Unit 2: Theory of Consumer Behaviour

Name: ____________________

Date: __/__/__

Notations and Assumptions

A consumer, in general, consumes many goods; but for simplicity, we shall consider the consumer's choice problem in a situation where there are only two goods.

We will refer to the two goods as good 1 and good 2. Any combination of the amount of the two goods will be called a consumption bundle or, in short, a bundle.

In general, we shall use the variable x_1 to denote the amount of good 1 and x_2 to denote the amount of good 2. x_1 and x_2 can be positive or zero. (x_1, x_2) would mean the bundle consisting of x_1 amount of good 1 and x_2 amount of good 2.

For values of x_1 and x_2, (x_1, x_2), would give us a bundle. For example, the bundle (5,10) consists of 5 units of good 1 and 10 units of good 2; the bundle (10, 5) consists of 10 units of good 1 and 5 units of good 2.

Consumer Budget

The consumer cannot buy any and every combination of the two goods that she may want to consume. The consumption bundles that are available to the consumer depend on the prices of the two goods and the income of the consumer. Given the fixed income and the prices of the two goods, the consumer can afford to buy only those bundles which cost less than or equal to their income.

Budget Set

Suppose the income of the consumer is M and the prices of the two goods are p_1 and p_2 respectively. If the consumer wants to buy x_1 units of good 1, she will have to spend p_1x_1 amount of money. Similarly, if the consumer wants to buy x_2 units of good 2, she will have to spend p_2x_2 amount of money.

Therefore, if the consumer wants to buy the bundle consisting of x_1 units of good 1 and x_2 units of good 2, she will have to spend $p_1x_1 + p_2x_2$ amount of money. She can buy this bundle only if she has at least $p_1x_1 + p_2x_2$ amount of money. Given the prices of the goods and the income of a consumer, she can choose any bundle if it costs less than or equal to the income she has. In other words, the consumer can buy any bundle (x_1, x_2) such that

$$p_1x_1 + p_2x_2 \leq M$$

The inequality is called the consumer's budget constraint. The set of bundles available to the consumer is called the budget set. The budget set is thus the collection of all bundles that the consumer can buy with her income at the prevailing market prices.

Budget Line

If both the goods are perfectly divisible4, the consumer's budget set would consist of all bundles (x_1, x_2) such that x_1 and x_2 are any numbers greater than or equal to 0 and $p_1x_1 + p_2x_2 \leq M$.

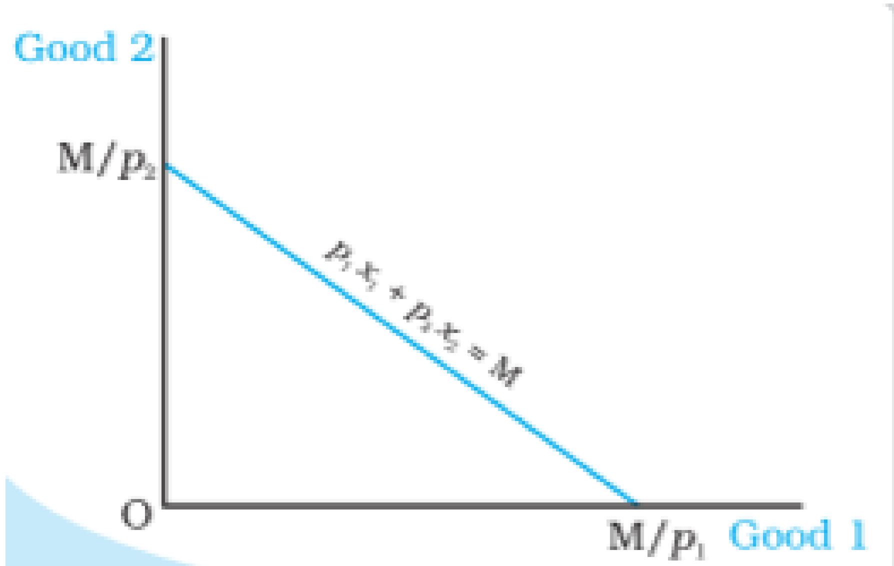
All bundles in the positive quadrant which are on or below the line are included in the budget set. The equation of the line is

$$p_1x_1 + p_2x_2 = M$$

The line consists of all bundles which cost exactly equal to M. This line is called the budget line. Points below the budget line represent bundles which cost strictly less than M. This can also be written as

$$x_2 = \frac{M}{p_2} - \frac{p_1}{p_2}x_1$$

The budget line is a straight line with horizontal intercept M/p_1 and vertical intercept M/p_2. The horizontal intercept represents the bundle that the consumer can buy if she spends her entire income on good 1. Similarly, the vertical intercept represents the bundle that the consumer can buy if she spends her entire income on good 2. The slope of the budget line is $-p_1/p_2$



Price Ratio and the Slope of the Budget Line

Think of any point on the budget line. Such a point represents a bundle which costs the consumer her entire budget. Now suppose the consumer wants to have one more unit of good 1. She can do it only if she gives up some amount of the other good.

