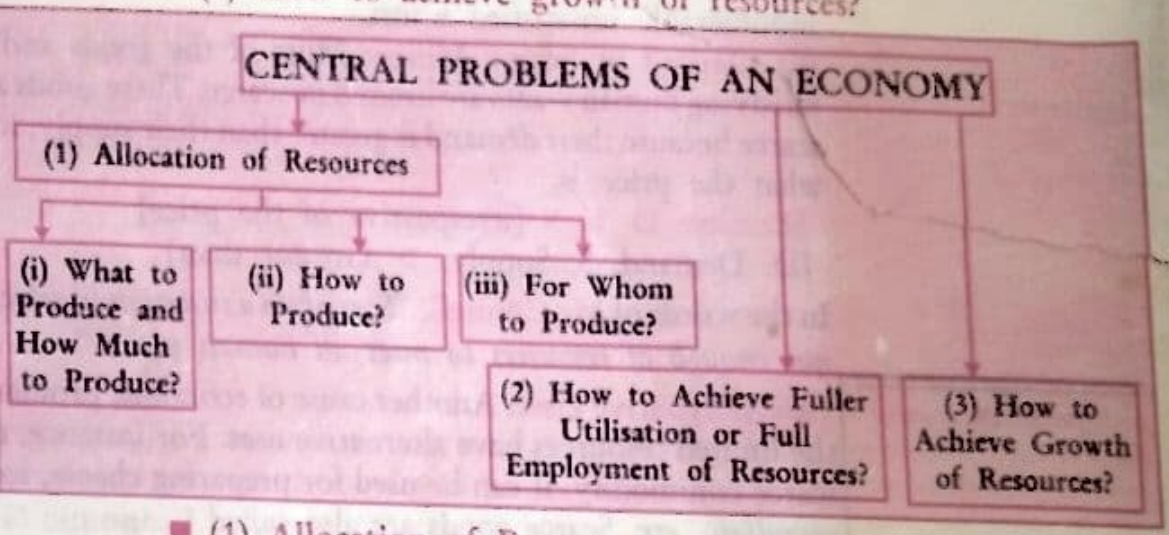
(1) The problem of allocation of resources
It has three aspects:
(i) What to produce and how much to produce?
(ii) How to produce? and
(iii) For whom to produce?
(2) How to achieve fuller utilisation of resources?
(3) How to achieve growth of resources?



(1) Allocation of Resources

It is the basic problem related to utilisation of resources for the production of different goods and services. It has three aspects, discussed as under:

(i) What to Produce and How much to Produce?

The first and foremost problem of every economy is what goods and services should be produced so as to satisfy the maximum wants of the people. This problem arises due to the fact that means are scarce in relation to their wants. Each economy has, therefore, to make a choice as to which wants it should satisfy and which ones it should forego. It involves two-fold decisions:

(a) Firstly, the economy has to decide what goods and services are to be produced. For instance, which of the *consumer goods* like sugar cloth, wheat, ghee, etc. are to be produced and which of the *capital goods* like machines, tractors, etc. are to be produced. Similarly choice has also to be made between the production of *war time goods* like rifles, guns, tanks and *peace time goods* like bread or butter.

(b) When an economy has taken a decision as to what goods or services are to be produced, then it has to decide about its quantity. How much of *consumer goods* and how much of *capital goods* are to be produced. For instance, if an economy decides to produce more of cloth and wheat within a given period and with limited means, then it will have to produce less of machines.

(ii) How to Produce?

The second main problem of an economy is: how to produce goods or how to organise production? This problem is concerned with the choice of *technique of production*. For example, production of cloth is possible either by handlooms or by modern machines. This problem is concerned with the efficient use of resources. It implies more production at less cost. Broadly, there are two techniques of production:

(1) Labour Intensive Technique: Under this technique, labour is used more than capital. (2) Capital Intensive Technique: Under this technique, capital is used more than labour. An economy must decide as to which technique is to be used in a given industry so that efficient production is obtained. *Efficient technique of production is that which uses the least amount of scarce resources to provide the same amount of output or in other words, the production would be undertaken at minimum cost.* The goods and services should be produced efficiently.

How to Produce is Essentially the Problem of Choice of Technique

In countries like India, it involves the choice between labour intensive technology and capital intensive technology. While labour intensive technology ensures greater employment and hence ensures social justice, capital intensive technology ensures greater efficiency and productivity. Hence, the conflict between the social justice, on the one hand and efficiency/productivity, on the other.

(iii) For Whom to Produce?

An economy has also to decide for whom to produce or how to distribute the production? This problem has two aspects:

(a) The first aspect relates to personal distribution. How should production (or income generated through production) be distributed among different individuals and households constituting society? It is also concerned with the problem of inequality in the distribution of income.

(b) The second relates to functional distribution. How should output (or income generated through production) be distributed among different factors of production viz. land, labour, capital and entrepreneur as their reward for the act of production? It is not also concerned with the problem of inequality.

(2) How to Achieve Fuller Utilisation or Full Employment of Resources?

The next central problem of an economy is of fuller utilisation of resources or to provide full employment. In every economy, the resources like land, labour, and capital are often not fully employed. Labour is unemployed and at the same time factories are idle. The land also remains under utilised. Since the resources are scarce, their unemployment or under utilisation is a waste. An economy has to solve the problem of unemployment and under utilisation of resources to achieve the goal of full employment. Every economy makes an earnest effort to remove involuntary unemployment. An economy is also to ensure that prices should remain stable under full employment situation.

(3) How to Achieve Growth of Resources?

Another central problem of an economy is to increase the level of production. It is also known as the problem of growth of resources. Each economy is faced with the problem of how to increase its production capacity so that total production is increased. An economy can achieve the objective of growth of resources through technological advancement.

Some Related Concepts

Closely related to the central problems of an economy, there are the two important concepts of:
(a) Production Efficiency and (b) Distribution Efficiency.
(a) Production Efficiency: It refers to the optimum utilisation of resources. Resources should be so utilised that it is not possible to increase the production of any one commodity without at the same time reducing the production of some other commodity.
(b) Distribution Efficiency: It refers to optimum distribution of national income. National income should be so distributed that it is not possible to increase the welfare (or satisfaction level) of one individual without at the same time decreasing the welfare or the satisfaction level of the other individual.
All economies of the world are affected by inefficiency. Some economies are more efficient than the others. Every economy should strive to achieve efficiency in the production and distribution of goods and services. Economy, as a whole, will stand to gain as a result of it.

- The slope of AC becomes ...
curve cuts AC curve at its ...
- There is an inverse relationship between ...
curves (AC,TC AR) cost curves are U shaped ...
inverted U shaped
- The U-shape of the long run Average Cost curve ...
economies and diseconomies of scale
- The minimum of AVC will always occur before the minimum of ...
and AVC can never be equal until total fixed cost is **zero**

Production Function

Production function can be defined as the functional relationship between physical inputs and physical output of a firm. It is the transformation of physical inputs into physical output.

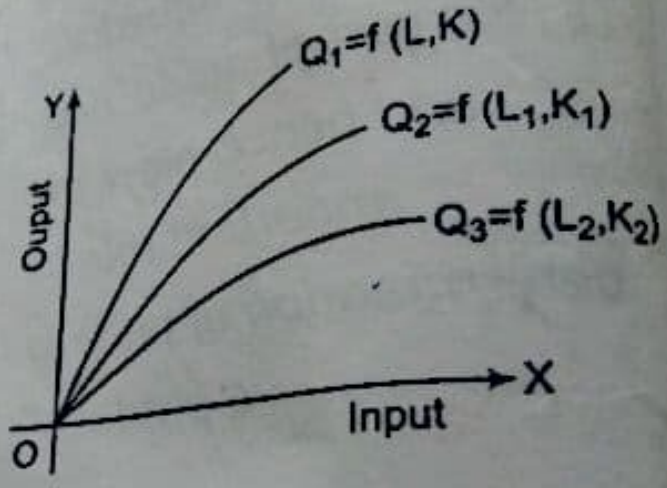
Symbollically $Q_X = f(i_1, i_2, i_3, i_4, \ldots, i_n)$

where, Q_X = Output of commodity X

i_1 = input 1

i_2 = input 2

i_n = input n.



So, production function is totally a technical relationship between tangible inputs required for production of a tangible output. A general production function in written is the equation form as

$$Q_X = f(L, K)$$

Q_x = Output of good X

L = labour units used

K = capital unit used

Where Q_1, Q_2 and Q_3 represents different production functions owing to different levels of input capital and input labour. There could be different production functions and may vary from producer to producer.

$$Q_x = f(3L, 2K) \quad \ldots(1)$$

$$Q_{x_1} = f(2L, 2K) \quad \ldots(2)$$

(iii) Scale of output tends to change with the change in the level of output.

