

ELASTICITY OF DEMAND

Elasticity:

Generally speaking, proportional/percentage change in the dependent variable due to a proportional change in the independent variable is called "elasticity."

Elasticity of Demand:

In demand function, we have:

$$Q_d = f(P, P_r, Y \dots)$$

If we are interested to know the proportional change in quantity demanded due to a proportional change in price of the commodity itself, we require the concept of price elasticity of demand. If we want to know the proportional change in quantity demanded due to proportional change in consumer's income, we need the concept of income elasticity of demand. Similarly if we are interested to know the relative or proportional or percentage change in quantity demanded due to proportional change in price of related goods, we require the concept of cross elasticity of demand. It means that elasticity of demand can be discussed under the following cases:

- i Price elasticity of demand (E_p);
- ii Income elasticity of demand (E_y); and
- iii Cross elasticity of demand (E_c)

The concept of elasticity of demand plays a pivoting role in various economic decisions.

MEASUREMENT OF ELASTICITY OF DEMAND

Lord Kelvin, a well known English scholar, says that:

"Your knowledge is of meager and unsatisfactory kind if you cannot measure what you are speaking about."

We must know some methods to measure elasticity of demand to reflect our sound knowledge about this concept. This credit goes to Marshall that he has introduced the concept of "unity" which serves as benchmark to measure elasticity of demand. Generally we observe the following three possibilities of degrees of elasticity of demand:

- (a) $E_d = 1$
- (b) $E_d > 1$
- (c) $E_d < 1$

Now we discuss all the concepts of elasticity of demand and their measurement.

PRICE ELASTICITY OF DEMAND

Proportional or percentage change in quantity demanded due to a proportional change in price of the commodity or service itself, is called price elasticity of demand. Thus:

$$\text{Price Elasticity of Demand} = \frac{\text{Proportional Change in Quantity Demanded}}{\text{Proportional Change in Price}}$$

$$\begin{aligned} \text{Symbolically, PED or } E_p &= \frac{\frac{\Delta Q_d}{Q_d}}{\frac{\Delta P}{P}} \\ &= \frac{\Delta Q_d}{Q_d} \times \frac{P}{\Delta P} \\ &= \frac{\Delta Q_d}{\Delta P} \times \frac{P}{Q_d} \end{aligned}$$

Mathematically speaking, if we divide the marginal demand function ($\frac{\Delta Q_d}{\Delta P}$) by the average demand function (Q_d/P), we find price elasticity of demand. Symbolically,

$$E_p = \frac{\Delta Q_d}{\Delta P} \div \frac{Q_d}{P} = \frac{\Delta Q_d}{\Delta P} \times \frac{P}{Q_d}$$

Here $\frac{\Delta Q_d}{\Delta P}$ = Marginal demand function or slope of demand function; and
 Q_d/P = Average demand function⁹.

INCOME ELASTICITY OF DEMAND

Proportional change in quantity demanded due to a proportional change in consumer's income, is called income elasticity of demand. We measure income elasticity of demand with help of the following formula:

$$\text{Income Elasticity of Demand (E}_y\text{)} = \frac{\text{Proportional Change in Quantity Demanded}}{\text{Proportional Change in Income}}$$

Symbolically,

$$E_y = \frac{\Delta Q_d}{Q_d} \div \frac{\Delta Y}{Y} = \frac{\Delta Q_d}{\Delta Y} \cdot \frac{Y}{Q_d}$$

Income elasticity can be calculated as under:

Income (Rs.)	Quantity Demanded (Kgs.)
5000	100
10000	150

In the given schedule,

$$\Delta Y = Y_2 - Y_1 = 5000$$

$$\Delta Q_d = Q_{d2} - Q_{d1} = 50$$

$$E_y = \frac{\Delta Q_d}{\Delta Y} \cdot \frac{Y}{Q_d} = \frac{50}{5000} \times \frac{5000}{100} = \frac{1}{2} < 1$$

The concept of income elasticity of demand is used to differentiate normal goods and inferior goods.

Normal Goods:

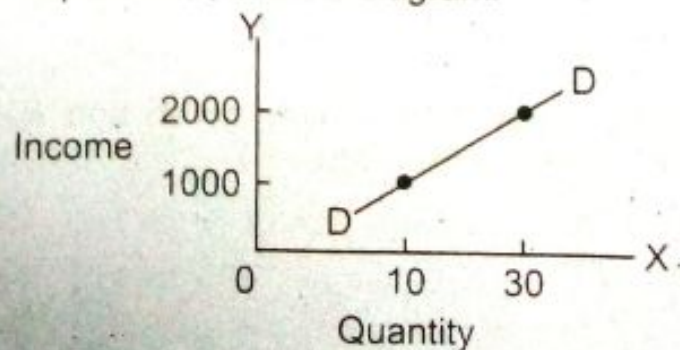
The goods, for which income elasticity of demand is positive, are called normal or superior goods.

It is explained with the help of a table and diagram.

