

QUESTIONS FOR PRACTICE SOLUTIONS

PART A: STATISTICS FOR ECONOMICS

Chapter-1:

Measures of Dispersion

1. What is meant by standard deviation? State the formula for its calculation.

Ans. Standard deviation is the square root of the arithmetic mean of the squares of deviations of the items from their mean value. This is generally denoted by sigma (σ) of the Greek language. Standard deviation is a most satisfactory scientific method of dispersion. Accordingly, it is a widely used method in statistical analysis. In the words of **Spiegel**, "The Standard deviation is the square root of the arithmetic mean of the squares of all deviations. Deviations being measured from arithmetic mean of the items." In the calculation of standard deviation, deviations are taken only from the mean value of the series and signs of deviations (+) or (-) are not ignored.

$$\sigma = \sqrt{\frac{\sum fdx'^2}{N} - \left(\frac{\sum fdx'}{N}\right)^2} \times C$$

2. Distinguish between absolute and relative measures of dispersion.

Ans.

S. no.	Basis	Absolute dispersion	Relative dispersion
1.	Define	When dispersion of a series is expressed in terms of the original unit of the series, it is called the absolute measure of dispersion.	The relative measure of dispersion expresses the variability of data in terms of some relative value or percentage.
2.	Methods	Range, quartile Deviation, Inter Quartile Deviation, Mean Deviation, Standard Deviation, Lorenz curve.	Coefficient of Range, Coefficient of quartile Deviation, Coefficient of Mean Deviation, Coefficient of Standard Deviation, Coefficient of variation.

3. Critically analyse standard deviation as a measure of dispersion.

Ans. The main merits of standard deviation are as follows:

- (i) **Based on all Values:** It is a comprehensive measure of dispersion as it is based on all the values of a series and does not ignore any value.
- (ii) **Certain Measure:** It is clear and certain measure of dispersion. Therefore, it can be used in all situations.
- (iii) **Little Effect of a Change in Sample:** Change in sample has little effect on standard deviation. This is because deviation is based on all the values of a sample.
- (iv) **Algebraic Treatment:** It is capable of further algebraic treatment.

The main demerits of standard deviation are as follows:

- (i) **Difficult:** It is difficult to calculate and make use of standard deviation as a measure of dispersion.

(ii) **Importance to Extreme Values:** In the calculation of standard deviation, extreme values tend to get greater importance.

4. State the formula for calculating standard deviation using assumed mean method in case of discrete series.

Ans. The following steps are to be followed to calculate standard deviation using Assumed Mean Method for the discrete series:

- (i) We take any value of the series as assumed average, written as A. Generally, the value of the item with the highest frequency is taken as assumed average.
- (ii) Deviations of different items from assumed average are obtained as $dx = (X - A)$.
- (iii) Deviations are multiplied by their corresponding frequencies and then sum total is obtained as $\sum fdx$. Also, deviations are squared (dx^2) and multiplied by the corresponding frequencies to obtain $\sum fdx^2$.
- (iv) The following formula is applied to calculate the value of standard deviation:

$$\sigma = \sqrt{\frac{\sum fdx^2}{N} - \left(\frac{\sum fdx}{N}\right)^2}$$

5. What is meant by coefficient of variation? How is it calculated?

Ans. Coefficient of variation is 100 times the coefficient of dispersion based on standard deviation of a statistical series. It is used to compare the variability, homogeneity, stability and uniformity of two different statistical series. Higher the value of the coefficient of variation, greater is the degree of variability and lower is the degree of stability. On the other hand, a lower value of coefficient of variation suggests lower degree of variability and higher degree of stability, uniformity, homogeneity and consistency.

In order to calculate coefficient of variation, standard deviation of the series is divided by mean of the series and multiplied by 100. It is estimated using the following formula:

$$\begin{aligned} \text{Coefficient of Variation} &= \frac{\sigma}{\bar{X}} \times 100 \\ &= \text{Coefficient of Standard Deviation} \times 100 \end{aligned}$$

6. Find standard deviation for the monthly wages of 10 workers, as given below:

S. No. of Workers	1	2	3	4	5	6	7	8	9	10
Wages	43	48	65	57	31	60	37	48	78	59

Sol.

Calculation of Standard Deviation by the Assumed Mean Method

S. No.	Wages (X)	(X - 50) d	d ²
1	43	-7	49
2	48	-2	4
3	65	+15	225
4	57	+7	49
5	31	-19	361
6	60	+10	100
7	37	-13	169
8	48	-2	4
9	78	+28	784
10	59	+9	81
N = 10	$\sum X = 526$	$\sum d = 26$	$\sum d^2 = 1,826$

$$\sigma = \sqrt{\frac{\Sigma d^2}{N} - \left(\frac{\Sigma d}{N}\right)^2}$$

$$\Sigma d^2 = 1,826, \Sigma d = 26, N = 10$$

$$= \sqrt{\frac{1,826}{10} - \left(\frac{26}{10}\right)^2}$$

$$= \sqrt{182.6 - 6.76} = \sqrt{175.84} = 13.26$$

7. Using step-deviation method, calculate standard deviation of the following series:

Size	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Frequency	30	58	62	85	112	70	57	26

Sol.

X	m	f	$\frac{(m - 55)}{10} = d'$	fd'	fd' ²
20-30	25	30	-3	-90	270
30-40	35	58	-2	-116	232
40-50	45	62	-1	-62	62
50-60	55	85	0	0	0
60-70	65	112	1	+112	112
70-80	75	70	+2	+140	280
80-90	85	57	+3	+171	513
90-100	95	26	+4	+104	416
		N = 500		$\Sigma fd' = 259$	$\Sigma fd'^2 = 1,885$

$$\sigma = \sqrt{\frac{\Sigma fd'^2}{N} - \left(\frac{\Sigma fd'}{N}\right)^2} \times i$$

$$\Sigma fd'^2 = 1,885, \Sigma fd' = 259, N = 500$$

$$= \sqrt{\frac{1,885}{500} - \left(\frac{259}{500}\right)^2} \times 10$$

$$= \sqrt{3.77 - 0.268} \times 10 = \sqrt{3.502} \times 10$$

$$= 1.871 \times 10 = 18.71$$

8. The number of students, the mean marks and standard deviation in each section of Class XII are given below. Calculate combined mean and standard deviation of all the students.

Section	No. of Students	Mean Marks	Standard Deviation
A	50	113	6
B	60	120	7
C	90	115	8

Sol.

$$X_{123} = \frac{N_1 \bar{X}_1 + N_2 \bar{X}_2 + N_3 \bar{X}_3}{N_1 + N_2 + N_3}$$

$$= \frac{(50 \times 113) + (60 \times 120) + (90 \times 115)}{50 + 60 + 90}$$

$$= \frac{5,650 + 7,200 + 10,350}{200}$$

$$= \frac{23,200}{200} = ₹ 116$$

Combined standard deviation of three series:

$$\sigma_{123} = \sqrt{\frac{N_1\sigma_1^2 + N_2\sigma_2^2 + N_3\sigma_3^2 + N_1d_1^2 + N_2d_2^2 + N_3d_3^2}{N_1 + N_2 + N_3}}$$

$$d_1 = \bar{X}_1 - \bar{X}_{123} = 113 - 116 = -3$$

$$d_2 = \bar{X}_2 - \bar{X}_{123} = 120 - 116 = 4$$

$$d_3 = \bar{X}_3 - \bar{X}_{123} = 115 - 116 = -1$$

$$\sigma_{123} = \sqrt{\frac{50(6)^2 + 60(7)^2 + 90(8)^2 + 50(-3)^2 + 60(4)^2 + 90(-1)^2}{50 + 60 + 90}}$$

$$= \sqrt{\frac{1,800 + 2,940 + 5,760 + 450 + 960 + 90}{200}}$$

$$= \sqrt{\frac{12,000}{200}} = \sqrt{60}$$

$$= 7.75$$

9. From the data given below, state which of the two is more consistent?

Class Interval	Frequency for series A	Frequency for series B
10-20	10	18
20-30	18	22
30-40	32	40
40-50	40	32
50-60	22	18
60-70	18	10

Sol.

Calculation of Coefficient of Variation (Series A)

Class Interval	f_A	m	$\frac{(m - 45)}{10} = d'$	fd'	fd'^2
10-20	10	15	-3	-30	90
20-30	18	25	-2	-36	72
30-40	32	35	-1	-32	32
40-50	40	45	0	0	0
50-60	22	55	+1	+22	22
60-70	18	65	+2	+36	72
	$N = 140$			$\Sigma fd' = -40$	$\Sigma fd'^2 = 288$

Calculation of Mean:

$$\bar{X} = A + \frac{\Sigma fd'}{N} \times i$$

$$= 45 - \frac{40}{140} \times 10$$

$$= 45 - 2.86$$

$$= 42.14$$

Calculation of standard deviation:

$$\begin{aligned}\sigma &= \sqrt{\frac{\sum fd'^2}{N} - \left(\frac{\sum fd'}{N}\right)^2} \times i \\ &= \sqrt{\frac{288}{140} - \left(\frac{-40}{140}\right)^2} \times 10 \\ &= \sqrt{2.057 - 0.082} \times 10 \\ &= \sqrt{1.975} \times 10 \\ &= 1.405 \times 10 = 14.05\end{aligned}$$

$$\begin{aligned}\text{C.V.} &= \frac{\sigma}{\bar{X}} \times 100 \\ &= \frac{14.05}{42.14} \times 100 = 33.34 \text{ per cent}\end{aligned}$$

Sol.**Calculation of Coefficient of Variation (Series B)**

Frequency	f_B	m	$\frac{(m - 45)}{10} = d'$	fd'	fd'^2
10-20	18	15	-3	-54	162
20-30	22	25	-2	-44	88
30-40	40	35	-1	-40	40
40-50	32	45	0	0	0
50-60	18	55	+1	+18	18
60-70	10	65	+2	+20	40
	$N = 140$			$\sum fd' = -100$	$\sum fd'^2 = 348$

Calculation of Mean:

$$\begin{aligned}\bar{X} &= A + \frac{\sum fd'}{N} \times i \\ &= 45 - \frac{100}{140} \times 10 \\ &= 45 - 7.14 = 37.86\end{aligned}$$

Calculation of standard deviation:

$$\begin{aligned}\sigma &= \sqrt{\frac{\sum fd'^2}{N} - \left(\frac{\sum fd'}{N}\right)^2} \times i \\ &= \sqrt{\frac{348}{140} - \left(\frac{-100}{140}\right)^2} \times 10 \\ &= \sqrt{2.486 - 0.510} \times 10 \\ &= \sqrt{1.976} \times 10 = 1.406 \times 10 = 14.06\end{aligned}$$

$$\begin{aligned}\text{C.V.} &= \frac{\sigma}{\bar{X}} \times 100 \\ &= \frac{14.06}{37.86} \times 100 = 37.14 \text{ per cent}\end{aligned}$$

C.V. (Series A) = 33.34 per cent

C.V. (Series B) = 37.14 per cent

Since, coefficient of variation is less for series A hence series A is more consistent.

