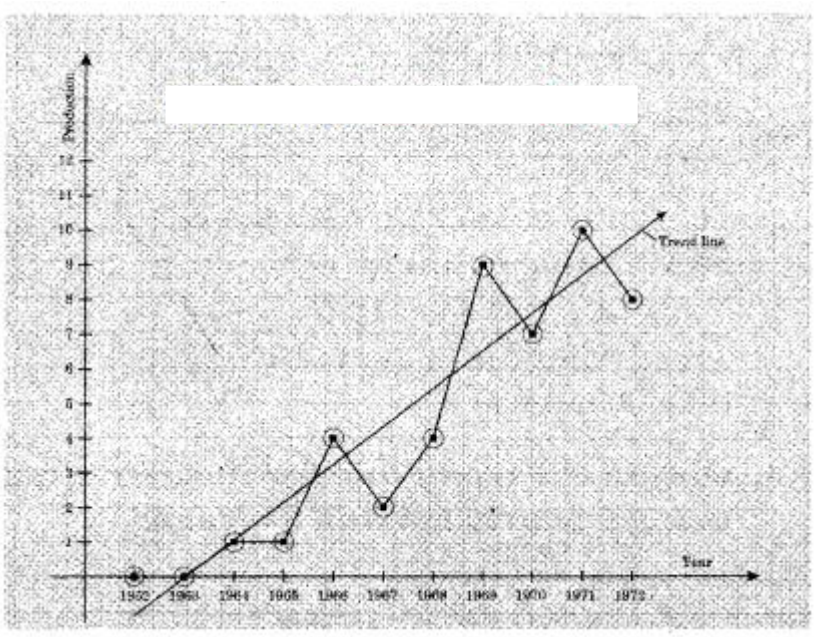
Maharashtra State Board 12th Commerce Maths Solutions Chapter 4 Time Series Ex 4.1

Question 1.
The following data gives the production of bleaching powder (in '000 tonnes) for the years 1962 to 1972.

Year	1962	1963	1964	1965	1966	
Production	0	0	1	1	4	
Year	1967	1968	1969	1970	1971	1972
Production	2	4	9	7	10	8

Fit a trend line by graphical method to the above data.
Solution:



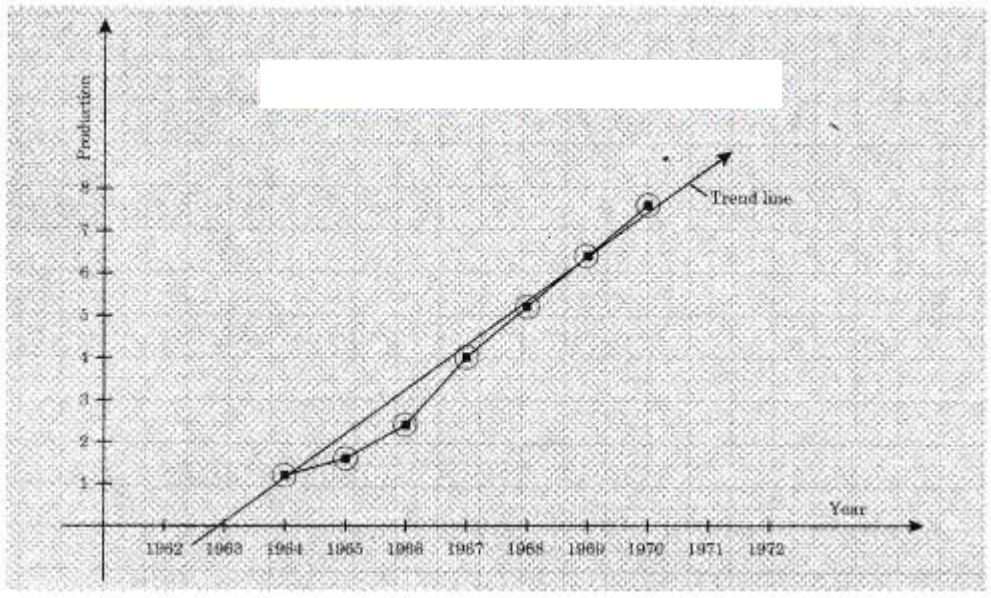
Question 2.
Use the method of least squares to fit a trend line to the data in problem 1 above. Also, obtain the trend value for the year 1975.
Solution:

Year t	Y Production	$u = \frac{t-1967}{1}$	u^2	uy
1962	0	−5	25	0
1963	0	−4	16	0
1964	1	−3	9	−3
1965	1	−2	4	−2
1966	4	−1	1	−4
1967	2	0	0	0
1968	4	1	1	4
1969	9	2	4	18
1970	7	3	9	21
1971	10	4	16	40
1972	8	5	25	40
Total	46	0	110	114

n = 11, let the trend line the
y = a + bu .....(I)
Σy = na + bΣu .....(i)
Σuy = aΣu + bΣu2 .....(ii)
Substituting the values of Σy, Σu, Σuy, & Σu2, we get
46 = 11a + 0
∴ a = 4.18 And
114 = 0 + b(110)
∴ b = 1.04
By (I) the equation of the trends line is
y = 4.18 + 1.04u
Where u = t – 1967 .....(iii)
For the year 1975 we have u = 8
Substituting in (iii) we get
Y= 4.18 + 1.04(8) = 12.5
Trend value for the year 1975 is 12.5 (in '000 tonnes).

