6 INDIFFERENCE CURVE TECHNIQUE

In view of the shortcomings of the utility analysis, modern economists have adopted a new technique—called the indifference curve technique—for the analysis of demand. In the following three chapters, we shall first consider this new tool of indifference curves, then analyse consumer's behaviour with its help, and finally study the various applications of the modern technique.

Scale of Preferences

All desires of a consumer are not of equal urgency or importance. Since his resources are limited and he cannot fulfil all his desires, he must pick and choose more important and more urgent desires for satisfaction. Thus, some desires take precedence of others. This is how a consumer ranks his desires and builds up a scale of preferences. Scarcity forces him to choose. Ability to arrange preferences in order of importance or urgency is inherent in human nature.

A prudent consumer exercises a lot of discrimination in his purchases. We find him substituting one commodity, partly or wholly, for another. He purchases a certain quantity of a commodity and no more. All the time, he is striving to reach an equilibrium position, *i.e.*, a position in which he derives maximum satisfaction from the use of money at his disposal.

But what is the criterion on which a consumer bases his choice? It is the relative evaluation of the utilities of the commodities included in his purchase plan. Since utility is subjective, the evaluation is obviously by himself. This means that a consumer has in his mind a definite scale of preferences which guides him in his purchases. For example, some students would like to spend their monthly allowance on the purchase of useful books, while others will squander it in the canteen. It is the consumer's scale of preferences which would determine his purchase plan. This scale of preferences is shaped by consumer's temperament and tastes. Thus, the priorities in a consumer's purchase plan are determined by his scale of preferences.

As we have mentioned already, a prudent consumer seeks to maximise his satisfaction from the purchases he makes, *i.e.*, reach an equilibrium position. But in order to be able to do so, a consumer must build up a scale of preferences on which all objects of desire or pursuit find their place, and which registers the terms on which they would be accepted as equivalent, or preferred one to the other.

The consumer's scale of preferences is independent of the prices ruling in the market. He builds up his scale of preferences from the commodities he consumes. On the basis of this scale of preferences, he knows that one combination of the goods yields him the same satisfaction as another.

In the discussion of consumer preference, we have to make certain assumptions to enable us to reach valid conclusions. The main assumptions are:

(i) **Completeness.** We assume that the consumer's scale of preferences is so complete that he is able to choose any one of the two combinations of commodities presented to him or is indifferent between them.

(ii) **Non-satiation.** A consumer prefers more to less.

(iii) **Consistency or Transitivity.** If a consumer regards Q better than R and R better than S, obviously he will prefer Q to S, if this choice is open. Consumers' choices have to be consistent.

(iv) **Continuity or Substitutability.** Unless one combination can be substituted for another, the consumers' preferences will not be possible.

(v) **Convexity.** The indifference curve is convex to the origin and shows the diminishing rate of marginal rate of substitution to be explained presently.

It is not to be supposed, however, that actually a

consumer has a complete or consistent scale of preferences in his mind or that he is fully conscious of it all the time. Certain commodities usually figure in the weekly or monthly purchases and are thus purchased by habit. A conscious choice is made in the case of new purchases. But consumers are rational beings. We can construct a theory of demand because scales of preferences are in some degree rational and stable through time, and purchases are usually made according to them. Actually, there is sufficient degree of stability in the spending pattern of consumers so that a realistic theory of demand can be propounded.

Actual purchases made by a consumer may not, however, be in conformity with his scale of preferences. They rather depend on the amount of money in his pocket and the commodities available at the time as well as on their relative prices. Consumer's purchasing power does not depend merely on the amount of money he has. The real purchasing power depends also on the current price level. If he finds that the market has gone down, he will be able to purchase more, and vice versa. Given the scale of preferences, a consumer will arrange his purchases in the light of realised purchasing power of his resources.

INDIFFERENCE CURVES

On the basis of a consumer's scale of preferences, we can draw indifference curves. An indifference curve represents satisfaction of a consumer from two commodities. It is drawn on the assumption that for all possible points (or combinations of the two commodities) on an indifference curve, the total satisfaction (or utility) remains the same. Hence, the consumer is indifferent as to the combinations lying on an indifference curve. It is an iso-utility curve.

