UNIT 5 CONSUMER EQUILIBRIUM: CARDINAL AND ORDINAL APPROACHES

Structure

5.0   OBJECTIVES

This unit will enable you to:

l   understand and analyse how a consumer attains equilibrium;

l   use cardinal utility theory to explain consumer behaviour;

l   describe the law of diminishing marginal utility;

l   explain consumer's equilibrium in terms of the Marshallian law of equi-marginal utility. Also use this law to   explain the law of demand;

l   explain the concept of consumer's surplus;

l   explain consumer's behaviour in terms of ordinal utility theory, the Hicks-Allen approach

l   describe consumer's equilibrium condition in terms of ordinal utility theory;

l   decompose price effect into substitution effect and income effect;

l   graphically derive price consumption curve and income consumption curve, and demand curve for a good;

l   understand the difference between normal, inferior, and Giffen   goods;

l   provide a comparative evaluation of the two competing theories.

5.1   INTRODUCTION

In the previous unit we have introduced the concept of demand function, various determinants of demand and its elasticity. In this unit, we continue the discussion on

demand and focus our attention on consumer's behaviour in order to explain the law of demand. The law of demand says that when price of a commodity is lowered a larger quantity is demanded, and when price rises a smaller quantity is demanded, other things remaining the same. In other words, the law states that price and quantity demanded are inversely related. In this unit we will introduce you two contending theories - Alfred   Marshall's *cardinal utility theory of demand*, and J.R. Hick's and R.G.D. Allen's *preference approach* (or the indifference curve theory, or the ordinal utility theory) of consumer behaviour.

In Hicks-Allen approach some of the restrictive assumptions of the *Marshallian* approach are dropped. Particularly, that utility is a cardinal concept and is measurable on a numerical scale with an absolute zero and that marginal utility of money is constant are relaxed. *Marshallian* theory is also based on the law of   diminishing marginal utility as well as on inter-personal comparisons of utility. In the preference approach these limitations are overcome with the help of Hicks-Allen formulation, which is based on the indifference curve technique.   We will first develop the properties of indifference curves. Using the indifference curves and in conjunction with prices of goods and the consumer's money income (or budget) we will be showing how a rational consumer attains equilibrium.

Since consumer's choice depends on prices and money income, and as prices change or money income changes, the consumer's equilibrium choice will also change. We explain how to derive the price-consumption curve and the income-consumption curve. We will then show how the demand curve for a good can be derived from the price consumption curve. This part of the discussion ends by pointing out the difference among normal good, inferior good and Giffen good. It is only in the case of Giffen good that the law of demand is violated and the demand curve for a good is upward sloping rather than downward sloping. The law of demand need not be violated in case of inferior good. As we will be showing it, all depends on the working of two opposing forces -the substitution effect and the income effect.

5.2   THE CARDINAL UTILITY APPROACH

Alfred Marshall (1842-1924), an important member of the neo- classical school of economics, gave us the cardinal *utility theory* of consumer behaviour in his book ***Principles of Economics*** (1890). According to him, a consumer derives utility from consuming a commodity. Following ***Jeremy Bentham*** (1748-1832) the founder of the Utilitarian School of Ethics, utility is defined as the subjective sensation - pleasure, satisfaction, wish fulfilment, cessation of need - which are derived from consuming a commodity and the experience of which is the object of consumption. Marshall assumed that utility (which is the want satisfying power of a commodity) could be measured quantitatively in the same way as one can measure weights and heights. In other words, utility is cardinally measurable - numerical or quantitative scale exists for measuring it. See that this is a very highly restrictive assumption. For instance, it is possible to say that a person, say, Mili gets 2 units of utility from a cup of tea. If utility is a cardinal concept, then it requires a complementary   assumption specifying the unit   of measurement. Bentham used a psychological unit of measurement called Utils. However, it cannot be taken as a standard unit for measurement due to its variation from individual to individual. Hence, Marshall took money as the unit of measurement. It has the advantage of uniformity for all individuals in the economy. In the illustration above Mili would receive 2 rupees worth of utility from a cup of tea. Besides adopting money as a measuring rod for utility, Marshall made another complementary assumption. He assumed the marginal utility of money to remain constant for each consumer.   That implies the measuring rod must remain constant.

Cardinal measurability of utility also implies that utilities derived from the consumption of different quantities of a commodity can be added and also can be compared across

various individual consumers. Thus, one can speak of total utility and marginal utility derived from consuming a commodity. Marginal utility (MU) is defined as the addition to total utility when an additional unit of a commodity is consumed. Thus, MU is the ratio of extra utility to an extra unit of the commodity consumed.

I. Illustration of MU

Quantity	Total Utility	Marginal Utility
commodity X	(TU)	(MU)
1	2.00	-
2	5.00	3.00
3	9.00	4.00
4	14.00	5.00
5	17.00	3.00
6	9.00	.00
7	20.00	1.00

For the first unit the marginal utility cannot be calculated. The dash sign in the illustration indicates that. For the second unit of commodity X consumed the total utility are 5. Hence marginal utility is $(5-2)/(2-1)=3/1=3$, since the change in quantity is only one unit ($\Delta X=1$). In other words,

$$MU = \frac{(TU_2 - TU_1)}{(\Delta X = 1)}$$

Where TU_1 is utility derived from consuming one unit of X and TU_2 is total utility derived from consuming two units of commodity X. In general, then

$$MU = \frac{TU_n - TU_{n-1}}{X_n - X_{n-1}}$$

where n and n - 1 are the number of units of the commodity consumed.

Another important assumption, which Marshall made, is independence of utility. What it means is that utility derived from, say, consuming a *Samosa* is independent of utility derived from consuming, say, *Sandwiches*.

Together, all these assumptions would imply that if our consumer's taste can be represented by means of a utility function of the form

$$U = f (X_1; X_2; Xn),$$

then such a function will have the property of additivity and separability. This would mean that $\qquad U = U(X_1)+ U (X_2)+...+U (X_n)$

where $\qquad U (X_1)=f_1(X_1)$

$$U (X_2) = f_2 (X_2)$$

....

....

$$U(X_n) = fn(X_n).$$

Utility derived from a good depends on the quantity consumed of that good alone. And total utility or total satisfaction derived from consumption will depend on the sum of utilities derived from consuming all the commodities. The object of consumption is to make this total utility as high as possible.

It is important to remember that when a utility function is used to represent a consumer's taste, like $U = f(X_1)$, marginal utility derived from consuming, say, commodity 1 is given by the first partial derivative of U with respect to X_1, that is $\delta U/\delta X_1$, marginal analysis is based on calculus technique. The use of calculus method requires the assumption that each and every commodity must be perfectly divisible or as finely divisible as possible. So, consumption of any commodity can be varied in as small an amount as possible. This makes the utility function continuous and twice differentiable.

The ***Marshallian*** theory of consumer behaviour is also based on the non-satiation assumption. In other words, consumers are never satiated with any good. Satiation would imply that the marginal utility of a good becomes zero. Non-satiation also implies that more of a good is preferred to less of the same good.

Check Your Progress 1

1. The following table shows the relationship between total utility derived from consuming various quantities of milk. Calculate the marginal utility.

Qty. of milk (good X) in litres	1	3	5	8	12
Total Utility (in Rupees)	10	15	28	40	56

5.3 THE LAW OF EVENTUAL DIMINISHING MARGINAL UTILITY

The law of eventual diminishing marginal utility forms the basis of the *Marshallian* theory of demand. This law says that after sufficient quantity of a good is consumed, consumer experiences diminishing marginal utility from additional units consumed. To put it differently, the law states that after sufficient quantity of a good has been consumed each additional unit of consumption yields less and less additional utility. This law is based on introspection and has the following rationale: when a fewer units of a good are available, a utility maximising consumer would be using them to satisfying the most pressing (urgent) needs. However, as more and more units of a good become available, the needs to which they are used or put become less and less important and hence yield less and less additional utility.

Suppose that there is water shortage in your residential area, and you get only one tumbler a day, how will you use it? Surely, you will use it for drinking purpose only, and may be for cooking. But, suppose, you get one or two additional tumblers a day. You may then use it for bathing and washing. As more and more water becomes available you may start using it to satisfy less and less urgent needs, like cleaning your car, watering your garden, and if enough water still remains available, you may even involve in water fights - "activities that are far removed from the notion of water as an absolute essential for human survival". (J.QUIRK).
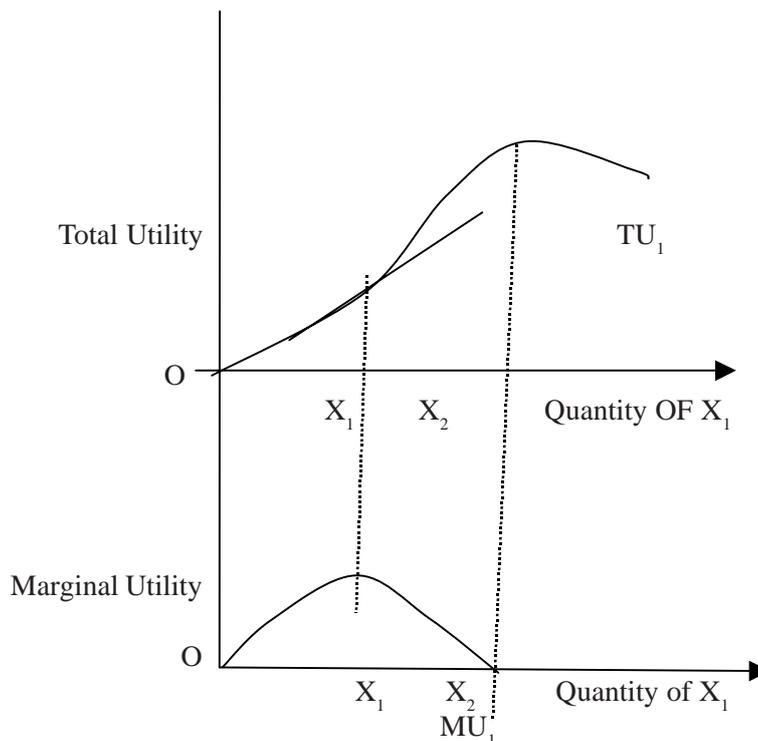
Fig. 5.1 **The upper segment shows total utility curve TU$_1$ and the corresponding MU$_1$ is in the lower segment. Note that at OX$_1$, MU$_1$ is at its maximum and TU$_1$ shows the highest rate of rise. Beyond this point, TU$_1$ keeps rising, but at smaller and smaller rates. It reaches its maximum at OX$_2$ when MU$_1$ falls to zero.**

As consumption increases from an initial low level (say, from zero), total utility increases at an increasing rate. This feature implies that the marginal utility is increasing (upto X$_1$). Beyond OX$_1$ for all successive consumption of X$_1$ total utility starts increasing at a diminishing rate. As a result marginal utility tends to fall. Hence, the law of eventual diminishing utility starts operating from OX$_1$.

