasticities of demand.

They are of the following five types:

(1) Elastic Demand (E_P > 1):

Demand is said to be elastic if the change in price causes a more than proportionate change in quantity demanded. A 10 p.c. change in price causes quantity demanded to change by more than 10 p.c. In other words, if E is greater than one, demand is said to be elastic (Fig. 2.42).

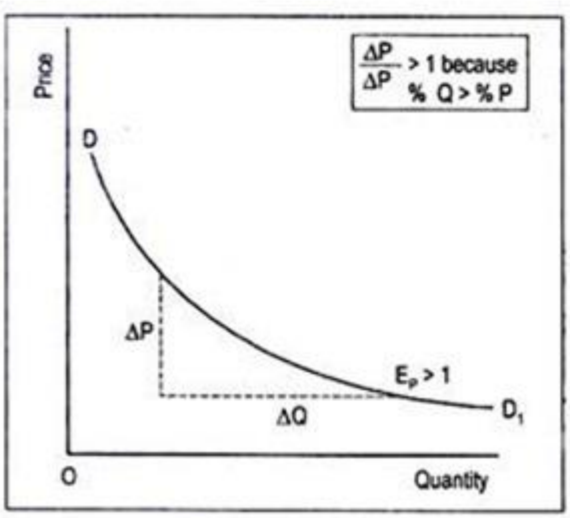


Fig. 2.42: Elastic Demand

Normally, demand is elastic for luxury goods. Let the price of gold per gm decline from Rs. 160 to Rs. 140. As a result, demand for gold rises from 1,000 kilograms to 2,000 kilograms. Thus,

E_P = 1,000/1,000 ÷ 20/160 = 1,000/20 .160/1,000 = 8
Since elasticity of demand for gold is greater than one, gold is a luxury item.

(2) Inelastic Demand (E_P < 1):
When the change in price causes a less than proportionate change in quantity demanded, demand is inelastic. A 10 p.c. cut in price may cause quantity demanded to fall by, say, 1 p.c. Thus, demand is said to be inelastic (E_p< 1), shown in Fig. 2.43. Usually, demand is inelastic for necessary goods.

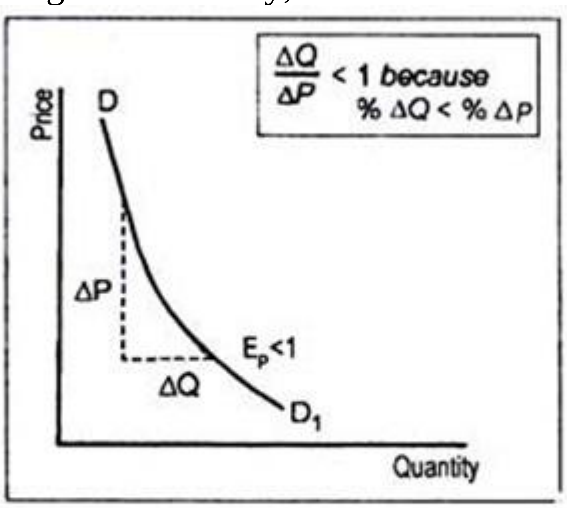


Fig. 2.43: Inelastic Demand

Suppose that following a drop in the price of wheat from paisa 40 per kilogram to paisa 20 per kilogram, demand for wheat rises from 1,600 kilograms to 2,000 kilograms. This means

E_P = 400/160 ÷ 20/40 = 400/20. 40/1,600 = 0.5

Thus, wheat has an inelastic demand since $E_P < 1$ and wheat is a necessary article.

(3) Unit elasticity of Demand ($E_P = 1$):

When the change in price causes the same proportionate change in quantity demanded, demand has unit elasticity. A 10 p.c. decline in price will lead to an exactly 10 p.c. increase in quantity demanded. Then $E_P = 1$ (Fig. 2.44).

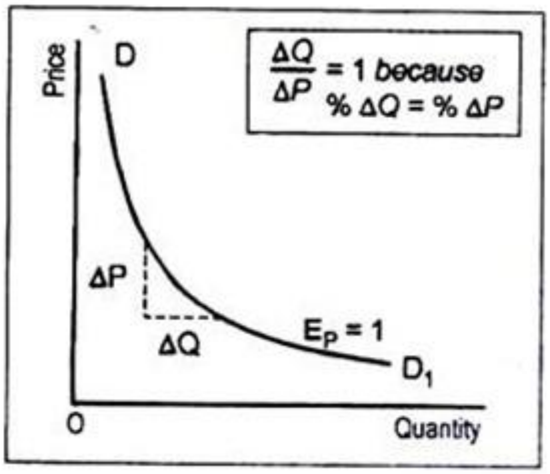


Fig. 2.44: Unitary Elastic Demand

Suppose that the price of a commodity declines from Rs. 200 to Rs. 100 per kilogram. As a result, demand for that commodity rises from 400 kilograms to 800 kilograms. Thus,

E_P = 400/400 ÷ 100/100 = 400/100. 100/400 = 1

(4) Perfectly Elastic Demand (EP = ∞)

When a slight change in price causes a great change in quantity demanded, the value of elasticity of demand tends to be infinity and demand is said to be infinite or perfectly elastic. In this case, the demand curve (DD,) becomes parallel to the horizontal axis (Fig. 2.45). Under perfectly competitive market, the demand curve for a product of an individual firm becomes perfectly elastic.

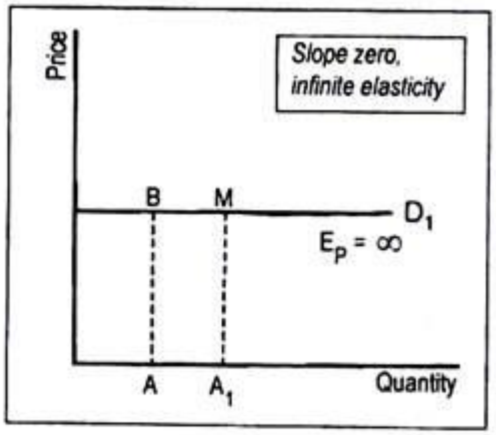


Fig. 2.45: Perfectly Elastic Demand

(5) Perfectly Inelastic Demand ($E_P = 0$):

If quantity demanded becomes completely unresponsive to price changes, the coefficient tends to be zero. In this case, whatever the price, even if it is zero, quantity demanded will remain fixed at a particular level. The demand curve, thus, becomes parallel to the vertical axis (Fig. 2.46) and demand is said to be completely (perfectly) inelastic.