Let us now start by considering a consumer who wants to buy apples and mangoes. He does not make purchases of the amounts of these two commodities arbitrarily. He knows it well that one combination of apples and mangoes gives him as much satisfaction (total utility) as another combination of less apples and more mangoes or another combination of more apples and less mangoes.

The consumer cannot tell how much satisfaction he secures from an apple or from a mango but he has got a scale of preferences between these two commodities so as to be able to compare the satisfaction derived from one basketful of apples and mangoes and another basketful of these two commodities. In other words, he knows what substitution of apples for mangoes or mangoes for apples will leave him with the same or equal satisfaction. Thus, our consumer has in his mind an indifference schedule. This schedule has several combinations of apples and mangoes from which he derives the same or equal total satisfaction. Or we can say that various combinations are equally preferred or desired by him.

We further clarify this point by giving an indifference schedule of the various combinations of apples and mangoes.

Indifference Schedule

Combination	*Apples*	*Mangoes*
1	15	1
2	11	2
3	8	3
4	6	4
5	5	5

In the above schedule, the consumer obtains as much total satisfaction (total utility) from 11 apples and 2 mangoes as from 8 apples and 3 mangoes and as well as from other combinations. In other words, our consumer feels indifferent whether he gets the 1st combination (15A+1M), the 2nd combination (11A+2M), the 3rd combination (8A+3M), the 4th combination (6A+4M) or the 5th combination (5A+5M). (Here A stands for apples and M stands for mangoes). The total satisfaction is the same in all these combinations. We shall now translate this schedule into a diagram and thus get an indifference curve IC in Fig. 6.1.

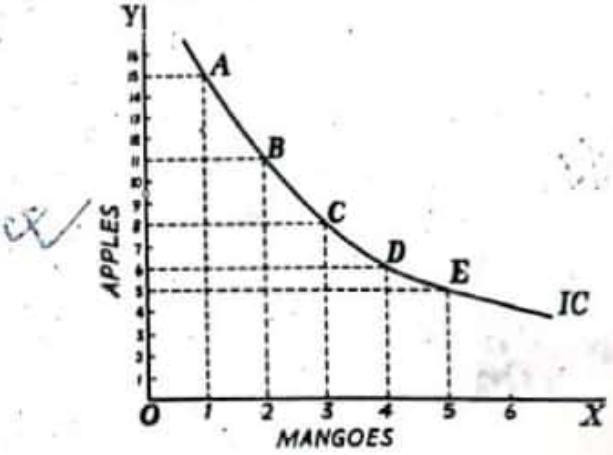

Fig. 6.1

In Fig. 6.1. mangoes are measured along the X-axis; their number increases from left to right. Apples are measured along Y-axis; and their number increases upwards.

If the consumer were at point A on the curve IC with 15 apples and 1 mango, he would be just as satisfied as at point B with 11 apples and 2 mangoes or at point C with 8 apples and 3 mangoes or at point D with 6 apples and 4 mangoes, and so on. These combinations give him the same satisfaction. If we join the points A, B, C, D and E, we get a continuous curve IC, each point on it showing equal satisfaction or the indifference of the consumer towards the various combinations. This is an **indifference curve.** Each point on it shows a combina-

tion of apples and mangoes which yields the same total satisfaction to our consumer.

Indifference Map

We can draw similar indifference curves showing combinations of apples and mangoes which represent greater and lesser satisfaction than that shown on indifference curve IC (see Fig. 6.2). In this figure, all points on IC_3 and IC_4 are preferred to all the points on IC_1 or IC_2 or IC_3. All combinations of apples and mangoes on IC_2 are equally preferred and are more preferred to all the combinations at various points on the IC_1. In other words, indifference curve IC_1 represents a lower level of satisfaction as compared with indifference curves IC_2, IC_3, IC_4, IC_5. It will thus be seen that indifference curves remind us of the weather maps showing the lines of equal pressure of the contour lines on a topographical map. A set of indifference curves is called **an indifference map.**