Let us examine some other aspects of the law of diminishing marginal utility through an example.

When you are very thirsty, the first glass of water will give you a very high level of utility. The second glass might give you even a higher utility. But as you go on taking glass after glass of water, a point will be reached when you will not wish to have it any more. At that point you are completely satiated with it. In the diagram, at the quantity OX$_2$ total utility reaches a maximum and marginal utility becomes zero. Beyond OX$_2$ total utility decreases implying that marginal utility becomes negative. So, a utility maximiser will not go beyond this point. In fact, we will be showing below that a rational consumer will be attaining equilibrium in the range OX$_1$ and OX$_2$. That is the range where the law of diminishing marginal utility holds as well as the assumption of non-satiation.

5.4 CONSUMER'S EQUILIBRIUM

Let us assume that a consumer is consuming only two goods X$_1$ and X$_2$. The utility which she receives from consuming X$_1$ and X$_2$ is given by the utility function U=f (X$_1$, X$_2$) and satisfies the property of eventual diminishing marginal utility. The consumer has a given money income to be spent on these two goods during the period we are analysing her behaviour. She cannot influence the prices, P$_1$ and P$_2$, of the goods, through her own action. Prices are given as parameters in   decision-making (consumption) as this consumer is one of the numerous consumers demanding X$_1$ and X$_2$. Thus, she has no market power. Since she is required to spend her entire income

on X_1 and X_2, the budget equation is given as,

$$M = P_1X_1 + P_2X_2$$

Where M is her nominal income. Since the consumer is a utility maximiser, her consumption problem can be formulated as follows:

Maximise

$$U = f (X_1, X2)$$

subject to the budget constraint

$$M = P_1X_1 + P_2X_2.$$

By using the *Marshallian Equi-Marginal Principle* (which is based on the Lagrange *Multiplier Technique*), we get the equilibrium condition,

$$MU_1 / P_1 = MU_2 / P_2 = \lambda$$

This is the first order condition (necessary) for achieving equilibrium. The second order condition (sufficiency) of equilibrium is given by the law of eventual diminishing utility. The second order condition will be automatically fulfilled so long as the marginal utility schedules for each good MU_1 and MU_2 are both downward sloping. It must be noted that whenever a consumer maximises utility, equilibrium is said to be attained. What the equilibrium condition says is that to maximise total utility $[U = f (X_1, X_2)]$ an individual consumer must equalise the ratio of marginal utility to price for each and every good and which in turn must be equal to constant marginal utility of money. In other words, to obtain maximum total utility a rational consumer must equalise the marginal utility per rupee of expenditure on each and every line of expenditure (that is, on each and every good).

This relationship represents the consumer's equilibrium condition. A consumer attains equilibrium when she maximises total utility from consuming X_1 and X_2. The equilibrium condition can also be stated in an alternative form:

$$MU_1 / MU_2 = P_1 / P_2 \quad ...(1)$$

The ratio of marginal utilities of goods X_1 and X_2 must equal the price ratio of the same two goods. This in turn, must equal marginal utility of money, which is constant by assumption.

Condition (1) above is the famous *Marshallian law of the equi-marginal utility*. It can be shown that if the ratio of marginal utility of the two goods is not equal to the price ratio, then without spending more in the aggregate, just by re-allocating the given amount of money income as between the two goods X_1 and X_2, the consumer can increase her total utility from consumption.

An illustration:

The following table gives an individual's marginal utility schedules for goods X_1 and X_2. If the prices of X_1 and X_2 are Rs. 2.00 each and that the individual has Rs. 20.00 of Income, which she spends on X_1 and X_2, what is the individual's equilibrium purchase of X_1 and X_2?

Q	1	2	3	4	5	6	7	8	9	10	11
MU_1	16	14	11	10	9	8	7	6	5	3	1
MU_2	15	13	12	8	6	5	4	3	2	1	0

The solution: The individual's equilibrium purchase is given by the conditions

$$MU_1/P_1 = MU_2/P_2$$

and the budget constraint must be fully satisfied. From the above table we derive the following.

Q	1	2	3	4	5	6	7	8	9	10	11
MU_1/P_1	8	7	5.5	5	4.5	4	3.5	3	2.5	1.5	0.5
MU_2/P_2	7.5	6.5	6	4	3	2.5	2	1.5	1	0.5	0

At $X_1 = 6$

MU_1/P_1 is 4

At $X_2 = 4$ units

MU_2/P_2 is 4

Hence $MU_1/P_1 = MU_2/P_2 = 4$.

The amount spent is $P_1X_1 + P_2X_2$ which is Rs.20.00 (2*6+2*4 = 12 + 8). Money income is also Rs. 20.00. Hence, the budget constraint is satisfied. The equilibrium purchase is $X_1 = 6$ units and $X_2 = 4$ units.

Since MU_1 falls from 16 to 1 as X_1 increases from 1 to 11 and MU_2 declines from 15 to zero as X_2 increases from 1 to 11, the second order condition is also fulfilled.

When there are more than one combination of two goods (X_1, X_2) at which the equi-marginal principle holds, one has to take recourse to the budget constraint to obtain the equilibrium combination and all other combinations violating the budget constraint have been rejected.

It should be noted that when the consumer consumes n goods, the law of equi- marginal utility would then read as:

$MU_1/P_1 = MU_2/P_2 = MU_3/P_3=..... =..MU_n/P_n = \lambda$ (the marginal utility of money)

with the second-order conditions (the law of eventual diminishing marginal utility must hold for each of the n goods).

Further illustration: What is the maximum total utility, which the consumer derives from consuming 6 units of X_1 and 4 units of X_2?

Remember total utility equals sum of marginal utilities.

From goods X_1 the total utility derived is 16+14+11+10+9+8, which equals 68 units of utility. From good X_2 it is 15+13+12+8, which equals 48. Hence, the maximum total utility derived from consuming 6 units of X_1 and 4 units of X_2 is (68 + 48), which equals 116 units of utility. At the given prices of X_1 and X_2, any other combination of these goods would generate less than 116 units of total utility.

Check Your Progress 2

1. The following table shows total utility (TU) and marginal utility (MU) schedules of *Roomali roti* and *Chicken curry* for an individual consumer.

| Qty: | Roomali roti | | Qty: | | Chicken curry | |
	TU	MU		(TU)	'MU
0	0	-	0	0	-
1	25	-	1	10	-
2	40	-	2	-	6
3	50	-	3	21	-
4	-	-	4	24	-
5	59	3	5	-	-
6	-	1	6	27	1

(a) Fill in the blanks on the table.

(b) Suppose that consumer's income is Rs.12 and prices of *Roomali roti* and *Chicken curry* are Rs.2 per 100 gm. each. What is the utility maximising combination of *Roomali roti* and Chicken *curry*?

5.5 THE BASIS OF THE LAW OF DEMAND IN THE CARDINAL APPROACH

The demand function for a good is not to be confused with the utility function. The utility function of a good expresses the relationship between the consumer's intake (or consumption) of the good and the resultant psychic satisfaction, happiness and utility derived. Remember that utility is defined in terms of the subjective sensation which one experiences in her mind and the experience of it is the object of consumption. In the utility function quantities of goods appears as arguments. In a way it reflects consumer's taste or preference scale. Consumer's money income and prices of goods do not enter the utility function.

The demand function of a good on the other hand, expresses a relationship between the quantity demanded and its own price, *ceteris paribus*. For each price, it would indicate the maximum quantity demanded. Moreover, for each quantity demanded, it would indicate the maximum price the consumer would be willing to pay. This implies that the demand function is based on some kind of maximising behaviour of the consumer. The demand curve shows the graph of the demand function in the price-quantity axis. Such a curve indicates the consumer's intentions and reflects the maximum boundary for the consumer. Thus, the demand curve indicates what the consumer plans or intends to purchase and consume at alternative prices of a good. Hence, it is the consumer's planning curve. At each price it records the consumer's utility maximising choice. The demand function (and its graph the demand curve) is derived from the utility function by using an optimisation (maximisation) process. Such a demand curve would be negatively inclined implying that the quantity demanded of a good and its own price will be inversely related. A fall (rise) in price leads to an increase (fall) in the quantity demanded. It reflects the law of demand, which states that other things remaining the same (*ceteris paribus),* a reduction in the price of a good leads to a larger quantity of the good being demanded, while an increase in the price of a good leads to a smaller quantity of the good being demanded.

The basis of Law of Demand in the Marshallian analysis is the Law (based on introspection) of Eventual Diminishing Marginal Utility. Take two commodities X_1 and

X_2, whose prices are known and given to the consumer. The consumer's money income is also given over the period we are analysing her behaviour. The consumer's utility function is

$$U = U (X_1, X_2)$$

with $\quad U_1 = U_1 (X_1)$

$$U_2 = U_2 (X_2)$$

and $\quad U = U_1 + U_2$ using U_1 and U_2, marginal utilities of X_1 and X_2 are derived as

$$MU_1 = \partial/\partial X_1 [U (X_1, X_2)] = \partial U/\partial X_1$$

$$MU_2 = \partial/\partial X_2 [U (X_1, X_2)] = \partial U/\partial X_2$$

Let the prices of X_1 and X_2 be P^0_1 and P^0_2 and the money income of the consumer is M^0. Total income is spent on X_1 and X_2. So

$$M^0 = P^0_1 X^0_1 + P^0_2 X^0_2 \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\text{(i)}$$

The consumer's equilibrium condition is

$$MU_1/P_1 = MU_2/P_2 = \lambda, \text{ where}$$

λ= marginal utility of money. That is

$$MU^0_1/P^0_1 = MU^0_2/P^0_2 \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\text{(ii)}$$

Solving (i) and (ii) we get the equilibrium consumption of X_1 and X_2 to be X_{01} and X_{02}. This generates the point N_0 in the diagram below (for goods X_1). Next consider a situation where the price of good X_1 falls from P^0_1 to P^1_1 with the price of good X_2 and the consumer's nominal income remaining unchanged at P^0_2 and M^0. The consumer's original equilibrium is disturbed.