Question 3.
Obtain the trend line for the above data using 5 yearly moving averages.
Solution:

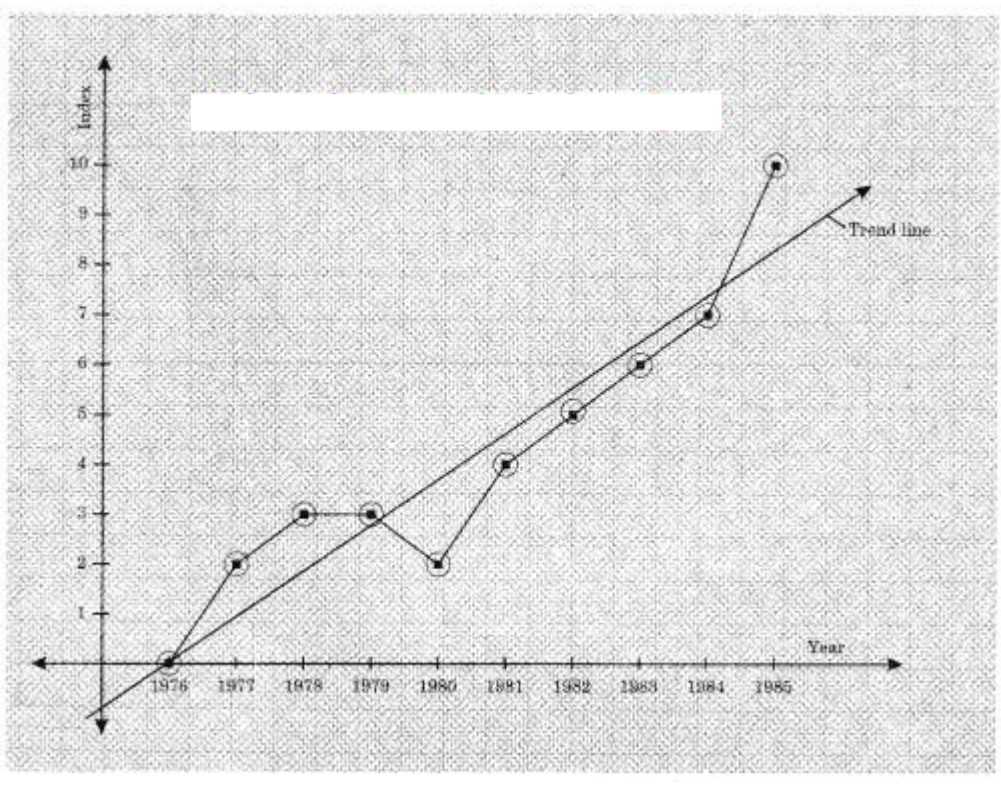
Year	Production Y	5 yearly moving total	5 yearly moving average (trends values)
1962	0	—	—
1963	0	—	—
1964	1	6	1.2
1965	1	8	1.6
1966	4	12	2.4
1967	2	20	4
1968	4	26	5.2
1969	9	32	6.4
1970	7	38	7.6
1971	10		
1972	8	—	—



Question 4.
The following table shows the index of industrial production for the period from 1976 to 1985, using the year 1976 as the base year.

Year	1976	1977	1978	1979	1980
Index	0	2	3	3	2
Year	1981	1982	1983	1984	1985
Index	4	5	6	7	10

Fit a trend line to the above data by graphical method.
Solution:



Question 5.
Fit a trend line to the data in problem 4 above by the method of least squares. Also, obtain the trend value for the index of industrial production for the year 1987.
Solution:

Year t	u	Y	u^2	uy
1976	–9	0	81	0
1977	–7	2	49	–14
1978	–5	3	25	–15
1979	–3	3	9	–9
1980	–1	2	1	–2
1981	1	4	1	4
1982	3	5	9	15
1983	5	6	25	30
1984	7	7	49	49
1985	9	10	81	90
.....	0	42	330	148

u = $t-1980.5_{12}$, n = 10, Σu = 0, Σy = 42, Σu^2 = 330, Σuy = 148
Let the trend line be y = a + bu .....(i)
where u = $t-1980.5_{12}$
i.e. u = 2t – 3961
Σy = na + bΣu .....(ii)
$\Sigma uy = a\Sigma u + b\Sigma u^2$ .....(iii)
Substituting the values of Σy, n, Σu, Σuy & Σu^2 We get
42 = 10a + 0
∴ a = 4.2 and
148 = 0 + 5.330
∴ b = 0.4485
∴ by (i) the equation of the trends line is
Y = 4.2 + 0.4485u .....(iv)
where u = 2t – 3961
For the year 1987,
u = 13 by (iv) we have
Y = 4.2 + 0.4485(13) = 10.0305
∴ The trend value for the year 1987 is 10.0305