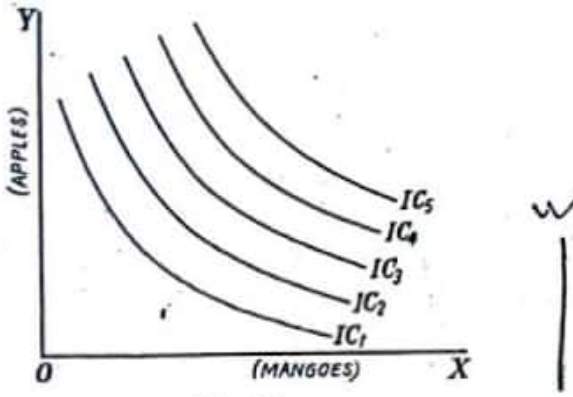

Fig. 6.2

It should be borne in mind that we cannot say how much more utility the higher indifference curve represents. That is, the aggregate utilities are rankable but not measurable; the jumps or increases in utility cannot be ranked. We cannot say how much greater utility does IC_2 represent than IC_1 and IC_3, than IC_2, and so on. If we could, we shall be making cardinal measurement of utility, a Marshallian assumption that we have rejected already.

MARGINAL RATE OF SUBSTITUTION

From the schedule given above, we can see that when we move from one combination of the two commodities to another, we are in fact substituting some units of one commodity for some units of another. We can also work out the rate at which this substitution takes place.

The Marginal Rate of Substitution shows how much of one commodity is substituted for how much of another or at what rate a consumer is willing to substitute one commodity for another in his consumption pattern. The concept of marginal rate of substitution is a tool of indifference curve technique and is parallel to the concept of marginal utility in the Marshallian analysis of demand.

Taking our previous example of substitution between apples and mangoes, we notice that when our consumer has 15 apples and one mango, he will be prepared to forgo 4 apples for 1 mango and yet remain at the same level of satisfaction. Or, in other words, we can say, in case he has the second combination, then he will be prepared to accept 4 apples for the loss of one mango. Here the marginal rate of substitution of mangoes for apples is 4:1.

Combination	*Apples*	*Mangoes*	*MRS of Mangoes for Apples*
1	15	1	—
2	11	2	4:1
3	8	3	3:1
4	6	4	2:1
5	5	5	1:1

The marginal rate of substitution may thus be defined as the amount of apples that is sacrificed for obtaining one mango or it may also be defined as the amount of apples that may be given to the consumer for the loss of one mango so that he may remain at the same level of satisfaction.

In Hicks' words, "we may **define marginal rate of substitution of X for Y as the quantity of Y which would just compensate the consumer for the loss of the marginal unit of X."**

Let us suppose that the consumer decides upon the fourth combination, which, in terms of our diagram (No. 6.1), means that he chooses the combination represented by a point on IC. Now the marginal unit of mangoes is the third mango, to acquire which he has had to forego two apples; or in other words, he will agree to get the fourth mango if he is compensated by two apples. At this point, the marginal rate of substitution of mango for apples is 2:1.

It is a common observation that, as we come to have more and more of one good, we shall be prepared to forego less and less of the other since our desire for the former becomes less and less intense with more and more of it. In technical language, it will be said that the marginal rate of substitution of good X for good Y will fall as we have more of X and less of Y. This is clearly brought out in the preceding table, where in combination 2 the marginal rate of substitution of mango for apples is 4:1, and it falls to 3:1 in combination 3 and further 2:1 in combination 4.

Thus, the principle is that as X is substituted for Y so as to keep the consumer at the same level of satisfaction, the marginal rate of substitution of X for Y diminishes.

This principle in indifference curve technique is

termed the diminishing marginal rate of substitution, and is parallel to the law of diminishing marginal utility in Marshallian utility analysis.

The marginal rate of substitution is indicated by the slope of an indifference curve at a point. That is, it represents a movement along an indifference curve, but not a movement among the curves.