10. The number of students, average marks per student and the standard deviation of the marks per student in an examination are as follows:

	Section A	Section B
Number of Students	50	100
Average Marks per student	120	85
Standard Deviation of the Marks per student	3	4

The degree of variation in marks per student is higher in case of which section?

Ans. Variation in the distribution of marks (Section A)

Coefficient of Variation, $C.V. = \frac{\sigma}{\bar{X}} \times 100$

$\sigma = \sqrt{9} = 3, \bar{X} = 120$

$\therefore C.V. = \frac{3}{120} \times 100 = 2.5$

Variation in the distribution of marks (Section B)

$C.V. = \frac{\sigma}{\bar{X}} \times 100$

$\sigma = \sqrt{16} = 4, \bar{X} = 85$

$\therefore C.V. = \frac{4}{85} \times 100 = 4.71$

The coefficient of variation is greater for Section B, hence there is greater variation in the distribution marks per student in Section B.



1. “Correlation does not always imply causation.” Comment.

Ans. Correlation does not always imply causation. Correlation is a numerical measure of direction and magnitude of the mutual relationship between the values of two or more variables. But presence of correlation does not necessarily imply causation, *i.e.*, cause and effect relationship but with presence of casual relationship, correlation is certain to exist.

2. Critically analyse Karl Pearson’s coefficient of correlation and state the method of calculating the same.

Ans. Merits of Karl Pearson’s coefficient of correlation:

- (i) It determines the exact extent or degree of correlation.
- (ii) It has various algebraic properties because of which calculation of coefficient of correlation becomes easier.

Demerits of Karl Pearson’s coefficient of correlation:

- (i) Karl Pearson’s coefficient of correlation involves a difficult procedure.
- (ii) It is deeply affected by the values of extreme items of the series.

Karl Pearson has given a quantitative method of calculating correlation. It is an important and widely used method of studying correlation. Karl Pearson’s coefficient of correlation is generally written as ‘r’. According to Karl Pearson’s method, the coefficient of correlation is measured as:

$$r = \frac{\Sigma xy}{N\sigma_x\sigma_y}$$

where, r = Coefficient of correlation; $x = X - \bar{X}$; $y = Y - \bar{Y}$; σ_x = Standard deviation of X series; σ_y = Standard deviation of Y series; N = Number of observations.

This formula is applied only to those series where deviations are worked out from actual average of the series, it does not apply to those series where deviations are calculated on the basis of assumed mean. Value of the coefficient of correlation calculated on the basis of this formula may vary between +1 and -1.

3. Enlist the properties of correlation coefficient.

Ans. The properties of correlation coefficient are as follows:

- (i) r has no unit. It is a pure number. It means units of measurement are not parts of r.
- (ii) A negative value of r indicates an inverse relation, and if r is positive, the two variables move in the same direction.
- (iii) If $r = 0$, the two variables are uncorrelated. There is no linear relation between them. However, other types of relation may be there.
- (iv) If $r = 1$ or $r = -1$, the correlation is perfect or proportionate. A high value of r indicates strong linear relationship, *i.e.*, +1 or -1.
- (v) The value of the correlation coefficient lies between minus one and plus one, *i.e.*, $-1 \leq r \leq +1$. If the value of r lies outside this range, it indicates error in calculation.

4. Elaborate upon various kinds of correlation.

Ans. (i) Simple correlation: When the relationship between only two variables is studied, it is called simple correlation. Like the relationship between price and demand or the relationship between money supply and price level.

(ii) Multiple correlation: When the relationship among three or more than three variables is studied simultaneously, it is called multiple correlation. In case of such correlation, the entire set of independent and dependent variables is simultaneously studied. For instance,

effects of rainfall, manure, water, etc., on per hectare productivity of rice are simultaneously studied.

(iii) **Partial correlation:** When more than two variables are involved and out of these the relationship between only two variables is studied treating other variables as constant, then the correlation is partial.

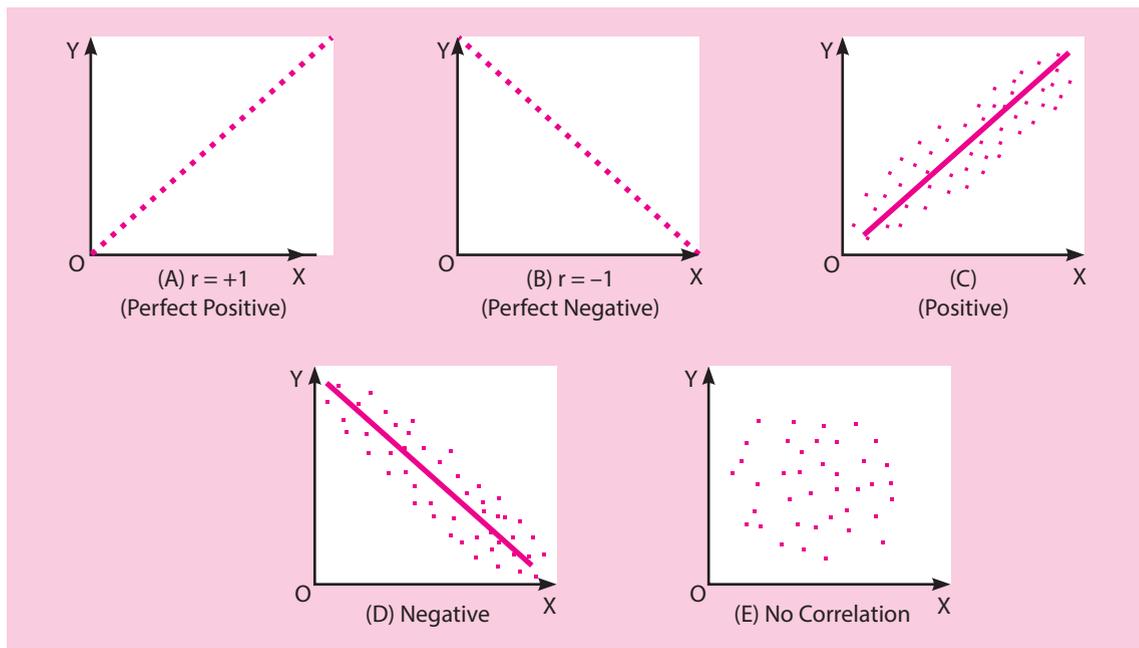
5. State the importance of correlation.

Ans. Following observations highlight the importance or significance of correlation:

- (i) **Formation of Laws and Concepts:** The study of correlation shows the direction and degree of relationship between the variables. This has helped the formation of various laws and concepts in economic theory, such as the law of demand and the concept of elasticity of demand.
- (ii) **Cause and Effect Relationship:** Correlation coefficient sometimes suggests cause and effect relationship between different variables. This helps in understanding why certain variables behave the way they behave.
- (iii) **Business Decisions:** Correlation analysis facilitates business decisions because the trend path of one variable may suggest the expected changes in the other. Accordingly, the businessman may plan his business decisions for the future.
- (iv) **Policy Formulation:** Correlation analysis also helps policy formulation. If the government finds a negative correlation between tax rate and tax collection, it should pursue the policy of low tax rate. Because, low tax rate would lead to high tax collection.

6. Explain the scatter diagram method of correlation and state the advantages of using this method.

Ans. Scattered diagram offers a graphic expression of the direction and degree of correlation. To make a scattered diagram, data are plotted on a graph paper. A dot is marked for each value. The course of these dots would indicate direction and closeness of the variables. Following diagrams show some of the possible directions and the degrees of closeness of the variables.



In the above diagrams, closeness of the dots towards each other in a particular direction indicates higher degree of correlation. If the dots are scattered (showing neither the closeness nor any direction), it is an indication of low degree of correlation.

Following are the merits of scattered diagram method:

- (i) Scattered diagram is a very simple method of studying correlation between two variables.
- (ii) Just a glance at the diagram is enough to know if the values of the variables have any relation or not.
- (iii) Scattered diagram also indicates whether the relation is positive or negative.

7. Estimate the coefficient of correlation using the data given below (use short-cut method):

X	9	8	7	6	5	4	3	2	1
Y	15	16	14	13	11	12	10	8	9

Ans.

X	Deviation (x = X - \bar{X}) x	Square of Deviation (x²)	Y	Deviation (y = Y - \bar{Y}) y	Square of Deviation (y²)	Multiple of Deviations (xy)
9	+4	16	15	+3	9	+12
8	+3	9	16	+4	16	+12
7	+2	4	14	+2	4	+4
6	+1	1	13	+1	1	+1
5	0	0	11	-1	1	0
4	-1	1	12	0	0	0
3	-2	4	10	-2	4	+4
2	-3	9	8	-4	16	+12
1	-4	16	9	-3	9	+12
$\Sigma X = 45$	$\Sigma x = 0$	$\Sigma x^2 = 60$	$\Sigma Y = 108$	$\Sigma y = 0$	$\Sigma y^2 = 60$	$\Sigma xy = 57$

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$$x = (X - \bar{X}), y = (Y - \bar{Y})$$

$$\bar{X} = \frac{45}{9} = 5, \bar{Y} = \frac{108}{9} = 12$$

$$\Sigma xy = 57, \Sigma x^2 = 60, \Sigma y^2 = 60$$

$$r = \frac{57}{\sqrt{60 \times 60}} = \frac{57}{60} = 0.95$$

Correlation coefficient (r) = 0.95

8. Given below is the data on marks obtained by 10 randomly chosen students in both the sections (A & B) of a school. Estimate coefficient of correlation for the same.

Marks obtained in Section A	100	101	102	102	100	99	97	98	96	95
Marks obtained in Section B	98	99	99	97	95	92	95	94	90	91

Ans. Let us denote the marks obtained by section A as X and the marks obtained by section B as Y.

Calculation of Karl Pearson's Coefficient of Correlation

X	Deviation (x = X - \bar{X}) x	Square of Deviation (x²)	Y	Deviation (y = Y - \bar{Y}) y	Square of Deviation (y²)	Multiple of Deviations (xy)
100	+1	1	98	+3	9	+3
101	+2	4	99	+4	16	+8
102	+3	9	99	+4	16	+12

102	+3	9	97	+2	4	+6
100	+1	1	95	0	0	0
99	0	0	92	-3	9	0
97	-2	4	95	0	0	0
98	-1	1	94	-1	1	+1
96	-3	9	90	-5	25	+15
95	-4	16	91	-4	16	+16
$\Sigma X = 990$	$\Sigma x = 0$	$\Sigma x^2 = 54$	$\Sigma Y = 950$	$\Sigma y = 0$	$\Sigma y^2 = 96$	$\Sigma xy = 61$

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$$= \frac{61}{\sqrt{54 \times 96}}$$

$$= 0.847$$

9. Calculate the coefficient of correlation between series X and Y on the basis of the data given below:

X	100	200	300	400	500	600	700
Y	0.3	0.5	0.6	0.8	1.0	1.1	1.3

Ans.