To restore equilibrium, MU_{01} must be reduced. MU^0_1 will be reduced if and only if quantity consumed of X_1 is increased. This follows from the law of diminishing marginal utility. At the new price of X_1, P^1_1, the consumption of X_1 is X^1_1; with

$MU_1/P^1_1 = MU_0/ P^0_2 (=\lambda)$. This gives us the point N^1_0 on the demand function (curve) of good X_1. We repeat the exercise for all values of P_1. The locus of the consumer's equilibrium consumption points defines the demand curve (Fig.5.2).
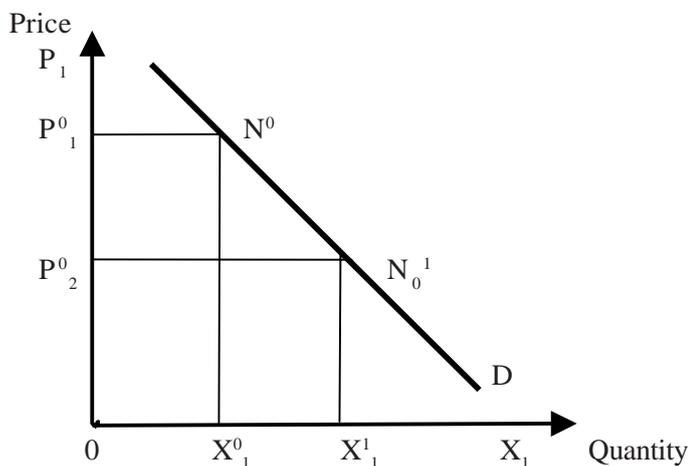

Fig. 5.2 shows the demand curve for the commodity X_1. It has been derived as locus of equilibrium consumption points of the consumer at different levels of price P_1.

The demand curve is downward sloping since the marginal utility schedule is downward sloping. However, the demand curve is not identical with the marginal utility schedule (unless λ is equal to unity). Consider the marginal utility schedule for good X_1, as shown in Fig. 5.2.

Check Your Progress 3

(i) Suppose the marginal utility schedule is given as $MU_x = 40 - 0.5\ Qx$. If marginal utility of money is equal to one and is constant, find out the demand schedule?

(Hint: set $P_x = MU_x$)

5.6 CONSUMER'S SURPLUS

Though Marshall was not the originator of the concept of consumer's surplus, he played a very significant role in providing it a theoretical structure, which could be used to derive many welfare propositions in economics. In particular it was used to measure the benefit derived by consumers from consuming a commodity (expressed in monetary terms). Marshall defined consumer's surplus as the difference between the price a consumer is willing to pay for a given quantity of a good rather than doing without it and the price that the consumer actually pays to acquire that quantity. It is the difference between the total willingness price and the actual price that one pays to acquire the good. Graphically it is illustrated as follows:
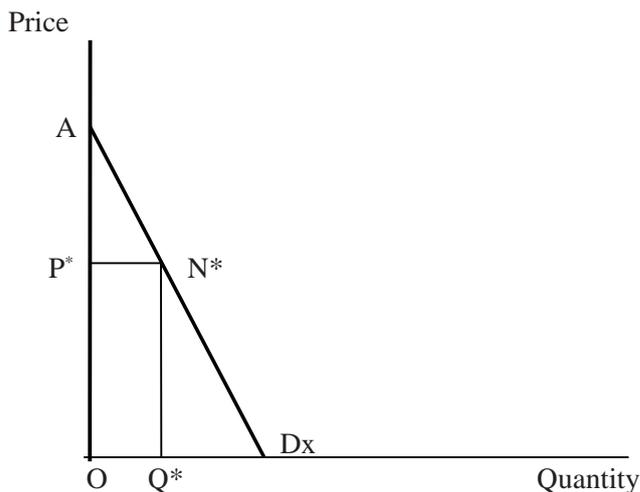

Fig. 5.3 shows consumer's surplus. As demand curve D_x shows maximum price per unit of X that the consumer is willing to pay, the area under D_x until point $Q^*(=OAN^*Q^*)$ is her willing to pay. But market price is OP^*. So she actually pays only $OP^*N^*Q^*$. Thus the difference, that is, the area AP^*N^* is the consumer's surplus.

Let D_x be the demand curve to a particular consumer. At the price OP^* she consumes OQ^* quantity. For OQ^* the total price that the consumer is willing to pay is given by the area under the demand curve upto OQ^* quantity. This area is OAN^*Q^*. The actual amount spent by the consumer is the area $OP^*N^*Q^*$. Consumer's surplus is the difference between the maximum (total) amount that the consumer is willing to pay and the actual amount that she pays. Hence, it is given by $OAN^*Q^* - OP^*N^*Q^*$. This equals the area AP^*N^* which represents the net gain to the consumer from consuming OQ^* quantity of good X. It must be noted that the Marshallian measure of consumer surplus is based on all the assumptions on which the Marshallian theory of demand is based. In particular, the assumption that utility of money is constant implies that Marshall ignored the income effect of a price change. Thus, the Marshallian demand curve only incorporates the substitution effect of a price change. Hence, consumer surplus must be measured on an income-compensated demand curve to reflect correctly

the gain to consumer from consuming a particular good. If one uses an observed demand curve to measure consumer surplus, it will be valid only in an uninteresting case of one per cent increase in income increasing consumption of each and every good by one per cent. The concept of consumer's surplus was used by Marshall and his disciple A.C. Pigou and many other neo-classical economists in deriving many welfare propositions and policy prescriptions in economics.

Check Your Progress 4

1   (a) When MU is zero, what happens to TU?

    (b) When total utility is increasing what happens to marginal utility?

    (c) When marginal utility is increasing what happens to total utility?

    (d) When total utility is stationary, neither increasing nor decreasing, what happens to marginal utility?

2.   Given the following MU schedule, when the price of good X is Rs.10 and marginal utility of money equals one, what will be the consumer's demand?

Qty. of X: (in kg.)	10	12	14	16	18	20	22
MU_x (in Rs.)	25	20	18	10	6	5	4

5.7   ORDINAL UTILITY APPROACH TO CONSUMER BEHAVIOUR: THE INDIFFERENCE CURVE

In the 1930s, an alternative theory of consumer behaviour was developed by J.R. Hicks of the Oxford University and R.G.D. Allen of the London School of Economics. It came to be known as *the preference approach to consumer behaviour*. It was called the preference - indifference curve approach and was developed as a response to increasing dissatisfaction with the Marshallian approach. In particular, economists of the neo-classical tradition started questioning the scientific validity of the assumptions of cardinal measurement of utility and constant marginal utility of money. Such assumptions, it was pointed out, reduced the explanatory as well as the predictive power of the model. It was also realised that those assumptions were not required to derive the law of demand and other related propositions of demand theory.

The preference theory starts with the premise that a consumer is able to express her preference for various commodity bundles. To give it a proper structure the preference function must satisfy certain properties. Before doing that some preliminaries must be discussed.

We use the symbol $\geq$ to mean preference indifference relations. Let us take two bundles (one can use the term market basket of goods), X_o and X_1, consisting of quantities of two goods X_1 and X_2 (may be wheat and milk). $X_1 > X_0$ implies that the bundle X_1 is preferred to the bundle X_0.

$X_1 = X_0$ implies that the bundle X_1 is indifferent to the bundle X_0.

Hence X_1 X_0 implies that the bundle X_1 is preferred to or indifferent to X_0 bundle.

If $X_1 \geq X_0$ then X_0 cannot be preferred to X_1 at the same time.

An indifference curve is defined as the set of combination of two goods (X_1 and X_2) which give the consumer same level of utility or satisfaction or which are equally preferred.

Properties of Indifference Curves

We now describe the properties of indifference curves.

(i) Indifference curves are downward *sloping*. A consumer would be indifferent between bundles if these contain more of one good and less of the other. Since total utility is constant on a given indifference curve, if something of one good is taken away, the consumer must be compensated by other good so that total utility remains constant.

Let an important point to be noted: Indifference curves must not touch the axes. Touching the axes implies consumption of one good becomes zero, and the essence or the main thrust of the indifference curve approach is lost. The formulation that an individual gets satisfaction or utility from a combination of two goods consumed is lost. Bundles, which have mixture of goods, are always preferred to bundles having only one of them. If we impose this condition implying $U(0; X_2) = U(X_1, 0) = 0$ then indifference curves will not touch the axis.

(ii) Indifference curves *must not intersect*, otherwise higher indifference curves will not reflect higher utility. That is, bundles lying on higher indifference curves cannot be preferred to bundles lying on lower indifference curves. The property of transitivity, non-satiation as well as reflexivity, and completeness would ensure that indifference curves do not intersect. In such a situation, the preference direction would be North and East.

(iii) Indifference curves are strictly convex to the origin. This has something to do with the curvature of the indifference curves. The law of diminishing marginal rate of substitution (MRS), to be discussed below, ensures strict convexity of the indifference curves.

A consumer's taste or preference scale is represented by not one indifference curve but by a set of indifference curves, which we call the indifference curve map. The graphical representation of which would be as follows:
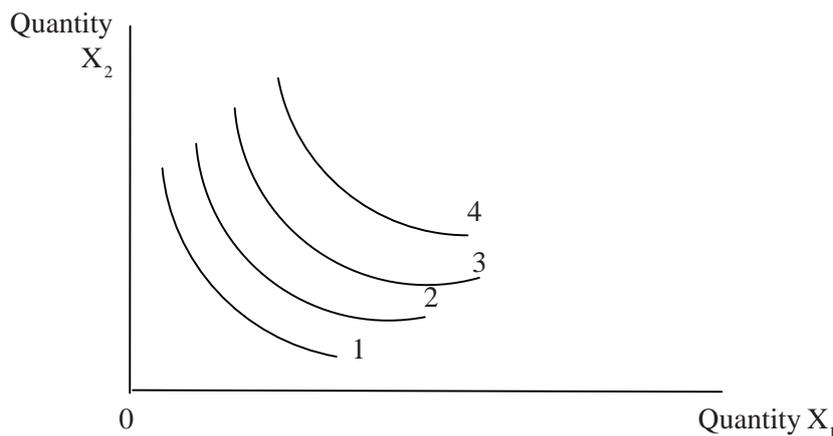

Fig. 5.4 shows the preference set of an individual. Each curve shows one level of satisfaction. A curve that lies to the North-East of any given curve, will show higher levels of satisfaction. These curves touch neither each other nor the axes.

We have shown only four indifference curves. In fact, there will be an indifference curve passing through each point in the commodity space. This is made possible by the assumption that the goods consumed are perfectly divisible (as finely divisible as possible). Hence, the commodity space can be jammed with indifference curves with their normal properties.

Marginal rate of substitution can be defined, as the rate at which commodity X_2 can be substitutional for X_1 in such a manner that consumer's total satisfaction remains constant. This rate keeps falling as we move along an indifference curve towards right. The idea is not so difficult to appreciate. We know that as the consumer gets larger quantity of X_1 he has to give up some of X_2. Why does it happen? As quantity of X_2 decreases, consumers "intensity" of liking for this increases, while the same for X_1 tends to decline. Hence for every increase in X_1 (of same magnitude) consumer will be willing to give up progressively smaller equilibrium of X_2 only. This diminishing MRS gives indifference curve the property of being strictly convex to the origin.