PRINCIPLE OF DIMINISHING MARGINAL RATE OF SUBSTITUTION

We have explained above the term marginal rate of substitution. An important principle of consumer behaviour emerges, *viz.*, as more and more of a good, say X, is substituted for another good, say Y, the marginal rate of substitution diminishes. This is due to the fact that as the consumer has more and more of good X, he goes on losing interest therein and he is prepared to give less and less of the other good Y for it.

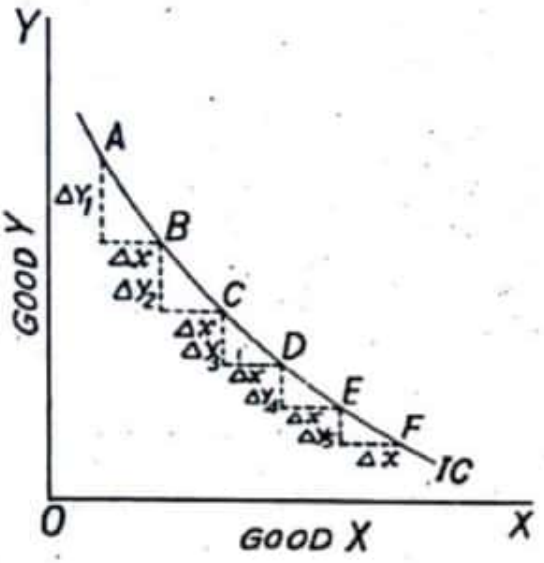

Fig. 6.3

Look at the figure 6.3. When the consumer slides down the curve IC from A to B, he foregoes ΔY_1 of good Y to obtain X of good X. Hence in this case the marginal rate of substitution of X for Y (MRS xy) is equal to $\frac{\Delta y_1}{\Delta x}$ We notice that as the consumer slides down further and further on the indifference curve, ΔY becomes shorter and shorter, while ΔX remains the same. This means that as the consumer has more and more of X *i.e.*, when he moves from A to B, from B to C, from C to D and so on, he is prepared to forego less and less of Y for a unit of X. From the above figure, it can be seen that ΔY_2 is less than ΔY_1 and ΔY_3 is less than ΔY_2 and ΔY_4 is less than ΔY_3, and so on. It follows, therefore, that as the stock of X with the consumer increases and his stock of Y decreases, he is willing to give less and less of Y for a given increment of X. In other words, the marginal rate of substitution of X for Y falls as the consumer has more of X and less of Y.

That the marginal rate of substitution falls is also clearly brought out in the preceding table. As already mentioned, the marginal rate of substitution of mangoes for apples is 4.1 to start with and it falls to 3:1 in combination 3, 2:1 in combination 4 and 1:1 in combination 5.

Let us try to understand the reasons for the diminishing, marginal rate of substitution. Why is the consumer prepared to forego less and less of the other commodity Y for a given increment of a commodity X? The reasons are:

(i) Since a particular want is satiable, the edge of a want for a good is blunted as the consumer has more and more of it. It is the diminishing intensity for a want that is responsible for the diminishing marginal rate of substitution (*i.e.*, offering less for a good whose stock is increasing). That is why, as the stock of X with the consumer increases, he will offer less and less of the other good Y for a unit increase in X.

(ii) Another reason for a declining marginal rate of substitution lies in the fact that goods are imperfect substitutes for one another. If X and Y, for instance, were perfect substitutes for each other, they would be regarded as one commodity. In that case increase in the stock of one commodity and decrease in that of the other would make no difference. Hence the marginal rate of substitution will not diminish, it will remain the same, for one commodity is good as another.

(iii) Also, the marginal rate of substitution of one good for another will not diminish if the want-satisfying power of the other good has increased at the same time. For instance, if with increase in the stock of the good X, the want-satisfying power of the good Y has increased, then more and more of Y will have to be offered for a unit increase in X to keep the consumer's satisfaction at the same level.