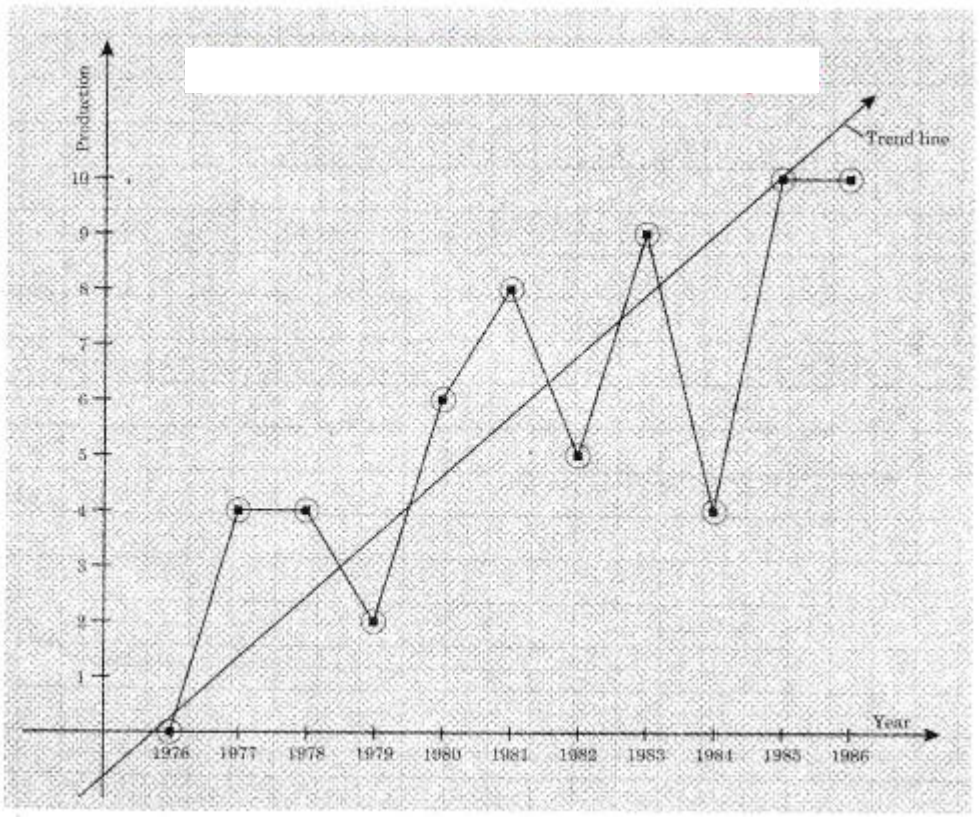
Question 6.
Obtain the trend values for the data in problem 4 using 4-yearly centered moving averages.
Solution:

Year	Y	4 yearly moving total	4 yearly moving average	2 unit moving total	4 yearly centered moving average
(1)	(2)	(3)	$(4)=\frac{(3)}{4}$	(5)	$(4)=\frac{(5)}{2}$
1976	0	—		—	—
1977	2			—	—
		8	2		
1978	3			4.5	2.25
		10	2.5		
1979	3			5.5	2.75
		12	3		
1980	2			6.5	3.25
		14	3.5		
1981	4			7.75	3.875
		17	4.25		
1982	5			9.75	4.875
		22	5.5		
1983	6			12.5	6.25
		28	7		
1984	7			—	—
1985	10			—	—

Question 7.
The following table gives the production of steel (in millions of tonnes) for the years 1976 to 1986.

Year	1976	1977	1978	1979	1980	1981
Production	0	4	4	2	6	8
Year	1982	1983	1984	1985	1986	
Production	5	9	4	10	10	

Fit a trend line to the above data by the graphical method.
Solution:



Question 8.
Fit a trend line to the data in Problem 7 by the method of least squares. Also, obtain the trend value for the year 1990.
Solution:

Year t	u	Y	u^2	uy
1976	−5	0	25	0
1977	−4	4	16	−16
1978	−3	4	9	−12
1979	−2	2	4	−4
1980	−1	6	1	−6
1981	0	8	0	0
1982	1	5	1	5
1983	2	9	4	18
1984	3	4	9	12
1985	4	10	16	40
1986	5	10	25	50
	0	62	110	87

$u = t - 1981$, n = 10, $\Sigma u = 0$, $\Sigma Y = 62$, $\Sigma u^2 = 110$, $\Sigma uy = 87$
Let the equation of the trend line be
$Y = a + bu$
where $u = t - 1981$ .....(i)
$\Sigma Y = na + b\Sigma u$ .....(ii)
$\Sigma uy = a\Sigma u + b\Sigma u^2$ .....(iii)
Substituting the values of Σy, n, Σu, Σuy, Σu^2 in (ii) & (iii)
$62 = 11a + 0$
$\therefore a = 5.6364$ And
$87 = 0 + 5(110)$
$\therefore b = 0.7909$
$\therefore$ by (i) equation of the trend line is $y = 5.6364 + 0.7909u$
Where $u = t - 1981$
For the year 1990,
$u = 9$
$\therefore y = 5.6364 + 0.7909(9)$
$\therefore y = 12.7545$ (in million tonnes)

Question 9.
Obtain the trend values for the above data using 3-yearly moving averages.
Solution:

Year	Y	3 yearly moving total	3 yearly moving average trend values $\left[\frac{(3)}{3}\right]$
(1)	(2)	(3)	
1976	0	—	—
1977	4	8	2.6767
1978	4	10	3.3333
1979	2	12	4.0000
1980	6	16	5.3333
1981	8	19	6.3333
1982	5	22	7.3333
1983	9	18	6.0000
1984	4	23	7.6767
1985	10	24	8.0000
1986	10	—	—

Question 10.
The following table shows the production of gasoline in the U.S.A. for the years 1962 to 1976.