(iv) It is studied only with reference to long period.

2. Three Basic Concepts of Production: Total Product, Average Production and Marginal Production

CONCEPTS OF PRODUCTION

Total Production or Total Product (TP)	Marginal Production or Marginal Product (MP)	Average Production or Average Product (AP)

(1) Total Production: Total production is the total amount of goods and services produced in a given period. Supposing a farmer, by employing one unit of labour on a given piece of land (measuring one hectare) produces 2 quintals of wheat. Then, 2 quintals of wheat will be the total production of a labourer. In other words, total production is the total units of the commodity produced by all the units of the variable factor along with the fixed factor of production. Thus, if 6 workers are employed on a machine and each worker is producing 6 units of the commodity, then total production would be $6 \times 6 = 36$ units.

(2) Marginal Production (MP): Marginal production is the change in total production due to application of one more or one less unit of variable factor. For example, if by the use of one unit of labour, 2 quintals of wheat are produced and by the use of two units of labour, 5 quintals of wheat are produced, then the marginal production (5 – 2) is 3 quintals of wheat. Therefore, to estimate MP, following formula is used:

$$MP = TP_n - TP_{n-1}$$

or

$$MP = \frac{\Delta TP}{\Delta L}$$

MP : Marginal Product
TP : Total Product
n : Units of input of the variable factor
ΔTP : Change in total production
ΔL : Change in the units of labour (variable factor used)

(3) Average Production (AP): Average production is per unit production of the variable factor. It is calculated by dividing the total production by the total units of variable factor used. Thus:

$$AP = \frac{TP}{L}$$

(Here AP = Average Production; TP = Total Production; L = Labour or Units of Variable Factor).

Supposing, total production of four labourers is 12 quintals of wheat. Their average production will be $\frac{12}{4}$ = 3 quintals.

ing Average
ion
ortant to note that
production is
l by dividing total
n with units of the
ctor (L), not with
he fixed factor.

Illustration 1.

Following table illustrates the concepts of TP, AP and MP.

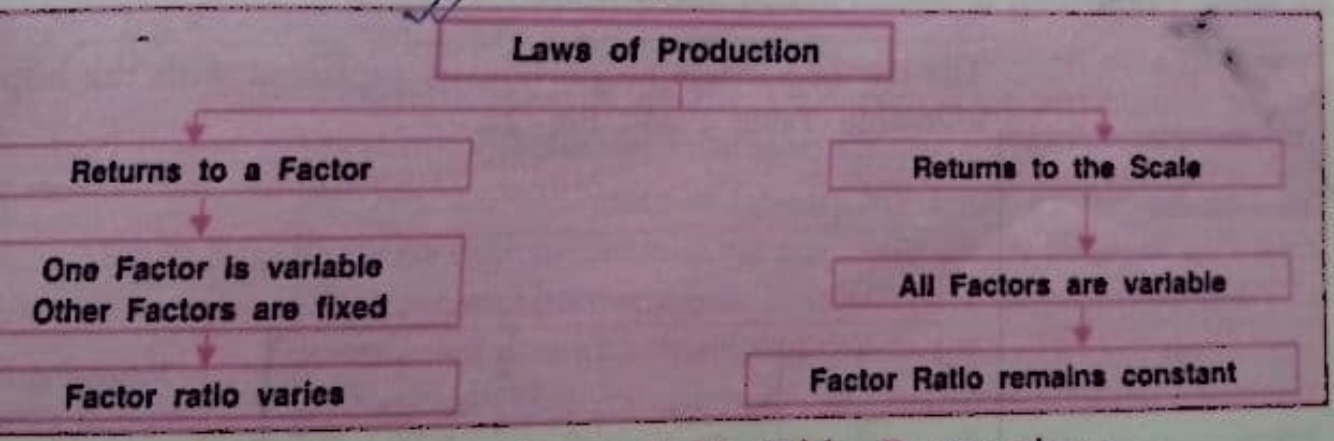
L (Labour)	TP (Total Product)	AP (Average Product)	MP (Marginal Product)
1	50	50 ÷ 1 = 50	$TP_1 - TP_0 = 50 - 0 = 50$
2	90	90 ÷ 2 = 45	$TP_2 - TP_1 = 90 - 50 = 40$
3	120	120 ÷ 3 = 40	$TP_3 - TP_2 = 120 - 90 = 30$
4	140	140 ÷ 4 = 35	$TP_4 - TP_3 = 140 - 120 = 20$

3. Changes in Production: Returns to a Factor and Returns to the Scale

In order to increase the output of a commodity, either the amount of factors of production is to be increased or the technique of production is to be improved upon. Assuming that technique of production remains constant, change in the amount of production (output) will depend exclusively on change in the amount of factors of production (inputs).

When a producer brings about a change in his production by increasing or decreasing only one factor of production and as a result, there is a change in the ratio of the factors used, then this proportional relationship between output and factor input is referred to as Returns to a Factor.

On the contrary, when a producer changes all the factors of production in the same proportion, the proportional relationship between output and factor inputs is referred to as Returns to the Scale. Together, the returns to a factor and returns to scale are known as laws of production.



. Returns to a Factor: Law of Variable Proportions

If the input of one factor is increasing while all other factors remain constant, then the proportion between the factors is changed. Supposing, there are two factors of production, i.e., land and labour. Land is a fixed factor and labour is a variable factor. Supposing, you have land measuring 2 hectares. You grow tomatoes on it with the help of one unit of labour. Accordingly, the proportion between labour and land will be 1 : 2. If the units of labour is increased to 2 then the new proportion between labour and land will be 2 : 2. In other words,

So, equation 1 and 2 represents two production function. In equation 1 firm is using 3 units of labour and 2 units of capital while in equation 2, firm is using 2 units of labour and 2 units of capital. A producer always plans for short-term production as well as long-term production. So, we can study the theory of production in short-term analysis and long-term analysis.

Short-Run Analysis

In short-run a producer experiments with several production functions to find which one is suitable for him in long-run. In theory of production short-run can be defined as the time period in which a firm can not change all the factors of production. Firm can change either one factor or few factors not all to change its output level.

So, in short-run we can classify all the factors of production in two categories

Fixed Factors Those factors which can't, be changed or replaced in a short span of time. *e.g.*, Building, machinery, plant, furnitures etc.

Variable Factors Those factors of production which can be changed as per the requirement of production or output level. *e.g.*, Labour units. So, in short-run if a firm wants to increas its output, firm can do so, only by increasing the units of variable factors.

o, in short-run analysis, What would be the optimum level production for firm, will be studied by law of variable oportions and expected return in short-run is known as turns to factor because we can change only few factors not ole scale of production.

otal Product

tal product or total output is the sum total of all output duced using all inputs. So, when we combine fixed ors and variable factors whatever is produced, aggregate hat is known as total product.

erage Product

age product is defined as the per unit product of ble factor *i.e.*, labour. So, if we divide total output of a by the number of units of variable factor used we get verage product of that variable factor.

$$AP_L = \frac{T_P}{Q_L}$$

TP – Total product

AP_L – Average product of labour

Q_L – Quantity of Labour used

Marginal Product

The marginal product of a firm can be defined as the change in total product due to employing one more or one less unit of variable input.

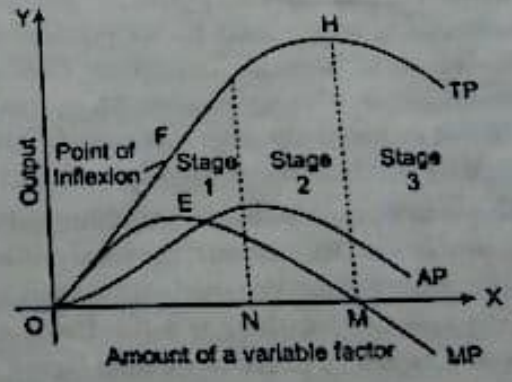
$$MP_L = TP_n - TP_{n-1}$$

Relationship *between* Total Product *and* Marginal Product

1. When MP is positive and increasing, then TP increases at increasing rate.
2. When MP is positive and decreasing, then TP increases at decreasing rate
3. When MP is zero, then TP reaches its maximum.
4. When MP becomes negative, TP starts falling.

Relationship *between* Average Product *and* Marginal Product

1. AP is the slope of straight lines connecting different points on TP curve to origin.
2. When AP increases MP also increases, but at a faster rate then AP.
3. When AP declines, MP also declines and at a faster rate then AP.
4. MP cuts AP at its maximum, so, MP = AP when AP is maximum.



Returns to Factor

In short-run analysis we have two laws which analyse the returns to factor.

These laws are

1. Law of diminishing returns and
2. Law of variable proportion.

Law of diminishing returns is narrow in concept and look after at those stages of production in which margin productivity starts declining. It doesn't study that stage which marginal product increases due to increasing retur of factor.