PROPERTIES OF INDIFFERENCE CURVES

The diagram of an indifference curve given already is a typical one. From the following paragraphs, it would become clear why indifference curves normally have this shape. Besides, we shall notice the properties of typical indifference curves. There are three characteristics of indifference curves:

(i) Downward sloping to the right,
(ii) Non-intersecting, and
(iii) Convex to the origin.

Downward Sloping or Negatively Sloped. To begin with, **an indifference curve slopes downwards from left to the right.** It is because when the consumer decides to have more units of one of the two goods, he will have to reduce the number of the units of the other good, if he is to remain on the same indifference curve, *i.e.*, if level of his satisfac-

is to remain the same. Looking at the diagram Fig. 6.1, we find that when the consumer moves from point A to point B, he has more mangoes than before, but the number of apples with him falls; similarly from B to C and from C to D. This is the meaning or implication of an **indifference curve** sloping downward from left to right.

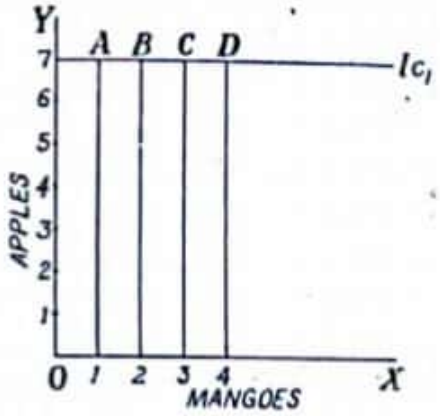

Fig. 6.4

To be surer of this property, let us for a moment suppose that instead of sloping downward to the right, an indifference curve is a horizontal straight line, as is indicated in the figure given above (Fig. 6.4). This shows that when the consumer is at point A, he has 7 apples and 1 mango and he is at a certain level of satisfaction, and that when he moves from the position A to the position B on the same indifference curve, he remains at the same level of satisfaction despite the fact that he has more of mangoes (*i.e.*, 2) and the same number of apples. This is obviously absurd. After all, the addition of a mango without losing any of the apples he had in the previous position, must take him on to a higher indifference curve rather than keeping him on the old indifference curve.

Similarly, if the indifference curve was a vertical straight line (see Figure 6.5 below), it would mean that the consumer remains at the same level of satisfaction even though the quantity of one good increases without the decrease in the quantity of the other. Combinations A and B, for example, lie on the same indifference curve and are, therefore, assumed to yield the same level of satisfaction. But this is quite absurd. How can the combination B, which contains the same number of mangoes but a greater number of apples as compared with A, give the same satisfaction as A? Hence, an indifference curve cannot be a vertical straight line.

Still another possibility, but still more absurd, is that an indifference curve may slope upwards to the right, as has been shown in diagram No. 6.6. At points A, B, and C . . . . , our hypothetical consumer is at the same level of satisfaction, because he is on the same indifference curve, but what is indeed startling is that he derives the same level of satisfaction when he is at A with 1 mango and 6 apples, and also at B when he has 2 mangoes and 10 apples and also at C with 3 mangoes and 13 apples, *i.e.*, when the units of both goods are increasing. This is absurd. Clearly an indifference curve cannot slope upwards to the right.

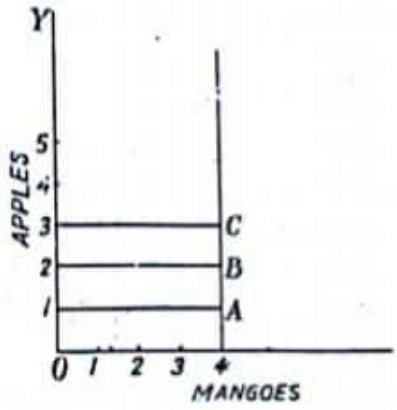

Fig. 6.5

Thus, we see that an indifference curve cannot be a horizontal straight line as in Fig. 6.4, nor can it be vertical straight line as in Fig. 6.5, nor sloping upwards as in Fig 6.6. Hence, by process of