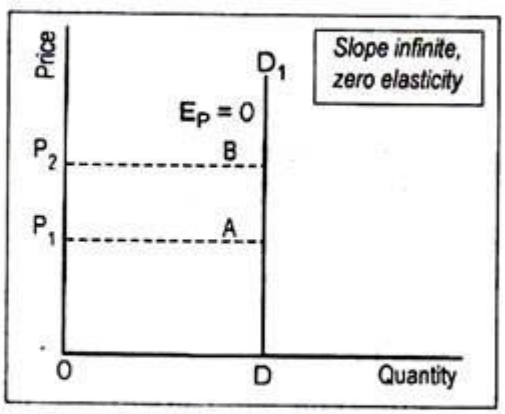


Fig. 2.46: Perfectly Inelastic Demand

Thus, elasticity of demand varies from zero to infinity.

Measurement of Elasticity of Demand:

There are three methods of measuring elasticity of demand. These are:

(a) Total outlay (revenue) method

(b) Point elasticity method

(c) Arc elasticity method

All these methods are described below:

1. Elasticity and Total Revenue or Outlay Method:

Marshall offered the method of total revenue or total outlay for estimating elasticity of demand. What the sellers receive from the sale of commodities is called total expenditure or outlay of buyers. There is no difference between total revenue and total outlay since what is spent by the buyers is received as income by the sellers.

Thus, total outlay/revenue is the price multiplied by the quantity purchases, i.e., TR = P × Q. Here we want to measure how much total outlay changes following a change in price. It depends upon the elasticity of demand.

(a) Elastic Demand:

Suppose price declines (rises). As a result, total expenditure rises (falls). Under the circumstance, the value of elasticity of demand becomes greater than one. In Fig. 2.47, we have drawn a demand curve having a value of greater than one.

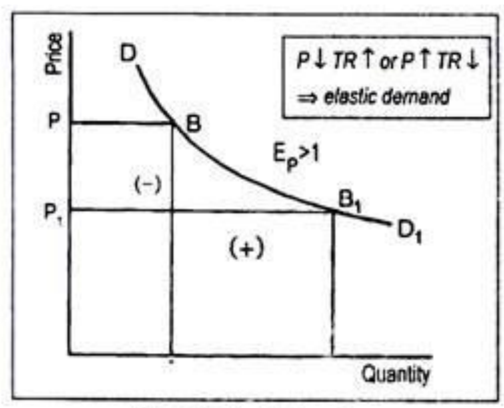


Fig. 2.47: Elastic Demand

At a price OP, OA is demanded. Thus, the total expenditure equals OP × OA = rectangle OPBA. As price drops to OP_1, the quantity demanded rises to OA_1. Now, the total expenditure becomes $OP_1 \times OA_1$ = rectangle $OP_1B_1A_1$.

Since rectangle $OP_1B_1A_1 >$ rectangle OPBA, demand is said to be elastic. Remember: When price and total outlay move in opposite direction, demand for the product becomes elastic.

(b) Inelastic Demand:

If the total outlay falls when price falls, or if total outlay rises when price rises, then demand is said to be inelastic (i.e., $E_p < 1$). In Fig. 2.48, initial total outlay is $OP_1 \times OA_1$ = rectangle OPBA. Now, if price falls, total outlay becomes $OP_1 \times OA_1$ = rectangle $OP_1B_1A_1$. Fig. 2.48 suggests that the rectangle OPBA is larger than the rectangle $OP_1B_1A_1$. Hence, demand is inelastic.

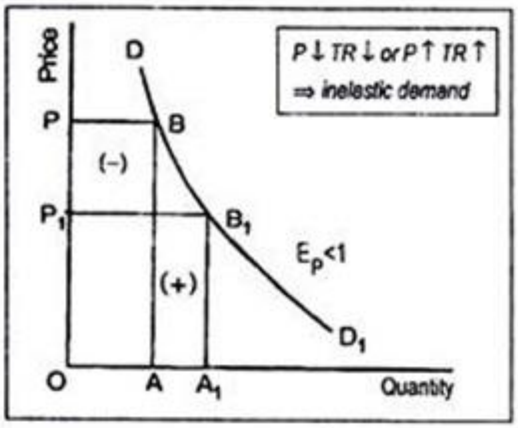


Fig. 2.48: Inelastic Demand

(c) Unit Elasticity:

Irrespective of variations in demand and price, if the total outlay does not change, then demand is unit elastic (i.e., $E_p = 1$). In Fig. 2.49, we see that at price OP, total outlay is rectangle OPBA. When price declines to OP, total outlay becomes the area $OP_1B_1A_1$.

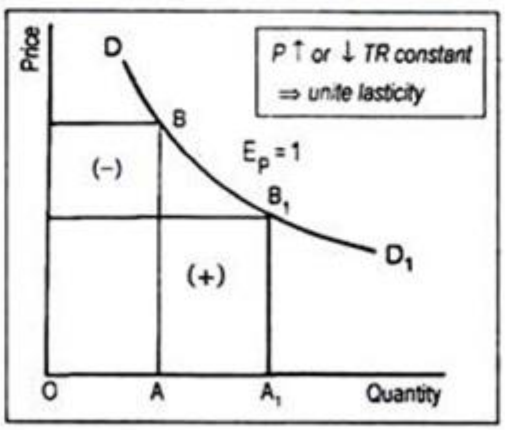


Fig. 2.49: Unitary Elastic Demand

Since rectangle OPBA = rectangle $OP_1B_1A_1$, demand is said to have a unitary elasticity. The demand curve then looks like a rectangular hyperbola since the area of all the rectangles formed by the demand curve is always the same.

(d) Perfectly Elastic Demand:

In this case, at a particular price, any amount is demanded. Fig. 2.45 suggests that at a price OD, quantity demanded may be OA or OA_1 or any amount. More revenue is earned at OA_1 than at OA, although price is kept fixed.

(e) Perfectly Inelastic Demand:

Fig. 2.46 tells us that as price rises, revenue rises. The vertical straight line demand curve says that, whatever the price, quantity demanded remains the same.

These relations between elasticity of demand and total outlay (P × Q = TR) may be presented here in a tabular form:

Table 2.9: Elasticity and TR

Change in price	E_p	Change in TR	Nature of the good
Increase	$E_p > 1$	Decrease	Luxury
Decrease	$E_p > 1$	Increase	
Increase	$E_p < 1$	Increase	Necessary
Decrease	$E_p < 1$	Decrease	
Increase	$E_p = 1$	No change	—
Decrease	$E_p = 1$	No change	

The relationship between elasticity and total outlay can also be explained in terms of Fig. 2.50 where we measure price of the commodity on the vertical axis and the total outlay on the horizontal axis. Here ABCD is the total outlay curve.