A unit of good 1 costs p_1. Therefore, she will have to reduce her expenditure on good 2 by p_1 amount. With p1, she could buy p_1/p_2 units of good 2. Therefore, if the consumer wants to have an extra unit of good 1 when she is spending all her money, she will have to give up p_1/p_2 units of good 2.

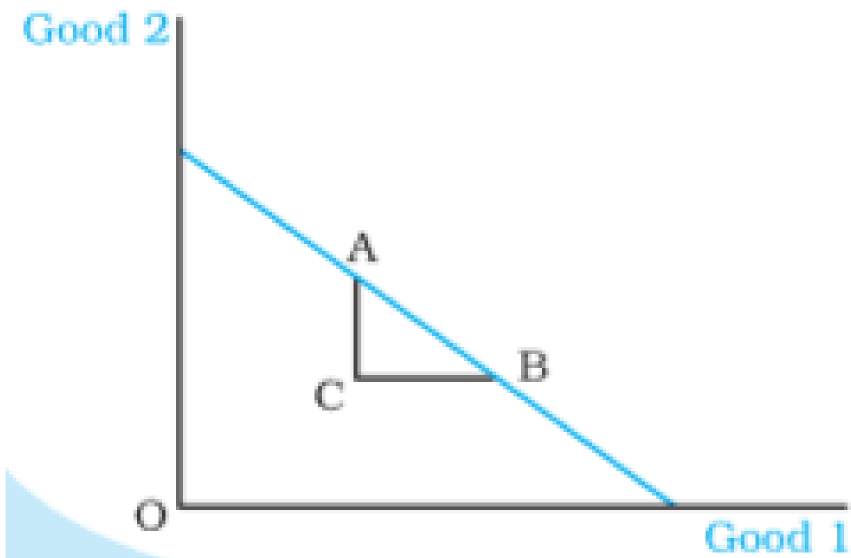
In other words, in the given market conditions, the consumer can substitute good 1 for good 2 at the rate p_1/p_2. The absolute value of the slope of the budget line measures the rate at which the consumer can substitute good 1 for good 2 when she spends her entire budget.

Points Below the Budget Line

Consider any point below the budget line. Such a point represents a bundle which costs less than the consumer's income. Thus, if the consumer buys such a bundle, she will have some money left over. Compared to a point below the budget line, there is always some bundle on the budget line which contains more of at least one of the goods and no less of the other.

The point C lies below the budget line while points A and B lie on the budget line. Point A contains more of good 2 and the same amount of good as compared to point C.

Point B contains more of good 1 and the same amount of good 2 as compared to point C. Any other point on the line segment 'AB' represents a bundle which has more of both the goods compared to C.



Changes in Budget Set (When Consumer Income Changes)

The set of available bundles depends on the prices of the two goods and the income of the consumer. When the price of either of the goods or the consumer's income changes, the set of available bundles is also likely to change.

Suppose the consumer's income changes from M to M′ but the prices of the two goods remain unchanged. With the new income, the consumer can afford to buy all bundles (x_1; x_2) such that $p_1x_1 + p_2x_2 \leq M'$. Now the equation of the budget line is