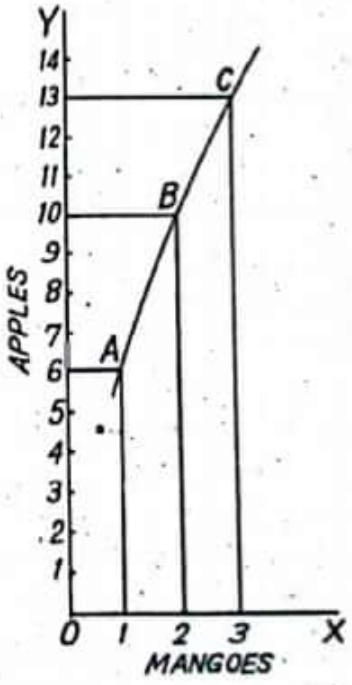

Fig. 6.6

elimination, we come to the conclusion that an indifference curve must slope downwards to the right. This is its first property.

Non-intersecting

The second property or characteristic of indifference curves is that **no two such curves will ever cut each other.** What absurdity follows when two indifference curves are shown as intersecting each

other may be explained with the help of diagram No. 6.7. At point B, our hypothetical consumer is on

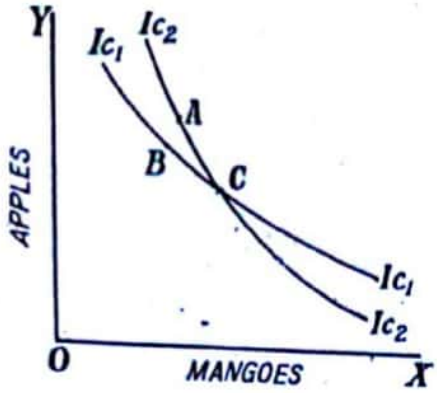

Fig. 6.7

the indifference curve IC_1, while at point A, he is on the higher indifference curve IC_2, *i.e.*, the combination represented by point A gives him a level of satisfaction higher than that he enjoys when he is at point B. But since the two indifference curves have been shown to be intersecting at point C, it means that point C lies on both indifference curves, which in turn means that C is at once equal to A and B which, as seen already, represent different levels of satisfaction. How can one level be equal to two different levels? It follows, therefore, that the indifference curves cannot cut each other.

Convexity

The third property of indifference curves is that **they are normally convex to the origin.** The implication of this convexity rule is that as we have more and more of good X and less and less of Y, the marginal rate of substitution of X for Y goes on falling. This is exactly what was brought out in the table given to explain the concept of the marginal rate of substitution. (See page 53). There we said that in combination 2 our hypothetical consumer had 11 apples and 2 mangoes. Now when he acquired one mango more, he had to forego 3 apples, *i.e.*, the marginal rate of substitution of mango for apples at that stage was 3:1. For a further addition of one mango, the consumer was now prepared to forego a smaller number of apples—two this time.

Let us prove convexity by exposing the absurdity if the curve is either concave or a straight line. Three figures of an indifference curve are given below. In Fig. 6.8(a) the indifference curve is convex to the origin: in Fig. (b), it is a straight line, and in Fig. (c) it is concave to the origin. From Fig. (a) it is evident that the marginal rate of substitution (MRS) of mangoes for apples falls (**cd** is smaller than **ab**). In Fig. (b), the MRS of mangoes for apples remains constant ($cd = ab$), which is against the normal behaviour of MRS (*i.e.*, diminishing). In Fig. (c) it actually increases (cd is larger than ab) which is quite the opposite of the normal behaviour of MRS. We have already seen that normally the marginal rate of substitution of a commodity diminishes as we have more of it. In other words, the normal shape of an indifference curve would be convex to the origin, as is given in Fig. (a) below. The other two shapes given in Fig. (b) and Fig. (c) are unrealistic.

Having studied the concept of indifference curve and its properties, we are now in a position to study the indifference curve analysis of demand.