So, here we discuss law of variable proportion wh incorporates the law of diminishing returns.

Law of Variable Proportion

Law of variable proportion examines the changes in the total product given some changes in the employment of variable product. This law examines the production function with one variable factor and other factors as fixed.

Assumptions of Law of Variable Proportion

The law of variable proportion holds good under following assumptions:

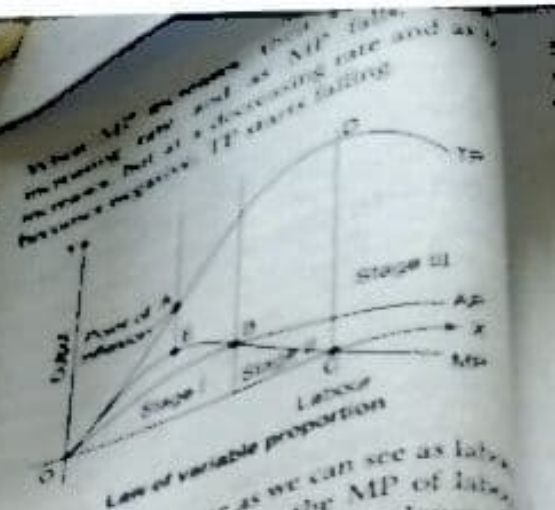
1. The state of technology is assumed to be constant. So there could be no improvement in technology in between when we are analysing the production function using this law. Because if improvement in technology is permitted then marginal and average product may rise given same level of inputs on account of better available technology.
2. Only one factor at a time is assumed to be variable and all other factors are assumed to be fixed because then only we can study that what would be the change in output due to change in variable factor.
3. Different units of variable factors are assumed to be homogeneous. Because if they are not homogeneous then we can't study the impact of change in variable factor only, then production function will show combined effect of change in variable input simultaneously with quality of input. (Hetrogeneous inputs imply different quality).
4. The Law is based upon the possibility of varying the proportions in which the various factors can be combined to produce a product. The law can't be applied to those cases where the factors must be used in fixed proportions to yeild a product. The law as formulated by **Joan Robinson** is widely used law of production in short-run analysis. The law states that as a producer employes successive units of variable factor with given amount of fixed factors, then initially marginal productivity will increase, followed by a decrease and ultimately will become negative.)

In other words as a producer combines additional units of a variable factor with given amount of fixed factors, the total product increases, but after a point of time starts falling. We shall explain this law using a schedule and diagram. We assume that there is a fixed amount of land available for production and labour is the only variable factor.

Law of Variable Proportion

Units of Land	Units of Labour	Marginal Product	Total Product	
1	1	5	5	(increasing return to factor)
1	2	10	15	
1	3	20	35	(decreasing returns to factor)
1	4	15	50	
1	5	7	57	
1	6	2	59	(negative returns)
1	7	-5	54	

, we see that as producer kept on increasing the labour inputs, initially 3rd labour input marginal product increased, then after 3rd unit it ed declining and became negative after 6th unit of labour, leading to ive returns to factor.



In the above diagrame as we can see as labo inputs increases on x-axis, the MP of labo increas, till point E and in corrspondance t TP increases at increasing rate till point After point A TP increases at decreasing ra So, point A is also called as point of inflexi because the TP curve changes its curvature, point A.

At point B, average product is maximu which means MP=AP, at point B, wh marks the end of first phase of producti which is otherwise known as phase increasing return.

In phase II MP is continuously falling and T is increasing at a decrasing rate and finall touches x-axis at point C, where MP=0 an TP is maximum at corresponding point D. From point C onwards phase III sets in whic is called the phase of negative returns.

A national producer will always operate in stage II of production. Stage III is ruled ou because 7 gives negative returns and in phase MP is rising and later begins to fall, whic means addition to TP. On first phase a producer will not stop because fixed factors o production have not been fully used upto thei potential.

Thus, a rational entrepreneur will not stop in phase I and will expand his production til marginal product become zero, which means till MP=0, hiring an extra variable input was contributing something to the TP.

So, it is clear that producer will not operate in either stage I or stage III. Therefore stage I and stage III are called as stage of economic absurdity or economic non-sense. So, stages I and III represent non-economic regions in production function.

Causes of Increasing Returns to Factor

1. In beginning the quantity of fixed factors of production is abundant relative to the quantity of the variable factor So, when more variable factor is added then efficiency of fixed factor increases.
2. The second reason is that as more units of the variable factors are employed the efficiency of the variable factor itself increases. This is because when there is sufficient quantity of the variable factor, it becomes possible to introduce specialisation or division of labour which results in higher productivity.

Causes of Diminishing Return

Pausity/ Fixity of Factors

1. Once a point is reached at which the amount of variable factor is sufficient to ensure the efficient utilisations of fixed factors, then any further increase in variable factor will lead to fall in marginal and average products, because fixed factor become inadequate in relations to variable factors.
2. **Mrs Joan Robinson** further said that we get diminishing returns because factor of productions are not perfect substitutes for each other. So, after a point need for more fixed factors can't be substituted by increasing variable factors of production.

So, diminishing returns operate because the elasticity of substitution between factors is not infinite.

Summary of Three Stages of Production

Stages	Term used	TP	MP	AP
I.	Increasing returns to factor	Increases at increasing rate	Increases initially and starts declining	Increases throughout the stage and reaches maximum
II.	Decreasing returns to factor	Increases at decreasing rate	Declines through out the stage and becomes zero	Starts declining
III.	Negative returns to factor	Starts falling	Becomes negative	Fails continuously

Long-Run Analysis

Long-run is a time period in which all inputs may be varied, but in which the basic technology of production can't be changed. The long-run corresponds to a situation that the firm faces when is planning to go into a new business (expand the scale of its operation). Like short-run, the long-run doesn't correspond to a specific length of time. In long-run a firm or producer searches for a that input combination of various inputs which will maximise firms output with least possible cost.

In long-run a producer has greater flexibility in terms of changing factor combinations and can change whole scale of production. Long-run analysis could be easily understood using the concept of isoquant and isocost line.

Isoquant Curve

In Isoquant curve is lows of all those points showing different combination of two inputs namely labour and capital which can be used to produce same level of output. Isoquants are similar to indifference curve in concept, the basic difference is that indifference curve is used to study consumer theory while Isoquants are used to study production theory. Every single point on an Isoquant represents different level of capital and labour used, but yeilds same level of output.

Properties of Isoquant Isoquant is downward sloping left to right, due to opportunity cost involved in production. To increase one unit of labour input we need to sacrifice some unit of capital input, to retain same level of output.

Isoquant is convex to the origin because of decreasing merginal rate of technical substitution. As we increase employment of one input, after a point of time we face pausity of other factor and thus, producer wants to sacrifice less and less of other input for each additional unit of first input.

Higher Isoquant represents higher level of input combinations. Any point on a higher Isoquant has atleast name of one input and no leps of other. Two different Isoquants can never intersect.

So, we can say that an Isoquant includes all the technically efficient methods for producing a given level of output. The production isoquant may assume various hopes depending upon the degree of substitutability of factors.

Law of Returns to Scale:

Long-Run Analysis of Production

In long-run expansion of output may be achieved by varying all factors. On long-run all factors are variable. So, in long-run to increase output we may change all factors of production in same proportion or by different proportions. Suppose we have an initial level of inputs and output.

$$X_0 = f(L_1K)$$

and we increase all the factors by the same proportions 'a' we will clearly obtain a new level of output X^*, higher than the original level X_0, $X^* = f(aL, aK)$

1. If X^* increases by the some proportion 'a' as the inputs, we say that there are constant returns to scale.
2. If X^* increases less then proportionally with the increase in the factors, we have decreasing returns to scale.
3. If X^* increases more than proportionally with the increase in the factors, we have increasing returns to scale.

curve is also negative indicating inverse relationship between price of the commodity and its quantity demanded.

4. Demand Function Or Determinants of Demand

Demand function shows the relationship between demand for a commodity and its various determinants. It shows how demand for a commodity is related to, say, price of the commodity or income of the consumer or other determinants.

Corresponding to two aspects of demand viz. individual demand and market demand, we have two types of demand function: (i) individual demand function, and (ii) market demand function.

4.1 Individual Demand Function

Individual demand function shows how demand for a commodity, by an individual consumer in the market, is related to its various determinants. Or, it shows the relationship between demand for a commodity by an individual consumer in the market and its various determinants. It is expressed as under:

$D_x = f\ (P, P_o, Y, T, E)$

It will be read as: Demand for Commodity x is a function (f) of price of the commodity (P); price of other goods (P_o); consumer's income (Y); taste (T) and expectations (E).