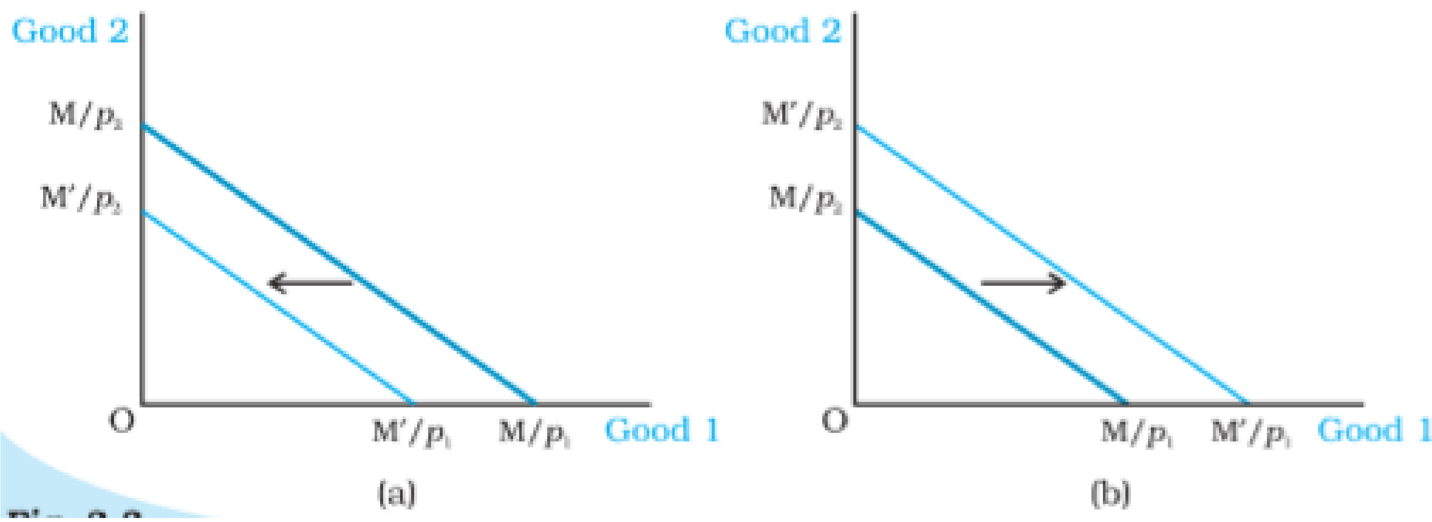
$$p_1x_1 + p_2x_2 = M'$$

It can also be written as

$$x_2 = \frac{M'}{p_2} - \frac{p_1}{p_2}x_1$$

If there is an increase in the income, ie if M' > M, the vertical intercept increases, and hence, there is a parallel outward shift of the budget line. If the income increases, the consumer can buy more of the goods at the prevailing market prices. (Diagram A)

Similarly, if the income goes down, ie if M' < M, the vertical intercept decreases, and hence, there is a parallel inward shift of the budget line. If income goes down, the availability of goods goes down (diagram B)



Changes in Budget Line (Changes in Prices of Good)

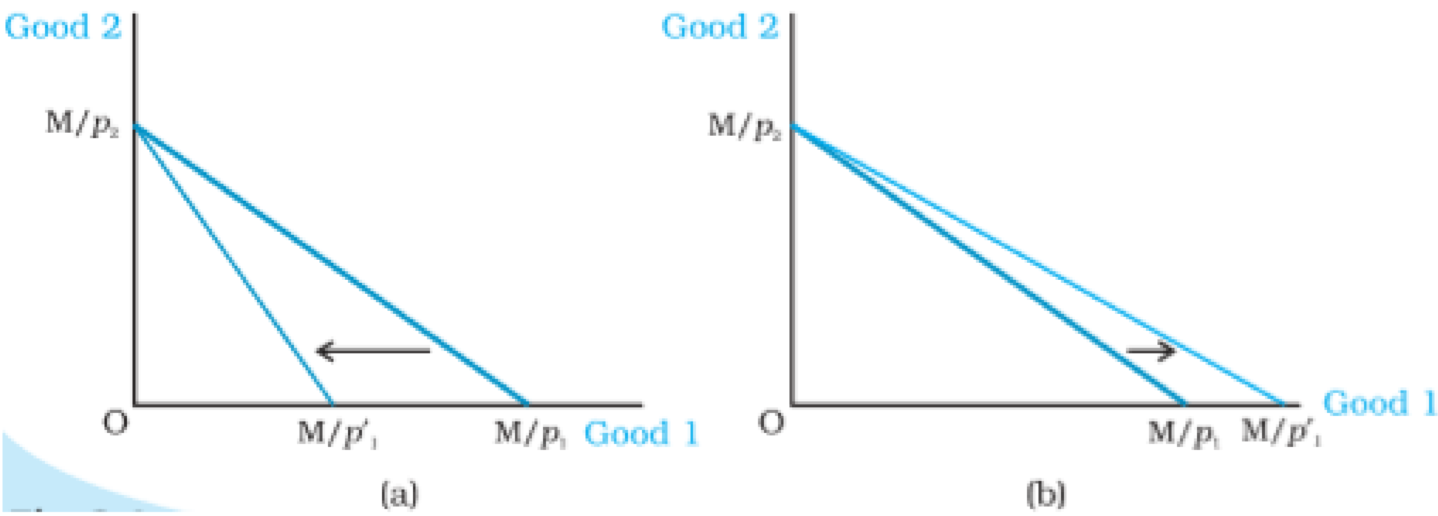
Now suppose the price of good 1 changes from p_1 to p'_1 but the price of good 2 and the consumer's income remain unchanged. At the new price of good 1, the consumer can afford to buy all bundles (x_1, x_2) such that $p'_1x_1 + p_2x_2 \leq M$. The equation of the budget line is

$$p_1'x_1 + p_2x_2 = M$$

It can also be written as

$$x_2 = \frac{M}{p_2} - \frac{p_1'}{p_2}x_1$$

The slope of the budget line has changed after the price change. If the price of good 1 increases, ie if $p'_1 > p_1$, the absolute value of the slope of the budget line increases, and the budget line becomes steeper (it pivots inwards around the vertical intercept). If the price of good 1 decreases, i.e., $p'_1 < p_1$, the absolute value of the slope of the budget line decreases and hence, the budget line becomes flatter (it pivots outwards around the vertical intercept.