X	Deviation ($x = X - \bar{X}$) x	Square of Deviation (x^2)	Y	Deviation ($y = Y - \bar{Y}$) y	Square of Deviation (y^2)	Multiple of Deviations (xy)
100	-300	90000	0.3	-0.5	0.25	150
200	-200	40000	0.5	-0.3	0.09	60
300	-100	10000	0.6	-0.2	0.04	20
400	0	0	0.8	0	0	0
500	100	10000	1.0	0.2	0.04	20
600	200	40000	1.1	0.3	0.09	60
700	300	90000	1.3	0.5	0.25	150
$\Sigma X = 2800$	$\Sigma x = 0$	$\Sigma x^2 = 280000$	$\Sigma Y = 5.6$	$\Sigma y = 0$	$\Sigma y^2 = 0.76$	$\Sigma xy = 460$

$$X = \frac{2800}{7} = 400,$$

$$Y = \frac{5.6}{7} = 0.8$$

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$$= \frac{460}{\sqrt{280000 \times 0.76}}$$

$$= 0.997$$

10. Estimate correlation coefficient from the data given in question 7 using direct method.

Ans.

Calculation of Correlation Coefficient (Direct Method)

X	X ²	Y	Y ²	XY
9	81	15	225	135
8	64	16	256	128
7	49	14	196	98
6	36	13	169	78
5	25	11	121	55
4	16	12	144	48
3	9	10	100	30
2	4	8	64	16
1	1	9	81	9
ΣX = 45	ΣX ² = 285	ΣY = 108	ΣY ² = 1,356	ΣXY = 597

$$N = 9, \Sigma XY = 597, \Sigma X = 45, \Sigma Y = 108, \Sigma X^2 = 285, \Sigma Y^2 = 1,356$$

$$\begin{aligned} r &= \frac{9 \times 597 - 45 \times 108}{\sqrt{9 \times 285 - (45)^2} \sqrt{9 \times 1,356 - (108)^2}} \\ &= \frac{5,373 - 4,860}{\sqrt{2,565 - 2,025} \sqrt{12,204 - 11,664}} \\ &= \frac{513}{\sqrt{540 \times 540}} \\ &= \frac{513}{540} \\ &= +0.95 \end{aligned}$$



1. What are index numbers? State its importance.

Ans. Index number is a statistical tool that shows changes in a variable or a group of related variables with respect to time, geographic location or other characteristics.

The importance of index numbers is highlighted through the following points:

- (i) Index numbers enable us to measure the value of money during different periods of time and come up with solutions in order to correct inflationary or deflationary gaps in the system.
- (ii) Index numbers help to ascertain the living standards of people. It indicates the changes in the real income.
- (iii) Cost of living index is a useful guide to the government and private enterprises to make necessary adjustments in salaries and allowances of the workers.

2. Distinguish between consumer price index number and wholesale price index number.

Ans. The basic difference between consumer price index number and wholesale price index number is as under:

- (i) Consumer price index is the index number which measures the average change in prices paid by the specific class of consumers for goods and services consumed by them in the current year in comparison with base year. Whereas, wholesale price index measures the relative changes in the prices of commodities traded in the wholesale markets.
- (ii) In case of consumer price index number, the basic purpose is to know cost of living of a specified group of consumers in the society. In case of wholesale index number, the basic purpose is to assess the situations of overall demand and supply in the economy. Rising prices indicate a situation of excess demand, while falling prices suggest a situation of deficient demand. Wholesale price index focuses on the rate of inflation in the economy.

3. Enlist the features of a good base year.

Ans. Base year is the year of comparison. It is also called reference year, from which we want to measure extent of change in the current year. The index number of base year is generally assumed to be 100.

A good base year should bear the following characteristics:

- (i) It should be a normal year, not showing wide fluctuations in the parameters related to the index number.
- (ii) It should be a year for which reliable statistical data are available, so that comparison of the performance of the other years with the base year becomes meaningful.
- (iii) It should not be a year too far from the period of study. Otherwise, relative change over time would not make much sense.
- (iv) It should be neither very long nor very short a period. Generally, it is not more than a year and not less than a month.

4. Why is Fisher's index number known as the ideal index number?

Ans. Fisher's index is called an ideal index because of the following reasons:

- (i) It is based on geometric mean which is the best average considered for computing index numbers.
- (ii) Fisher's formula provides weighted index number.
- (iii) Equal importance is given to base year and current year prices and quantities.
- (iv) Fisher's index satisfies tests of ideal index like Time Reversal Test and Factor Reversal Test.

5. Enlist the major problems faced in the construction of index numbers.

Ans. The main problems which are faced in the construction of index numbers are as under:

- (i) **Purpose of Index Number:** There are various types of index numbers, constructed with different objectives. Before constructing an index number, one must define the objective. Because, the construction of index number is significantly influenced by the objective or purpose of the study.
- (ii) **Selection of Base Year:** Selection of base year is another problem in the construction of index number. Base year is the reference year. It is the year with which prices of the current year are compared. As far as possible, base year should be a normal year, that is, it should be the one without much ups and downs. Otherwise, the index values would fail to capture the real change in the variable.
- (iii) **Selection of Goods and Services:** Having defined the objective, the problem is of the selection of goods or services to be included in the index number. To construct the Consumers' Price Index, for example, all commodities are not included. It is neither possible nor desirable to include all the goods and services produced in the country. We have to choose those goods and services which represent most of others in the market. Larger the number of goods and services, more representative is the index number.
- (iv) **Selection of the Prices of the Goods and Services:** Having selected the goods and services, the problem arises of prices to be selected. Broadly, in the construction of price index, the problem is whether to adopt retail prices or wholesale prices, controlled or open market prices. The choice would depend upon the objective or purpose of the study.
- (v) **Selection of Weights:** While constructing index number, weights are accorded to different commodities according to their relative significance. While constructing weighted index number, one must justify his choice of weighting technique in accordance with the nature and objective of his study.
- (vi) **Choice of Average:** In finding out average values, different kinds of average may be used, geometric average, arithmetic average, etc. The choice of average significantly influences the results. Different kinds of averages may give different index number of a given change in price.
- (vii) **Selection of Formula:** Index numbers can be constructed with the help of many formulae. One has to decide about the method to be used while constructing the index number.

6. List the steps involved in the construction of the consumer price index.

Ans. Calculation of consumer price index by using Family Budget Method involves the following steps:

- (i) The current year's price (p_1) of each commodity is divided by the base year's price (p_0) of the respective commodities. Then the resultant is multiplied by 100. These are called price relatives of the current year.

$$\text{Price Relatives of the Current Year (R)} = \frac{\text{Price of the Current Year (} p_1 \text{)}}{\text{Price of the Base Year (} p_0 \text{)}} \times 100$$

- (ii) Aggregate expenditure on each item is considered as the weight of the item. Hence, the weight (W) of a commodity is calculated by multiplying the price (p_0) of a commodity in the base year with the quantity (q_0) of the commodity consumed in the base year.
- (iii) The price relative (R) of each item is multiplied with their respective weights ($W = p_0q_0$). These products are added to find ΣRW .
- (iv) The sum of weights ΣW or Σp_0q_0 is calculated.
- (v) These values are substituted in the following formula to find the consumer's price index:

$$\text{Consumer Price Index} = \frac{\text{Sum of Products of the Price Relative with Weights}}{\text{Sum of Weights}}$$

$$\text{Thus: } P_{01} = \frac{\Sigma RW}{\Sigma W}$$

7. From the following data, construct an index for 2020 taking 2011 as base using Simple Average of Price Relatives Method.

Goods	Price in 2011	Price in 2020
A	50	70
B	40	60
C	80	90
D	110	120
E	20	20

Ans.

Index Number using Arithmetic Mean of Price Relatives

Goods	Price in 2011 (₹) P_0	Price in 2020 (₹) P_1	Price Relatives $\left(\frac{P_1}{P_0} \times 100\right)$
A	50	70	140.0
B	40	60	150.0
C	80	90	112.5
D	110	120	109.1
E	20	20	100.0
			$\Sigma \frac{P_1}{P_0} \times 100 = 611.6$

$$\begin{aligned}
 P_{01} &= \frac{\frac{\Sigma P_1}{\Sigma P_0} \times 100}{N} \\
 &= \frac{611.6}{5} \\
 &= 122.32
 \end{aligned}$$

8. Construct index number of price from the following data by applying:
 (i) Laspeyres method,
 (ii) Paasche's method, and
 (iii) Fisher's method.

Goods	2011		2020	
	Price	Quantity	Price	Quantity
A	2	8	4	6
B	5	10	6	5
C	4	14	5	10
D	2	19	2	13

Ans.

Goods	2011 (Base Year)		2020 (Current Year)		P ₁ Q ₀	P ₀ Q ₀	P ₁ Q ₁	P ₀ Q ₁
	P ₀	Q ₀	P ₁	Q ₁				
A	2	8	4	6	32	16	24	12
B	5	10	6	5	60	50	30	25
C	4	14	5	10	70	56	50	40
D	2	19	2	13	38	38	26	26
					ΣP ₁ Q ₀ = 200	ΣP ₀ Q ₀ = 160	ΣP ₁ Q ₁ = 130	ΣP ₀ Q ₁ = 103

(i) Laspeyre's Method:

$$\begin{aligned}
 P_{01} &= \frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times 100 \\
 &= \frac{200}{160} \times 100 \\
 &= 125
 \end{aligned}$$

(ii) Paasche's Method:

$$\begin{aligned}
 P_{01} &= \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \times 100 \\
 &= \frac{130}{103} \times 100 \\
 &= 126.21
 \end{aligned}$$

(iii) Fisher's Index Number:

$$\begin{aligned}
 P_{01} &= \sqrt{\frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times \frac{\sum P_1 Q_1}{\sum P_0 Q_1}} \times 100 \\
 &= \sqrt{\frac{200}{160} \times \frac{130}{103}} \times 100 \\
 &= \sqrt{1.8} \times 100 \\
 &= 1.256 \times 100 \\
 &= 125.6
 \end{aligned}$$

Laspeyre's method = 110.24.

Paasche's method = 114.48.

Fisher's method = 125.6

9. Construct consumer price index number for 2020 on the basis of 2011 from the following data using Family Budget Method:

Items	Prices in 2011 (in ₹)	Prices in 2020 (in ₹)	Weights
Food	200	280	30
Rent	100	200	20
Clothing	150	120	20
Fuel and Lighting	50	100	10
Miscellaneous	100	200	20

Ans.

**Construction of Consumer Price Index for 2020
(Base 2011 = 100) By the Family Budget Method**

Items	Weights W	Prices in 2011 p ₀ (in ₹)	Prices in 2020 p ₁ (in ₹)	$\left(\frac{P_1}{P_0} \times 100\right)$ P	p ₀ W = V	PV
Food	30	200	280	140	6000	8,40,000
Rent	20	100	200	200	2000	4,00,000
Clothing	20	150	120	80	3000	2,40,000
Fuel and Lighting	10	50	100	200	500	1,00,000
Miscellaneous	20	100	200	200	2000	4,00,000
					ΣV = 13,500	ΣPV = 19,80,000

$$\begin{aligned} \text{Consumer Price Index} &= \frac{\Sigma PV}{\Sigma V} \\ &= \frac{19,80,000}{13,500} = 146.67 \end{aligned}$$

10. Using Weighted Average Price Relative Method, construct index number for 2020 based on 2011 prices.

Items	Weight	Prices in 2011 p ₀ (in ₹)	Prices in 2020 (in ₹)
A	20	200	320
B	14	400	420
C	15	100	120
D	18	40	60
E	10	20	28

Ans.