Year	Production (million Barrels)	Year	Production (million Barrels)
1962	0	1970	6
1963	0	1971	7
1964	1	1972	8
1965	1	1973	9
1966	2	1974	8
1967	3	1975	9
1968	4	1976	10
1969	5		

(i) Obtain trend values for the above data using 5-yearly moving averages.
(ii) Plot the original time series and trend values obtained above on the same graph.
Solution:
(i)

Year	Production (million barrels)	5 yearly moving total	5 yearly moving average trend values $(4)=\frac{(3)}{5}$
(1)	(2)	(3)	
1962	0	—	—
1963	0	—	—
1964	1	4	0.8
1965	1	7	1.4
1966	2	11	2.2
1967	3	15	3
1968	4	20	4
1969	5	25	5
1970	6	30	6
1971	7	35	7
1972	8	38	7.6
1973	9	41	8.2
1974	8	44	8.8
1975	9	—	—
1976	10	—	—

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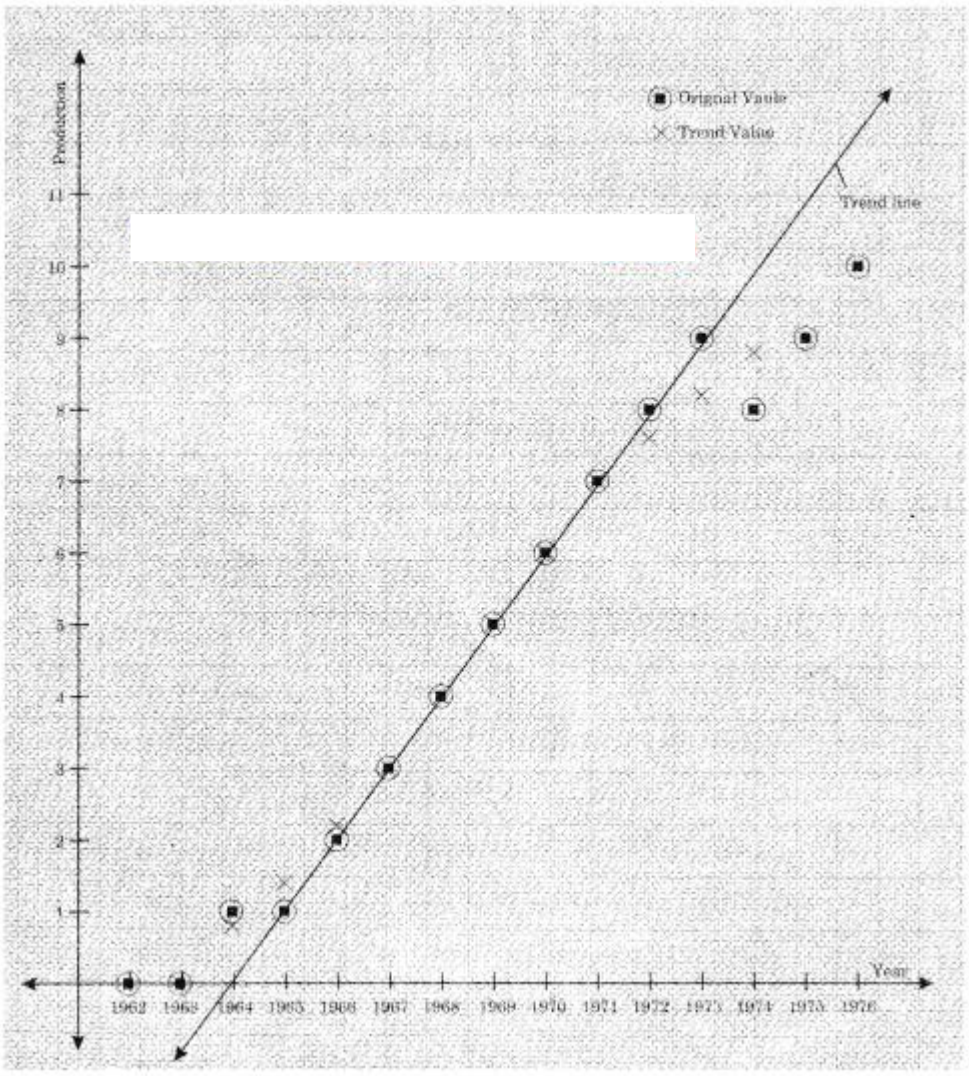
(ii)



Maharashtra State Board 12th Commerce Maths Solutions Chapter 4 Time Series Miscellaneous Exercise 4

(I) Choose the correct alternative.

Question 1.
Which of the following can't be a component of a time series?
(a) Seasonality
(b) Cyclical
(c) Trend
(d) Mean
Answer:
(d) Mean

Question 2.
The first step in time series analysis is to
(a) Perform regression calculations
(b) Calculate a moving average
(c) Plot the data on a graph
(d) Identify seasonal variation
Answer:
(c) Plot the data on a graph

Question 3.
Time-series analysis is based on the assumption that
(a) Random error terms are normally distributed.
(b) The variable to be forecast and other independent variable are correlated.
(c) Past patterns in the variable to be forecast will continue unchanged into the future.
(d) The data do not exhibit a trend.
Answer:
(c) Past patterns in the variable to be forecast will continue unchanged into the future.