Preferences of The Consumer

In economics, it is assumed that the consumer chooses her consumption bundle based on her tastes and preferences over the bundles in the budget set. It is generally assumed that the consumer has well-defined preferences to the set of all possible bundles. She can compare any two bundles. In other words, between any two bundles, she either prefers one to the other or she is indifferent to the two. Furthermore, it is assumed that the consumer can rank the bundles in order of her preferences over them.

Bundle	**Preference**
(2, 2)	First
(1, 3) (3, 1)	Second
(1, 2) (2, 1)	Third
(1, 1)	Fourth
(0, 0) (0, 1) (0, 2) (0, 3) (0, 4) (1, 0) (2, 0) (3, 0) (4, 0)	Fifth

Monotonic Preferences

Consumer's preferences are assumed to be such that between any two bundles (x1, x2) and (y1, y2), if (x1, x2) has more of at least one of the goods and no less of the other good as compared to (y1, y2), the consumer prefers (x1, x2) to (y1, y2). Preferences of this kind are called monotonic preferences. Thus, a consumer's preferences are monotonic if and only if between any two bundles, the consumer prefers the bundle which has more of at least one of the goods and no less of the other good as compared to the other bundle.

Consider the bundle (2, 2). This bundle has more of both goods compared to (1, 1); it has equal amount of good 1 but more of good 2 compared to the bundle (2, 1) and compared to (1, 2), it has more of good 1 and equal amount of good 2. If a consumer has monotonic preferences, she would prefer the bundle (2, 2) to all the three bundles (1, 1), (2, 1) and (1, 2).

Substitution Between Goods

Consider two bundles such that one bundle has more of the first good as compared to the other bundle. If the consumer's preferences are monotonic, these two bundles can be indifferent only if the bundle having more of the first good has less of good 2 as compared to the other bundle. Suppose a consumer is indifferent between two bundles (x_1, x_2) and $(x_1 + \Delta x_1, x_2 + \Delta x_2)$. Monotonicity of preferences implies that if $\Delta x_1 > 0$ then $\Delta x_2 < 0$, and if $\Delta x_1 < 0$ then $\Delta x_2 > 0$; the consumer can move from (x_1, x_2) to $(x_1 + \Delta x_1, x_2+\Delta x_2)$ by substituting one good for the other.

The rate of substitution between good 2 and good 1 is given by the absolute value of $\Delta x_2/\Delta x_1$. The rate of substitution is the amount of good 2 that the consumer is willing to give up for an extra unit of good 1. It measures the consumer's willingness to pay for good 1 in terms of good 2. Thus, the rate of substitution between the two goods captures a very important aspect of the consumer's preference.

A consumer is indifferent to the bundles (1, 2) and (2, 1). At (1, 2), the consumer is willing to give up 1 unit of good 2 if she gets 1 extra unit of good 1. Thus, the rate of substitution between good 2 and good 1 is 1.

Diminishing Rate of Substitution

The consumer's preferences are assumed to be such that she has more of good 1 and less of good 2, the amount of good 2 that she would be willing to give up for an additional unit of good 1 would go down. The consumer's willingness to pay for good 1 in terms of good 2 would go on declining as she has more and more of good 1

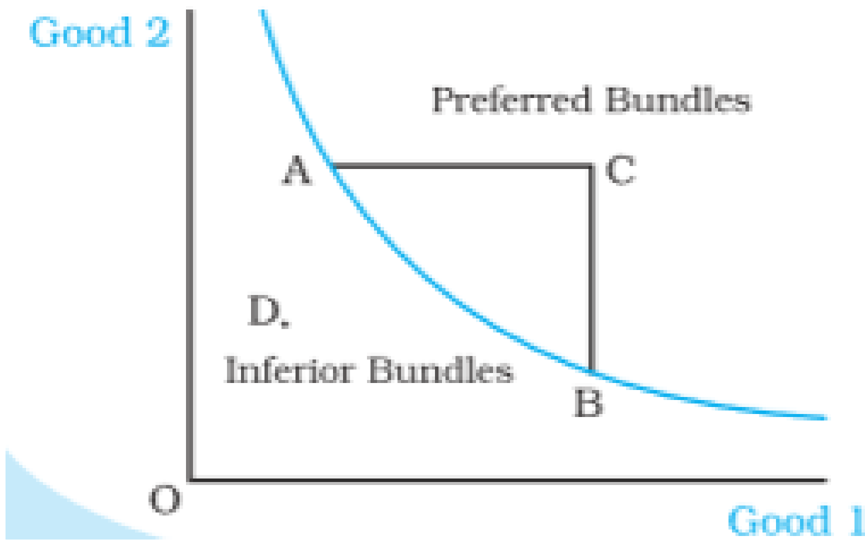
Indifference Curve

A consumer's preferences to the set of available bundles can often be represented diagrammatically. We have already seen that the bundles available to the consumer can be plotted as points in a two-dimensional diagram.

Such a curve joining all points representing bundles among which the consumer is indifferent is called an indifference curve. Consider a point above the indifference curve. Such a point has more of at least one of the goods and no less of the other good as compared to at least one point on the indifference curve.