Substitute Relationship and Convexity

The curvature of the indifference curves reflects the degree of substitutability between the commodities. That is, flatness or straightness of the curves shows to what extent commodities are substitutes for each other. In case of perfect substitutes, the indifference curves are downward sloping straight lines [Fig. 6.8. (b)], whereas if they are either horizontal (Fig. 6.4), or vertical (Fig. 6.5), the consumer will not be willing to substitute one commodity for another. Goods which can be substituted somewhat (not perfect substitutes) are represented by indifference curves which are somewhat convex to the origin. But greater the degree of convexity, the poorer are the substitutes. The flatter or less convex curves represent better substitutes.

7 INDIFFERENCE CURVE ANALYSIS OF DEMAND

We now undertake the study of the demand theory with the help of the indifference curve technique. We begin with what is known as the price line.

PRICE LINE OR BUDGET LINE

It has already been explained that a higher indifference curve shows a higher level of satisfaction than a lower one. A rational consumer will, therefore, try to reach the highest possible indifference curve in order to obtain the highest possible level of satisfaction. In this pursuit, our consumer will be governed by the amount of the money or income he has to spend on goods, and the prices of the goods in the market. Suppose our consumer has Rs. 15 to spend on apples and mangoes. Further suppose that the price of mangoes in the market is Rs. 1.50 per unit and the price of apples is Re. 1 per unit. With Rs. 15, he can buy 10 (=OM) mangoes and no apples or 15 apples (=OA) and no mangoes. (See Fig 7.1).

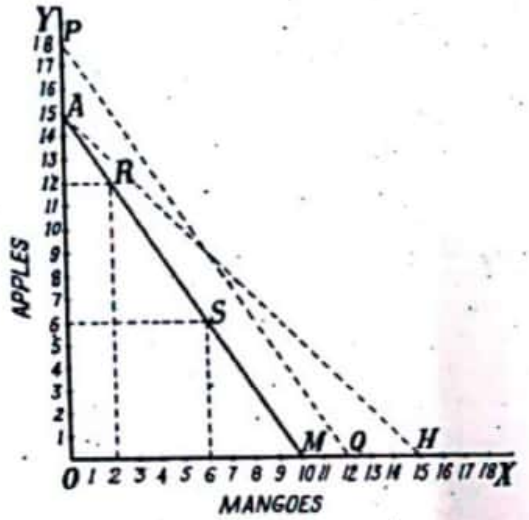

Fig. 7.1

By joining points A and M, we get what is called **Price Line** or **Price Opportunity Line.** It is also called **Price-income Line** or **Budget Line** or **Budget Constraint Line.** This line shows all possible combinations of two goods (in our case apples and mangoes) that the consumer can buy if he spends the whole of his given sum of money on his purchases at the given prices. Thus, at point R, our consumer will be having 2 mangoes and 12 apples and will be spending all his money (Rs. 15) on the two goods—Rs. 3 on mangoes and Rs. 12 on apples. And at point S, he will be buying 6 mangoes and 6 apples with Rs. 15.

Shifting the Price Line

If money with our consumer increases to Rs. 18, the price line will shift to PQ. For with Rs. 18, he can buy either 12 mangoes (=OQ) or 18 apples (=OP), prices of mangoes and apples remaining the same. It may be carefully noted that, since prices of mangoes and apples remain unchanged, PQ will be parallel to AM.

If the total amount of money (Rs. 15) and price of apples (Re. 1 per unit) remain the same but the price of mangoes falls from Rs. 1.50 to Re. 1 per unit, the price line will shift from AM to AH. AH will not be parallel to AM because the price ratio has changed.

From the above, it follows that the shape and the position of the price line will depend on two factors: (1) the total amount of money a consumer has for purchasing goods; and (2) price ratio of the goods in the market.

The slope of the price line may be distinguished from the slope of the indifference curve. The slope of the price line is (the negative of) the price ratio, *i.e.*, the ratio of the price of X to the price of Y. But the slope of the indifference curve at any point is called the marginal rate of substitution of X for Y. The marginal rate of substitution gives the rate at which the consumer is **willing to substitute** X for Y.

whereas the price ratio shows the rate at which he can substitute X for Y.

CONSUMER'S EQUILIBRIUM OR MAXIMISING SATISFACTION

Let us explain, with the help of indifference curves, how a consumer reaches an equilibrium position. The consumer is said to be in equilibrium when he obtains the maximum possible satisfaction from his purchases, given the prices in the market and the amount of money he has for making purchases.