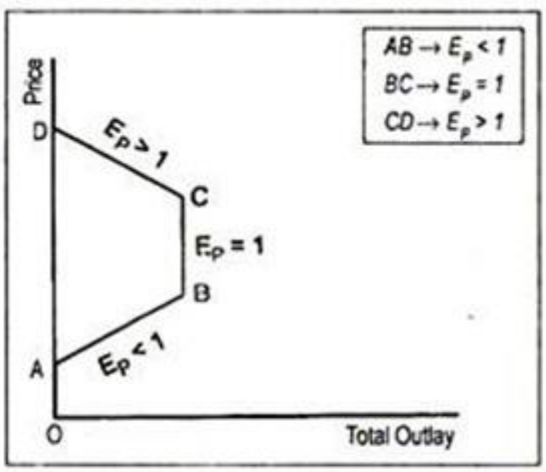


Fig. 2.50: Total Outlay Curve and Elasticity of Demand

In the segment AB, demand is inelastic ($E_p < 1$), because price and total outlay move in the same direction. Demand is said to be elastic ($E_p > 1$) in the region CD since price and total outlay move in opposite direction. As total outlay remains invariant when price changes in the region BC, demand is unitary elastic.

2. Point Elasticity Method of Measurement:

When the change in price is infinitesimally small, Marshallian method may not provide accurate estimate of elasticity of demand. In that case, a geometrical method may be employed. This method aims at measuring elasticity of demand at a particular point on a demand curve.

So long, we tried to calculate the elasticity over certain area or segment of a demand curve and the terms elastic, inelastic and unit elastic had been applied to the whole demand curve. However, such is not true. It may happen that the demand for a product can be elastic in one price range and inelastic in another.

In fact, the degree of elasticity varies from one price range to another. So, it is better to calculate elasticity at a particular point on a demand curve to have an accurate estimate. This is explained in terms of Fig. 2.51.

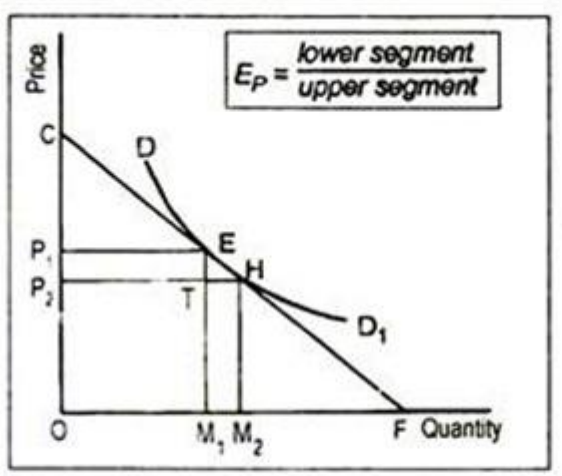


Fig. 2.51: Point Elasticity

Demand curve is DD_1. To measure elasticity of demand at point E, we have drawn a straight line CF tangent to DD_1 at point E. Points E and H are very close to each other. As price declines from OP_1 to OP_2, quantity demanded rises from OM_1 to OM_2.

The formula for elasticity of demand is:

$E_P = \Delta Q/Q \div \Delta P/P$

The slope of the demand curve is:

$\Delta P/\Delta Q = M_1E / M_1F$

$\therefore \Delta Q/\Delta P = M_1F / M_1E$

The second component of the elasticity formula is:

$P/Q = M_1E / OM_1$

$\therefore E_P = \Delta Q/\Delta P. P/Q = M_1F/M_1E. M_1E/OM_1 = M_1F/OM_1$

Note that EM_1F, CP_1E and COF are similar triangles, the elasticity of demand curve DD_1 at point E can be measured as:

$\therefore E_P = M_1F/OM_1 = P_1O/P_1 = EF/EC$

Thus, elasticity of demand at point E on a curvilinear demand curve DD_1 is approximately equal to

EF/EC = lower segment of the demand curve/upper segment of the demand curve

On the basis of this method of measurement, one can estimate elasticity of demand on a linear demand curve, shown in Fig. 2.52.

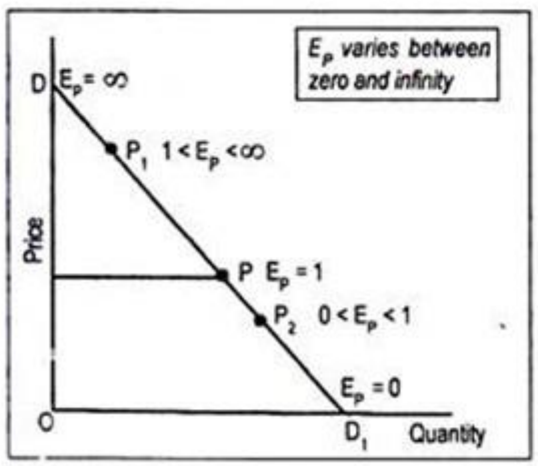


Fig. 2.52: Elasticity of Demand (O → ∞)

Here, DD_1 is a linear demand curve. Elasticity of demand varies from point to point on a demand curve. At point P, elasticity of demand is PD_1/PD. As the distance between PD_1 and PD is the same, it is unit elastic (i.e., $E_p = 1$). As we move downwards along the curve DD_1 from the mid-point, say point P_2, elasticity declines. At P_2 it is, inelastic (i.e., $0 < E_p < 1$) since $P_2D_1 < P_2D$.

At point D_1, elasticity is zero since $0/DD_1$is equal to zero. Further, as we move upwards from the mid-point, elasticity increases. At P_1, it is elastic (i.e., $1 < E_p < \infty$) since $P_1D_1 > P_1D$. On the other hand, at point D, it is infinite since $DD_1/0$ is equal to infinity. Thus, at lower prices it is inelastic, and at higher prices it is elastic.

Thus, elasticity of demand on a straight line demand curve varies from zero to infinity ($0 \leq E_p \leq \infty$).

3. Arc Elasticity Method:

For very small movements in price and quantity, point elasticity method is an appropriate one. In other words, point elasticity method measures (price) elasticity of demand at a particular point on the demand curve. However, if price change is somewhat of a larger magnitude then geometrical method may give misleading estimate.

To avoid this problem, elasticity is measured over an arc of the demand curve. In other words, when we intend to estimate (price) elasticity of demand over some portion (i.e., the arc) of the demand curve, we then have arc elasticity method. Sometimes we know two prices and two quantities.

Under the circumstance, the point elasticity method may not provide good estimate. What is required in this case is the average elasticity of two prices and two quantities. This is called 'arc' elasticity, because it measures the average elasticity on an arc of a demand curve.