Calculation of Weighted Index Number

Items	Weight	Prices in 2011 p ₀ (in ₹)	Prices in 2020 p ₁ (in ₹)	$\left(\frac{P_1}{P_0} \times 100\right)$ P	PW
A	20	200	320	$\frac{320}{200} \times 100 = 160$	3,200
B	14	400	420	$\frac{420}{400} \times 100 = 105$	1,470
C	15	100	120	$\frac{120}{100} \times 100 = 120$	1,800
D	18	40	60	$\frac{60}{40} \times 100 = 150$	2,700
E	10	20	28	$\frac{28}{20} \times 100 = 140$	1,400
	ΣW = 77				ΣPW = 10,570

$$\begin{aligned} P_{01} &= \frac{\Sigma PW}{\Sigma W} \\ &= \frac{10,500}{77} = 137.27 \end{aligned}$$



PART B: INTRODUCTORY MICROECONOMICS

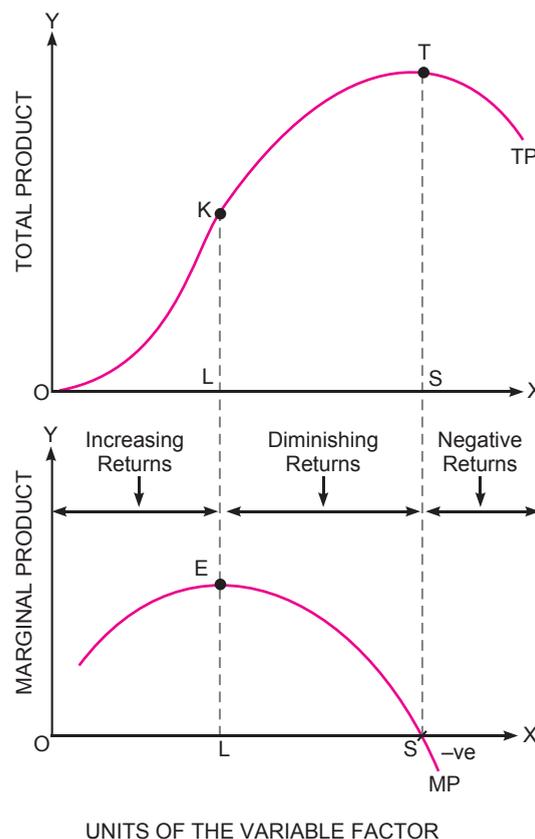
Chapter-1:

Production Function and Returns to a Factor:

1. State the relationship between MP and TP with the help of a suitable diagram.

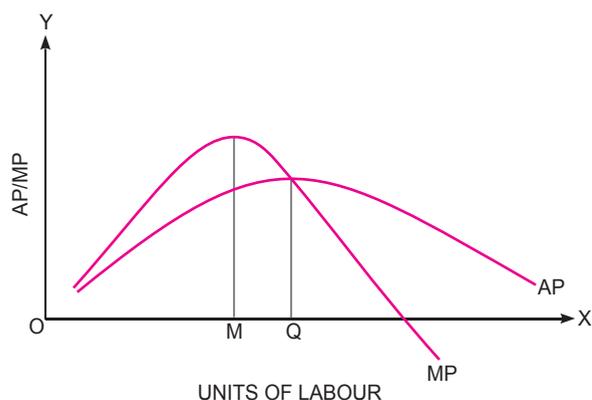
Ans. The figure below explains the relationship between TP and MP.

- (i) When MP increases, TP increases at an increasing rate. (Point O to K on TP curve and point OE on MP curve)
- (ii) When MP decreases, TP increases at a diminishing rate. (Point K to T on TP curve and E to S on MP curve)
- (iii) When MP is constant, TP increases at constant rate.
- (iv) When $MP = 0$, TP is maximum. (At point T on TP curve and point S on MP curve)
- (v) When MP is negative, TP declines. (After point T on TP curve and after point S on MP curve)



2. “AP can rise even when MP is falling.”. Defend or refute the statement.

Ans. The statement is true. Average product (AP) can rise even when marginal product falls. AP continues to rise until falling MP is greater than AP. See AP and MP corresponding to output range MQ in figure below.



3. Distinguish between short run and long run production function.

Ans.

Short Period Production Function	Long Period Production Function
(i) Some factors are variable while others are fixed.	(i) All factors are variable.
(ii) Short period production function is of variable proportions type.	(ii) Long period production function is of constant proportions type.
(iii) Scale of output remains constant.	(iii) Scale of output changes.
(iv) Behaviour of output is studied with reference to 'Returns to a Factor' or 'Law of Variable Proportions'.	(iv) Behaviour of output is studied with reference to 'Returns to Scale'.

4. Enlist the causes of diminishing returns to a factor.

Ans. Diminishing returns to a factor occur due to the following reasons:

- (i) **Fixity of the Factors:** As more and more units of a variable factor are combined with the fixed factor, the latter gets excessively utilised. It suffers greater wear & tear and loses its efficiency. Hence, the diminishing returns.
- (ii) **Factors as Imperfect Substitutes of each other:** Factors of production are imperfect substitutes of each other. Accordingly, fixed factor cannot be replaced by other factors.
- (iii) **Poor Coordination between the Factors:** The coordination between the fixed and variable factors is impaired as more and more of a variable factor is employed, other factors remaining constant so that marginal product of the variable factor declines.

5. In which stage of production will a rational, profit maximizing producer stop and why?

Ans. A long as the cost of producing successive unit is less than the revenue received from the sale of the additional unit, a rational producer should not stop production. Thus production is stopped only when MR becomes equal to MC. (Highest productivity is experienced in stage-II)

6. Explain the law of variable proportions with the help of a hypothetical schedule.

Ans. The law of variable proportions is explained with the help of following schedule:

Law of Variable Proportions

Units of Land	Units of Labour	Total Product	Marginal Product	
1	1	2	2	} Increasing MP implying increasing returns to a factor
1	2	5	3	
1	3	9	4	
1	4	12	3	} Diminishing MP implying diminishing returns to a factor
1	5	14	2	
1	6	15	1	
1	7	15	0	} Negative MP implying negative returns to a factor
1	8	14	-1	

[**Note:** The point from where MP stops increasing, from that very point it starts diminishing. Thus, overlapping is indicated in the above table when MP = 4.]

The above table shows that as more and more units of labour (variable factor) are combined with fixed amount of land, MP (marginal product) tends to rise till 3 units of labour are employed. In this situation, TP (total product) increases at an increasing rate. This is a situation of increasing returns to the factor. But, with the application of 4th unit of labour, situation of diminishing returns sets in: MP starts decreasing and TP increases only at a decreasing rate. Diminishing MP reduces to zero when 7th unit of labour is added, and MP becomes negative (-1) when 8th unit of labour is also employed. Total output is maximum (= 15), when marginal output is zero and it starts declining (from 15 to 14) when marginal output is negative (-1).

7. Calculate TP and AP from the following data:

Units of Labour Employed	1	2	3	4	5	6
MP	30	32	27	24	20	12

Ans.

Units of Labour Employed	MP	TP	AP
1	30	30	30
2	32	62	31
3	27	89	29.7
4	24	113	28.25
5	20	133	26.6
6	12	145	24.17

8. The following table shows the AP of a factor. Determine TP for each given level of AP.

Level of Employment	1	2	3	4	5	6
AP	50	48	45	42	39	35

Ans.

Level of Employment	AP	TP	AP
1	50	50	50
2	48	96	46
3	45	135	39
4	42	168	33
5	39	195	27
6	35	210	15

9. Fill the missing values in the table given below:

Units of Variable Factor	TP	AP	MP
0	0	0	—
1	—	2	—
2	—	—	4
3	—	4	—
4	—	4	—
6	—	3	0

Ans.

Units of Variable Factor	TP	AP	MP
0	0	0	—
1	2	2	2
2	6	3	4
3	12	4	6
4	16	4	4
6	18	3	0

10. Explain and illustrate the concepts of total product, average product and marginal product.

Ans. (i) Total Product (TP) is the sum total of output produced by all units of variable factor along with some constant amount of the fixed factors used in the process of production. **Example:** 10 workers producing 5 chairs each, TP = 10 × 5 = 50 chairs.

(ii) Average Product (AP) is output per unit of labour (L).

$$AP = \frac{TP}{L} = \frac{50}{10} = 5 \text{ chairs}$$

(iii) Marginal Product (MP) is change in total output when one more unit of the variable factor is used (fixed factor remaining constant).

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

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

Example: Output when 10 workers are employed = 50 chairs.

Output when one more worker, *i.e.*, 11 workers are employed = 56 chairs.

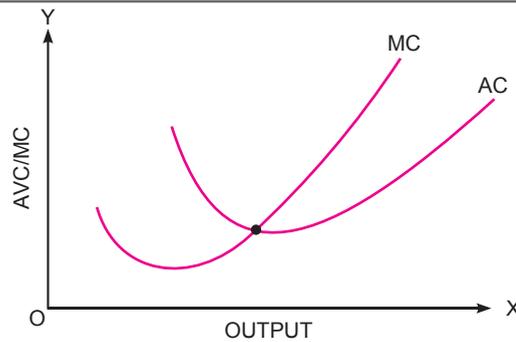
$$\begin{aligned} MP_{11} &= TP_{11} - TP_{10} \\ &= 56 - 50 = 6 \text{ chairs} \end{aligned}$$



1. Explain the relationship between AC and MC with the help of a table and diagram.

Ans. In figure below offers the following observations highlighting the relationship between marginal cost (MC) and average cost (AC):

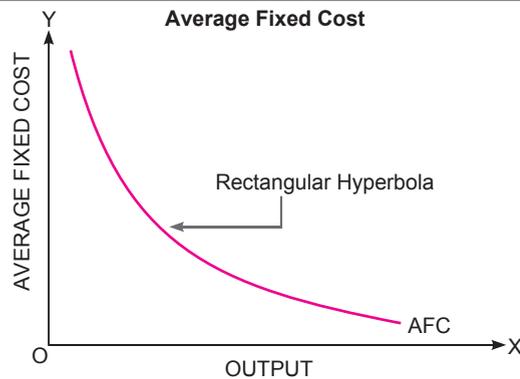
- (i) When AC is falling, $AC > MC$.
- (ii) When AC is rising, $AC < MC$.
- (iii) When AC is constant, $AC = MC$.
- (iv) MC curve cuts AC curve at its lowest point. Here, $AC = MC$.
- (v) AC can fall even when MC is rising.
- (vi) Both AC and MC curves are U-shaped.