(1) Price of Commodity: Ordinarily, the amount of a commodity demanded depends on its price. Other influencing factors remaining constant or *"Other things being equal" (ceteris paribus)*, change in the price of a commodity causes a change in its demand also. Ordinarily, with the rise in the price of a commodity, its demand contracts. Conversely, with the fall in the price of a commodity, its demand extends. This inverse relationship between price of the commodity and its demand, is called Law of Demand.

(2) Price of Other Goods: Demand for a commodity is also influenced by the change in the price of other goods. Other goods are of two types: (i) Substitute Goods: These are the goods which can be substituted for each other, such as tea and coffee, or ball-pen and ink-pen. In case of such goods, increase in the price of one causes increase in demand for the other and decrease in the price of one causes decrease in the demand for the other. Increase in the price of coffee, for example, will increase the demand for tea – the consumers will shift from the consumption of coffee to the consumption of tea.

How do we distinguish between Related Goods and Unrelated Goods?
Goods are said to be related when demand for one changes in response to change in price of the other. For example, increase in price of coffee is expected to cause increase in demand for tea. So, tea and coffee are related goods. Goods are unrelated when demand for one is independent of any change in price of other. Demand for ..., for example, is not affected by change in price of ... Shoes and sugar are unrelated.

(ii) Complementary Goods: Complementary goods are those goods which complete the demand for each other, and are, therefore, demanded together. In other words, complementary goods are those goods which jointly satisfy a particular want. Pen and ink, or bread and butter may be cited as examples. In case of complementary goods, a fall in the price of one causes increase in the demand of the other and a rise in the price of one causes decrease in the demand for the other. For example, when the price of fountain pen rises, its demand will fall; as a result demand for ink will also fall. Conversely, if the price of fountain pen falls, its demand will rise; also will rise the demand for ink.

(3) Income of the Consumer: Change in the income of the consumer also influences his demand for different goods. The demand for normal goods tends to increase with increase in income, and vice-versa. On the other hand, the demand for inferior goods like coarse grain tends to decrease with increase in income, and vice-versa.

(4) Taste and Preference: The demand for goods and services depends on individual's tastes and preferences. These terms are used in broad sense. They include fashion, habit, custom, etc. Tastes and preferences of the consumers are influenced by advertisement, change in fashion, climate, new inventions, etc. Other things being equal, demand for those goods increases for which consumers develop tastes and preferences. Contrary to it, if a consumer has no taste or preference for a product, its demand will decrease.

(5) Expectations: If the consumer expects that price in future will rise, he will buy more quantity in present, at the existing price. Likewise, if he hopes that price in future will fall, he will buy less quantity in present or may even postpone his demand

will be less demand. In the latter case, will concentrate with the rich. Large sector of the ciety will be poor and because of its low income, market demand will also be low.

5. Law of Demand

Why are Goods Demanded?

We demand goods and services because these have the capacity to satisfy our wants. The capacity to satisfy human wants is called 'Utility'. Thus, we can state that goods are demanded because these possess utility. In fact, production of goods implies creation of utility and demand for goods implies using-up the utility.

The law of demand states that, other things being equal, the demand for a good extends with a decrease in price and contracts with an increase in price. In other words, there is an inverse relationship between quantity demanded of a commodity and its price, provided other factors influencing demand remain unchanged. The term 'other things being equal' implies that income of the consumer, his tastes and preferences and prices of other related goods remain constant.

The Law of Demand states that other things remaining constant, quantity demanded of a commodity increases with a fall in price and diminishes when price increases.

5.1 Explanation

Law of demand may be explained with the help of demand sche...

Table 3. Demand Schedule

P, (Rs)	Q, (Units)
10	100
9	150
8	200

The schedule shows extension of demand in response to decrease in price of the commodity. Thus, demand stretches from 100 to 150 units when price reduces from Rs 10 to Rs 9 per unit. It may be further illustrated with the help of demand curve:

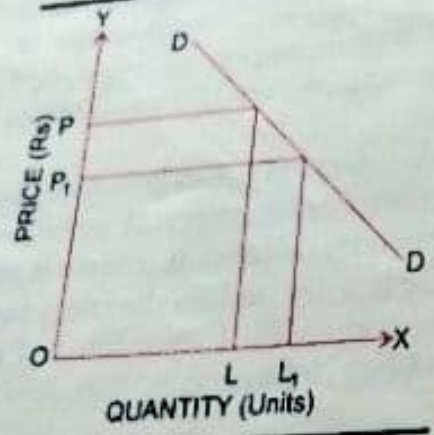


Fig. 3

In Fig. 3, demand curve DD shows that demand for commodity-X extends from OL to OL_1 when price falls from OP to OP_1. In fact, downward slope of demand curve is an expression of the law of demand.

5.2 Assumptions of the Law of Demand

Law of demand holds good when "other things remain the same." It means factors influencing demand other than price are assumed to be constant. These constitute the assumptions of the law. It applies to normal goods and not to Giffen goods. The main assumptions of the law are as follows:

(1) Tastes and preferences of the consumers remain constant.
(2) There is no change in the income of the consumer.
(3) Prices of the related goods do not change.
(4) Consumers do not expect any change in the price of the commodity in the near future.

Note a Point Here
Assumptions of the law of demand refer to all other determinants of demand than price of the commodity. These other determinants are assumed to remain constant.

5.3 Why More of a Good is Purchased When its Price Falls? Or Why Does Demand Curve Slope Downwards?

Downward slope of demand curve indicates that more is purchased in response to fall in price. Thus, there is inverse relationship between price of a commodity and its quantity demanded. This may be explained in terms of the following factors:

(1) Law of Diminishing Marginal Utility: According to this law, as a consumer, in a given time, increases the consumption of a commodity, the utility from each successive unit goes on diminishing. A consumer gets maximum satisfaction when the price of a commodity is equal to its marginal utility. As more units are bought, their marginal utility diminishes. Consequently, a consumer will buy more and more units of a commodity only when he has to pay less and less price for each successive unit. It is, therefore, clear that with fall in price, more units of a commodity will be demanded and with rise in price, less units of a commodity will be demanded.

Income Effect can be Positive or Negative
It is positive when increase in income causes increase in demand. It occurs in case of normal goods. Income effect is negative when increase in income causes decrease in demand. It occurs in case of inferior goods.

(2) Income Effect: *Income effect is the effect on the change in the quantity demanded when the real income of buyer changes as a result of the change in the price of commodity alone.* Change in the price of a commodity causes a change in the real income of the consumer. Real income is that income which is measured in terms of goods and services. With fall in price, real income increases. The increased real income is used to buy more units of the commodity. Thus, demand extends with increase in real income. Conversely, rise in price leads to fall in real income and hence, contraction of demand.

(3) Substitution Effect: *Substitution effect refers to substitution of one commodity for the other when it becomes relatively cheaper.* Thus, when the price of commodity- X falls, it becomes cheaper in relation to commodity-Y. Accordingly, X is substituted for Y. Tea and coffee are substitutes, with fall in the price of tea, it is substituted for coffee. It is called *substitution effect*. As a result of this effect, a consumer, in order to get maximum satisfaction, will buy more units of that commodity whose price has fallen in relation to

the substitute commodity. In the above example, consumers substitute tea for coffee and so demand for tea will extend. This is substitution effect. Conversely, if the price of tea rises, consumers will substitute coffee for tea and hence demand for tea will extend.

(4) Size of Consumer Group: When the price of a commodity falls, many consumers who were not buying it at its previous price begin to purchase it. Consequently, demand extends. Conversely, when the price rises, some of the consumers will withdraw from the market and thus demand will fall. In this way, change in price is followed by change in the size of consumer group which, in turn, will influence the total demand for the commodity.

(5) Different Uses: Many goods have alternative uses. Gram is used for human consumption as well as for the consumption of horses. When the price of gram is high, it will be used to meet more important demand, i.e., for human consumption alone. Thus, total demand will fall. On the other hand, with fall in its price, it will be demanded both for human as well as animal consumption. Consequently, fall in price of gram will lead to more demand for it.

5.4 Exceptions to the Law of Demand

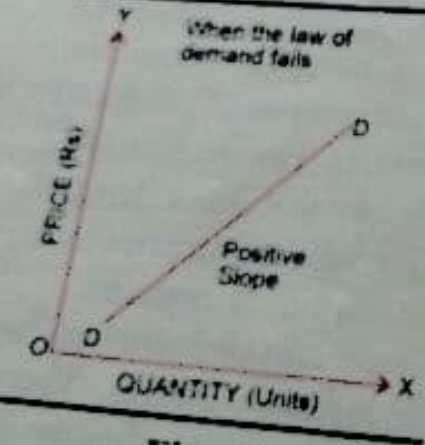


Fig. 4

Law of demand has some exceptions as well. There are some commodities whose demand increases when their price rises and decreases when their price falls. In this case, the demand curve DD slopes upwards from left to right as shown in Fig. 4. It means a positive slope. First of all, this fact was analysed by Sir Robert Giffen. So, it is also called Giffen's Paradox. The main causes of the demand curve being exceptional are as under:

(1) Articles of Distinction: This exception was first of all discussed by Veblan. According to him, articles of distinction have more demand only if their prices are sufficiently high. Diamond, jewellery, costly carpets, etc. have more demand because their prices are abnormally high. It is so because distinction is bestowed on diamond, jewellery, etc. by the society because of their being costly. Accordingly, their demand is also high. If their prices fall, they will no longer be considered as articles of distinction and so their demand will decrease.