Income	Quantity Demanded
1000	10
2000	30

$$E_y = \frac{\Delta Q_d}{\Delta Y} \cdot \frac{Y}{Q_d} = \frac{20}{1000} \times \frac{1000}{10} = 2 > 0$$

For further explanation, see the diagram:



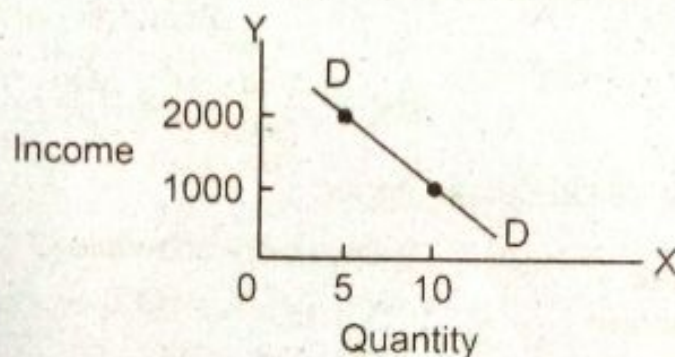
We find positively sloped demand curve which reflects normal goods.

Inferior Goods:

The goods, for which income elasticity of demand is negative, are called inferior goods. It is explained with the help of following table and diagram.

Income	Quantity Demanded
1000	10
2000	5

$$E_y = \frac{\Delta Q_d}{\Delta Y} \cdot \frac{Y}{Q_d} = \frac{-5}{1000} \times \frac{1000}{10} = -\frac{1}{2} < 0$$



We find negatively sloped demand curve which reflects inferior goods

CROSS ELASTICITY OF DEMAND

Proportional change in quantity demanded of one good due to proportional change in the price of another good, is called cross elasticity of demand. Thus:

$$\begin{aligned} E_c &= \frac{\Delta Q_d(A)}{Q_d(A)} \div \frac{\Delta P(B)}{P(B)} \\ &= \frac{\Delta Q_d(A)}{Q_d(A)} \times \frac{P(B)}{\Delta P(B)} \\ &= \frac{\Delta Q_d(A)}{\Delta P(B)} \times \frac{P(B)}{Q_d(A)} \end{aligned}$$

The concept of cross elasticity of demand appears in case of related goods, i.e. substitute goods and complementary goods. Cross elasticity is positive for substitute goods and negative for complementary goods.

Substitute Goods:

Generally speaking,

"The goods which can be used in place of each other, are called substitute goods".

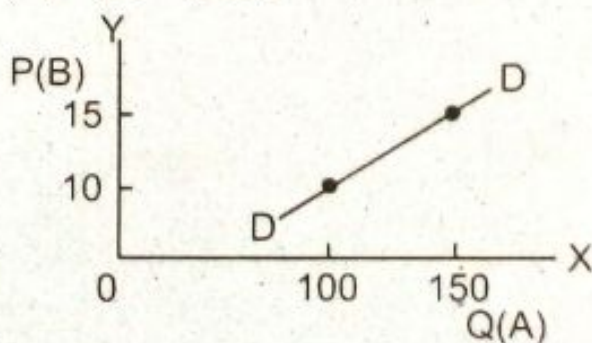
Technically speaking,

"The goods, for which cross elasticity of demand is positive, are called substitute goods".

It is explained in the following table and diagram.

P(A)	P(B)	Qd(A)	Qd(B)
10	10	100	90
10	15	150	50

$$E_c = \frac{\Delta Q_d(A)}{\Delta P(B)} \times \frac{P(B)}{Q_d(A)} = \frac{50}{05} \times \frac{10^2}{100_2} = 1 > 0$$



We find positively sloped demand curve which reflects that goods (A) and (B) are substitute goods.

Complementary Goods:

Generally speaking,

"The goods which are demanded jointly are called complementary goods".

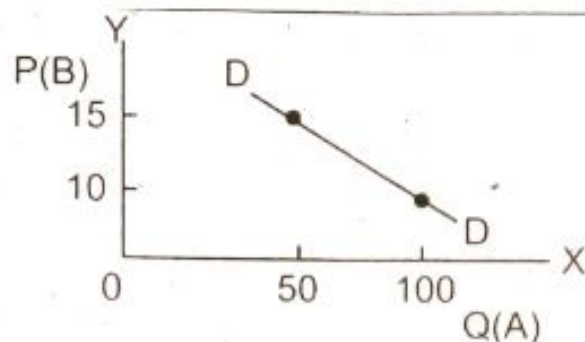
Technically speaking,

"The goods, for which cross elasticity of demand is negative, are called complementary goods".

It is explained in the following table and diagram.

P(A)	P(B)	Qd(A)	Qd(B)
10	10	100	90
10	15	50	50

$$E_c = \frac{\Delta Q_d(A)}{\Delta P(B)} \times \frac{P(B)}{Q_d(A)} = \frac{-50}{5} \times \frac{10^2}{100_{50}} = -1 < 0$$



We find negatively sloped demand curve which reflects that goods (A) and (B) are complementary goods.

Points to be remembered:

We can differentiate related goods in the light of the concept of cross elasticity of demand as under:

- i. If $E_c > 0 \Rightarrow$ related goods are substitutes i.e. tea and coffee.
- ii. If $E_c < 0 \Rightarrow$ related goods are complements i.e. car and petrol.
- iii. If $E_c > 1 \Rightarrow$ related goods are close substitutes i.e. Pepsi and Coke.
- iv. If $0 < E_c < 1 \Rightarrow$ related goods are poor substitutes i.e. cycle and car.
- v. If $E_c = 0 \Rightarrow$ The goods are unrelated or independent i.e. car and sugar.
- vi. The cross elasticity between two goods, whether substitutes or complements, is only a one-way traffic, i.e. only the quantity demanded of the related good changes while its own price does not change.