The point C lies above the indifference curve while points A and B lie on the indifference curve. Point C contains more of good 1 and the same amount of good 2 as compared to A. Compared to point B, C contains more of good 2 and the same amount of good 1. And it has more of both the goods compared to any other point on the segment AB of the indifference curve.

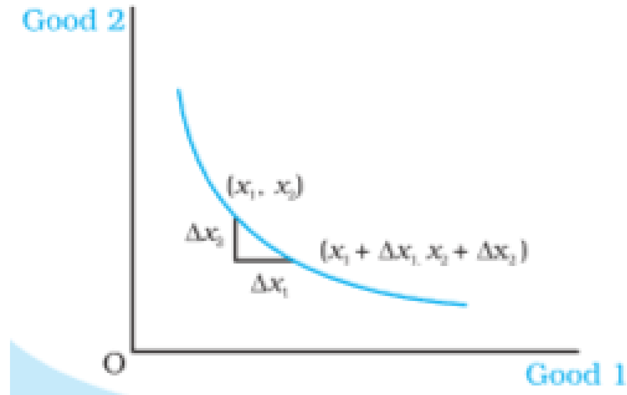
If preferences are monotonic, the bundle represented by the point C would be preferred to bundle represented by points on the segment AB, and hence, it would be preferred to all bundles on the indifference curve



Shape of the Indifference Curve

Think of any two points (x_1, x_2) and $(x_1 + \Delta x_1, x_2 + \Delta x_2)$ on the indifference curve. Consider a movement from (x_1, x_2) to $(x_1 + \Delta x_1, x_2 + \Delta x_2)$ along the indifference curve. The slope of the straight line joining these two points gives the change in the amount of good 2 corresponding to a unit change in good 1 along the indifference curve. Thus, the absolute value of the slope of the straight line joining these two points gives the rate of substitution between (x1, x2) and (x1 + Δx_1, x_2 + Δx_2).

For very small changes, the slope of the line joining the two points (x_1, x_2) and $(x_1 + \Delta x_1, x_2 + \Delta x2)$ reduces to the slope of the indifference curve at (x_1, x_2). Thus, for very small changes, the absolute value of the slope of the indifference curve at any point measures the rate of substitution of the consumer at that point. Usually, for small changes, the rate of substitution between good 2 and good 1 is called the marginal rate of substitution (MRS).

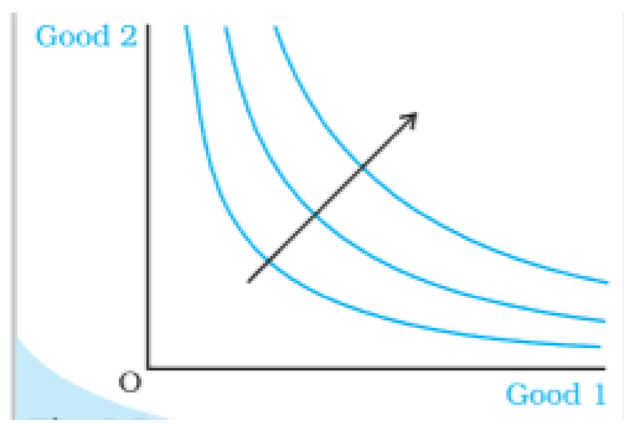


Indifference Map

The consumer's preferences over all the bundles can be represented by a family of indifference curves as shown in the diagram. This is called an indifference map of the consumer.

All points on an indifference curve represent bundles which are considered indifferent by the consumer.

Monotonicity of preferences imply that between any two indifference curves, the bundles on the one which lies above are preferred to the bundles on the one which lies below.



Utility

Often it is possible to represent preferences by assigning numbers to bundles in a way such that the ranking of bundles is preserved. Preserving the ranking would require assigning the same number to indifferent bundles and higher numbers to preferred bundles. The numbers thus assigned to the bundles are called the utilities of the bundles; and the representation of preferences in terms of the utility numbers is called a utility function or a utility representation.

Bundle	U_1	U_2
(2, 2)	5	40
(1, 3) (3, 1)	4	35
(1, 2) (2, 1)	3	28
(1, 1)	2	20
(0, 0) (0, 1) (0, 2) (0, 3) (0, 4) (1, 0) (2, 0) (3, 0) (4, 0)	1	10

Optimal Choice of the Consumer

From the bundles which are available to her, a rational consumer always chooses the one which she prefers the most.

Among the bundles that are available to her, (2, 2) is her most preferred bundle. Therefore, as a rational consumer, she would choose the bundle (2, 2).

Where on the budget line will the optimum bundle be located? The point at which the budget line just touches (is tangent to), one of the indifference curves would be the optimum.