5.8   CONSUMER'S BUDGET CONSTRAINT

Since any individual consumer is one of the many consumers in the market for a good, she will not have any market power, implying that the market price of the good cannot be influenced through her own action. Also given is the consumer's money income (the budget) for the period we are analysing her consumption behaviour. The given money income in conjunction with the given market prices of goods would define the consumer's budget set, the feasible consumption choice set, or simply the consumption possibilities curve (line).

Let M_0 be the consumer's money income, X_1 and X_2 are the two goods consumed, P_1 and P_2 are the prices of X_1 and X_2. Then the budget equation is,

$$M_0 = P_1 X_1 + P_2 X_2$$

This implies that money income must be spent on the two goods, X_1 and X_2, and income   equals expenditure. The budget must be completely exhausted in buying (purchasing). The activity of savings/dissavings does not give any utility/disutility to the individual consumer. The theory of consumer choice (behaviour) is a static partial equilibrium theory. We are not yet concerned with inter-temporal decisions. The graph of the budget equation would look something like the following:
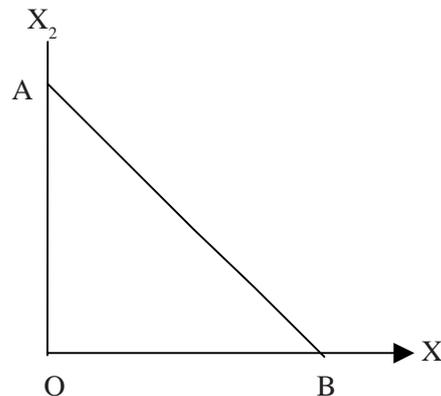

Fig. 5.5   shows the budget line. If all the money income M_0 is spent on two goods X_1 and X_2 at given prices P_1 and P_2 respectively, the consumer can buy one combination out of those given by line AB.

 AB is the graph of the budget equation   The co-ordinate of 'A' is M_0/P_2 and that of 'B' is M_0/P_1. They indicate that if the entire income is spent on X_1 then the maximum amount of X_1 that the consumer can consume is OB. The consumption of X_2 would be zero. Similarly, if the consumer spends only on X_2, the maximum attainable consumption is OA, with consumption of X_1 zero. Any allocation of income between X_1 and X_2 would lie on the linear line AB. This line is called the *budget line* or real income line or expenditure line or the price line. It is linear as prices are constant.

Query: What happens to the budget line when money income and prices change in the same proportion? Say, money income doubles and prices double?

Let $M_1 = 2 M_0$; $P_{11} = 2P^0_1$; $P^1_2 = 2 P^0_2$.

The co-ordinate of 'A' will be M_1/P_{12}. This equals $2M_0/2P^o_2$, hence equals

M_0/P^0_2.

The co-ordinate of 'B' will be M_1/P^1_1. This equals $2M_0/2P^0_1$, which equals

M_o/P^0_1.

Hence, the co-ordinates of 'A' and 'B' remain unchanged. The line AB remains unchanged.

Check Your Progress 5

1. If the consumer's money income is Rs.100, price of good one is Rs.5, price of good two is Rs.10, draw the budget line.

2. When prices both the commodities double and money income also doubles, what happens to the budget line?

5.9 CONSUMER'S EQUILIBRIUM IN THE ORDINAL UTILITY APPROACH

A consumer attains equilibrium whenever she is maximising utility. This implies that in the preference approach, or, indifference curve analysis, the consumer chooses the most preferred commodity bundle, which she can buy with her budget. We have to combine the consumer's tastes or preference with the budget constraint and the consumer's indifference curve map is defined in the same commodity space. The indifference curve mapping is super imposed on the budget get the consumer's equilibrium or utility maximising choice. This is given by the highest indifference curve consistent with the budget.

In the figure below the indifference curves touch or intersect the budget line at five different points N_1, N_2, N^*, N_3 and N_4, giving us five possible equilibrium points.
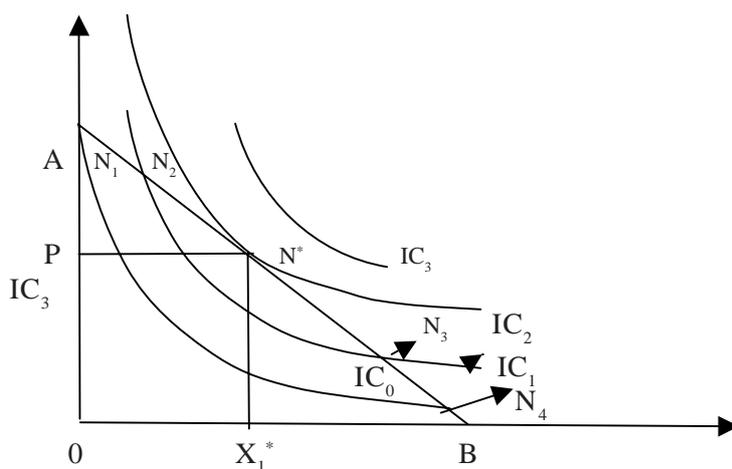

Fig. 5.6 shows indifference map and budget set of a consumer. The budget line comes in contact with three indicated indifference curves at N_1, N_2 , N_3 , N_4 and N^* points. But at N^* it merely touches IC_2 – making it the highest attainable IC.

At N_1 the budget is exhausted and the level of welfare (utility) attained is shown by indifference curve IC_0.

At N_2 the budget is exhausted and the level of welfare is shown by indifference curve IC_1.

At N_3 the level of utility is once again shown by indifference curve IC_1.

At N_4 it is shown by IC_0.

At N^* the budget is exhausted and the level of welfare (utility) attained is shown by IC_2.

None of the points N_1, N_2, N_3, N_4 and N^* violate the budget constraints. In terms of the level of welfare or utility attained the ranking of the points would be:

$$N^* > N_2 > N_1$$

or $\qquad N^* > N_3 > N_4$

Hence, the consumer's utility is maximised at N^*.

IC_2 is the highest indifference curve consistent with the budget constraint. With given money income and prices the consumer cannot attain the level of welfare indicated by the indifference curve IC_3. N^* is the most preferred commodity bundle since it has the highest ranking among the bundles in the attainable set. N^* represents consumer's equilibrium point. What is the characteristic of the equilibrium point? The budget line (price line) AB is tangential to the indifference curve, IC_2, at the point N^*. This implies that the slope of the budget line equals the slope of the indifference curve IC_2. Slope of the budget line is the price ratio (P_1/P_2) while that of the indifference curve is dX_2/dX_1. Both the slopes are negative. At the point N^*,

$$P_1/P_2 = dX_2/dX_1, \text{ with } dX_2/dX_1 \text{ negative.}$$

Multiplying both sides by -1 we get $P_1/P_2 = - dX_2/dX_1$.

$\qquad (-) dX_2/dX_1$ is the consumer's MRS $_{X1X2}$. Hence $P_1/P_2 = $ MRS $_{X1X2}$ at point N^*

This is the first order condition of equilibrium. The law of diminishing MRS gives the second-order condition of equilibrium. This implies that strict convexity of the indifference curves is sufficient to ensure the fulfilment of the second-order condition of equilibrium.

This will also guaranty that equilibrium is also unique. As

$$\text{MRS }_{X1X2} = MU_1/MU_2,$$

The equilibrium condition can also be restated as

$$P_1/P_2 = \text{MRS }_{X1 X2} = MU_1/MU_2,$$

or, $\qquad MU_1/P_1 = MU_2/P_2.$

Thus, we are back to the Marshallian equi-marginal principle of equilibrium condition without, however, the restrictive assumptions of measurability of utility and constant marginal utility of money.

5.10 SPECIAL CASES

Let us relax some of the assumptions of indifference curve analysis and suppose that the indifference curves are just convex, or, are straight lines with MRS constant. There are three possibilities, which will follow:

$P_1/ P_2 > MRS_{X1X2}$ at corner point A. The implication is

$P_1/ P_2 > MRS_{X1X2} = MU_1/ MU_2$, or, $MU_2/ P_2 > MU_1/ P_1$

Hence, per rupee of expenditure, the consumer gets higher marginal utility from good 2 than good 1. As a result the consumer would go on spending more on good X_2 till the entire income is exhausted on it and will consume OA of X_2 and zero amount of X_1.
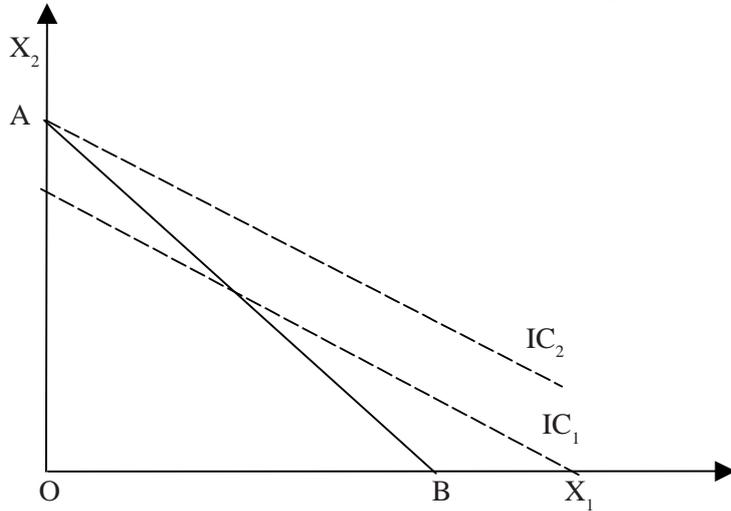

Fig. 5.7 (a)

However, though IC$_2$ is the highest indifference curve touching the budget line at point A, the equilibrium condition $P_1/ P_2 = MRS_{X1X2}$ is not satisfied and the second-order conditions are also not met.

Case II

Once again we will get a corner solution. This time $P_1/ P_2 < MRS_{X1X2}$.