Question 4.
Moving averages are useful in identifying
(a) Seasonal component
(b) Irregular component
(c) Trend component
(d) Cyclical component
Answer:
(c) Trend component

Question 5.
We can use regression line for past data to forecast future data. We then use the line which
(a) Minimizes the sum of squared deviations of past data from the line.
(b) Minimizes the sum of deviations of past data from the line.
(c) Maximizes the sum of squared deviations of past data from the line.
(d) Maximizes the sum of deviation of past data from the line.
Answer:
(a) Minimizes the sum of squared deviations of past data from the line

Question 6.
Which of the following is a major problem for forecasting, especially when using the method of least squares?
(a) The past cannot be known
(b) The future is not entirely certain
(c) The future exactly follows the patterns of the past
(d) The future may not follow the patterns of the past
Answer:
(d) The future may not follow the patterns of the past

Question 7.
An overall upward or downward pattern in an annual time series would be contained in which component of the time series
(a) Trend
(b) Cyclical
(c) Irregular
(d) Seasonal
Answer:
(a) Trend

Question 8.
The following trend line equation was developed for annual sales from 1984 to 1990 with 1984 as base or zero year. Y1 = 500 + 60X (in 1000 Rs.) The estimated sales for 1984 (in 1000 Rs) is:
(a) ₹ 500
(b) ₹ 560
(c) ₹ 1,040
(d) ₹ 1100
Answer:
(a) ₹ 500

Question 9.
What is a disadvantage of the graphical method of determining a trend line?
(a) Provides quick approximations
(b) Is subject to human error
(c) Provides accurate forecasts
(d) Is too difficult to calculate
Answer:
(b) Is subject to human error

Question 10.
Which component of time series refers to erratic time series movements that follow no recognizable or regular pattern.
(a) Trend
(b) Seasonal

(c) Cyclical
(d) Irregular
Answer:
(a) Trend

(II) Fill in the blanks.

Question 1.
_____ components of time series is indicated by a smooth line.
Answer:
Trend

Question 2.
_____ component of time series is indicated by periodic variation year after year.
Answer:
Seasonal

Question 3.
_____ component of time series is indicated by a long wave spanning two or more years.
Answer:
Cyclical

Question 4.
_____ component of time series is indicated by up and down movements without any pattern.
Answer:
Irregular

Question 5.
Addictive models of time series _____ independence of its components.
Answer:
assume

Question 6.
Multiplicative models of time series _____ independence of its components.
Answer:
does not assume

Question 7.
The simplest method of measuring the trend of time series is _____
Answer:
graphical method

Question 8.
The method of measuring the trend of time series using only averages is _____
Answer:
moving average method

Question 9.
The complicated but ancient method of measuring the trend of time series is _____
Answer:
least-squares method

Question 10.
The graph of time series clearly shows _____ of it is monotone.
Answer:
trend

(III) State whether each of the following is True or False.

Question 1.
The secular trend component of the time series represents irregular variations.
Answer:
False

Question 2.
Seasonal variation can be observed over several years.

Answer:
True

Question 3.
Cyclical variation can occur several times in a year.
Answer:
False

Question 4.
Irregular variation is not a random component of time series.
Answer:
False

Question 5.
The additive model of time series does not require the assumptions of independence of its components.
Answer:
False

Question 6.
The multiplicative model of time series does not require the assumption of independence of its components.
Answer:
True

Question 7.
The graphical method of finding trends is very complicated and involves several calculations.
Answer:
False

Question 8.
Moving the average method of finding trends is very complicated and involves several calculations.
Answer:
False

Question 9.
The least-squares method of finding trends is very simple and does not involve any calculations.
Answer:
False

Question 10.
All three methods of measuring trends will always give the same results.
Answer:
False

(IV) Solve the following problems.

Question 1.
The following table shows the productivity of pig-iron and ferro-alloys ('000 metric tonnes)

Year	1974	1975	1976	1977	1978
Production	0	4	9	9	8
Year	1979	1980	1981	1982	
Production	5	4	8	10	

Fit a trend line to the above data by graphical method.

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Solution:

Question 2.
Fit a trend line to the data in Problem IV (1) by the method of least squares.
Solution:

Year t	Y	u	u^2	uy
1974	0	−4	16	0
1975	4	−3	9	−12
1976	9	−2	4	−18
1977	9	−1	1	−9
1978	8	0	0	0
1979	5	1	1	5
1980	4	2	4	8
1981	8	3	9	24
1982	10	4	16	40
	57	0	60	38

u = $t-19781$, Σy = 57, Σu = 0, Σu^2 = 60, Σuy = 38, n = 9
Let the equation of the trend line be
Y = a + bu where u = t – 1978 .....(i)
Σy = na + bΣu .....(ii)
$\Sigma uy = a\Sigma u + b\Sigma u^2$ .....(iii)
Substituting the values of Σu, n, Σuy, Σu^2 in (ii) & (iii) we get
57 = 9a + 0 ∴ a = 6.3333
38 = 0 + b . 60 ∴ b = 0.6333.
∴ The equation of the trend line is
y = 6.3333 + 0.63333u where u = t – 1978

Question 3.
Obtain the trends values for the data on problem IV (1) using 5 yearly moving averages.