(2) Ignorance: Sometimes, out of ignorance, the consumers feel that a good is worthless if its price is low and so purchase very little quantity of the same. But if the same good is priced high, it will attract more demand.

(3) Giffen Goods: Giffen goods may be defined as those goods whose price effect is positive and income effect is negative. In other words, (i) Giffen goods are those goods in case of which price effect is positive that is the demand falls with a fall in price and rises with an increase in price (ii) Giffen goods are those goods in case of which income effect is negative that is the demand falls with a rise in income and rises with a fall in income. In other words, Giffen goods are those inferior goods in the case of which income effect is negative and stronger than the substitution effect of a change in price. As a result, when price of such commodities falls, their demand also shrinks. All Giffen goods are inferior goods, but all inferior goods are not Giffen Goods. Inferior goods are those goods whose income effect is negative. Note the following difference: Both in case of inferior goods and Giffen goods income effect is negative. But in case of Giffen goods, negative income effect is always stronger than the substitution effect, while in case of inferior goods, it may or may not be so. Law of demand fails only if negative income effect is stronger than the substitution effect. So that while law of demand may or may not fail in case of inferior goods, it must always fail in case of Giffen goods.

Exceptions should not be confused with Assumptions. It is important not to confuse exceptions with assumptions of the law of demand. Exceptions refer only to those rare situations when law of demand fails even when assumptions of the law are kept intact. Do not convert assumptions into exceptions.

producing a particular commodity in the market.

5. Supply Function Or Factors affecting Supply of a Commodity

Supply function studies the functional relationship between supply of a commodity and its various determinants. The supply of a commodity mainly depends on the goal of the firm, price of the commodity, price of other goods, prices of factors of production used in the production of the commodity and state of technology. In other words, supply of a commodity is a function of several factors as expressed in the form of the following equation:

$S_x = f(P_x, P_o, N_F, G, P_F, T, E_X, G_P)$

(Here, S_x = Supply of commodity X; f = Functional relation; P_x = Price of commodity X; P_o = Price of other goods; N_F = Number of firms, G = Goal of the firm, P_F = Price of factors of production, T = Technology; E_X = Expected future price; G_P = Government policy)

(1) Price of the Commodity: There is a direct relationship between price of a commodity and its quantity supplied. Generally, higher the price, higher the quantity supplied, and lower the price, lower the quantity supplied.

(2) Prices of other Goods: The supply of a good depends upon the prices of other goods. An increase in the prices of other goods makes them more profitable for the firms. They will increase their supply. On the other hand, the supply of the good, the price of which has not changed, will become relatively less profitable. The supply of such a good may decrease.

(3) Number of Firms: Market supply of a commodity also depends upon number of firms in the market. Increase in the number of firms implies increase in market supply and conversely, decrease in the number of firms implies decrease in market supply of a commodity.

(4) Goal of the Firm: If the goal of the firm is to maximise profits, more quantity of the commodity will be offered at high price. On the other hand, if the goal of the firm is to maximise sales or maximise output or employment more will be supplied even at the same price.

(5) Price of Factors of Production: Supply of commodity is also affected by the price of factors used for the production of the commodity. If the factor price decreases, cost of production also reduces, accordingly supply increases. Conversely, if the factor price increases cost of production also increases and supply tends to decrease.

(6) Change in Technology: Change in technology also affects supply of the commodity. Improvement in the technique of production reduces cost of production. Consequently, profits tend to increase inducing an increase in supply.

(7) Expected Future Price: If the producer expects price of the commodity to rise in the near future, current supply of the commodity should reduce. If, on the other hand, fall in the price is expected, current supply should increase.

(8) Government Policy: 'Taxation and subsidy' policy of the government also affects market supply of the commodity. Increase in taxation tends to reduce the supply, while subsidies tend to induce greater supply of the commodity.

6. Law of Supply

Law of supply states that, other things remaining constant, there is a positive relationship between price of a commodity and its quantity supplied. Thus more is supplied at higher price and less at the lower price.

In other words, there is positive relation between the price and quantity supplied.

The law of supply states that other things remaining constant, quantity supplied of a commodity increases with increase in the price and decreases with a fall in its price.

6.1 Explanation

Law of supply is explained with the help of following supply schedule.

Be Sure
That the law of supply only explains the extension and contraction of supply in response to increase and decrease in price of the commodity. It does not explain increase or decrease in supply.

The Table 3 shows that quantity supplied increases from 100 to 200 units when price increases from Rs 10 to Rs 11 per unit.

Table 3. Supply Schedule

P_x (Rs)	S_x (Units)
10	100
11	200
12	300

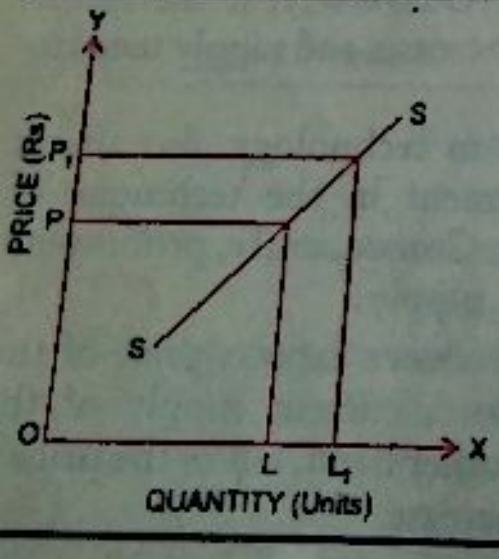


Fig. 3

The law may also be explained with the help of supply curve, as under (Fig. 3):

Supply curve (SS) slopes upward and shows increase in quantity supplied in response to increase in price of the commodity. Thus, quantity supplied increases from OL to OL_1, when price rises from OP to OP_1.

6.2 Assumptions of the Law of Supply

(1) There is no change in the prices of the factors of production.

(2) There is no change in the technique of production.
(3) There is no change in the goal of the firm.
(4) There is no change in the prices of related goods.
(5) Producers do not expect change in the price of the commodity in the near future.

6.3 Exceptions to the Law of Supply

The positive relationship between price and quantity supplied of a commodity may not always hold good, or may not firmly hold good in certain situations, as under:

(1) The law of supply does not apply strictly to agricultural products whose supply is governed by natural factors. If due to natural calamities, the production of wheat is less then its supply will not increase, however high the price may move.

(2) Supply of goods having social distinction will remain limited even if their price may rise high.

(3) Sellers may be willing to sell more units of perishable goods although their price may be falling.

Profit Maximisation Decision Under Constraint

The problem facing the firm is that of a constrained profit maximisation, which may take one of the following forms

1. *Maximise profit by maximising the output given constrained level of budget.*
2. *Maximise profit by minimising the cost of production for a given level of output.*

Case I Maximise profit π, subject to cost constraint

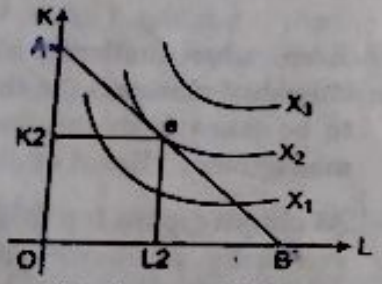
$$\text{Max } \pi = R - \bar{C} \quad \bar{C} = \text{Constrained cost}$$
$$\pi = PX - \bar{C} \quad R = \text{Revenue}$$
$$\pi = \text{profit}$$

So, for profit maximisation we need to maximise (output),

We assume

1. *A given production function* $X = f(L, K, N, Y)$.
2. *Factor prices, wage (w), rate of interest (r) for labour and capital respectively.*

The firm in equilibrium when it maximises its output given its total cost outlay and the prior of the factors, w and r.



Producer equilibrium

In this as we can see that the maximum level of output the firm can produce, given the cost constraint, is X_2 defined by the tangency of the Isocost line and the highest isoqnant. The optimal combination of factors production is K_2 and L_2, for prices w and r.

Higher levels of output (to the right side of e) are desirable, but not attainable due to the cost constraint posed by Isocost line AB.

Other points on AB below it, lie on a labour isoquant than X_2. Hence, X_2 is the maximum output possible under the above assumption (of given cost outlay, given production function and given factor prices).