Output	Total Cost	AC	MC
0	10	∞	—
1	20	20	10
2	28	14	8
3	34	11.3	6
4	38	9.5	4
5	42	8.4	4
6	48	8	6
7	56	8	8
8	72	9	16

2. State the behaviour of AFC and also suggest whether it can ever be equal to zero or not.

Ans. As output increases, average fixed cost continuously decreases. This is because total fixed cost remains unchanged with the change in the level of output, *i.e.*, it is constant at all levels of output. The average fixed cost curve (AFC) is a rectangular hyperbola and can never touch any axis or be equal to zero.



3. Why is the short period average cost curve 'U' shaped?

Ans. The short period cost curve (AC) is U-shaped, as its behaviour is governed by the law of variable proportions. Initially, because of increasing returns to a factor, AC tends to fall. Eventually, because of decreasing returns to a factor, AC tends to rise. However, the process of change is very gradual. Because of which AC tends to be U-shaped, not V-shaped.

4. Why does the difference between average total cost and average variable cost decrease as the output is increased? Can these two be equal at some level of output? Explain.

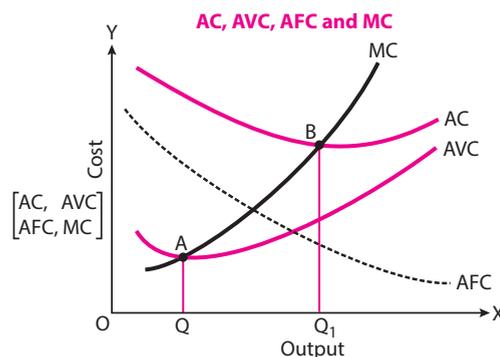
Ans. The difference between average total cost and average variable cost is called average fixed cost and it goes on decreasing as the level of output is increased. $AFC = TFC/Q$, as TFC is constant and Q is rising the per unit fixed cost goes on decreasing but as it will never become zero hence ATC and AVC will never be able to intersect each other.

5. "ΣMC = TC." Defend or refute the statement.

Ans. This statement is refuted as $EMC = TVC$ not TC. MC shows the rate of change in cost and TC also includes TFC which does not change with change in the level of output. Hence it is only TVC which changes and its impact is captured by TVC.

6. Show AC, AVC, AFC and MC in the same diagram and also state why MC cuts AC and AVC from their minimum point.

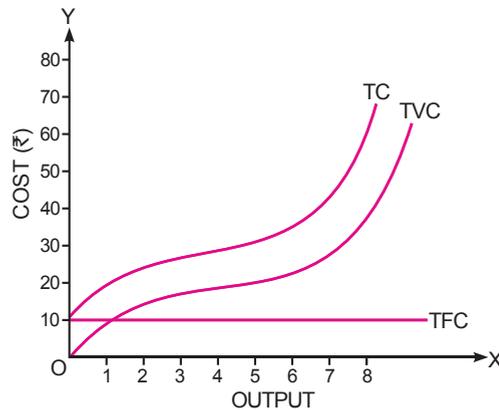
Ans.



MC declines faster than AC and reaches its lowest point earlier than AC and hence intersects AC, AVC and AFC from below.

7. Comment upon the relationship between TC, TVC and TFC with the help of a suitable diagram.

- Ans.** (i) Total cost is the sum of total variable cost and total fixed cost. So, TC curve is the vertical summation of TFC and TVC curves.
- (ii) TC and TVC curves are parallel to each other.
- (iii) TFC curve is parallel to X-axis as shown in figure below. Fixed cost is constant at ₹ 10 at all levels of output. Hence, TFC curve is parallel to X-axis. TVC is zero at zero level of output. With increase in output, TVC also increases. Correspondingly, TC also increases. Thus, both TC and TVC curves are inverse S-shaped.



8. Using the data given below, estimate the value of AFC and AVC.

Unit of Output	0	3	5
Total Cost (₹ '000)	50	80	120

Ans.

Output	TC	TFC	TVC	AFC	AVC
0	50	50	—	—	—
3	80	50	30	16.67	10
5	120	50	70	10	14

9. Complete the following table:

Output	TC	TVC	MC
0	12	—	—
1	18	—	—
2	21	—	—

Ans.

Output	TC	TVC	MC
0	12	0	—
1	18	6	6
2	21	9	3

10. Complete the following table:

Output	TVC	AVC	MC
1	10	—	—
—	—	8	6
3	27	—	—
—	—	10	13

Ans.

Output	TVC	AVC	MC
1	10	10	10
2	16	8	6
3	27	9	11
4	40	10	13



1. Why do the AR and MR curves coincide with each other in the case of a perfectly competitive market?

Ans. AR is the per unit change in revenues & MR is the rate of change in TR by sale of one more unit. As under perfect competition a firm can sell any units of output but at the price fixed by the industry. Hence AR and MR coincide with each other.

2. Comment upon the curvature of TR due to fluctuations in the shape of MR.

Ans. Following observations highlight the relationship between marginal revenue (MR) and total revenue (TR):

- (i) When MR is positive and constant, TR should increase at a constant rate.
- (ii) When MR is falling, TR should increase at a decreasing rate.
- (iii) When MR is zero, TR should be maximum.
- (iv) When MR is negative, TR starts declining.

3. Explain the relationship between AR and MR. Give an illustration.

Ans. (i) When average revenue is constant, it is equal to marginal revenue.
 (ii) When average revenue is diminishing, it is greater than marginal revenue.
 (iii) Marginal revenue can be zero or negative but not the average revenue.

Illustration:

Output (Q)	AR ₁ (₹)	AR ₂ (₹)	TR ₁ (₹)	TR ₂ (₹)	MR ₁ (₹)	MR ₂ (₹)
1	10	10	10	10	10	10
2	10	9	20	18	10	8
3	10	8	30	24	10	6
4	10	7	40	28	10	4
5	10	6	50	30	10	2
6	10	5	60	30	10	0
7	10	4	70	28	10	-2

The above table shows:

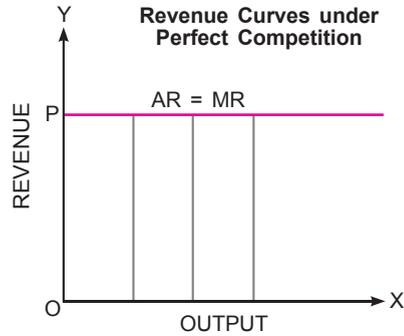
- When AR is constant (AR₁), AR₁ = MR₁.
- When AR is decreasing (AR₂), MR₂ is decreasing faster than AR₂.
- MR can be zero or negative, but AR is always positive.

4. Why is AR = Price = Demand curve?

Ans. $AR = \frac{TR}{Q} = \frac{P \times Q}{Q} = P$. Hence we can say that AR = Price. AR is what the seller gets and D is what the consumer demands.

5. What is meant by marginal revenue? How is it different from average revenue?

Ans. Marginal revenue is the rate of change in TR when an additional unit of output is sold. Average revenue = Marginal revenue at all levels of output as shown in figure below. This is because AR (= price) is constant.



6. Explain the relationship between TR, AR and MR with the help of a table.

Ans. Total revenue is the sum of marginal revenues at different levels of output. It can also be found by multiplying price (AR) with the quantity of output. From the TR schedule, we can derive the AR and MR as under:

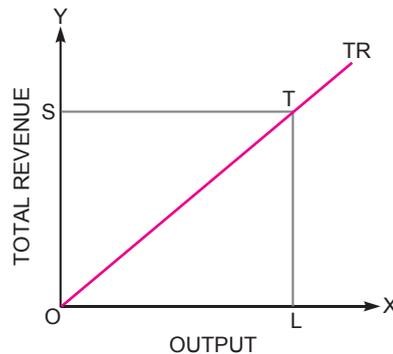
Units of Output (Q)	TR (₹)	$AR = \frac{TR}{Q}$ (₹)	$MR = \frac{\Delta TR}{\Delta Q}$ Or $MR = TR_n - TR_{n-1}$ (₹)
1	100	100	100
2	180	90	80
3	240	80	60
4	280	70	40
5	300	60	20
6	300	50	0
7	280	40	-20

The above table shows that:

- (i) TR increases at a decreasing rate, because MR is decreasing.
- (ii) TR is maximum (= ₹ 300) when MR = 0.
- (iii) TR starts declining when MR is negative.

7. Comment upon the shape of TR under perfect competition.

Ans. A firm under perfect competition is free to sell any quantity of the good it produces at a given price. Hence, as AR is constant, MR is also constant. Implying that TR increases at a constant rate and is a straight line sloping upward and starting from the point of origin.



The TR curve shoots from the origin and increases at a constant rate.

8. Complete the following table:

Units Sold	TR	MR	AR
1	10	10	—
2	—	—	9
3	24	—	—
4	—	4	7
5	30	—	6
6	30	0	—
7	28	—	4
8	—	-4	3

Ans.

Units Sold	TR	MR	AR
1	10	10	10
2	18	8	9
3	24	6	8
4	28	4	7
5	30	2	6
6	30	0	5
7	28	-2	4
8	24	-4	3

9. Calculate TR and MR from the following data:

Price per unit (₹)	1	2	3	4	5	6	7
Units Sold	10	9	8	7	6	5	4

Ans.

Price per unit (₹)	Units Sold	TR	MR
1	10	10	10
2	9	18	8
3	8	24	6
4	7	28	4
5	6	30	2
6	5	30	0
7	4	28	-2

10. Given below is the TR schedule of a seller, calculate AR and MR for 6 units and state whether this seller is in a perfectly competitive market or not.

Quantity Sold	TR
5	300
6	330

Ans.

Quantity Sold	TR	AR	MR
5	300	60	—
6	330	55	30

It is not a perfectly competitive market because AR (price) is not the same and AR and MR are not equal.



1. Define supply and discuss the factors affecting the same.

Ans. Supply refers to various quantities of a commodity that the producers are willing to sell at different possible prices of the commodity at a point of time.

Following is a list of factors that affect supply.

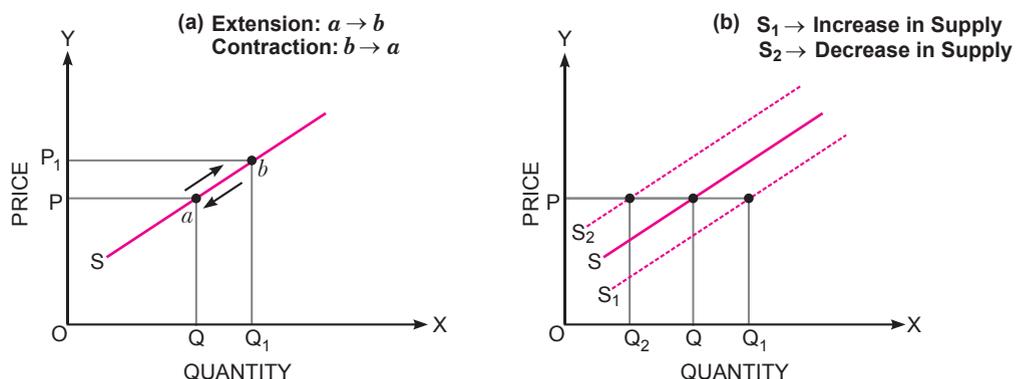
- (i) **Technological Change:** When there is technological improvement, output is produced at lower cost. Lower cost of production increases the supply of the commodity. The supply curve shifts to the right and in case technology becoming outdated, there is leftward shift in supply curve.
- (ii) **Price of Related Goods:** When price of a related good increases, the quantity supplied of the concerned good decreases and there is backward shift in supply curve. Supply curve shifts forward in case price of the related good decreases.
- (iii) **Price of Factors of Production:** If factor price decreases, cost of production also decreases. Accordingly, supply increases and the supply curve shifts to the right. If factor price increases, cost of production also increases. Accordingly, supply tends to decline and there is a backward shift in supply curve.
- (iv) **Number of Firms in the Industry:** Market supply of a commodity depends upon number of firms in the industry. Increase in the number of firms implies increase in market supply and there is forward shift in supply curve. Conversely, decrease in the number of firms reduces the market supply of a commodity and there is backward shift in supply curve.