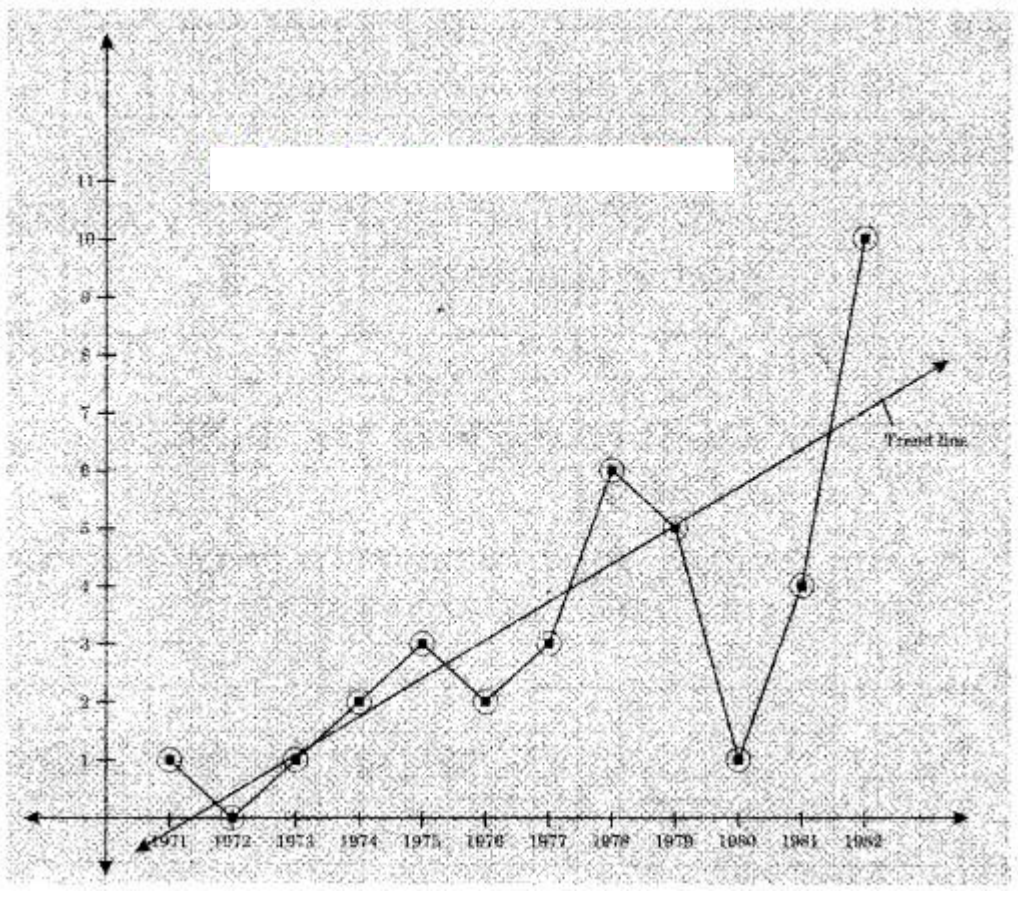
Solution:

Year	Production	5 yearly moving total	5 yearly moving average
(1)	(2)	(3)	(4) = (3)/5
1974	0	—	—
1975	4	—	—
1976	9	30	6
1977	9	35	7
1978	8	35	7
1979	5	34	6.8
1980	4	35	7
1981	8	—	—
1982	10	—	—

Question 4.
The following table shows the amount of sugar production (in lac tonnes) for the years 1971 to 1982.

Year	Production	Year	Production
1971	1	1977	3
1972	0	1978	6
1973	1	1979	5
1974	2	1980	1
1975	3	1981	4
1976	2	1982	10

Fit a trend line to the above data by graphical method.
Solution:



Question 5.
Fit a trend line to data in problem 4 by the method of least squares.
Solution:

Year t	Y	u	u^2	uy
1971	1	−11	121	−11
1972	0	−9	81	0
1973	1	−7	49	−7
1974	2	−5	25	−10
1975	3	−3	9	−9
1976	2	−1	1	−2
1977	3	1	1	3
1978	6	3	9	18
1979	5	5	25	25
1980	1	7	49	7
1981	4	9	81	36
1982	10	11	121	110
Total	38	0	572	160

u = $t-1976.5_{12}$, Σy = 38, Σu = 0, Σu_2 = 572, Σuy = 160, n = 12
Let the equation of the trend line be
y = a + bu .....(i)
where u = $t-1976.5_{12}$
u = 2t – 3953
Σy = na + bΣu .....(ii)
$\Sigma uy = a\Sigma u + b\Sigma u_2$ .....(iii)
by (ii) 38 = 12o + 0 ∴ a = 3.1867
by (iii) 160 = 0 + b . 572 ∴ b = 0.2797
∴ by (i), Equation of the trend line is
Y = 3.1667 + 0.2797u where u = 2t – 3953.

Question 6.
Obtain trend values for data in Problem 4 using 4-yearly centered moving averages.

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Solution:

Year	Production	4 yearly moving total	4 yearly moving average	2 unit moving total	4 yearly centered moving average (trend value)
(1)	(2)	(3)	$(4) = \frac{(3)}{5}$	(5)	$\frac{(5)}{2}$
1971	1			—	—
1972	0			—	—
		4	1		
1973	1			2.5	1.25
		6	1.5		
1974	2			3.5	1.75
		8	2		
1975	3			4.5	2.25
		10	2.5		
1976	2			6	3
		14	3.5		
1977	3			7.5	3.75
		16	4		
1978	6			7.75	3.875
		15	3.75		
1979	5			7.75	3.875
		16	4		
1981	2			9	4.5
		20	5		
1981	4			—	
1982	10			—	

Question 7.
The percentage of girls' enrollment in total enrollment for years 1960-2005 is shown in the following table.

Year	1960	1965	1970	1975	1980
Production	0	3	3	4	4
Year	1985	1990	1995	2000	2005
Production	5	6	8	8	10

Fit a trend line to the above data by graphical method.