Suppose we have the following information about two prices and quantities:

Price (P)	Demand (Q)
Rs. 60.00 (P_1)	400 (Q_1)
Rs. 50.00 (P_2)	800 (Q_2)

Here changes in both price and quantity are much larger. Using old price (P_1) and old quantity (Q_1), one finds the value of elasticity of demand as:

$E_P = \Delta Q / \Delta P. P_1/Q_1 = - 400/100. 60/400 = -6.0$

When new price (P_2) and new quantity (Q_2) are taken into account, the coefficient becomes

$E_P = \Delta Q / \Delta P. P_2/Q_2 = - 400/100. 50/800 = -2.5$

Thus, estimation of elasticity in accordance with the formula for point elasticity method gives vastly different results. In other words, since elasticity of demand varies depending on the base, one should consider average price and average quantity demanded to calculate elasticity of demand.

That is to say, we want to measure average elasticity over an arc of the demand curve (i.e., mid-point or average, price and quantity):

$$E_{arc} = -\frac{\Delta Q}{\left(\frac{Q_1+Q_2}{2}\right)} \div \frac{\Delta P}{\left(\frac{P_1+P_2}{2}\right)}$$

$$= \frac{\Delta Q}{\left(\frac{Q_1+Q_2}{2}\right)} \times \frac{\left(\frac{P_1+P_2}{2}\right)}{\Delta P}$$

$$= -\frac{\Delta Q}{\Delta P}\left(\frac{P_1+P_2}{Q_1+Q_2}\right)$$

In our above example, the arc elasticity is

$$E_{arc} = -\frac{400}{10}.\frac{60+50}{400+800} = -\frac{400}{10}.\frac{110}{1200} = -3.66$$

In terms of Fig. 2.53, we want to compute arc price elasticity of demand over the arc AB of the demand curve DD_1. In other words, we want to measure elasticity between points A and B. The above formula measures arc elasticity over the straight line AB.

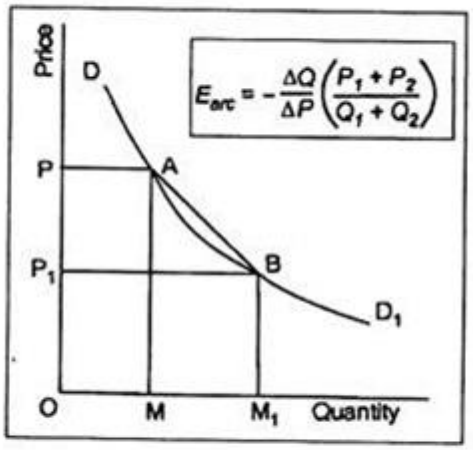


Fig. 2.53: Arc Elasticity

To do so, we have to take the average of prices (OP and OP_1) and average of quantities (OM and OM_1). Greater the convexity of the demand curve between A and B, one obtains almost perfect estimate of elasticity. Or greater the concavity of the demand curve between points A and B, the poorer the approximation of measurement of arc elasticity.

As we go on making the price change smaller and smaller, the arc of the demand curve may vanish or converge to a point. So, as a special case of arc elasticity, the concept of point elasticity becomes relevant.

Factors Determining Elasticity of Demand:

There are various factors on which elasticity of demand depends:

(a) Nature of the Commodity:

In the first place, it depends on the nature of the commodity. Commodities which are supposed to be essential or critical to our daily lives must have an inelastic demand, since price change of these items does not bring about a greater change in quantity demanded.

But, luxury goods have an elastic demand. Demand for these good can be quickly reduced when their prices rise. When their prices fall, consumers demand these goods in larger quantities. However, whether a particular commodity is a necessary or a luxury depends on income, tastes and preferences of the consumer.

A particular good may be necessary to someone having an inelastic demand. Same commodity may be elastic to another consumer. For instance, owning a TV may be a luxury item to a low income person. But the same may be bought as an essential item by a rich person.

(b) Availability of Substitutes:
Secondly, commodities having large number of substitutes must have an elastic demand. Some products, such as Horlicks, Complan, Viva, Maltova, Milo, etc., have quite a large number of close substitutes. A change in the price of, say, Horlicks—the prices of other substitutes remaining constant—will lead a consumer to substitute one beverage for another.

If the price of Horlicks goes down, buyers will demand more of it and less of its substitutes. Conversely, demand is fairly inelastic in the case of those commodities which do not have a large number of substitutes.

(c) Extent of Uses:
Thirdly, there are some commodities which can be used for a variety of purposes. For example, electricity. If price per unit of electricity consumed falls, people will reduce their consumption of its substitutes (e.g., coal, gas, etc.) and increase the consumption of electricity.

Coefficient of price elasticity of demand in this case must be greater than one. On the other hand, when a commodity is used only for one or two purposes, a price change will have less effect on its quantity demanded and, therefore, demand will be inelastic.

(d) Habit Good:
Fourthly, there are some commodities consumed out of habits and conventions—they have an elastic demand. Even in the face of rising prices of those commodities or falling income, people will consume those (such as, cigarette).

For this reason, price elasticity as well as income elasticity of demand for this type of commodity is inelastic. Further, gold ornaments are used in the marriage ceremony rather out of convention, though gold prices are rising. When gold is used in this way, its demand becomes inelastic.

(e) Time Dimension:
Fifthly, shorter the time, lower will be the elasticity of demand. This is because in the short run satisfactory substitutes of a product may not be available. Thus, demand for a product in the short run usually becomes inelastic. Such a commodity will be elastic in the long run when close substitutes may be produced.

Thus, the response of quantity demanded to a change in price will tend to be greater (smaller), the longer (shorter) the time-span considered. In the long run, there is enough time for adjustments to be made following a change in price.

(f) The Importance of being Unimportant:
Sixthly, people often pay little attention to the price of a product if it constitutes a relatively small part in their budget. For example, if the fire of railway ticket of a tourist who travels by rail once in a year is increased form Rs. 125 to Rs. 135, then he may not postpone his journey. This means he is unresponsive to such price hike and his demand is inelastic. This is called 'the importance of being unimportant'.

(g) Durability:
Finally, durable commodities have an elastic demand. If the price of these goods rises, people will spend less on these goods. On the other hand, following a fall in the price of durable commodities (e.g., refrigerator), people demand more of them. In the case of non-durable commodities, demand is elastic.

Importance of the Concept of Elasticity of Demand:
The concept of elasticity of demand has both theoretical and practical value.

The concept may be used in understanding as well as tackling various economic problems:
(a) Price Determination:
Use of the concept of elasticity of demand is required in the price determination of a commodity under different market conditions. Under perfect competition, in the short run in which supply is absolutely inelastic price depends upon the elasticity of demand.

If demand suddenly falls—supply remaining fixed—prices will fall, and, if demand suddenly rises, prices will rise as output cannot be increased. Again, the stability of prices also depends on the elasticity of demand and elasticity of supply. If either the demand or the supply is elastic, fluctuations in prices will be within narrow limits.