2. Define law of supply. What is meant by the assumption ‘other things remaining the same’ on which the law is based?.

Ans. Law of supply states that, other things remaining constant, quantity supplied increases with increase in own price of a commodity and decreases with decrease in own price of a commodity. So, there is a positive relationship between own price of a commodity and its quantity supplied. The usage of the latin phrase “Ceteris paribus” which means “all other things being equal”, is used in economics, while stating any law it is used to suggest the effect of one economic variable on the other, provided all the other variables remain the same.

3. Distinguish between change in supply and change in quantity supplied with the help of a suitable diagram and table.

Ans. Movement along the supply curve or change in quantity supplied refers to extension and contraction of supply of a commodity caused by change in own price of the commodity. When price increases, there is an upward movement ($a \rightarrow b$) along the supply curve, called extension of supply; and when price decreases, there is a downward movement ($b \rightarrow a$) along the supply curve, called contraction of supply. Shown in figure below.



Shift of supply curve or change in supply refers to increase or decrease in supply of a commodity caused by change in factors other than own price of the commodity. When other factors change in a positive direction, the supply curve shifts to the right showing increase in supply; and when other factor changes in a negative direction, the supply curve shifts to the left showing a decrease in supply. See Fig. (b).

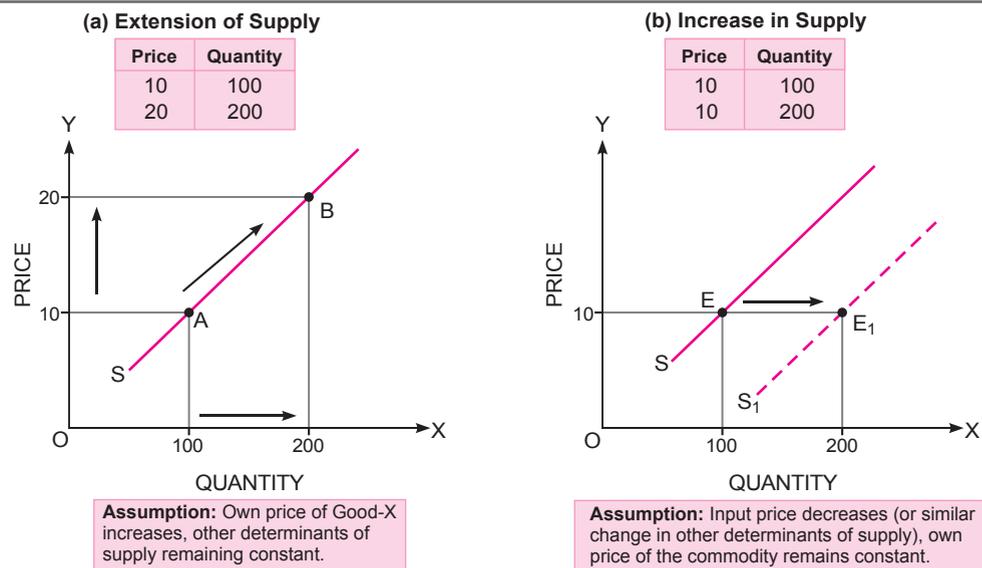
4. What will be the price elasticity of supply at a point on a positively sloped, straight line supply curve?

Ans. The price elasticity of supply at a point on a positively sloped, straight line supply curve can take the following forms:

- unitary elastic if it starts from the origin.
- greater than unitary elastic if it starts from the Y-axis.
- less than unitary elastic if it starts from the X-axis.

5. Explain the meaning of ‘increase in supply’ and ‘increase in quantity supplied’ with the help of a schedule.

Ans. When a rise in own price of a commodity leads to increase in quantity supplied of a commodity, it is called extension/expansion of supply. If quantity supplied increases due to factors other than own price of the commodity, it is a situation of increase in supply. Tables (a) and (b) show the situations of ‘extension of supply’ and ‘increase in supply’ respectively. Likewise, the figure below shows extension of supply and increase in supply respectively.

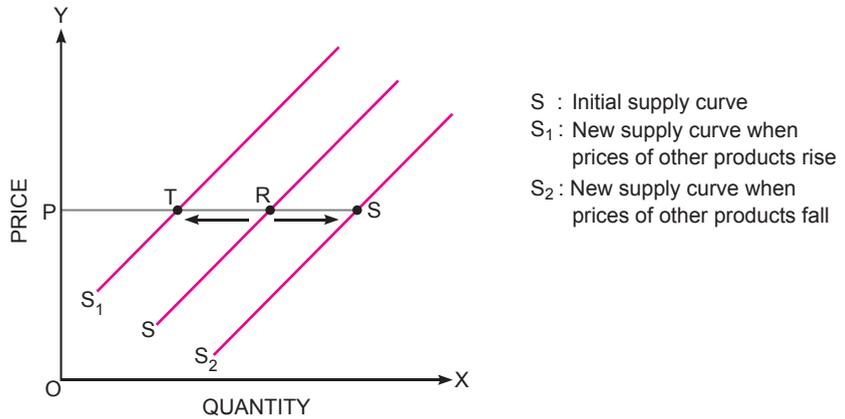


6. How does increase in the prices of related goods affect the supply of a good?

Ans. Prices of other products may rise or fall.

In case of a rise in prices of other products, other products start yielding greater profit than the given product, on the assumption that cost of production in case of all the products remains constant. Accordingly, the producers will start shifting to the production of other products. Less of the given good will be produced. Supply curve of the given good will shift to the left from S to S₁, as shown in figure below.

In case of a fall in prices of other products, profit on the other products will start shrinking. The producers will start shifting to the production of the given good. Implying that the supply curve of the given good will shift to the right from S to S₂, as shown in figure below.



7. At a price of ₹ 8 per unit, the quantity supplied of a commodity is 200 units. Its price elasticity of supply is 1.5. If its price rises to ₹ 10 per unit, calculate its quantity supplied at the new price.

Sol.

$$\text{Price elasticity of supply } (E_s) = \frac{P}{Q} \times \frac{\Delta Q}{\Delta P}$$

$$1.5 = \frac{8}{200} \times \frac{\Delta Q}{2}$$

$$\frac{\Delta Q}{50} = 1.5$$

$$\Rightarrow \Delta Q = 75$$

Quantity supplied at new price = 200 + 75 = 275 units (Supply will rise with rise in price).

8. When the price of a commodity falls from ₹ 10 per unit to ₹ 9 per unit, its quantity supplied falls by 20 per cent. Calculate the price elasticity of supply.

Sol.

$$\% \text{ fall in price} = \frac{1(=10-9)}{10} \times 100 = 10$$

$$E_s = \frac{\% \text{ change in quantity supplied}}{\% \text{ change in price}}$$

$$= \frac{20}{10}$$

$$= 2$$

9. The price of a commodity is ₹ 5 per unit and its quantity supplied is 600 units. If its price rises to ₹ 6 per unit, its quantity supplied rises by 25%. Calculate the price elasticity of supply.

Sol.

$$\% \text{ rise in price} = \frac{1(=6-5)}{5} \times 100 = 20$$

$$E_s = \frac{\% \text{ change in quantity supplied}}{\% \text{ change in price}}$$

$$= \frac{25}{20}$$

$$= 1.25$$

10. Total revenue of a firm rises from ₹ 50 to ₹ 100 when the price of its product rises from ₹ 5 per unit to ₹ 10 per unit. Calculate the price elasticity of supply.

Ans.

$$TR = P \times Q$$

$$TR_1 = ₹ 50$$

$$TR_2 = ₹ 100$$

$$P_1 = ₹ 5$$

$$P_2 = ₹ 10$$

$$Q_1 = \frac{50}{5} = ₹ 10$$

$$Q_2 = \frac{100}{10} = ₹ 10$$

$$P_{es} = \frac{P}{Q} \times \frac{\Delta Q}{\Delta P}$$
$$= \frac{5}{10} \times \frac{0}{5} = 0$$

Perfectly inelastic demand.



1. Why can a firm sell any quantity of a commodity but at the same price as determined by the industry under perfect competition?

Ans. A firm under perfect competition can sell any quantity of a commodity at the existing price because:

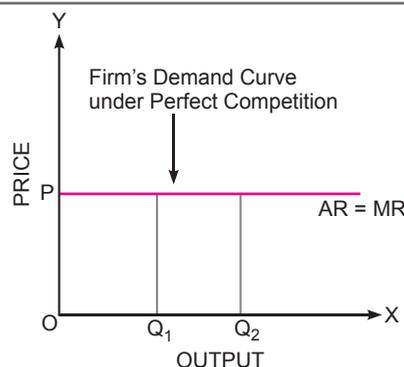
- (i) Goods sold are homogeneous in nature
- (ii) There are large number of small sellers in the market, so large that any change in quantity sold by one firm does not affect the total market supply of the commodity implying that the market price does not change.
- (iii) If a firm tries to sell at a higher prices, it loses the entire market because there are a large number of sellers in the market. On the other hand, if it tries to sell at a lower price so as to capture the entire market, it cannot, simply because it is one of the very small firms in the market and lacks resources to cater to the entire market demand.

2. Explain the feature of 'free entry and exit' in case of perfect competition.

Ans. Under perfect competition, there is no legal restriction on the entry or exit of the firms. A firm can enter and leave any industry, any time. Thus, whenever there are extra-normal profits some new firms will enter the industry and whenever there are extra-normal losses, some existing firms will leave the industry. Consequently, under perfect competition only normal profits prevail in the long run.

3. Draw the demand curve of a firm under perfect competition and describe its curvature.

Ans. Under perfect competition, the demand curve or average revenue curve of a firm is a horizontal straight line parallel to X-axis. It implies the firm will sell the product at the prevailing price which is determined by the industry. The individual firm cannot influence the price. See the following figure:



4. Enlist some features of perfect competition.

Ans. The features of perfect competition are as follows:

- (i) **Large Number of Firms or Sellers:** The number of firms selling a particular commodity is so large that any increase or decrease in the supply of one particular firm hardly influences the total market supply. Accordingly, any individual firm fails to make any influence on the price of the commodity.
- (ii) **Large Number of Buyers:** Not only is the number of sellers very large, number of buyers is very large as well. Accordingly, like an individual firm, an individual buyer is also not able to influence price of the commodity.
- (iii) **Homogeneous Product:** All sellers sell identical units of a given product. Therefore, the price of the product throughout the market will be the same. Selling homogeneous product at the

given price rules out the possibility of advertisement or other sale-promotion expenses. So that there are no selling costs in perfectly competitive market.