Since $MU_1/ P_1 > MU_2/ P_2$, the individual gets higher utility from good X_1 than from good X_2. The entire money income will be spent on good X_1. We have a corner solution at point B; IC$_1$ being the highest indifference curve touching the budget line AB. Again equilibrium condition is not satisfied. The consumer consumes only X_1 equal to OB and nothing of X_2. We will have unique equilibrium.
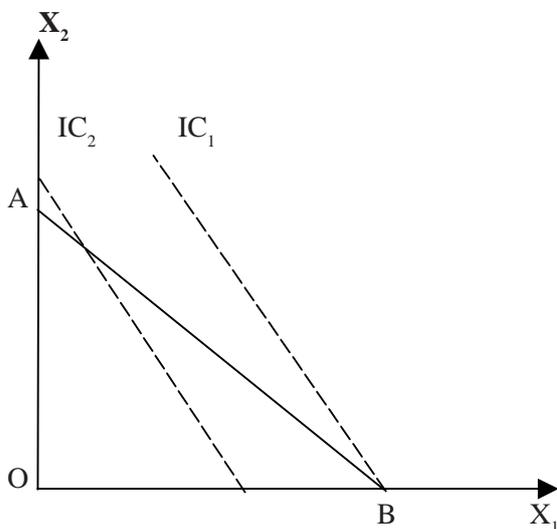

Fig. 5.7 (b)

Case III

In the third case the slopes of indifference curve and the budget line would be identical. One indifference curve, IC_1, overlaps the budget line AB. Hence, every point on the budget line AB from A to B is an equilibrium point. In other words, we get multiple equilibrium solution in this case. Note that at every point on AB, $P_1 / P_2 = MRS_{X1X2}$ and equilibrium condition is satisfied.
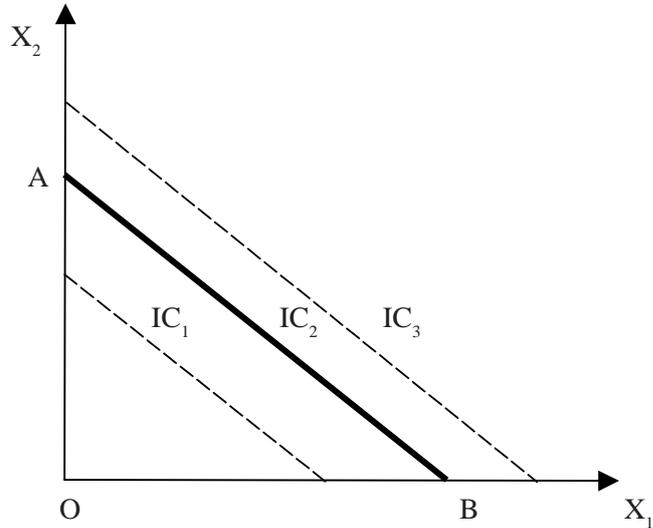

Fig. 5.7(c)

Next, Suppose indifference curves are concave rather than convex to the origin

Concavity of indifference curves implies that MRS $_{X1X2}$ is increasing as we move down an indifference curve. As a consequence, at the point an indifference curve is tangential to the budget line, instead of maximising utility the consumer is in fact minimising utility since the second-order condition is not met. To maximise utility the consumer has to move to a corner point either A [Fig. 5.8(a)] or B [Fig. 5.8(b)]. Once again note that the consumer's equilibrium condition is not satisfied both at A and B.
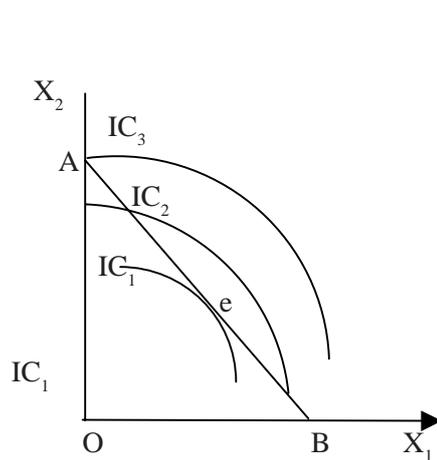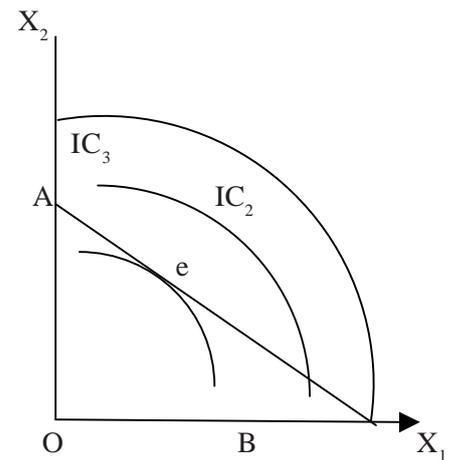

Fig.5.8 (a)

Fig. 5.8(b)

Note: Corner point solutions imply the consumer consuming only one commodity. The consumer is said to be a monomaniac.

Warning: It is quite possible that even with strict convexity assumption the consumer might attain a corner solution unless we invoke the restriction U (O, X_2)=U (X_1, O) = 0.

If the consumer gets utility only from a combination of two goods consumed then corner solutions are ruled out.
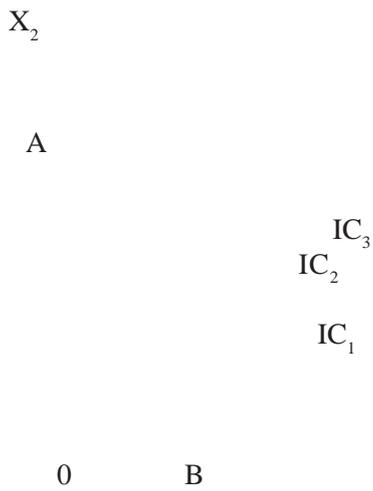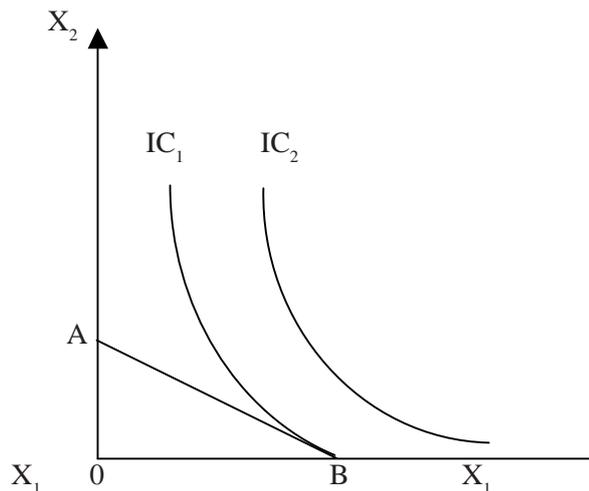
X_2

A

IC$_3$

IC$_2$

IC$_1$

0   B X_1

Fig.5.9(a)

X_2

IC$_1$ IC$_2$

A

0   B X_1

Fig.5.9(b)

X_2 45^0

c

b

a

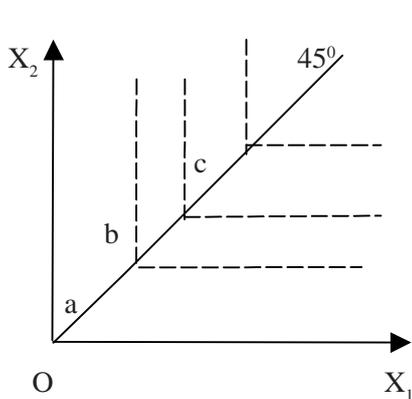O X_1

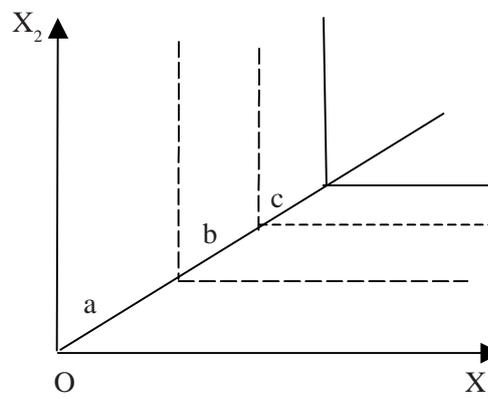**Fig.5.10(a)**

X_2

c

b

a

O X_1

Fig.5.10(b)

Example (i): The right and the left of a pair of shoes are perfect complements. If you have one of right shoes and two of the left then the extra left shoe will be totally useless. It will not add to your utility unless you are able to get an extra right shoe to match that of extra left. Let X_1 be right and X_2 be left shoes. Then the consumer will always operate at the corner points a, b, c of the indifference curves I_0, I_1, I_2 of Fig. 5.10.

On the horizontal and vertical segments, the marginal utilities of X_1 and X_2 will be zero. Utility increases when moving from I_0 to I_1 to I_2 only when the consumer is able to increase consumption of both X_1 and X_2 in a fixed proportion.

Example (ii): If X_1 is hydrogen and X_2 is oxygen, to produce water we need to combine hydrogen and water in the ratio - two units of hydrogen and one unit of oxygen. Once again, the indifference curves are L- shaped with the consumer always operating at the corner points, a, b, c on indifference curves I_0, I_1, I_2. This time the corner points lie on a linear ray from the origin with a slope less than 45°. If X_1 is oxygen and X_2 is hydrogen then the slope of the ray would be greater than 45°.

Consumer's Equilibrium with L-shaped Indifference Curves

IC$_2$ is the highest (farthest from the origin) indifference curve touching the budget line AB, at point N*.Hence N* is the most preferred commodity bundle, the utility-maximising choice. However, the equilibrium condition cannot be applied here since at the corner point of an L-shaped indifference curve slope is not defined, as a result MRS $_{X1X2}$ is not defined. Hence, we cannot equate price ratio P_1/P_2 to the consumer's MRS.
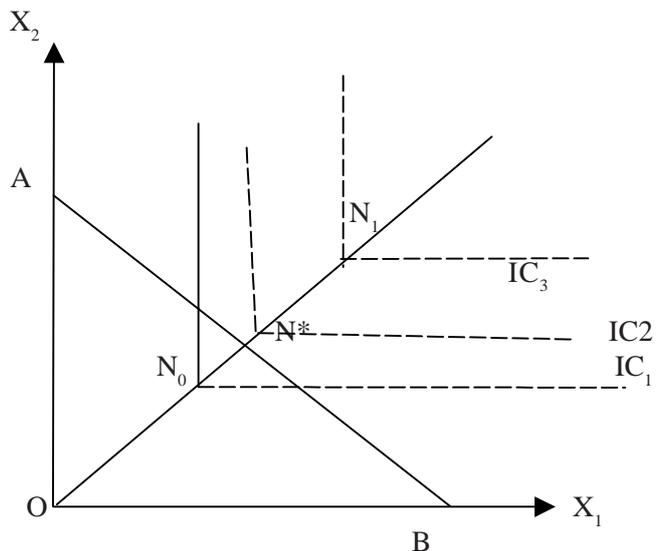
Fig.5.10(c)

Check Your Progress 6

1. The following table shows combinations of two goods X and Y along an indifference curve.

X:	0	1	2	3	4	5	6	7	8	9	10
Y:	30	23	17	12	8	5	3	2	1.2	0.5	0.0

(a) Calculate the marginal rate of substitution at each point on the indifference curve.