Further, if the demand for an agricultural commodity is inelastic, increased production may spell disaster to the economic condition of farmers. So the government can adopt measures to save the plight of the farmers.

A monopoly seller must have a knowledge relating to the elasticity of demand for his product while determining the price of his commodity.

A monopolist will produce a commodity in the range of his demand curve where demand is said to be elastic. He will never produce in the range of the demand curve where demand is inelastic. Obviously, price determination of the monopoly product will be governed by the elasticity of demand.

(b) Wage Determination:

The concept of elasticity of demand is employed in wage determination. Wages, in modern days, are determined through the process of collective bargaining. Trade union will be successful in raising the wage rate provided labour demand is deemed to be inelastic. This is because of the fact that the degree of substitution between labour and other labour substituting inputs is less.

Trade union becomes cautious in demanding higher wage rates when the demand for labour is said to be elastic. Under the circumstance, the employer may be forced to employ more machines (assumed to be a cheaper input) than labour.

Anyway, this concept may be employed in analysing the problems connected with changes in the conditions of supply. Economists are interested in knowing the effect on employment in the software industry following a rise in the wages of workers engaged in this industry. We can answer this question in terms of Fig. 2.60.

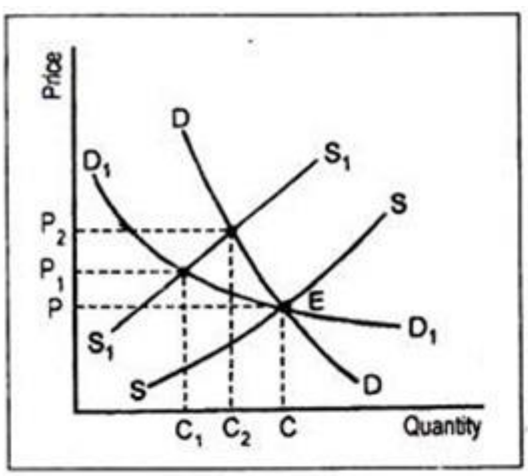


Fig. 2.60: Demand for and Supply of Computer

Here DD is a rather inelastic demand curve whereas demand curve D_1D_1 is an elastic one. Both these demand curves intersect the supply curve, SS, at point E. Thus the equilibrium price is OP and equilibrium quantity demanded and supplied is OC.

Let there be an increase in the wages of workers in the computer industry. Consequently, the supply curve for computer will shift left to S_1S_1 and the price will rise to OP_2 if demand curve is assumed to be DD and to OP_1 if demand curve is D_1D_1. However, output contracts more in the case of elastic demand (from OC to OC_1). If demand is inelastic, output will shrink less (from OC to OC_2).

"The general rule is that where demand is elastic, a change in supply will cause the quantity sold to change rather than price; where demand is inelastic, price changes rather than the quantity sold. Thus, trade union will find it more difficult to obtain a wage increase for its members without creating unemployment where the elasticity of demand for the product made is high." (Jack Harvey)

(c) Policy Determination:

The concept of elasticity of demand is of great importance to a finance minister. While imposing tax or raising the existing tax rates, the finance minister must have sufficient knowledge of the elasticity of demand for the taxed commodity.

If the demand for the product is inelastic, the purpose of the tax—say revenue-earning—will be served. That is why taxes are mostly imposed or rates of taxes are raised in the case of commodities having inelastic demand.

Again, the concept may be used in the determination of incidence of a tax. It is easier to shift the burden of taxes on to the consumers if the product demand is assumed to be inelastic. Further, whether exportable or importable be taxed or not, the concept of elasticity may be of great use.

(d) Exchange Rate Determination:

In international trade too, the concept may be employed. For instance, as far as exchange rate (i.e., the rate at which one currency is exchanged for another currency) determination is concerned, the concept of elasticity of demand is of great importance.

The concept of elasticity of demand is used to justify whether devaluation of a currency is a right step in curbing balance of payment problems of a country. Devaluation is expected to correct the balance of payments disequilibrium if the sum of the elasticities of demand for export and import exceeds unity.

In international trade theory, within the limits set by the comparative costs, the terms of trade also depends on the elasticity of demand of each country for the goods of other countries.

In fine, elasticity of demand is a concept which has much applicability as far as business decision-making is concerned and is, therefore, of much importance in modern economics. In fact, most businessmen should try to form as precise an idea of elasticity as possible.

The concept of elasticity of demand is useful in business decision-making because **“it is a convenient shorthand way of expressing the effects of price change on demand for a commodity and as such it is relevant to price fixing.”**

methods used for measuring price elasticity of demand are as follows:

1. Total Expenditure Method.

2. Proportionate Method.

3. Point Elasticity of Demand.

4. Are Elasticity of Demand.

5. Revenue Method.

1. Total Expenditure Method:

Dr. Marshall has evolved the total expenditure method to measure the price elasticity of demand. According to this method, elasticity of demand can be measured by considering the change in price and the subsequent change in the total quantity of goods purchased and the total amount of money spent on it.

Total Outlay = Price X Quantity Demanded

There are three possibilities:

(i) If with a fall in price (demand increases) the total expenditure increases or with a rise in price (demand falls), the total expenditure falls, in that case the elasticity of demand is greater than one i.e. ED > 1.

(ii) If with a rise or fall in the price (demand falls or rises respectively), the total expenditure remains the same, the demand will be unitary elastic or ED = 1.

(iii) If with a fall in price (Demand rises), the total expenditure also falls, and with a rise in price (Demand falls) the total expenditure also rises, the demand is said to be less classic or elasticity of demand is less than one (ED < 1).

This can be expressed with the help of a Chart.

Leibhafasky has given the following formula to measure elasticity of demand:

$$Ed = 1 - \frac{\Delta Exp}{X \Delta P}$$

Where ED = Elasticity of demand

ΔExp = Change in Expenditure

X = Initial demand

ΔP = Change in price.

Table Representation : The method of total expenditure has been explained with the help of Table 1.

Table 1.

Price (P)	Quantity Demanded (Q)	Total Outlay (PQ)	Elasticity of demand (Ed)
10	1	10	
9	2	18	
8	3	24	$Ed > 1$
7	4	28	
6	5	30	
5	6	30	$Ed = 1$
4	7	28	
3	8	24	
2	9	18	
1	10	10	$Ed < 1$

In the Table we find three possibilities:

A. More Elastic Demand:

When price is Rs. 10 the quantity demanded is 1 unit and total expenditure is 10. Now price falls from Rs. 10 to Rs. 6, the quantity demanded increases from 1 to 5 units and correspondingly the total expenditure increases from Rs. 10 to Rs. 30. Thus it is clear that with the fall in price, the total expenditure increases and vice-versa. So elasticity of demand is greater than one or ED >1.