- (iv) **Perfect Knowledge:** Buyers and sellers have full knowledge regarding the prevailing market price. As a consequence, only one price prevails in the market.
- (v) **Free Entry and Exit of Firms:** A firm can enter and leave any industry freely. There is no legal restriction on the entry.
- (vi) **Independent Decision-making and Freedom from Checks:** There is no agreement between the sellers regarding production, quantity and price. Nor is there any restriction regarding the sale and purchase of any commodity.
- (vii) **Perfect Mobility:** Factors of production are perfectly mobile under perfect competition. Factors will move to that industry which pays the highest remuneration.
- (viii) **No Extra Transport Cost:** For one price to prevail throughout the market, it is essential that there is no extra transport cost for the consumers while buying a commodity from different sellers.

5. What is meant by a market? State the basis on which markets are segmented.

Ans. Market refers to the mechanism that brings buyers and sellers of a commodity in contact with each other.

Following are the basis on which markets are segmented:

- (i) **Area:** Market in economics does not mean any particular place where buyers and sellers meet, rather it means the entire area over which buyers and sellers are spread and have close contact with one another.
- (ii) **Buyers and Sellers:** Both buyers and sellers are needed in the market. If one of the two does not exist in any region it will not be called a market. It is not necessary that buyers and sellers be physically present to bargain or transact business. They may establish contact among themselves on phone or other available mode of communication.
- (iii) **One Commodity:** In economics, every commodity has its own market, *e.g.*, wheat market, sugar market, etc. As many commodities, so many markets.
- (iv) **Free Competition:** There should be free competition between buyers and sellers. In such a market, buyers try to buy at the cheapest rate and the sellers try to sell at the highest rate. As a result of it, there will be one price for one commodity throughout the market.

6. “A firm under perfect competition earns supernormal profits.” Defend or refute the statement.

Ans. This statement is refuted because a firm under perfect competition does not earn supernormal profits.

A perfectly competitive firm in the long run can earn only normal profits, *i.e.*, there will be zero abnormal profits. It is owing to the freedom of entry and exit. In case abnormal profits ($TR > TC$ or $AR > AC$) are earned, new firms will join the industry. This will shift market supply curve to the right. Accordingly, market price will reduce and abnormal profits would be wiped out. In a situation of abnormal losses ($TR < TC$ or $AR < AC$), some of the existing firms will leave the industry. Accordingly, market supply curve will shift to the left, forcing the price to move up, till the situation of zero abnormal profits is reached.

7. What is the implication of ‘large number of buyers and sellers’ under perfect competition?

Ans. The number of buyers and sellers of a commodity is very large under perfect competition. The number of firms selling a particular commodity is so large that an individual seller contributes only a small fraction to the market supply. Thus, any increase or decrease in supply by an individual firm hardly impacts the total market supply and consequently, an individual firm cannot impact price of the commodity. A firm is a price taker, NOT a price maker.

Not only is the number of sellers very large, but the number of buyers is also very large under perfect competition. It is so large that by varying his demand, an individual buyer cannot affect

total market demand for a commodity. Accordingly, like an individual firm, an individual buyer cannot affect market price. Consequently, under perfect competition, only normal profits prevail in the long run.

8. What is meant by a homogeneous product? Why is it a principle feature of a firm under perfect competition?

Ans. Homogeneous products refer to those products which possess the same characteristics or perceived attributes. So that uniform price prevails in the market for all the sellers of a commodity. In a perfectly competitive market, the product of all the firms is homogeneous. The significance of this feature is as under:

- (i) Because the buyers find the product of firms as homogeneous, only one price must prevail in the market.
- (ii) If ever an individual firm tries to charge a higher price, it would lose all its buyers to the competing firms. Accordingly, exploitation of the consumer is ruled out.
- (iii) Homogeneous product does not allow a firm any control over its price. Accordingly, firm's demand curve (under perfect competition) becomes a horizontal straight line.

9. Why is a firm under perfect competition a price taker and not a price maker?

Ans. An individual firm under perfect competition is a price taker and not a price maker owing to the following reasons:

- (i) An individual firm under perfect competition makes such a small contribution to the market supply, that total supply schedule (or industry's supply curve) virtually remains unaffected by any change in the firm's supply. Accordingly, market price remains unaffected.
- (ii) All firms in the market are selling homogeneous product. Accordingly, even partial control over price is not possible (through product differentiation).
- (iii) If any firm tries to fix its own price it would not succeed. Higher price (than the market price) would drive the buyers to a large number of other sellers. Lower price would be an irrational decision when any amount of the commodity can be sold by a firm at the existing price.

10. Is perfect competition a reality? Give reasons in support of your answer.

Ans. No; perfect competition is not a reality, it is a theoretical concept, a type of market structure that does not exist in the practical world. All real markets exist outside the perfect competition model because it is an abstract, theoretical model. One of the principal attributes of a firm under perfect competition is of homogeneous products but in the real world even with a product as simple as bottled water, producers will vary method of purification, product size, brand identity etc., in order to build a customer base.

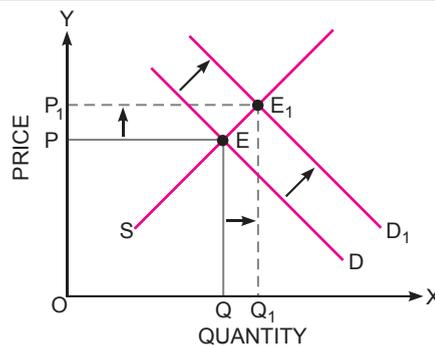


Chapter-6:

Market Equilibrium Under Perfect Competition and Effects of Shifts in Demand and Supply

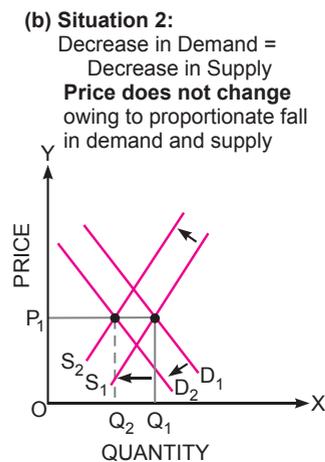
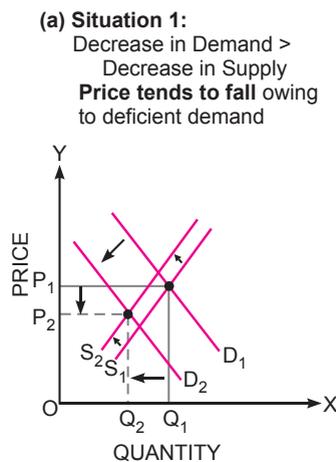
1. What happens to the price of a good when market demand increases?

Ans. When the demand increases while supply remains constant, the equilibrium price increases. Figure shows that while supply remains unchanged and demand curve shifts upward (rightward) from D to D_1 , the equilibrium price will increase from OP to OP_1 and equilibrium quantity increases from OQ to OQ_1 .



2. There is a simultaneous decrease in demand and supply of a commodity. When will it result in: (i) No change in equilibrium price. (ii) A fall in equilibrium price.

Ans.



The diagrams explain the following situations:

In D_1 is the initial demand curve and S_1 is the initial supply curve. OP_1 is equilibrium price and OQ_1 equilibrium quantity. Due to decrease in demand, D_2 is the new demand curve. Due to decrease in supply, S_2 is the new supply curve. In the diagram, decrease in demand (from D_1 to D_2) is more than decrease in supply (from S_1 to S_2).

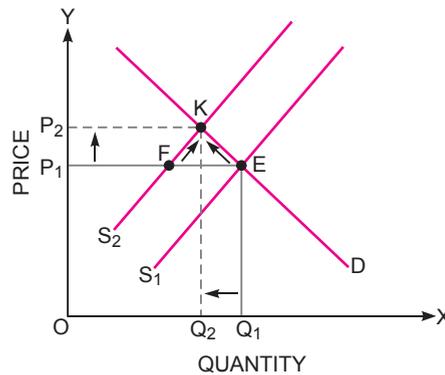
(i) $\downarrow D = \downarrow S$: (decrease in demand is exactly equal to decrease in supply). In this situation, the market price remains unchanged, *i.e.*, OP_1 . Equilibrium quantity decreases from OQ_1 to OQ_2 .

(ii) $\downarrow D > \downarrow S$: (decrease in demand is greater than decrease supply). In this situation the market price falls from OP_1 to OP_2 , as in figure. Equilibrium quantity decreases from OQ_1 to OQ_2 . It is a situation of excess supply.

3. How does increase in price of input affect the equilibrium quantity and equilibrium price?

Ans. Increase in input prices of a commodity leads to decrease in its supply. Decrease in supply implies a shift in the supply curve to the left. It is indicated by S_2 in Figure. This sets in motion the Chain effects.

Effect of a decrease in supply of a good on its equilibrium price and equilibrium quantity is discussed with reference to Figure below.



In this figure, D is the initial demand curve and S_1 is the initial supply curve. E is the initial equilibrium where supply and demand curves intersect each other. OQ_1 is the equilibrium quantity and OP_1 is the equilibrium price. Owing to decrease in supply, supply curve shifts to the left, from S_1 to S_2 . As an immediate impact of decrease in supply, there is excess demand equal to EF (at the existing price). Due to the pressure of excess demand, price of the commodity tends to be higher than the equilibrium price. The rise in price leads to extension of supply and contraction of demand. The extension of supply occurs from point F towards point K . Contraction of demand occurs from point E towards point K . The process of extension of supply and contraction of demand continues till the excess demand is fully eliminated. K is the point of new equilibrium where the market clears itself once again. Corresponding to the new equilibrium, equilibrium price increases from OP_1 to OP_2 and equilibrium quantity decreases from OQ_1 to OQ_2 .

4. Distinguish between direct intervention and indirect intervention by the government in market price.

Ans. Direct intervention by the government in market price is through the tools of price ceiling and price flooring.

Indirect intervention by the government in the market price is through the tools of taxation and subsidy.

5. “Demand and supply are like two blades of a scissor.” Explain with reference to equilibrium price and quantity.

Ans. Yes, demand and supply are like two blades of a scissor both demand and supply are equally important for determining price in the market. There is no use of demand for a product if there is no supply for the product and vice versa. One of the two may play a more active role in price determination in the short run but both are needed to determine the price in the long run.

6. Discuss the impact of change in demand on equilibrium price and equilibrium quantity in a situation where: (i) Supply is perfectly elastic, and (ii) Supply is perfectly inelastic.

Ans. (1) **When Supply is Perfectly Elastic:** Increase or decrease in demand for a commodity does not cause any change in its price in case supply of the commodity is perfectly elastic. Only the equilibrium quantity tends to change. This is illustrated in Fig. (A) and Fig. (B).