In terms of Marshallian or utility analysis, a consumer is said to be in equilibrium, in case of one commodity, when its price and marginal utility have been equated. When we are considering more than one commodity, a consumer's expenditure is completely adjusted (or he is in equilibrium) when marginal utilities of money in each direction of his purchase have been equalised (or marginal utilities are in proportion to the prices, see chapter 5) and thus maximum satisfaction obtained according to the law of maximum satisfaction.

Equilibrium with Indifference Curves. Let us now consider how a consumer reaches an equilibrium position with the help of indifference curves.

In order to explain how a consumer reaches equilibrium position, we shall make the following assumptions:

(i) our consumer has an indifference map showing his scale of preferences for various combinations of the two goods—apples and mangoes. This scale of preferences remains the same throughout the analysis;

(ii) he has a given and constant amount of money to spend on the goods and if he does not spend it on one good, he must spend it on the other;

(iii) prices of the goods in the market are given and constant;

(iv) each of the goods is homogeneous and divisible; and

(v) the consumer acts rationally, that is, he tries to maximise his satisfaction.

Suppose our consumer has an indifference map, shown in the following diagram (Fig. 7.2). Further suppose that the price line facing the consumer is AM, given a certain amount of money he has to spend on apples and mangoes and the prices of apples and mangoes in the market. Since his income and the relative prices of the two goods to be purchased are shown by the price-income line AM, his equilibrium must be on some point on this line. That is why this line is called the price-opportunity line. It is this line that contains all the possible opportunities of combining the two goods that are open to our hypothetical consumer. Any point not lying on this price line cannot be a possible equilibrium point, because his present price-income situation will not allow him to move on to that point (or purchase that combination).

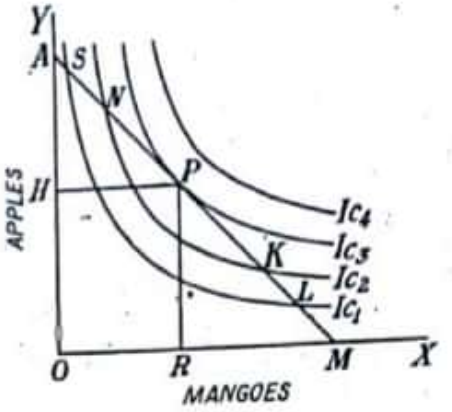

Fig. 7.2

Actually, the consumer will be in equilibrium at the point P, *i.e.*, he will be buying OR mangoes and OH apples. **The consumer will maximise his satisfaction and be in equilibrium at a point where the price line touches (or is tangent to) an indifference curve.** Such a point in our diagram is P which lies on indifference curve IC_3. This is the highest indifference curve to which he can go, given the money he has and the prices of the goods in the market. Given a price line, there can only be one point such as P, since no two indifference curves can cut one another and all are convex to the origin. Any combination other than P on the given price line can be shown to give less satisfaction to the consumer, for all other points on the price line must lie on indifference curves of a lower order than that on which P lies.

Thus, if our consumer chooses a combination of mangoes and apples represented by S, he will be on a lower indifference curve IC_1 and will thus be getting less satisfaction than when he chooses the point P and is on a higher indifference curve IC_3. The combination represented by point N will also give him less satisfaction, because it lies on indifference curve IC_2, which is also lower than IC_3 at which P lies. Similarly, all other points on the price line to the left of P will be less attractive in the estimation of our consumer than P. Likewise, on all points to the right of P on the price line AM, such as K and L, the consumer will not be in equilibrium, because all of them lie on indifference curves lower than IC_3.

In equilibrium at point P, the marginal rate of substitution (MRS) of mangoes for apples is equal to the price ratio between these two goods, since both the indifference curve IC_3 and the price line AM have the same slope at point P (MRS of mangoes for apples is given by the slope of the indifference curve and the price ratio is given by the slope of the price line AM). Thus, at point P,