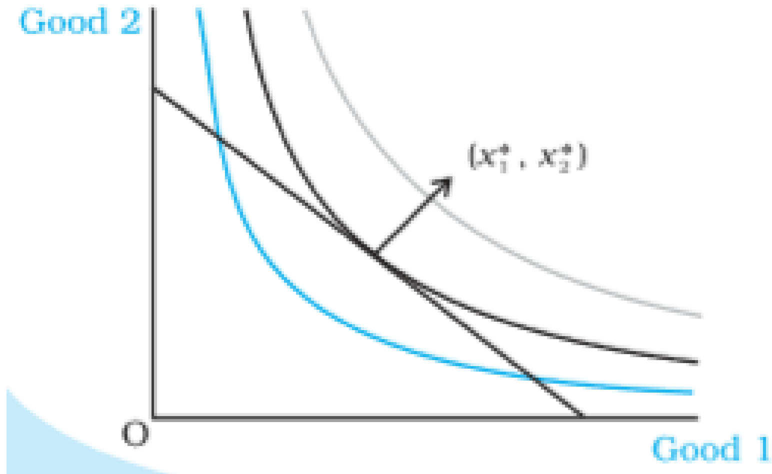
To see why this is so, note that any point on the budget line other than the point at which it touches the indifference curve lies on a lower indifference curve and hence is inferior.

Therefore, such a point cannot be the consumer's optimum. The optimum bundle is located on the budget line at the point where the budget line is tangent to an indifference curve.

At (x^*_1, x^*_2), the budget line is tangent to the black coloured indifference curve. The first thing to note is that the indifference curve just touching the budget line is the highest possible indifference curve given the consumer's budget set.

Bundles on the indifference curves above this, like the grey one, are not affordable. Points on the indifference curves below this, like the blue one, are certainly inferior to the points on the indifference curve, just touching the budget line.

Any other point on the budget line lies on a lower indifference curve and hence, is inferior to (x^*_1, x^*_2). Therefore, (x^*_1, x^*_2) is the consumer's optimum bundle.



Demand

Meaning of Demand

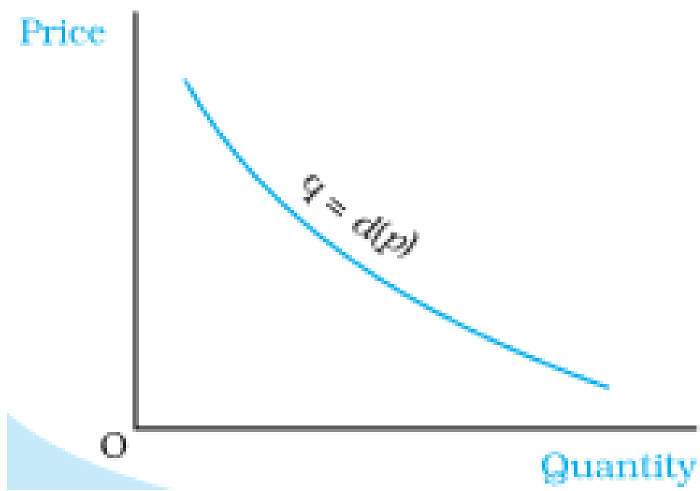
Demand refers to the consumer's ability to buy and willingness to pay for a good.

Demand Curve and the Law of Demand

If the prices of other goods, the consumer's income and her tastes and preferences remain unchanged, the amount of a good that the consumer optimally chooses, becomes entirely dependent on its price. The relation between the consumer's optimal choice of the quantity of a good and its price is very important, and this relation is called the demand function. The consumer's demand for a good as a function of its price can be written as

$$q = d(p)$$

where q denotes the quantity and p denotes the price of the good. The graphical representation of the demand function is called the demand curve.



Consider a consumer whose income is M and let the prices of the two goods be p1 and p2. Suppose, in this situation, the optimum bundle of the consumer is (x^*_1, x^*_2).

Now, consider a fall in the price of good 1 by the amount Δp_1. The new price of good 1 is $(p_1 - \Delta p_1)$. Note that the price change has two effects

(i) Good 1 becomes relatively cheaper than good 2 as compared to what it was before.

(ii) The purchasing power of the consumer increases. The price change, in general, allows the consumer to buy more goods with the same amount of money as before. She can buy the bundle which she was buying before by spending less than M.

Both these effects of the price change, the change in the purchasing power and the change in the relative price, are likely to influence the consumer's optimal choice. To find out how the consumer would react to the change in the relative price, let us suppose that her purchasing power is adjusted in a way such that she can just afford to buy the bundle (x*1, x*2). At the prices $(p_1 - \Delta p_1)$ and p_2, the bundle (x^*_1, x^*_2) costs $(p_1 - \Delta p_1)\, x^*_1 + p_2 x^*_2$

$$p_1 x_1^* + p_2 x_2^* - \Delta p_1 x_1^*$$

$$= M - \Delta p_1 x_1^*$$

Therefore, if the consumer's income is reduced by the amount $\Delta p_1 x^*_1$ after the fall in the price of good 1, her purchasing power is adjusted to the initial level.9 Suppose, at prices $(p_1 - \Delta p_1)$, p_2 and income $(M - \Delta p_1 x^*_1)$, the consumer's optimum bundle is (x^{**}_1, x^{**}_2) must be greater than or equal to x^*_1.