(b) When price of X is Rs.3.0 and the price of Y is Re.1.0, utility is maximised on this curve. What is the utility maximising combination? Explain.

5.11   THE PRICE-CONSUMPTION CURVE

Let us now consider a situation where the price of a commodity changes (falls or rises) with everything else (the price of the other goods and the consumer's money (nominal) income, as well as tastes) unchanged. We assume further that the consumer was initially in equilibrium. We show resultant outcome with help of Fig. 5.11.
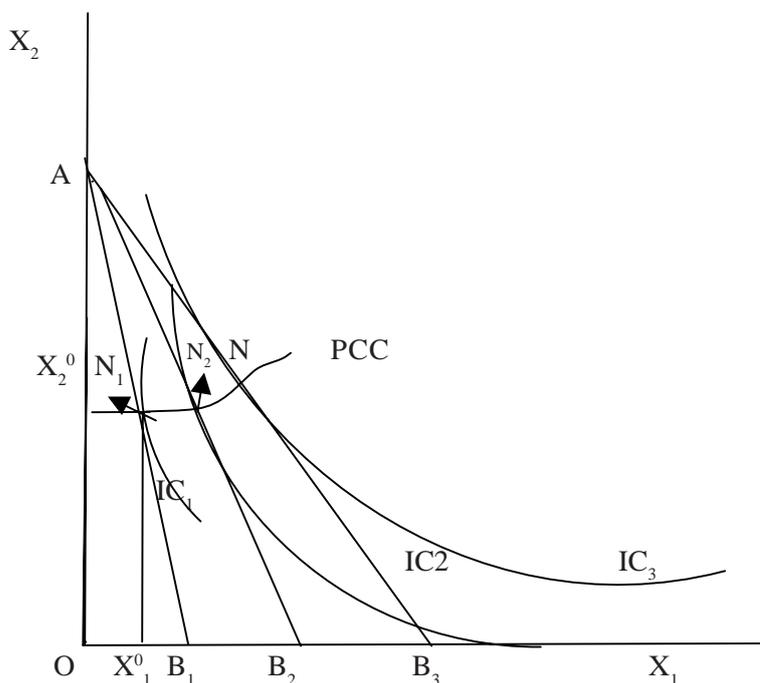

Fig. 5.11

With the original set of prices of the two goods P_{01} and P_{02}, and money income M_0, the consumer's equilibrium is at point N_1. It satisfies both the first-and-second order conditions of equilibrium. The utility maximising quantities of the two goods consumed are given by OX_{01} and OX^0_2. Next, let the price of X_1 fall continuously from P^0_1 to P^1_1 with P_2 constant at P^0_2 and money income is also constant at M_0. The point A remains unchanged. However, point B moves to the right to B_1, B_2, B_3 with $OB_1 = M_o/P^1_1$, $OB_2 = M_o/P_1^2$ and $OB_3 = M_o/P^3_1$.

The purchasing power in terms of X_2 remains unchanged, and is equal to OA. When price of good X_1 falls the budget line becomes flatter and flatter (P_1/P_2 falls). Since the budget line shifts from AB to AB_1 to AB_2, the consumer's equilibrium shifts from N_1 to N_2 to N_3. The level of welfare (utility) increases from IC_1 to IC_2 to IC_3. With the shift in equilibrium points the equilibrium quantity of X_1 bought and consumed expands. If we take the locus of the consumer's equilibrium with changing prices of good X_1 we get the price-consumption curve (PCC) of good X_1 whose shape can be anything from downward sloping to horizontal to upward sloping. The shape depends on the amount spent on good X_1 as its price falls. With amount spent on X_1 increasing, PCC will be downward sloping. With amount-spent constant, PCC will be horizontal. Lastly, with amount spent decreasing, PCC will be upward sloping. But how do we discern the amount spent on good X_1? At the prices P^0_1 and P_2^0 the individual is in equilibrium at N_1. The two goods were bought in X_1^0 and X_2^0 quantities. Therefore, the amount spent on X_1 was $P_1^0X_1^0$. As price falls to P_1^1, the consumer buys X_1^1 quantity. Hence the amount spent is $P_1^1X_1^1$.

If $P_1^1X_1 > P_1^0X_1^o$, then we can infer from the total expenditure method that the elasticity of demand is greater than one. The PCC slopes downward to the right. If $P^1_1X^1_1 = P_1^0X_1^0$, elasticity will be unity. Finally, when $P_1^1X_1^1 < P_1^0X_1^0$, the demand is inelastic and the PCC slopes upwards.

Check Your Progress 7

Draw a price-consumption curve (PPC) for good X_1 when P_1 rises with price of X_2 and money -income being unchanged.

5.12 THE INCOME -CONSUMPTION CURVE

Starting from an initial equilibrium situation, we now allow consumer's money income to vary with prices of the two goods X_1 and X_2 remaining constant. With money income changing and prices of goods remaining constant, the consumer's budget line shifts outward (for a rise in income) and inward (for a fall in income) in a parallel manner.

In the following Fig. 5.12 when income raises the budget line moves from AB to A_1B_1 to A_2B_2 with price ratio P_1/P_2 given by the slope of the budget lines remaining constant.
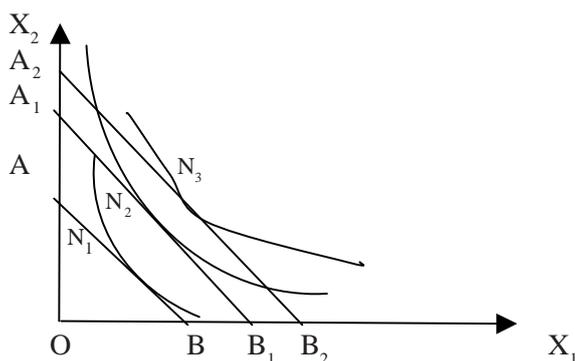

Fig. 5.12

When income increases and we record the consumer's consumption behaviour by taking the locus of consumer's equilibrium points we trace out the income-consumption curve for goods X_1 and X_2.

An income-consumption curve (ICC) for a good (say, X_1) shows the effect on consumption of good X_1 when money income varies with prices remaining unchanged. Such a curve can be linear or non-linear. At every point on such a curve (points like N_1, N_2, N_3), $(P_1/P_2) = MRS_{X1X2}$, and since (P_1/P_2) is constant MRS_{X1X2} will also be constant. Moreover, indifference curves are also parallel.

5.13 THE PRICE EFFECT, SUBSTITUTION EFFECT, INCOME EFFECT

Starting once again from an initial position with money income M_0 and prices P^0_1 and P^0_2, the consumer attains equilibrium at N_1 consuming OX_{01} of good X_1 and OX^0_2 of good X_2 (see Fig. 5.11). Suppose that price of good X_2 falls, with money income and price of good X_2 remaining unchanged. What happens? We explain it with the help of Fig. 5.13.
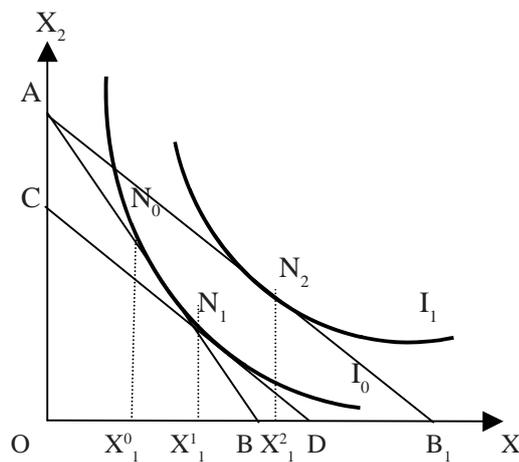

Fig. 5.13

The consumer's initial position is depicted by budget line AB and equilibrium is at N_0, the point where the indifference curve I_0 is tangential to the budget line AB. At the initial situation the quantity demanded of X_1 is OX^0_1. We now let the price of X_1 fall from P^0_1 to P^1_1 with everything else unchanged. *The budget line rotates about point A in an anti-clockwise direction and becomes flatter.* Its position moves from AB to AB_1. With P_2 remaining constant, the purchasing power of money in terms of good X_2 remains unchanged in OA. With P_1 falling the purchasing power in terms of goods X_1 increases from OB to OB_1. Originally at N_0, $P_1/P_2 = MRS_{X1X2}$. With P_1 falling, this equilibrium is disturbed and P_1/P_2 becomes less than MRS_{X1X2}. When the consumer is thrown out of equilibrium she undertakes consumption adjustment. With P_1 falling, she can attain N_2 on indifference curve I_1. At N_2 once again the price ratio (new P_1/P_2) becomes equal to MRS, which has also changed between N_0 and N_2. Both the first-order and second-order conditions are fulfilled at N_2. Note that *equilibrium point is always characterised by the tangency between budget line and indifference curve*. At the new equilibrium point quantity demanded increases from OX_1^0 to OX^2_1. When price of good X_1 falls the quantity demanded of X_1 increases by $X^0_1X^2_1$. This we call the price effect. It gives the change in demand induced by a change in own price.

When price of a good changes, the relative price ratio changes. From the consumer's point of view, good X_1 becomes relatively cheaper and even though the price of good

X_2 has not changed it has become relatively more expensive. Any change in relative price brings into play two forces: *the substitution effect and the income effect*. The substitution effect results from the fact that a rational consumer would always tend to substitute the relatively cheaper good for the relatively more expensive good. The income-effect results from the fact that when price of good changes the consumer's real income changes. Induced by this change consumer's consumption will change in general and consumption of the good whose price has changed in particular.

How do we separate these two effects? There are two approaches to the problem. One is the ***Hicksian*** method of decomposing the total price effect into substitution effect and income effect. The second method is due to a Russian economist, ***E. Slutsky***. In order to ascertain the magnitude of the two effects of a price change, we have to eliminate, first, one of the two effects. Normally the income effect is eliminated first in order to provide us with the magnitude of the substitution effect. Since income effect arises due to a change in real income brought about by a price change with money income held constant, to eliminate income effect we have to hold real income constant. This becomes necessary due to the fact that a change in real income causes consumption to vary. The real income can be held constant if money income can be adjusted to price changes. You know that

Real Income = Money Income/Price of a Good. That is, $RI = MI / P = M_0/ P^0_1$.

(i) When P_1 falls from P^0_1 to P^1_1 with M_0 constant real income increases. Hence money income needs to be reduced at the same time when price of a good falls. So, $RI = M_1/P^1_1$, where

$P^1_1 < P^0_1$ and $M_1 < M_0$.