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Solution:

Question 8.
Fit a trend line to the data in Problem 7 by the method of least squares.
Solution:

Year t	Production Y	u	u^2	uy
(1)	(2)	(3)	(4)	(5)
1960	0	–9	81	0
1965	3	–7	49	–21
1970	3	–5	25	–15
1975	4	–3	9	–12
1980	4	–1	1	–4
1985	5	1	1	5
1990	6	3	9	18
1995	8	5	25	40
2000	8	7	49	56
2005	10	9	81	90
Total	51	0	330	157

u = $t-1980.55$, Σy = 51, Σu = 0, Σu^2 = 330, Σuy = 157, n = 10
Let the equation of the trend line be
Y = a + bu where u = $t-1980.55$ .....(i)
Σy = na + bΣu .....(ii)
$\Sigma uy = a\Sigma u + b\Sigma u^2$ .....(iii)
Substituting the values of Σy, Σu, n, Σuy, Σu^2 We get
51 = 10a + 0 ∴ a = 5.1
and 157 = 0 + 6.330 ∴ b = 0.4758
by (i) equation of the trend line is
Y = 5.1 + 0.4758u where u = $t-1980.55$

Question 9.
Obtain trend values for the data in Problem 7 using 4-yearly moving averages.

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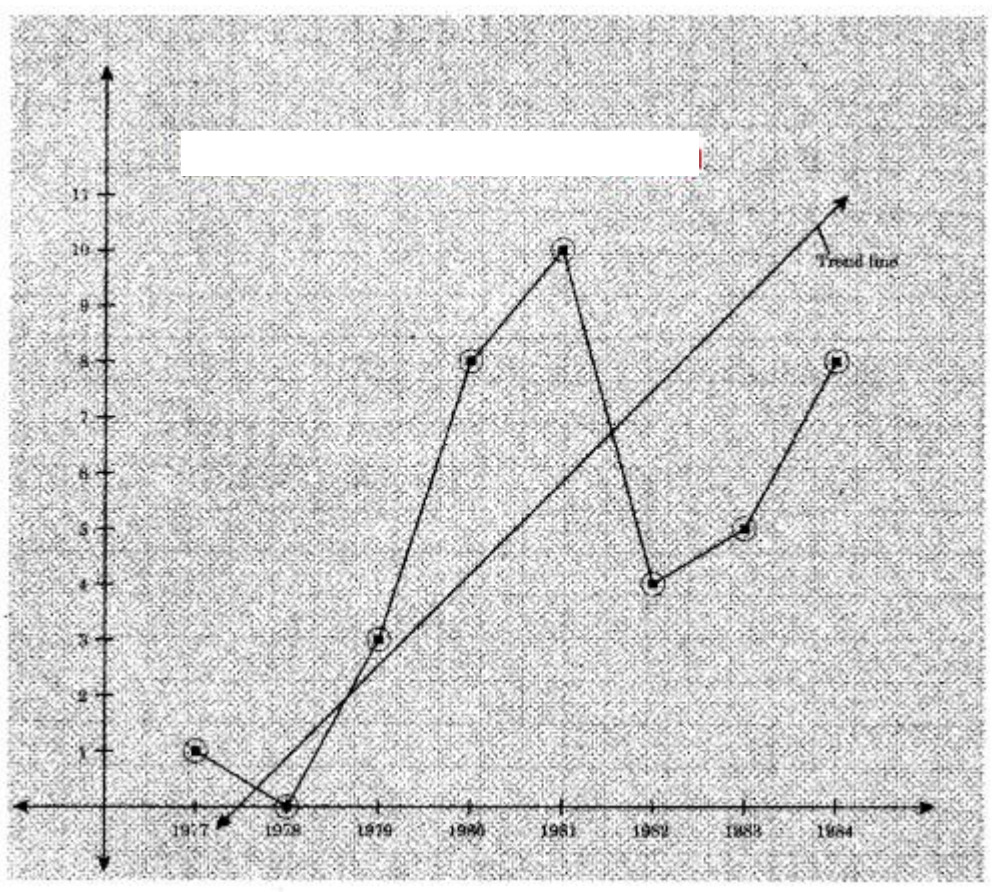
Solution:

Year t	Production Y	4 yearly moving total	4 yearly moving average
1960	0		
1965	3		
		10	2.5
1970	3		
		14	3.5
1975	4		
		16	4
1980	4		
		19	4.75
1985	5		
		23	5.75
1990	6		
		27	6.75
1995	8		
		32	8
2000	8		
2005	10		

Question 10.
The following data shows the number of boxes of cereal sold in the years 1977 to 1984.

Year	1977	1978	1979	1980
No. of boxes in ten thousands	1	0	3	8
Year	1981	1982	1983	1984
No. of boxes in ten thousands	10	4	5	8

Fit a trend line to the above data by graphical method.
Solution:



Question 11.
Fit a trend line to data in Problem 10 by the method of least squares.
Solution:

Year t	Y	u	u^2	uy
(1)	(2)	(3)	(4)	(5)
1977	1	−7	49	−7
1978	0	−5	25	0
1979	3	−3	9	−9
1980	8	−1	1	−8
1981	10	1	1	10
1982	4	3	9	12
1983	5	5	25	25
1984	8	7	49	56
Total	39	0	168	79

u = $t-1980.5_{12}$, Σy = 39, Σu = 0, Σu_2 = 168, Σuy = 79, n = 8
Let the equation of the trend line by
Y = a + bu
Where u = 2t – 3961 .....(i)
Σy = na + bΣu .....(ii)
$\Sigma uy = a\Sigma u + b\Sigma u_2$ .....(iii)
Substituting the values of Σy, n, Σu, Σuy, Σu_2, in (ii) & (iii)
39 = 8a + 0 ∴ a = 4.875
79 = 0 + b (168) ∴ b = 0.4702
by (i) the equation of the trend line is
Y = 4.875 + 0.4702u Where u = 2t – 3961.