Law of Demand

If a consumer's demand for good moves in the same direction as the consumer's income, the consumer's demand for that good must be inversely related to the price of the good.

Normal Goods and Inferior Goods

The demand function is a relation between the consumer's demand for a good and its price when other things are given. Instead of studying the relation between the demand for a good and its price, we can also study the relation between the consumer's demand for the good and the income of the consumer.

The quantity of a good that the consumer demands can increase or decrease with the rise in income depending on the nature of the good. For most goods, the quantity that a consumer chooses, increases as the consumer's income increases and decreases as the consumer's income decreases. Such goods are called normal goods. Thus, a consumer's demand for a normal good move in the same direction as the income of the consumer. However, there are some goods the demands for which move in the opposite direction of the income of the consumer. Such goods are called inferior goods.

Substitutes and Complements

We can also study the relation between the quantity of a good that a consumer chooses and the price of a related good. The quantity of a good that the consumer chooses can increase or decrease with the rise in the price of a related good depending on whether the two goods are substitutes or complementary to each other. Goods which are consumed together are called complementary goods.

Examples of goods which are complement to each other include tea and sugar, shoes and socks, pen, and ink, etc. Since tea and sugar are used together, an increase in the price of sugar is likely to decrease the demand for tea and a decrease in the price of sugar is likely to increase the demand for tea. Similar is the case with other complements. In general, the demand for good moves in the opposite direction of the price of its complementary goods.

Shifts in The Demand Curve

Given the prices of other goods and the preferences of a consumer, if the income increases, the demand for the good at each price changes, and hence, there is a shift in the demand curve. For normal goods, the demand curve shifts rightward and for inferior goods, the demand curve shifts leftward.

Given the consumer's income and her preferences, if the price of a related good changes, the demand for a good at each level of its price changes, and hence, there is a shift in the demand curve. If there is an increase in the price of a substitute good, the demand curve shifts rightward. On the other hand, if there is an increase in the price of a complementary good, the demand curve shifts leftward.

Movements along the Demand Curve and Shifts in the Demand Curve

As it has been noted earlier, the amount of a good that the consumer chooses depends on the price of the good, the prices of other goods, income of the consumer and her tastes and preferences. The demand function is a relation between the amount of the good and its price when other things remain unchanged.

The demand curve is a graphical representation of the demand function. At higher prices, the demand is less, and at lower prices, the demand is more. Thus, any change in the price leads to movements along the demand curve. On the other hand, changes in any of the other things lead to a shift in the demand curve.

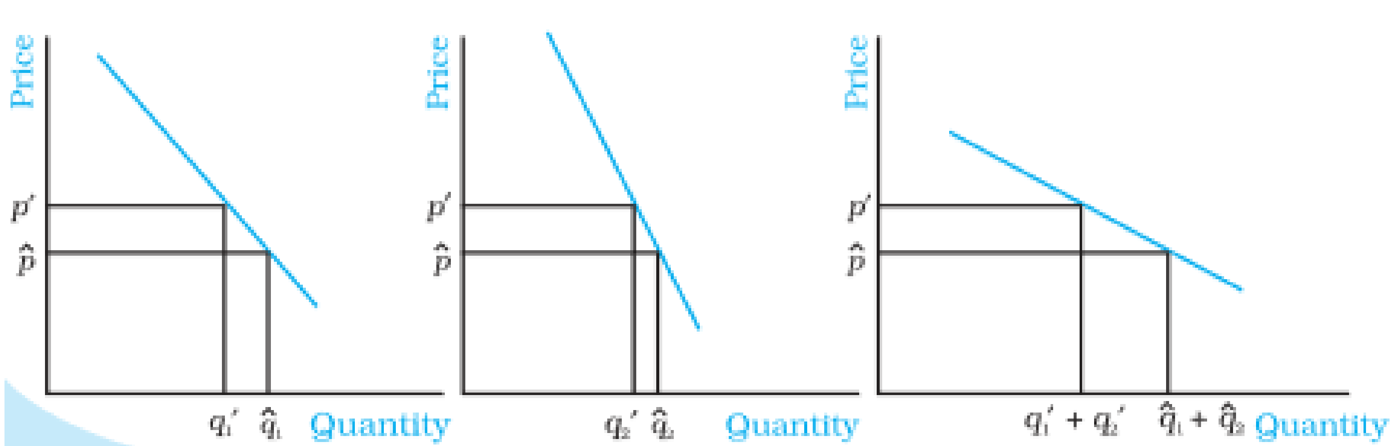
Market Demand

The market demand for a good can be derived from the individual demand curves. Suppose there are only two consumers in the market for a good. Suppose at price p′, the demand of consumer 1 is q'_1 and that of consumer 2 is q'_2.