(ii) When P_1 rises from P^0_1 to P^1_1 (with $P^1_1 > P^0_1$) and M_0 constant, real income falls. Hence to hold real income constant money income needs to be adjusted upward. New money income is M_1, with $M_1 > M_0$. In the process,

$RI = M_0/P^0_1$ becomes M_1/P^1_1.

An upshoot of the whole discussion is that to eliminate income effect consumer's money income needs to be adjusted to hold real income constant. With real income held constant, if the quantity demanded increases (decreases) with price of the good falling (rising), the change in demand (increase or decrease) must be due to operation of pure substitution effect. Once we have got the substitution effect, we restore the consumer's original level of money income, which will cause a further change in the quantity demanded of the good whose price has changed due to variation in real income. This latter variation in the quantity demanded (increase or decrease) is known as the income-effect of a price change.

The difference between methods of *John Hicks* and *E. Slustky* lies in their interpretation of holding real income constant. In Hicks, holding real income constant implies holding utility constant at the original level. While in Slutsky, holding real income constant means holding purchasing power of money income constant. In other words, when price changes the consumer should be given that much money income, which would make the original bundle of goods affordable. In the following, we will concentrate on the Hicksian method only.

Hicksian Method of Isolating Substitution and Income Effects

With money income at M_0 and prices of two goods at P^0_1 and P^0_2, the consumer's budget line is AB with the slope given as P^0_1/P^0_2. The consumer's equilibrium point will be at $P^0_1/P^0_2 = MRS_{X1X2}$ (see Fig. 5.13).

The quantity demanded of X_1 is OX^0_1. With price of X_1 falling to P^1_1, price of X_2

remaining at P^0_2 and money income at M_0 the budget line swings to AB_1. The consumer's equilibrium shifts to N_2. The quantity demanded increases to OX^2_1.

The total increase in quantity demanded is $X^0_1X^2_1$, which is the price effect. The price effect (PE) equals substitution effect (SE) plus income effect (IE), that is,

$\qquad$ PE = SE + IE.

In order to eliminate income-effect, Hicks would like the consumer's original utility to be restored since a price fall would increase utility from I_0 to I_1. To hold utility constant at I_0 we have come to reduce consumer's money income by AC in terms of good X_2 or DB_1 in terms of good X_1. The intermediate budget line CD shows the money income required at the new price ratio P^1_1/P^0_2 as indicated by the slope of the price line AB_1 to allow the consumer to attain the level of utility achieved before the price fall. The budget line CD is tangential to the indifference curve IC_0 at N_1, the point where first and second order conditions for equilibrium are satisfied. The movement from N_0 to N_1 is Hicksian substitution effect. Consequently *the increase in quantity demanded from OX^0_1 to OX^1_1 is due to the Hicksian substitution effect.* This increase is caused by a fall in the relative price of good X_1, with real income held constant. We now restore the consumer's original money income (M_0). At the lower price of good X_1 the consumer is back on the budget line AB_1. On this budget line the consumer attains equilibrium at point N_2. The movement from N_1 to N_2 is the income-effect. The quantity demanded increases farther from OX^1_1 to OX^2_1. This increase is due to a gain in real income when price of a good X_1 falls.

Hence $\quad$ PE $= X^0_1X^2_1$

$\qquad\qquad$ SE $= X^0_1X^1_1$

$\qquad\qquad$ IE $= X^1_1X^2_1$

$\qquad\qquad$ PE = SE + IE.

$\qquad\qquad X^0_1X^2_1 = X^0_1X^1_1 + X^1_1X^2_1$

Mathematically seen, the sign of substitution effect is always negative. This is because of quantity demanded and price moving in opposite direction. The sign of income effect is also negative for normal goods. This implies when price of a good falls (rises) as a consequence of real income increases (decreases), the demand for normal good will increase (decrease). Hence via the change in real income, quantity demanded and price move in opposite direction when we consider normal goods. For inferior goods, however, the mathematical sign of income-effect will be positive, implying quantity demanded and own price will move in the same direction. For a normal good the mathematical sign of price-effect will also be negative, because price-effect is the sum of substitution effect and income- effect. Since for a normal good the quantity demanded and own price are inversely related, the demand curve for the good will be downward sloping. The price effect has a negative sign.

What happens when the good (X_1) is an inferior good? By *definition an inferior good is a good whose consumption varies inversely with real income*. That is, if price remains constant money income and real income will move in the same direction. Let us analyse the sign of PE, SE and IE.

$\quad$ We have seen that $\qquad$ PE = SE + IE

$\qquad\qquad\qquad\qquad\qquad$ PE = - ve and + ve

$\qquad\qquad\qquad\qquad\quad$ as $\quad$ PE >, =, < 0

In case of normal goods, substitution and income effects reinforce each other by working in the same direction. However, in case of inferior goods they work in the

opposite direction. Thus, substitution *effect has a negative sign while income-effect has a positive sign. The sign of price-effect will depend on which of the two effects dominate (SE or IE).* So we have the following situations:

If SE dominates and outweighs IE then the price effect will still have a negative sign. The demand curve for the inferior good is still downward sloping. The law of demand continues to be valid

If IE dominates and outweighs the negative SE, PE will have a positive sign. The law of demand is invalidated. The demand curve for the inferior good is upward sloping. This is a perverse demand curve and we get the case of Giffen *Paradox*. The goods for which demand curves are upward sloping are called Giffen Goods.

SE and IE have equal weights. The price effect is zero. The quantity demanded does not respond when price changes. The demand curve for the good is a vertical straight line parallel to the price axis.

5.14 DERIVATION OF THE DEMAND CURVE FOR A GOOD

Normal Good Case

Now we turn to derivation of demand curve for a good. We shall first consider the case of normal goods. The upper panel of Fig. 5.14 is simply a reproduction of Fig. 5.13.

When X_1 is a normal good and its price falls, demand for X_1 is increased by $X^0_1 X^2_1$ in the diagram. In the lower panel diagram the demand curve for X_1 is derived from the upper panel. In the lower panel, the horizontal axis measures the quantity demanded of X_1 as in the upper panel. However, the vertical axis in the lower panel measures the price of good X_1 given by the slopes of the budget lines. The initial price of good X_1, is given by $P^0_1 = OA/OB$; when price falls, it is given by $P^1_1 = OA/OB_1$ with $P^1_1 < P^0_1$.
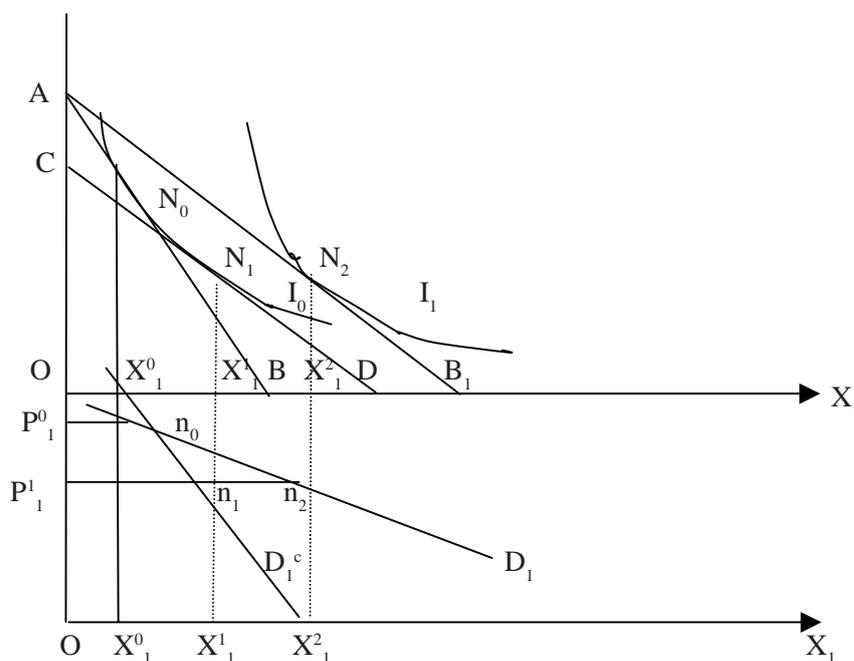

Fig. 5.14

At these prices of good X_1 the quantity demanded are OX^0_1 and OX^2_1. These are given by points n_0 and n_2 in the lower segment of Fig. 5.14. Joining points like n_0 and

n_2 we get the demand curve for X_1. We can generate more points like n_0 and n_2 by taking the other values of P_1. If X_1 is a normal good the demand curve for X_1 is downward sloping. The demand curve D_1 incorporates both the substitution effect and the income effect of a change in price of good X_1. In the lower panel there is another demand curve labelled D^c_1, which is called the compensated demand curve for X_1. The consumer is compensated for the price change through an adjustment in her money income to hold real income constant (that is, utility constant). This demand curve incorporates only the substitution effect of a price change, income-effect being eliminated via the adjustment in money income. We record the quantity demanded at points N_0 and N_1 that is, OX^0_1 and OX^1_1. This information is translated into the lower panel diagram to give us point's n_0 and n_1 when the price of good X_1 is P^0_1 and P^1_1. Joining points like n_0 and n_1 we derive the compensated demand curve for X_1. The compensated demand curve will always be downward sloping and the mathematical sign of substitution effect is always negative. Its shape does not depend on the nature on the good, whether it is normal or inferior.

5.15   INFERIOR GOOD & GIFFEN PARADOX

In case of an inferior good whose consumption falls as the consumer's real income increases, and consumption rises when real income falls. On the other hand, the *Giffen goods are goods whose consumption falls when price of the good falls, and rises when price of the good rises.* These are illustrated below in Fig. 5.15.