B. Unitary Elastic Demand:

If price is Rs. 6, demand is 5 units so the total outlay is Rs. 30. Now price falls to Rs. 5, the demand increases to 6 units but the total expenditure remains the same i.e., Rs. 30. Thus it is clear that with the rise or fall in price, the total expenditure remains the same. The elasticity of demand in this case is equal to one or

ED = 1.

C. Less Elastic Demand:

If price is Rs. 5, demand is 6 and total outlay is Rs. 30. Now price falls from Rs. 5 to Re. 1. The demand increases from 6 units to 10 units and hence the total expenditure falls from Rs. 30 to Rs. 10. Thus it is clear that with the fall in price, the total expenditure also falls and vice-versa. In this case, the elasticity of demand is less than one or ED <1.

Diagrammatic Representation:

The total expenditure can be explained with the help of Fig. 7.

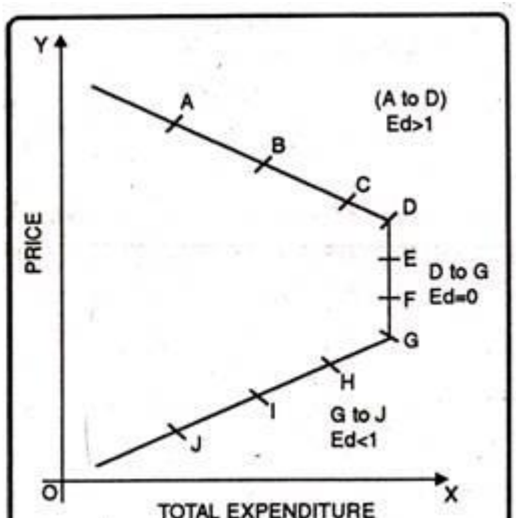


Fig. 7.

In the fig., there are three phases of the total expenditure curve.

Downward sloping (from A to D), (ii) Vertical (from D to G), (iii) Upward sloping (G to J).

(i) Downward Sloping Curve:

If the price- total expenditure curve slopes downward from left to right, it means the elasticity of demand is greater than one. As we see in the diagram that when price falls from Rs. 10 to Rs. 5 the total expenditure increases from Rs. 10 to Rs. 30. It means, there is opposite relationship between price and total expenditure. The elasticity of demand in this case is greater than one. Thus the curve from A to D represents the elasticity greater than one or ED >1.

(ii) Vertical Curve.

If price-total expenditure curve is vertical or parallel to 7-axis, it means that with fall in price from Rs. 6 to Rs. 5 the total expenditure remains the same. Thus if total expenditure does not change with the rise or fall in price, the elasticity of demand will be equal to one. Thus by joining points D and G we get vertical curve showing elasticity of demand equal to one or Ed =1.

(iii) Upward Sloping Curve:

If price-total expenditure curve rises upward from left to right, it means the elasticity of demand is less than one. In the diagram, we find that when price falls from Rs. 5 to Re. 1the total expenditure also falls from Rs. 30 to Rs. 10. It means by joining G, H, I, J we get an upward sloping curve showing elasticity of demand less than one or ED < 1. Thus it is clear that the changes in total expenditure due to changes in price also affect the elasticity of demand.

2. Proportionate Method:

This method is also associated with the name of Dr. Marshall. According to this method, "price elasticity of demand is the ratio of percentage change in the amount demanded to the percentage change in price of the commodity."

It is also known as the Percentage Method, Flux Method, Ratio Method, and Arithmetic Method. Its formula is as under:

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

$$= \frac{\dfrac{\text{Change in quantity demanded}}{\text{Amount demanded before change}}}{\dfrac{\text{Change in Price}}{\text{Price before change}}}$$

Implications:

(a) This method should be used when there is a very small change in price and quantity demanded.

(b) The coefficient of price elasticity of demand is always negative. It is because when price changes, demand changes in the opposite direction. But by convention, we ignore negative sign.

(c) The elasticity of demand is relative. It is not expressed in any unit rather expressed in percentage or infractions.

3. Point Method:

This method was also suggested by Marshall and it takes into consideration a straight line demand curve and measures elasticity at different points on the curve. This method has now become very popular method of measuring elasticity. In this we take a straight line demand curve, which connects the demand curve with both the axes OX and OY. In the diagram OX axis represents the quantity demanded and OY axis represents the price.

Case (i) Linear Demand Curve:

In Fig. 8 RS is a straight line demand curve. Initially, price is OP or QA and OQ or PA is the initial demand. At OP' new price the demand is OQ'. At point R elasticity of demand can be measured with the following formula.

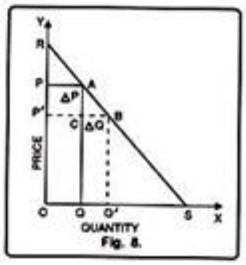


Fig. 8.

$$Ed = \frac{\text{Change in Demand}}{\text{Original Demand}} + \frac{\text{Change in price}}{\text{Original price}}$$

$$E = \frac{QQ'}{OQ} + \frac{PP'}{OP}$$

or $$\frac{CB}{OQ} + \frac{CA}{AQ} = \frac{CB}{OQ} \times \frac{AQ}{CA} = \frac{CB}{CA} \times \frac{AQ}{OQ} \qquad ...(i)$$

Since ΔACB and ΔAQS are similar triangles, therefore, the proportion of their sides will be equal as

$$\frac{CB}{CA} = \frac{QS}{AQ}$$

This equation (*i*) can be written as under :

$$\frac{QS}{AQ} \times \frac{AQ}{OQ} = \frac{QS}{OQ}$$

By deleting AQ, from both sides, elasticity of demand is equal to $\frac{QS}{OQ}$.

Since ΔAQS and ΔRPA are similar, the ratio of their sides will also be equal. Therefore

$$\frac{QS}{AS} = \frac{PA}{AR} \text{ or } \frac{QS}{PA} = \frac{AS}{AR}$$

$$\frac{QS}{OQ} = \frac{AS}{AR} \text{ (Since OQ = AP)}$$

$$\frac{AS}{AR} \text{ mean } \frac{\text{Lower Segment}}{\text{Upper Segment}}$$

The elasticity of demand may not be same at all points on a curve.

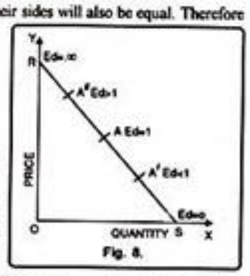


Fig. 8.