Then, the market demand of the good at p′ is $q'_1 + q'_2$. Similarly, at price $\hat{p}$, if the demand of consumer 1 is $\widehat{p1}$ and that of consumer 2 is 2 $\widehat{q2}$, the market demand of the good at $\hat{p}$ is $\widehat{q1} + \widehat{q2}$.

Thus, the market demand for the good at each price can be derived by adding up the demands of the two consumers at that price. If there are more than two consumers in the market for a good, the market demand can be derived similarly.

The market demand curve of a good can also be derived from the individual demand curves graphically by adding up the individual demand curves horizontally as shown in the diagram. This method of adding two curves is called horizontal summation.



Elasticity of Demand

The demand for good moves in the opposite direction of its price. Sometimes, the demand for good changes considerably even for small price changes. On the other hand, there are some goods for which the demand is not affected much by price changes. Demands for some goods are very responsive to price changes while demands for certain others are not so responsive to price changes.

Price elasticity of demand is given as:

$$e_D = \frac{percentage\ change\ in\ demand\ for\ the\ good}{percentage\ change\ in\ the\ price\ of\ the\ good}$$

Consider the demand curve of a good. Suppose at price p0, the demand for the good is q^0 and at price p^1, the demand for the good is q1. If price changes from p^0 to p^1, the change in the price of the good is, $\Delta p = p^1 - p^0$, and the change in the quantity of the good is, $\Delta q = q^1 - q^0$. The percentage change in price can also be written as

$$e_D = \frac{\frac{(q^1 - q^0)}{q^0}}{\frac{(p^1 - p^0)}{p^0}}$$

1. If at some price, the percentage change in demand for a good is less than the percentage change in the price, then $|e_D| < 1$ and demand for the good is said to be inelastic at that price.
2. If at some price, the percentage change in demand for a good is equal to the percentage change in the price, $|e_D| = 1$, and demand for the good is said to be unitary elastic at that price.
3. If at some price, the percentage change in demand for a good is greater than the percentage change in the price, then $|e_D| > 1$, and demand for the good is said to be elastic at that price.

Elasticity Along a Linear Demand Curve

Let us consider a linear demand curve q = a – bp. Note that at any point on the demand curve, the change in demand per unit change in the price is

$$\frac{\Delta q}{\Delta p} = -b$$

If we substitute the above in the bottom equation

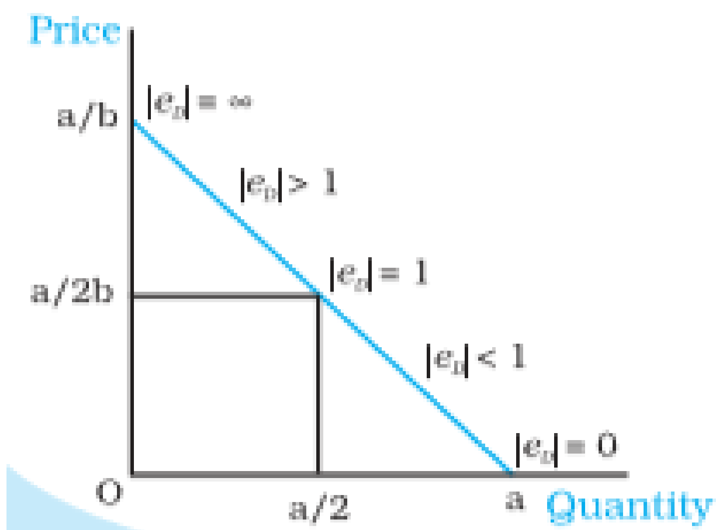
$$e_D = \frac{\frac{(q^1 - q^0)}{q^0}}{\frac{(p^1 - p^0)}{p^0}}$$

We get

$$e_D = -b\frac{p}{q} = -\frac{bp}{a - bp}$$

The elasticity of demand is different at different points on a linear demand curve. At p = 0, the elasticity is 0,

1. At q = 0, elasticity is ∞.
2. At p = a/2b, the elasticity is 1,
3. At any price greater than 0 and less than a/2b, elasticity is less than 1,
4. At any price greater than a/2b, elasticity is greater than 1



Factors Determining Price Elasticity of Demand for a Good

The price elasticity of demand for a good depends on the nature of the good and the availability of close substitutes of the good. Consider, for example, necessities like food. Such goods are essential for life and the demands for such goods do not change much in response to changes in their prices. Demand for food does not change much even if food prices go up.

On the other hand, demand for luxuries can be very responsive to price changes. In general, demand for a necessity is likely to be price inelastic while demand for a luxury good is likely to be price elastic.

Though demand for food is inelastic, the demands for specific food items are likely to be more elastic. For example, think of a variety of pulses. If the price of this variety of pulses goes up, people can shift to some other variety of pulses which is a close substitute.

The demand for a good is likely to be elastic if close substitutes are easily available. On the other hand, if close substitutes are not available easily, the demand for a good is likely to be inelastic.