Inferior Good Case

AB is the initial budget line with M_0 income and P^0_1, P^0_2 as prices of X_1 and X_2. On AB the individual is in equilibrium at N_0 with quantity demanded of X_1 being OX^0_1. Let P_1 fall from P^01 with income remaining at M_0. The individual attains equilibrium at N_2 with OX^2_1 as the quantity demanded of X_1. The Hicksian substitution effect is the movement from N_0 to N_1 on indifference curve IC_0, increases the quantity demanded from OX^0_1 to OX^2_1.
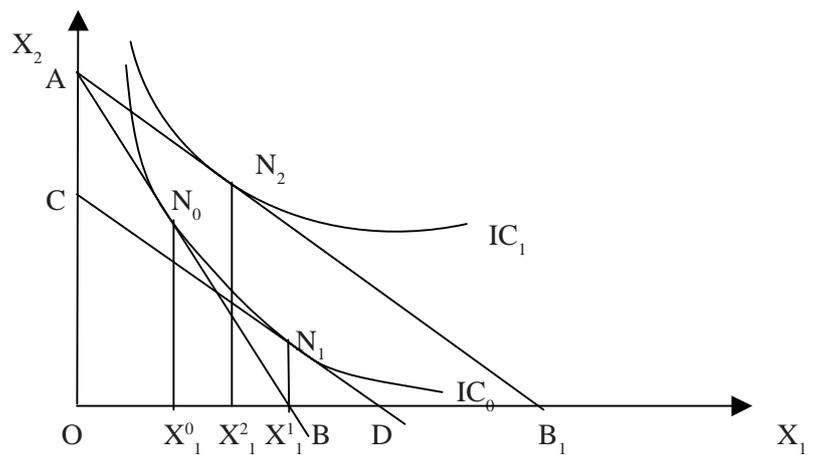

Fig. 5.15

However, in the case depicted here substitution effect dominates over income effect. Hence there is net increase in demand equal to $X^0_1 X^2_1$. The demand curve for X_1 will still be downward sloping being steeper than the demand curve for a normal good.
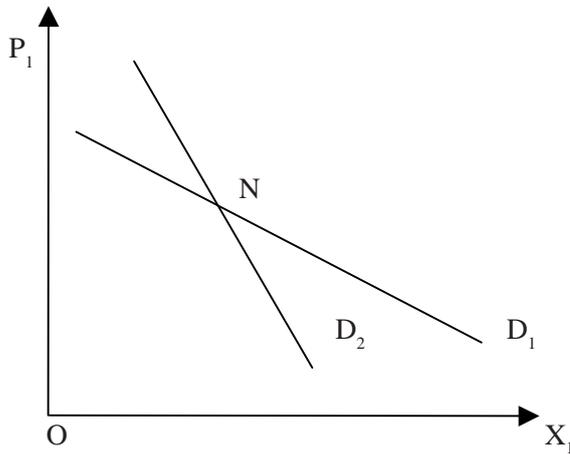
Fig. 5.15 a

D_1 is the demand curve for a normal good.

D_2 is the demand curve when X_1 is an inferior good.

The Giffen Good Case

This case is depicted in Fig. 15.16 below

In the diagram, X_1 is still an inferior good. When P_1 has fallen, the substitution effect leads to an increase in consumption from OX^0_1 to OX^1_1, by $X^0_1 X^1_1$.

The income effect leads to a decrease in consumption from OX^1_1 to OX^2_1 by $X^1_1 X^2_1$.

As you can make out from the diagram the income effect dominates over the substitution effect. As a result the quantity demanded falls as price falls. On balance demand has fallen by $X^0_1 X^2_1$. The law of demand is violated as   the demand curve for X_1 is upward sloping. This is the **Giffen** case or **Giffen paradox**. Mr. Robert Giffen, a British statistician of the late nineteenth century observed from empirical studies of household expenditures that consumers buy more of some goods (like brown meat), when price rises. Such goods are called **Giffen goods** after the name of its originator. For Giffen **Paradox** to hold, the following conditions must be met:

The income-effect must have a positive sign. Consumption of the good (X_1 in our case) falls as income rises, and rises as income falls. In other words, the good must be an **inferior good**.

(ii) The positive income-effect must outweigh the negative substitution effect to make the price effect positive. This implies   price   and quantity demanded having a positive correlation.
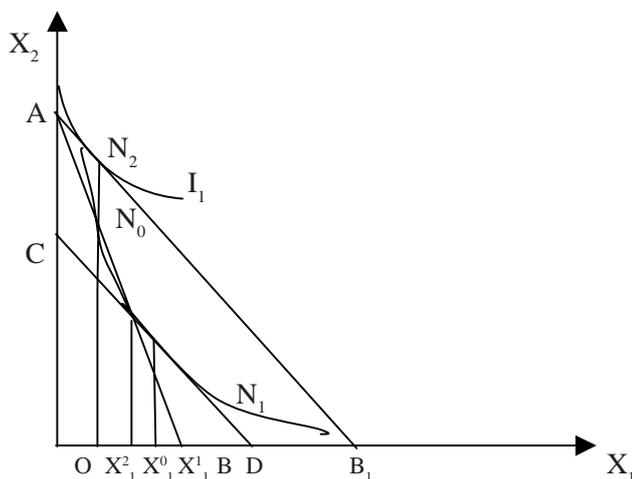

Fig. 5.16

Check Your Progress 8

1. Can complementary goods be inferior goods?

5.16 LET US SUM UP

In this unit we have covered a wide range of theme, starting from the Marshallian cardinal utility approach to demand theory. We end up with a discussion on inferior goods and Giffen paradox using the indifference curve approach. We saw how the law of eventual diminishing marginal utility formed the basis of the Marshallian explanation to the law of demand. We have also seen how the law of equi-marginal utility principle was used to derive the consumer's equilibrium condition. Though Marshall was aware of the Giffen paradox, he could not explain it, as he was unable to make a distinction between substitution effect and the income effect of a price change. The reason behind such a lapse on the part of Marshal was his assumption of constant marginal utility of money.

We have discussed the indifference curve approach in great detail. Starting from the properties of indifference curve, which reflects consumer's preferences we have tried to explain consumer's equilibrium. An important concept in this approach is the marginal rate of substitution (MRS) between any pair of commodities, as determined subjectively by consumer's preferences. It is supposed to be a psychological rate of exchange. The concept of MRS together with consumer's budget and the market prices of goods would determine the equilibrium choice for each consumer. In the Marshallian theory the second order condition of equilibrium is given by the law of eventual diminishing utility. On the other hand, in the indifference curve approach, or, Hicks-Allen approach the second order condition is given by the law of diminishing MRS. It must be noted that conceptually there is no connection between the law of diminishing marginal utility and the law of diminishing MRS.

We have also seen how in the indifference curve approach consumption of goods responds to a change in either prices or consumer's budget. From the first type of response we get the price-consumption curve while from that of the second we get the income-consumption curve. We then derived the demand curve for a good from the price-consumption curve. The shape of price consumption curve as seen would be depending on whether the good is normal, inferior or Giffen. In the same way the shape of the income consumption curve would also depend on whether the good is normal or inferior. In the last section, we have made clear the technical differences between an inferior good and a Giffen good.

5.17 KEY WORDS

Cardinal	:	The quantitative numbers used for measurements, like 1,2,3, and so on.
Consumer Equilibrium	:	A consumer attains equilibrium whenever marginal utility per rupee of expenditure is equalised on each and every good. In other words, the ratio of marginal utility to price must be equalised for each and every good, and must equal the constant marginal utility of money. This is also known as the Law of Equi-marginal Utility.
Consumer's Budget Constraint	:	A consumer given money income in conjunction with the given prices of goods defines the budget constraint. In other words, what combinations of goods are affordable is indicated by the budget constraint. It indicates what money income will buy.

Consumer's Surplus : Defined as the difference between the total prices that a consumer is willing to pay for a given quantity of a good rather than doing without it and the actual price that the consumer pays to acquire the given quantity. In other words, it is the difference between the total value of the good to the consumer and the total amount that the consumer pays on it. The concept was used by Alfred Marshall and his disciple A.C. Pigou to derive welfare propositions in economics.

Giffen Good : When consumption of a good and its own price move in the same direction, it is called a Giffen good. For such a good the demand curve is upward sloping. When price falls consumers buy less and when price rises they buy more.

Income Consumption Curve : It shows how consumption varies when a consumer's money income changes with prices of goods and preferences remaining unchanged.

Income Effect : The effect on consumption of a good when real income changes with relative price of the good unchanged. For normal goods the mathematical sign of income effect is negative whereas for inferior goods it is positive.

Inferior Good : When consumption of good changes in the opposite direction to a change in income, it is called an inferior good. For such a good, when income rises consumption falls, and when income falls consumption rises.

Indifference Curve : A curve showing the combinations of two goods, which would be equally preferred by the consumer.

Marginal Utility : Defined as additional utility per additional unit of the commodity consumed. It measures the change in total utility resulting from an extra unit of consumption of a commodity.

Marginal Rate of Substitution (MRS) : It is the psychological rate of substitution between any pair of goods defined on a given indifference curve. In other words, how much of one good the consumer must give up per unit of the other good acquired so that the consumer remains on an indifference curve. It is something, which the consumer works in her mind.

Normal Good : When consumption of good changes in the same direction as income changes it is called a normal good.

Ordinal : The numbers used to represent an ordering like 1st, 2nd and 3rd.

Price Effect : The change in consumption of a good when price of good changes with money income and price of the other good held constant.

Price-Consumption Curve : The curve that shows how consumption changes when price of a good changes with everything else unchanged including money income, prices of all other goods and

the consumer's taste.

Substitution Effect	:	The effect on consumption of a good when relative price of good changes with money income adjusted to hold real income constant. Mathematically, the sign of substitution effect is always negative.
Total Utility	:	The total satisfaction derived from consumption, which will be the sum of marginal utilities.
Utility	:	is defined as a want satisfying power of a commodity. It is the subjective sensation, which an individual derives from consuming a commodity. If such a sensation can be measured quantitatively on a numerical scale we call it cardinal utility.

5.18 SOME USEFUL BOOKS

For this unit, the books referred to in Block -1 (units 1,2,3) are useful.

5.19 ANSWERS OR HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1.

X	1	3	5	8	12
MU_x	-	5/2	13/2	12/3	16/4

Check Your Progress 2

In equilibrium $MU_x/P_x = MU_y/P_y$

Hence, 4 units of X and 3 units or Y will be consumed where X is *Roomali roti* and Y is chicken curry.

Check Your Progress 3

(i) $MU_x = P_x$ when $l = 1$ ($MU_m = 1$)

Since $MU_x = 40 - 0.5 Q_x$,

$MU_x = P_x = 40 - 0.5 Q_x$

Hence, the demand equation is

$P_x = 40 - 0.5 Q_x$

The demand schedule coincides with the MU schedule.

Check Your Progress 4

(i) (a) TU is contant

(b) MU is positive

(c) Total utility is increasing at an increasing rate

(d) MU is zero.

(ii) In equilibrium $P_x = MU_x$

Hence, 16 units of X will be demanded.

Check Your Progress 5

(i) Read section 5.8 and answer.

(ii) Budget line remains unchanged.

Check Your Progress 6

(i) MRS = - dy/ dx

7/1, 6/1, 5/1, 4/1, 3/1, 2/1, 1/1, 0.8/1, 0.7/1, 0.5/1

(ii) $P_x/P_y = 3.0/1.0 = 3.0$

In equilibrium $P_x/P_y = MRS$

and MRS = 3 when X=5, and Y=5 units.

Check Your Progress 7

(i) Read 5.11 and answer.

Check Your Progress 8

(i) No, since complementary goods are consumed together. When income increases their consumption must go up, when income falls the consumption also falls together.