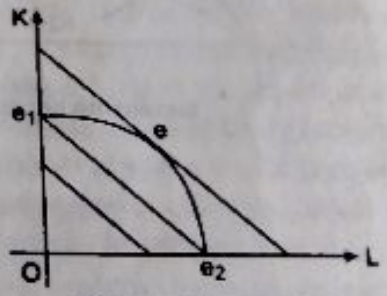
At the point of tangency 'e' the slope of the isocost line (w/r) is equal to the slope of the isoquant ($^{MP_L}/_{MP_K}$). This constitutes the 1st condition for equilibrium. The 2nd condition is that the isoquants must be convex to the origin.

In summary, the condition for equilibrium of the firm are

$$\text{Slope of isoquant} = \text{slope of isocost}$$
$$\frac{w}{r} = \frac{MP_L}{MP_K} = \frac{r\pi / rL}{r\pi / rK} = MRTS_{LK}$$

The isoquants must be convex to the origin. If the isoquant is concave the point to tangency of the isocost and the isoquent curves doesn't define an equilibrium position. In this figure output depicted by concave isoquant can be produced with lower cost of e_1 which lies on a lower isocost curve than e.

Note With a concave isoquant we have a 'corner solutions'



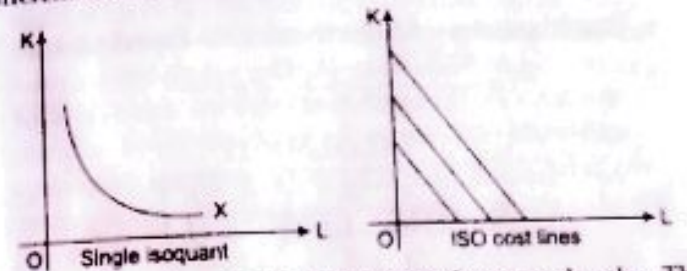
Concare isoquants

Case II *Minimisation of Cost for a Given Level of Output*

The conditions for equilibrium of the firm are formally the same as in case I.

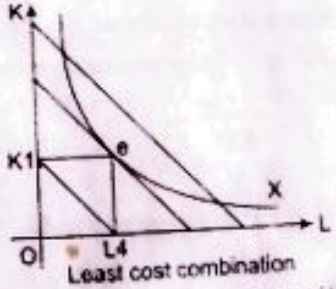
1. There must be tangency of the given isoquant and the lowest possible is cost curve.
2. Isoquant must be convex at the point of tangency. However the problem is conceptually different in the case of cost minimisation. The entrepreneur wants to produce agiven predecided output (*e.g.*, a bridge or a building or 1000 units of car) with the minimum cost possible.

In this case we have a single isoquant representing the single level of output, but we have a set of iso cost curves representing different level of cost outlay.



Isocost curves closer to the origin show a lower total outlay. The isocost lines are parallel because they are drawn on the assumption of costant prices of factor, since wand do not change, all the isocost curves have the same slope w/r.

The firm minimises its cost by employing the combination of K and L determined by the point of tengency of the $\overline{X}$ isoquant with the lowest isocost line.



In this figure on X-axis we are measuring units of labour and on y-axis units of capital.

In the diagramme points below 'e' are desirable because they show lawer cost, but are not attainable for the determined output $\overline{X}$. Points above show higher costs. Hence, point e is the lest cost point, the point denoting the least cost combination of the factors k and l for producing $\overline{X}$

Clearly we can see that conditions for equilbrium (lest possible cost) are the same as in case I, that is equality of slopes of isoquant and the isocost curve and convexity of the isoquant.

So, point e satisfies both condition and therfore is the equilibrium point for the firm.

Ridge Lines

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isoquant, then
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Elasticity of Demand

Elasticity of demand measures the degree of responsiveness in quantity demanded of that commodity in response to the change in factors affected demand of that commodity mainly its price, price of related goods and income of the consumer.

Elasticity is a mode to evaluate the change in quantity of commodity that will be affected by a change in price or income or change in price of related goods. The concept of elasticity plays a significant role in economic theory as well as feild of applied economics. It was Alfred Marshall, who introduced the concept of elasticity.

Price Elasticity of Demand

Price elasticity of demand is defined as the degree of responsiveness quantity demanded of a commodity in response to change in price of that commodity.

$$Ep = \frac{\text{\% change in the quantity demanded}}{\text{\% change in price}}$$

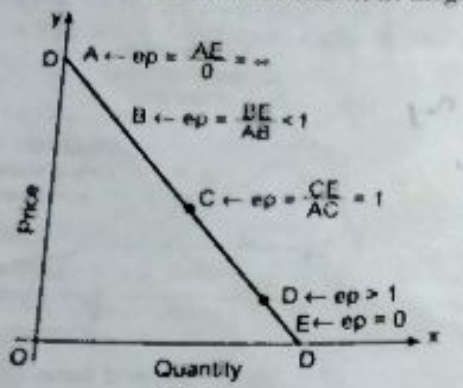
Price elasticity of demand can be measured through following methods.

Point Method or Geometrical Method

Under this method price elasticity of demand is measured at a particular point on a linear demand curve. This method was developed by Professor Marshall. Point elasticity on a straight line demand curve can be calculated as

$$ep = \frac{\text{lower segment}}{\text{upper segment}}$$

So, using following diagram we can illustrate price elasticity of demand at different points on a demand curve. So at points *A, B, C, D* and *E* we have different level of elasticities of demand as shown in diagram.



Price elasticity

Total Outlay Method

Total outlay method for measuring price elasticity of demand was originally suggested by Alfred Marshall. As per this method, price elasticity of demand is measured as change in total expenditure of consumer given changes in prices of the commodity. This method doesn't tell us about exact numerical changes in quantity demanded of a commodity rather they tell us about the degree of elasticity of demand.

Mainly elasticity under this method is measured in three category

Elastic Demand (Ep > 1)

When any change in price of a commodity brings changes in expenditure as per law of demand then elasticity is said to be more than 1 i.e.

Price	Quantity	Expenditure
4	20	80
5	15	75

So, when price rises from ₹ 4 to ₹ 5 then demand should go down and expenditure should also go down as per law of demand.

Inelastic Demand (Ep < 1)

When any change in price of a commodity brings such changes in total expenditure which is opposite to the what law of demand says, then demand is called inelastic. So, its price goes up

Price	Quantity	Expenditure
4	20	80
5	17	85

We see that quantity demanded goes down as per law of demand, but change in total expenditure is opposite instead of declining it has gone up. So ep < 1.

Unitary Elasticity (Ep = 1)

If an increase in price reduces, quantity demanded of that quantity, but there is no such change in total outlay/expenditure then demend is called Unitary elastic.

Price	Quantity	Expenditure
4	20	80
5	16	80

So, we see that there is change in qty demanded but there is no change in expenditure due to changes in price of the commodity.

Percentage Method

Using this method we can measure the value of price elasticity demand. Using both previous method we can get only an indication about elasticity not its true value. This method is most popular to calculate elasticity of demand. As per this method

$$Ep = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}}$$

$$= \frac{\frac{q_1 - q_0}{q_0} \times 100}{\frac{P_1 - P_0}{P_0} \times 100}$$

Where q_1 = New quantity demanded
q_0 = Old quantity demanded
P_1 = New price
P_0 = Old price

$$Ep = \frac{\frac{\Delta q}{q_0} \times 100}{\frac{\Delta P}{P_0} \times 100}$$

Where, $\Delta q = q_1 - q_0$ $\quad \Delta P = P_1 - P_0$

$$= \frac{\Delta q}{q_0} \times \frac{P_0}{\Delta P} \quad = \frac{\Delta q}{\Delta P} \times \frac{P}{q}$$

Interpretation

Whenever we use this method, we get result with negative sign. This is due to the fact that there is an inverse relationship between price and quantity demanded of a commodity given other things remaining constant. So lets say price falls from ₹ 5 to ₹ 3 of a commodity as a result of which qty demanded changes from 10 units to 15 units. So,

$$ep = \frac{5}{-2} \times \frac{5}{10} = \frac{1}{2}$$

$$\Delta P = P_1 - P_0 = 3 - 5 = -2$$

$$\Delta q = q_1 - q_0 = 15 - 10 = 5$$

$$= \frac{5}{-4} = \frac{-5}{4} = -1.25$$

So, what we can do is to neglect the negative sign and take absolute value which is 1.25 and then looking at the price change we can interpret price elasticity of demand. So, in this example price is falling from ₹ 5 to ₹ 3 So, we will say that in case of this commodity a one unit change in price will bring 1.25 units change in quantity demanded of that commodity.

Example At ₹ 4 per unit, 50 units of a commodity is demanded. If price falls from ₹ 4 to ₹ 2 then what will be the new quantity demanded when price elasticity of demanded is 2.