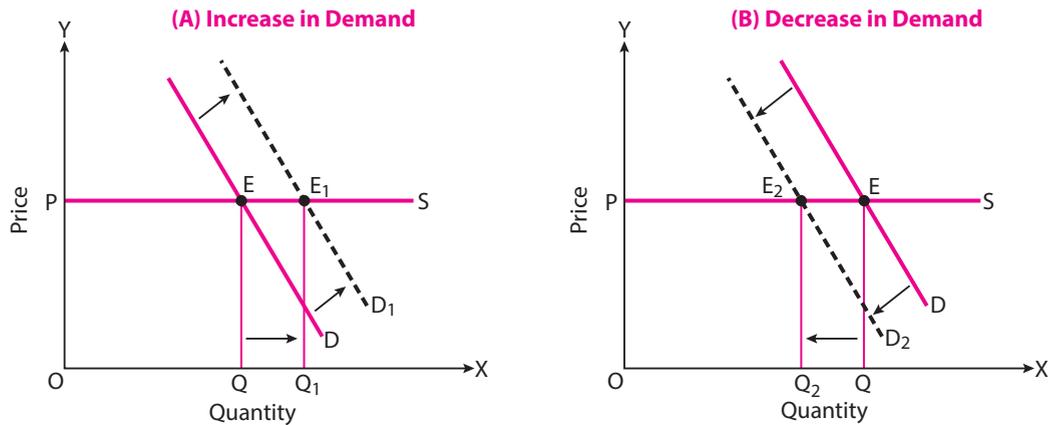


Fig. (A) shows E as the point of equilibrium where perfectly elastic supply curve (S) intersects demand curve (D). OP is the equilibrium price.

Forward shift in demand curve from D to D_1 leaves price of the commodity unaffected. It continues to be OP. However, equilibrium quantity increases from OQ to OQ_1 .

Likewise, backward shift in demand curve from D to D_2 [as in Fig. (B)] only causes a decrease in the equilibrium quantity from OQ to OQ_2 . Price of the commodity remains unaffected at OP.

(2) **When Supply is Perfectly Inelastic:** In a situation of perfectly inelastic supply (or constant supply), increase or decrease in demand causes a full impact on price of the commodity. Of course, equilibrium quantity remains constant simply because supply is constant.

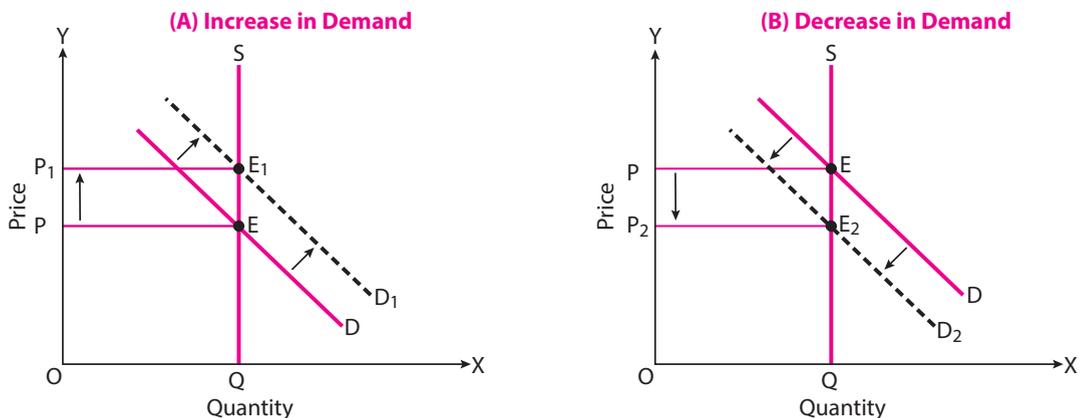


Fig. (A) shows E as the point of equilibrium where perfectly inelastic supply curve (S) intersects demand curve (D). OP is the equilibrium price.

Forward shift in demand curve from D to D_1 shifts equilibrium point from E to E_1 . The price of the commodity increases from OP to OP_1 but equilibrium quantity continues to be OQ.

Likewise, backward shift in demand curve from D to D_2 [as in Fig. (B)] shifts equilibrium point from E to E_2 . This causes a decrease in equilibrium price from OP to OP_2 . Equilibrium quantity of the commodity remains unaffected at OQ.

7. Discuss the impact of change in supply on equilibrium price and equilibrium quantity in a situation where: (i) Demand is perfectly elastic, and (ii) Demand is perfectly inelastic.

Ans. (1) **When Demand is Perfectly Elastic:** Increase or decrease in supply of a commodity does not cause any change in its price in case demand for the commodity is perfectly elastic. Only the equilibrium quantity tends to change. This is illustrated in Fig. (A) and Fig. (B).

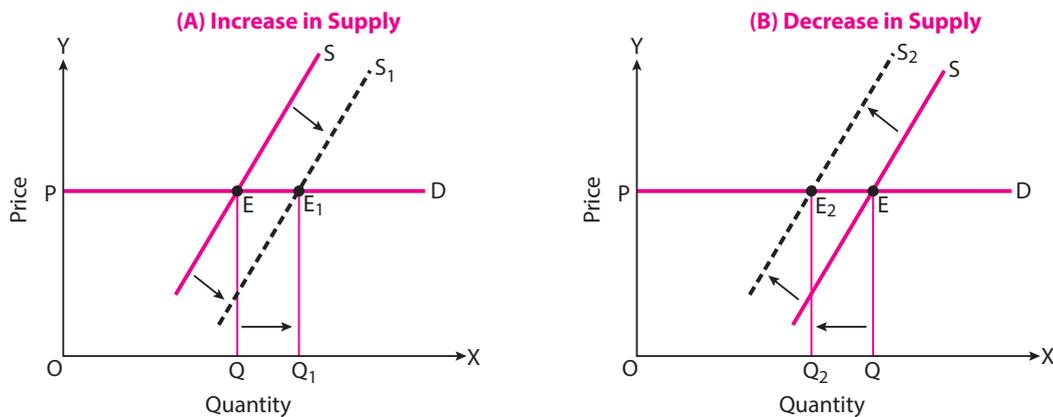


Fig. (A) shows E as the point of equilibrium where perfectly elastic demand curve (D) intersects supply curve (S). OP is the equilibrium price.

Forward shift in supply curve to the right from S to S₁ leaves price of the commodity unaffected. It continues to be OP. However, equilibrium quantity increases from OQ to OQ₁. Likewise, backward shift in supply curve to the left from S to S₂ [as in Fig. (B)] only causes a decrease in the equilibrium quantity from OQ to OQ₂. Price of the commodity remains unaffected at OP.

(2) **When Demand is Perfectly Inelastic:** In a situation of perfectly inelastic demand (or constant demand), increase or decrease in supply causes a full impact on price of the commodity. Of course, equilibrium quantity remains constant, simply because demand is constant.

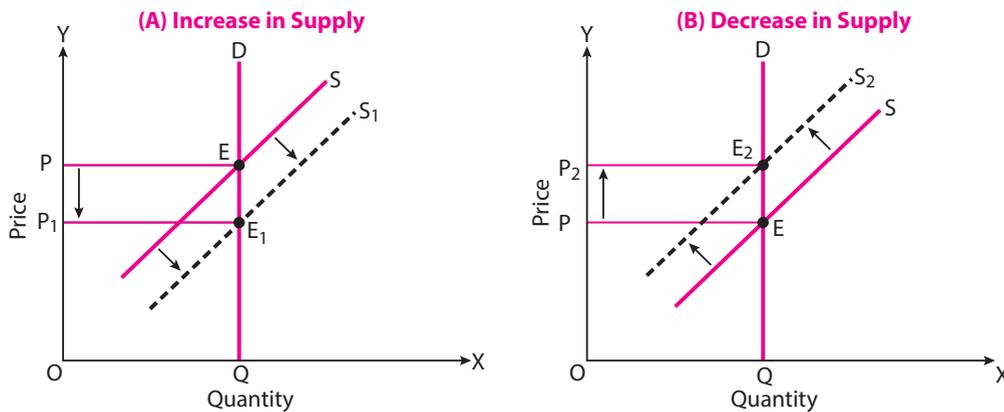


Fig. (A) shows E as the point of equilibrium where supply curve (S) intersects perfectly inelastic demand curve (D). OP is the equilibrium price.

Forward shift in supply curve from S to S_1 leaves equilibrium quantity of the commodity unaffected. It continues to be OQ . The equilibrium point shifts from E to E_1 indicating decrease in equilibrium price from OP to OP_1 .

Likewise, backward shift in supply curve from S to S_2 [as in Fig. (B)] only causes an increase in the equilibrium price from OP to OP_2 ; whereas quantity of the commodity remains unchanged at OQ .

8. Show the change in equilibrium price and equilibrium quantity due to simultaneous shift in demand and supply curves. Use diagram.

Ans. See Answer 5 above.

9. Suppose the demand and supply curves of a commodity-X in a perfectly competitive market are given by:

$$Q_d = 1,400 - p$$

$$Q_s = 1,000 + 3p$$

Find the equilibrium price and the equilibrium quantity.

Ans. At equilibrium

$$Q_d = Q_s$$

$$1400 - P = 1000 + 3P$$

$$4P = 400$$

$$P = 100$$

Hence, equilibrium price = ₹ 100

Equilibrium quantity:

$$Q_d = 1400 - P$$

$$1400 - 100 = 1300 \text{ units}$$

$$Q_s = 1000 + 3P$$

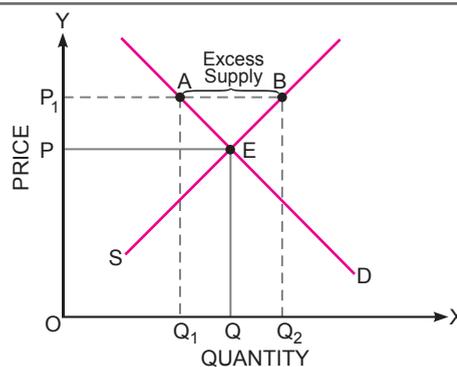
$$= 1000 + 3(100)$$

$$= 1000 + 300$$

$$= 1300 \text{ units}$$

10. Suppose the price of a good is higher than equilibrium price. Explain the changes that will establish equilibrium price.

Ans. In the figure below, D is the market demand curve and S is the market supply curve. Market demand and market supply curves are equal at point E . Thus, point E shows the equilibrium price. This point signifies that equilibrium price is OP and equilibrium quantity is OQ .



In the diagram, OP is the equilibrium price which is less than the prevailing market price OP_1 . At the given market price, there is excess supply = AB . Pressure of excess supply leads to reduction in market price. Owing to a fall in price, quantity demanded tends to rise, leading to an downward movement along the demand curve, from point A to point E . Also, a fall in price

leads to backward movement along the supply curve, from point B to point E, indicating a fall in quantity supplied.

Movements along the supply and demand curves would continue to occur till excess supply is eliminated, and equilibrium is restored. This occurs at point E, where market demand = market supply, and equilibrium price = OP.