In Fig. 9 point A lies in the middle of RS line, therefore $\frac{AS}{AR} = 1$. Here elasticity of demand is equal to unity. At point A'' elasticity of demand in greater than one $\left(\frac{A''S}{A''R} > 1\right)$. Similarly at point A' elasticity of demand is less than one. At point S elasticity of demand is equal to zero whereas at point R elasticity of demand is infinite.

Case (ii) Non-Liner Demand Curve:

It is possible that the demand curve is not a straight line but a curve. Even then the above technique shall be applicable. The only change to be made is that a tangent is drawn on the demand curve at a point at which we want to measure elasticity of demand.

In Fig 10 DD_1 is the demand curve and we raw a line RS to measure the elasticity of demand. At point A demand curve DD1 and RS line touches each other. Therefor, both have same slope. Therefore, a point A, elasticity of demand is Ed = AS/AR

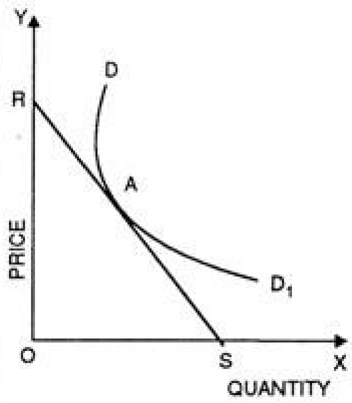


Fig. 10.

4. Arc Elasticity of Demand:

"Arc elasticity is a measure of the average responsiveness to price change exhibited by a demand curve over some finite stretch of the curve" Prof. Baumol

"Arc elasticity is the elasticity at the mid-point of an arc of a demanded curve" Watson

"When elasticity is computed between two separate points on a demand curve, the concept is called Arc elasticity" Leftwitch

This method of measuring elasticity of demand is also known as "**Average Elasticity**". In this method, we use $\frac{P_1 + P_2}{2}$ rather than P. Thus, we apply $\frac{Q_1 + Q_2}{2}$ rather than q. The formula for arc elasticity of demand is as follows.

$$\text{Arc. Elasticity of Demand } (E_A) = \frac{\dfrac{\text{Change in Demand}}{\text{Original Demand + New Demand}}}{\dfrac{\text{Change in Price}}{\text{Original Price + New Price}}}$$

Arc. Elasticity of Demand in notational form can be expressed as :

$$E = \frac{Q - Q_1}{Q + Q_1} \div \frac{P - P_1}{P + P_1}$$

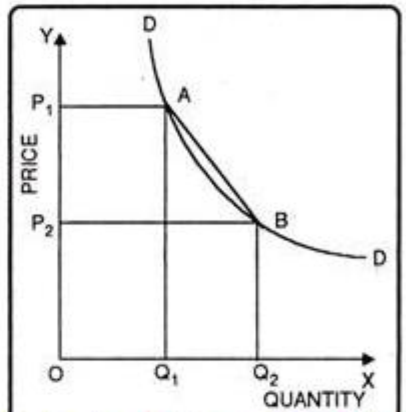
where Q = Original quantity demanded

Q_1 = New quantity demanded

P_1 = Original price

P_2 = New Price

This can be shown with the help of a diagram 11.



In figure 11 quantity is measured on X-axis while price

5. Revenue Method:

Mrs. Joan Robinson has given this method. She says that elasticity of demand can be measured with the help of average revenue and marginal revenue. Therefore, sale proceeds that a firm obtains by selling its products are called its revenue. However, when total revenue is divided by the number of units sold, we get average revenue.

On the contrary, when addition is made to the total revenue by the sale of one more unit of the commodity is called marginal revenue. Therefore, the formula to measure elasticity of demand can be written as,

E_A = A/ A-M

Where E_d represents elasticity of demand, A = average revenue and M = marginal revenue. This method can be explained with the help of a diagram 12.

In this diagram 12, revenue has been shown on OY- axis while quantity of goods on OX-axis. AB is the average revenue or demand curve and AN is the marginal revenue curve. At point P on demand curve, elasticity of demand is calculated with the formula, In this way, value of Ep is one which means that price elasticity of demand is unitary. Similarly, if it is more than one, price elasticity of demand is greater than one and if it is less than one, price elasticity of demand is less than unity.

a) The price elasticity,

(b) The income elasticity,

(c) The cross-elasticity of demand.

The price elasticity of demand:

The price elasticity is a measure of the responsiveness of demand to changes in the commodity's own price. If the changes in price are very small we use as a measure of the responsiveness of demand the point elasticity of demand. If the changes in price are not small we use the arc elasticity of demand as the relevant measure. The point elasticity of demand is defined as the proportionate change in the quantity demanded resulting from a very small proportionate change in price. Symbolically we may write

$$e_p = \frac{dQ}{Q} \Big/ \frac{dP}{P} \qquad (2.4)$$

or

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

If the demand curve is linear

$$Q = b_0 - b_1 P$$

its slope is $dQ/dP = -b_1$. Substituting in the elasticity formula we obtain

$$e_p = -b_1 \cdot \frac{P}{Q}$$

which implies that the elasticity changes at the various points of the linear-demand curve. Graphically the point elasticity of a linear-demand curve is shown by the ratio of the segments of the line to the right and to the left of the particular point. In figure 2.33 the elasticity of the linear-demand curve at point F is the ratio

$$\frac{FD'}{FD}$$

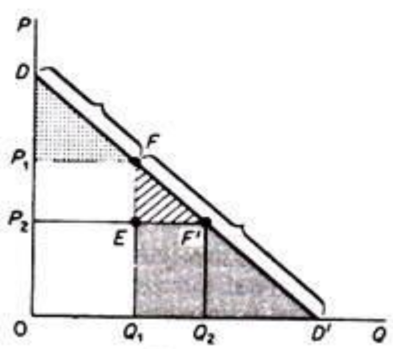


Figure 2.33

Proof

From figure 2.33 we see that

$$\Delta P = P_1P_2 = EF$$
$$\Delta Q = Q_1Q_2 = EF'$$
$$P = 0P_1$$
$$Q = 0Q_1$$

If we consider very small changes in P and Q, then $\Delta P \approx dP$ and $\Delta Q \approx dQ$. Thus, substituting in the formula for the point elasticity, we obtain

$$e_p = \frac{dQ}{dP} \cdot \frac{P}{Q} = \frac{Q_1Q_2}{P_1P_2} \cdot \frac{0P_1}{0Q_1} = \frac{EF'}{EF} \cdot \frac{0P_1}{0Q_1}$$