Solution

$$\Delta P = P_1 - P_0 = 2 - 4 = -2$$

$$\Delta q = q_1 - q_0 = q_1 - 50$$

So, $$ep = \frac{\Delta q}{\Delta P} \times \frac{P}{Q}$$

$$-2 = \frac{q_1 - 50}{-2} \times \frac{4}{50} = \frac{1}{25} = 1$$

$$\Rightarrow \quad -2 = -\frac{q_1 - 50}{25}$$

$$\Rightarrow \quad -2 \times 25 = -(q_1 - 50)$$

$$\Rightarrow \quad -50 = 50 - q_1$$

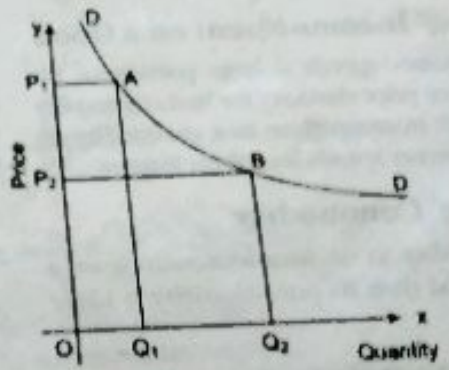
$$q_1 = 100$$

So, in the above example we have taken value of ep as -2 while solving the question otherwise we may get wrong result.

Arc Method *of* Elasticity

The geometric or point method we discussed earlier can be used to measure price elasticity only in case of linear demand curve having a constant slope. But to study real life situations economist prefer non-linear demand curve. So, using Arc method we can measure elasticity of demand over a finite range or arc of the non-linear demand curve.

Arc elasticity represents average reaction or responsiveness of quantity demanded of a commodity due to price change. In the adjocent diagram suppose we need to measure arc elasticity on demand curve DD due to change in price of commodity from P_1 to P_2 as a result of which quantity demanded increases from q_1 to q_2



Arc method of elasticity

So, to measure arc elasticity of demand from point A to point B. We take the average of two prices (new original) and average of two quantities (new original).

Thus, the formula for price elasticity of demand using the method is

$$ep = \frac{\frac{Q_1 + Q}{2}}{\frac{P_1 + P}{2}} \cdot \frac{\Delta P}{\Delta Q}$$

$$= \frac{\frac{Q_1 + Q}{2}}{\frac{P_1 + P}{2}} \cdot \frac{\Delta Q}{\Delta P}$$

$$= \frac{\frac{Q_1 + Q}{2}}{\frac{P_1 + P}{2}} \cdot \frac{\Delta Q}{\Delta P}$$

$$= \frac{\Delta Q}{\Delta P} \cdot \frac{P_1 + P}{Q_1 + Q}$$

Determinants of Price Elasticity of Demand

There are several of determinants of price elasticity of demand

They are as follows

Availability of Substitute

If a commodity has many available substitutes then in case of price rise or fall consumers of that commodity have many substitutes to choose from, therefore quantity demanded of that commodity will react quickly to any change in price. So, on the other hand a commodity which has less available substitutes then price elasticity of demand for that good will be less

Share of Income Spent on a Good

If a consumer spends a large portion of his income then price elasticity for that commodity will be high in comparison to a commodity on which consumer spends less of his income.

Nature of Commodity

If a commodity is at luxurious nature or a luxurious good then its price elasticity is likely to be high.

Whereas if a commodity is of necessity nature ake like milk, salt, sugar, rice, wheatflour then ts price elasticity will be new because even if rice changes of these goods, consumer can't ake much changes in quantity demanded of ese commodities as these are very basic essary commodities.

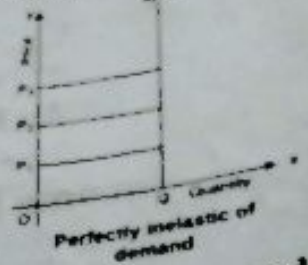
Types of Price Elasticity of Demand

There are five degree of price elasticity as we measure it in numerical value

Perfectly Inelastic Demand ($Ed = 0$)

When there is no change in quantity demanded of a commodity due to change in its price then the commodity is said to be perfectly inelastic. In this figure at all three different prices P_1, P_2 and P_3 quantity demanded doesn't change remains at Q

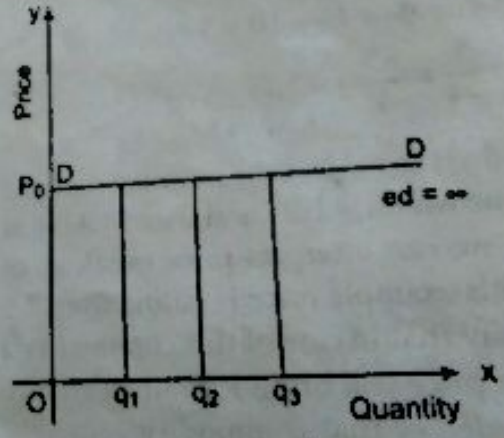
Price	Demand
5	25
10	25
15	25



Perfectly Elastic Demand ($Ed = \infty$)

When any change in price of a commodity may lead to a big change in quantity demanded of that commodity then elasticity of demand is said to be perfectly elastic or infinite

When quantity demanded of a commodity falls or rises to any extent even without any change in price of the commodity then price elasticity is said to be perfectly elastic. In this diagram, we can see that even at the same price P_0, quantity demanded may fall to q_1 or may rise to q_3 or any other extent. So, in case of perfectly elastic demand for a commodity it is very hard to predict that to which extent demand will fall or rise given a slight change in price of the commodity.

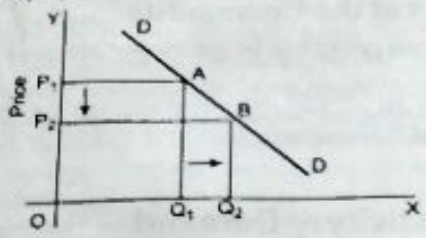


Perfect elasticity of demand

Elastic Demand ($1 < Ed < \infty$)

When quantity demanded of a commodity changes in greater proportion than the given change in price of the commodity, then demand said to be elastic demand having a value between more than 1 and less than infinity (∞).

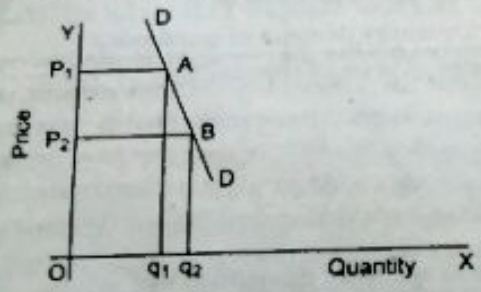
We can see in this diagram that a change in price from P_1 to P_2 leads to more than proportionate change in quantity demanded *i.e.*, Q_1 Q_2



Elastic demand

Inelastic Demand ($E_d < 1$)

When any change in price of a commodity leads to less than proportionate change in quantity demanded of a commodity, then elasticity of demand is said to be less than elastic or inelastic demand.



Inelastic demand curve

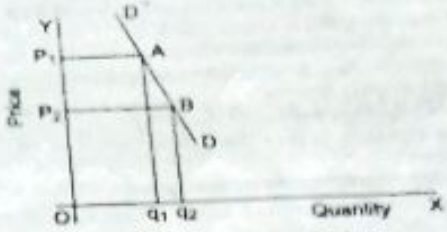
Quantity demand < proportionate change in Inelastic demand = proportionate change in price So, we can see that a change in price from P_1 to P_2 leads to a less than proportionate change in demand by q_1 q_1. So, elasticity of demand is less than elastic.

Unitary Elastic Demand ($Ed = 1$)

When a given changes in price of a commodity leads to equal proportionate change in quantity demanded of a commodity then demand is said to be unitary elastic.

Price (₹)	Quantity
5	30
10	20

We can see from the diagram that a change in price of commodity from P_1 to P_2 lead to increase in quantity demanded by same proportions q_1 to q_2



Unitary elastic demand

Income Elasticity *of* Demand

Income elasticity of demand means responsiveness of demand of a commodity with respect to change in income of the consumer. It captures the change in demand due to any change in income of the consumer.