From the figure we can also see that the triangles FEF' and FQ_1D' are similar (because each corresponding angle is equal). Hence

$$\frac{EF'}{EF} = \frac{Q_1D'}{FQ_1} = \frac{Q_1D'}{0P_1}$$

Thus

$$e_p = \frac{Q_1D'}{0P_1} \cdot \frac{0P_1}{0Q_1} = \frac{Q_1D'}{0Q_1}$$

Furthermore the triangles DP_1F and FQ_1D' are similar, so that

$$\frac{Q_1D'}{FD'} = \frac{P_1F}{FD} = \frac{0Q_1}{FD}$$

Rearranging we obtain

$$\frac{Q_1D'}{0Q_1} = \frac{FD'}{FD}$$

Thus the price elasticity at point F is

$$e_p = \frac{Q_1D'}{0Q_1} = \frac{FD'}{FD}$$

Given this graphical measurement of point elasticity it is obvious that at the mid-point of a linear-demand curve ep — 1 (point M in figure 2.34). At any point to the right of M

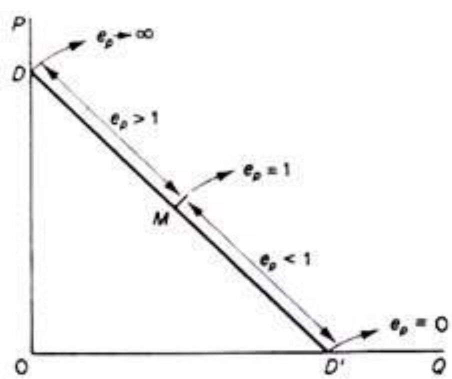


Figure 2.34

the point elasticity is less than unity (ep < 1); finally at any point to the left of M, ep > 1. At point D the ep → ∞, while at point D' the ep = 0. The price elasticity is always negative because of the inverse relationship between Q and P implied by the 'law of demand'. However, traditionally the negative sign is omitted when writing the formula of the elasticity.

The range of values of the elasticity is

$0 \leq ep \leq \infty$

If ep = 0, the demand is perfectly inelastic (figure 2.35)

If ep = 1, the demand has unitary elasticity (figure 2.36)

If ep = ∞, the demand is perfectly elastic (figure 2.37)

If 0 < e < 1, we say that the demand is inelastic.

If 1 < e < ∞, we say that the demand is elastic.

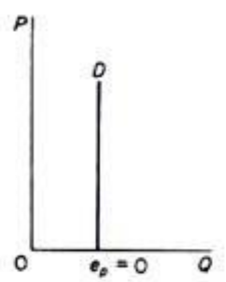


Figure 2.35

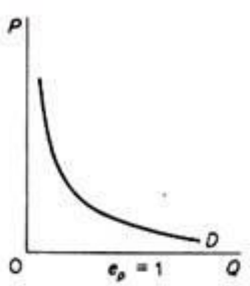


Figure 2.36

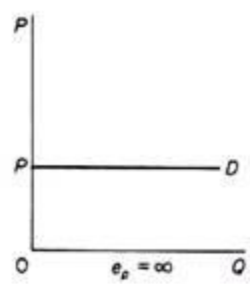


Figure 2.37

The basic determinants of the elasticity of demand of a commodity with respect to its own price are:

(1) The availability of substitutes; the demand for a commodity is more elastic if there are close substitutes for it.

(2) The nature of the need that the commodity satisfies. In general, luxury goods are price elastic, while necessities are price inelastic.

(3) The time period. Demand is more elastic in the long run.

(4) The number of uses to which a commodity can be put. The more the possible uses of a commodity the greater its price elasticity will be.

(5) The proportion of income spent on the particular commodity.

The above formula for the price elasticity is applicable only for infinitesimal changes in the price. If the price changes appreciably we use the following formula, which measures the arc elasticity of demand

$$e_p = \frac{\Delta Q}{\Delta P} \cdot \frac{\frac{P_1 + P_2}{2}}{\frac{Q_1 + Q_2}{2}} = \frac{\Delta Q}{\Delta P} \cdot \frac{(P_1 + P_2)}{(Q_1 + Q_2)}$$

They are elasticity is a measure of the average elasticity, that is, the elasticity at the mid¬point of the chord that connects the two points (A and B) on the demand curve defined by the initial and the new price levels (figure 2.38). It should be clear that the measure of the arc elasticity is an approximation of the true elasticity of the section AB of the de¬mand curve, which is used when we know only the two points A and B from the demand curve, but not the intermediate ones. Clearly the more convex to the origin the demand curve is, the poorer the linear approximation attained by the arc elasticity formula.

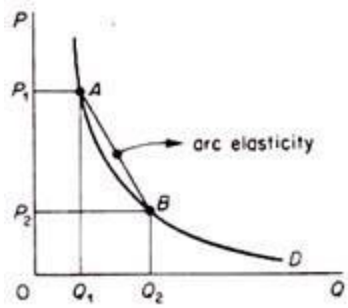


Figure 2.38

The income elasticity of demand:

The income elasticity is defined as the proportionate change in the quantity demanded resulting from a proportionate change in income. Symbolically we may write

$$e_Y = \frac{dQ}{Q} \Big/ \frac{dY}{Y} = \frac{dQ}{dY} \cdot \frac{Y}{Q} \qquad (2.6)$$

The income elasticity is positive for normal goods. Some writers have used income elasticity in order to classify goods into ‘luxuries’ and ‘necessities’. A commodity is considered to be a ‘luxury’ if its income elasticity is greater than unity. A commodity is a ‘necessity’ if its income elasticity is small (less than unity, usually).

The main determinants of income elasticity are:

1. The nature of the need that the commodity covers the percentage of income spent on food declines as income increases (this is known as Engel's Law and has some¬times been used as a measure of welfare and of the development stage of an economy).

2. The initial level of income of a country. For example, a TV set is a luxury in an underdeveloped, poor country while it is a 'necessity' in a country with high per capita income.

3. The time period, because consumption patterns adjust with a time-lag to changes in income.

The cross-elasticity of demand:

We have already talked about the price cross-elasticity with connection to the classific¬ation of commodities into substitutes and complements (see section I).

The cross-elasticity of demand is defined as the proportionate change in the quantity demanded of x resulting from a proportionate change in the price of y. Symbolically we have

$$e_{xy} = \frac{dQ_x}{Q_x} \bigg/ \frac{dP_y}{P_y} = \frac{dQ_x}{dP_y} \cdot \frac{P_y}{Q_x} \qquad (2.7)$$

The sign of the cross-elasticity is negative if x and y are complementary goods, and positive if x and y are substitutes. The higher the value of the cross-elasticity the stronger will be the degree of substitutability or complementarity of x and y. The main determinant of the cross-elasticity is the nature of the commodities relative to their uses. If two commodities can satisfy equally well the same need, the cross-elasticity is high, and vice versa. The cross-elasticity has been used for the definition of the firms which form an industry.