It is defined as

$$e_Y = \frac{\text{\% change in demand}}{\text{\% in income of the consumer}}$$

Algebraically

$$e_Y = \frac{\frac{q_1 - q_0}{q_0} \times 100}{\frac{Y_1 - Y_0}{Y_0} \times 100}$$

$$e_Y = \frac{\frac{\Delta q}{q_0} \times 100}{\frac{\Delta Y}{Y_0} \times 100}$$

$$e_Y = \frac{\Delta q}{q_0} \times \frac{Y_0}{\Delta Y} = \frac{\Delta q}{\Delta Y} \times \frac{Y_0}{q_0}$$

Q_0 = Original quantity

Y_0 = Original income

q_1 = New quantity

Y_1 = New Income

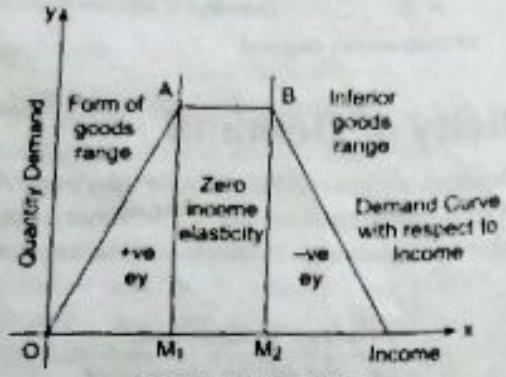
e_y = Income elasticity of demand.

In general all normal goods and services consumed by consumers have direct relationship with income so an increase in income will lead to more consumption where as a decrease in income will lead to decrease in consumption.

But analysing carefully we can understand the consumer behaviour and it will enable us to known the nature of commodity, whether it is an inferior good, normal good or a luxury good.

So,

1. If income elasticity is greater than one and less than infinity then the good is luxury good.
   If, $1 < e_y < \infty$, luxury good/useless good.
2. If income elasticity is greater than zero and less than 1, then the good is normal.
   If $0 < e_y < 1$, normal good.
3. If income elasticity is less than zero, then it is an inferior good.
   If $e_y < 0$, negative e_y means inferior good.



Relationship between income and quantity demanded

Determinants *of* Income Elasticity *of* Demand

There are various factors which determines income elasticity of demand.

They are as follows

Availability *of* Substitutes

If a consumer has more available substitutes than as income will fall he/she will switch to consumption of substitutes of that commodity and *vice versa*.

So, more then number of substitutes available more will be the income elastiuty of demand. If available substitutes are few or not available then consumer will be restricted to demand only that commodity. So low income elasticity.

Nature *of* Commodity

If a commodity is necessary good then income elasticity low because consumer can't substitute that good even if income falls because it is a necessary good. Whereas income elasticity will be high for a luxury good and negative for inferior good.

Proportion *of* Income Spent

Higher the proportion of income spent on the commodity higher will be the income elasticity and lesser proportion of income spent lesser will be the income elasticity.

Number of Uses of the Commodity

More the number of use, more will be the income elasticity, *vice versa*.

1. Time factor
2. Postponement of consumption
3. Real income

Cross Price Elasticity *of* Demand

Cross Price elasticity of demand measures the degree responsiveness in quantity demanded of one commodity with respect to any change in price of its related goods (*i.e.*, substitute goods and complimentary goods.)

So, we measure change in quantity demanded of a good let us good x due to any given change in price of good y where good could be its substitute or complimentary good.

The cross price elasticity can be defined as

$$e_{xy} = \frac{\% \text{ Change in quantity demand of commodity}}{\% \text{ Change in price of commodity y}}$$

$$e_{xy} = \frac{\frac{\Delta q_x}{q_x} \times 100}{\frac{\Delta P_y}{P_y} \times 100} = \frac{\Delta q_x}{q_x} \times \frac{P_y}{\Delta P_y}$$

Where, Δ_{qx} = change in quantity demanded of commodity x

q_x = Original *qty* demanded of commodity x

ΔP_y = Change in price of commodity y

P_y = Original price of commodity

e_{xy} – Cross price elasticity of good x due with respect of good

Cross price elasticity has arrange from $-\infty$ to $+\infty$

Substitute goods	$0 < e_{xy} < \infty$
Complimentary goods	$-\infty < e_{xy} < 0$

Elastic and Inelastic Demand

Demand for a commodity is often categorised as 'elastic' or 'inelastic'. It is a standard practice to treat demand for a commodity as 'elastic' if $E_d > 1$ (elasticity of demand is greater than unity). Implying that percentage change in quantity demanded is greater than percentage change in price of the commodity. Demand is treated as inelastic if $E_d < 1$ (elasticity of demand is less than unity). Implying that percentage change in quantity demanded is less than the percentage change in price of the commodity.

Miscellaneous Illustrations

Illustration 1.

(a) Price of the commodity X falls from Rs 5 per kg to Rs 4 per kg and the demand of consumer A for it rises from 4 kg to 6 kg. Express your opinion regarding the nature of elasticity of commodity X.

(b) If there is no change in the quantity demanded of commodity X, what will be the nature of the price elasticity?

Solution:

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

Here $P = 5$ and $P_1 = 4$

$\therefore \Delta P = 4 - 5 = -1$

$Q = 4; Q_1 = 6$

$\therefore \Delta Q = 6 - 4 = 2$

$$E_d = (-)\frac{5}{4} \times \frac{2}{-1} = \frac{10}{4} = 2 \cdot 5 \text{ or (greater than unity)}$$

Ans. (a) Elasticity of demand is greater than unity. (b) In this case nature of price elasticity of demand will be perfectly inelastic.

Illustration 2.

A consumer purchased 10 units of a commodity when its price was Rs 5 per unit. He purchased 12 units of the commodity when its price falls to Rs 4 per unit. What is the price elasticity of demand for the commodity at that price?

■ **Solution:**

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

$P = Rs\ 5;\ P_1 = 4;\ \Delta P = 4 - 5 = -1$

$Q = 10;\ Q_1 = 12;\ \Delta Q = 12 - 10 = 2$

$$E_d = (-)\frac{5}{10} \times \frac{2}{-1} = 1\ (Unity)$$

Ans. $E_d = 1$, unitary elasticity of demand.

■ **Illustration 3.**

A consumer buys 50 units of a good at Rs 4 per unit. When its price falls by 25 per cent its demand rises to 100 units. Find out the price elasticity of demand.

■ **Solution:**

Initial price (P) = Rs 4

Fall in price by 25% = $4 \times \frac{25}{100}$ = Re 1. New price (P_1) = Rs 4 − 1 = Rs 3.

Change in price (ΔP) = $P_1 - P = 3 - 4 = -1$

Initial Quantity = 50 units; New Quantity = 100 units;

Change in Quantity (ΔQ) = 100 − 50 = 50 units.

$$\text{Elasticity of demand} = (-)\frac{P}{Q} \times \frac{\Delta Q}{\Delta P} = (-)\frac{4}{50} \times \frac{50}{-1} = \frac{4}{1} = 4$$

Ans. Elasticity of demand = 4 (greater than unity).

■ **Illustration 4.**

As a result of 10 per cent fall in price of a good, its demand rises from 100 units to 120 units. Find out the price elasticity of demand.

■ **Solution:**

Percentage change in price = 10%

$$\text{Percentage change in demand} = \left(\frac{120 - 100}{100} \times 100\right)$$

$$= \frac{20}{100} \times 100 = 20\%$$

$$\text{ty of demand} = (-)\frac{\text{Percentage increase in demand}}{\text{Percentage decrease in price}} = (-)\frac{20\%}{-10\%} = 2$$

Ans. Elasticity of Demand = 2 (greater than unity).

Use of '–' sign as a prefix to the formula of Elasticity of Demand

A careful reader should observe that we have prefixed '–' sign to the formula of elasticity of demand. *We have written that:*

$$E_d = -\frac{\Delta q}{\Delta p} \cdot \frac{p}{q}$$

↑ '–' sign is prefixed to the formula

Why should it be done? Following is the reason:

Owing to inverse relationship between price and quantity demanded, elasticity of demand ought to be negative, like –1, –2, –3, etc. Thus, if price of the commodity reduces from Rs. 10 to Rs. 5 per unit and quantity demanded increases from 50 to 100 units of the commodity, elasticity of demand (in terms of the ratio between percentage change in quantity demanded and percentage change in price) would be

$$-2 \left[\frac{\Delta q}{\Delta p} \cdot \frac{p}{q} = \frac{50}{-5} \cdot \frac{10}{50} = -2 \right]$$

However, it is conventional to ignore the '–' sign and treat elasticity of demand just as 2 rather than –2. The rationale behind this convention is that mathematically – 3 is lesser than – 2 while in the context of elasticity of demand –3 shows higher elasticity of demand compared to –2. An alternative to ignoring the '–' sign is to prefix '–' sign to the formula of estimation of elasticity of demand. Accordingly, coefficient of E_d would always be found as positive.

Continuing with the same illustration (where $\Delta q = 50, \Delta p = -5, p = 10, q = 50$) elasticity of demand (when '–' sign is prefixed to the formula) would be worked out as under:

$$E_d = -\frac{\Delta q}{\Delta p} \cdot \frac{p}{q} = -\frac{50}{-5} \cdot \frac{10}{50} = 2$$

Thus, prefixing '–' sign to the formula avoids the hassle of ignoring the '–' sign while making comparisons of the coefficients of elasticity of demand.