Question 12.
Obtain trend values for data in Problem 10 using 3-yearly moving averages.
Solution:

Year	No. of boxes in ten thds	3 yearly moving total	3 yearly moving average (trend value)
(1)	(2)	(3)	$(4)=\frac{(3)}{3}$
1977	1	—	—
1978	0	4	1.3333
1979	3	11	3.6667
1980	8	21	7
1981	10	22	7.3333
1982	4	19	6.3333
1983	5	17	5.6667
1984	8	—	—

Question 13.
The following table shows the number of trade fatalities (in a state) resulting from drunken driving for the years 1975 to 1983.

Year	1975	1976	1977	1978	1979
No. of deaths	0	6	3	8	2
Year	1980	1981	1982	1983	
No. of deaths	9	4	5	10	

Fit a trend line to the above data by graphical method.

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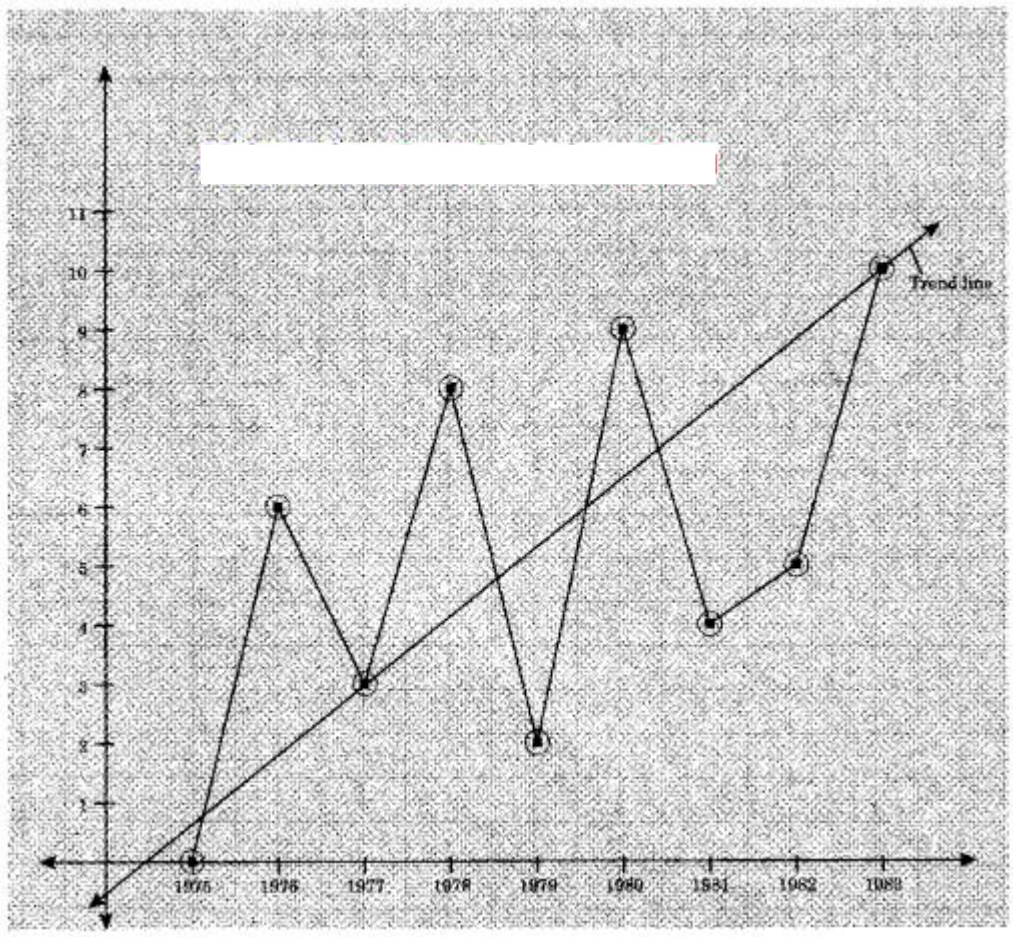
Solution:



Question 14.
Fit a trend line to data in Problem 13 by the method of least squares.
Solution:

Year t	No. of deaths y	u	u^2	uy
1975	0	−4	16	0
1976	6	−3	9	−18
1977	3	−2	4	−6
1978	8	−1	1	−8
1979	2	0	0	0
1980	9	1	1	9
1981	4	2	4	8
1982	5	3	9	15
1983	10	4	16	40
Total	47	0	60	40

u = $t-19791$, Σy = 47, Σu = 0, Σu^2 = 60, Σuy = 40, n = 9
Let the equation of the trends line be
Y = a + bu where u = t – 1979 .....(i)
Σy = na + bΣu .....(ii)
$\Sigma uy = a\Sigma u + b\Sigma u^2$ .....(iii)
Substituting values of Σy, n, Σu, Σuy, Σu^2 in (ii) & (iii)
We get 47 = 9a + 0 ∴ a = 5.2222
and 40 = 0 + b(60) ∴ b = 0.6667
∴ by (i) the equation of the trend line is
Y = 5.2222 + 0.6667u Where u = t – 1979.

Question 15.
Obtain trend values for data in Problem 13 using 4-yearly moving averages.

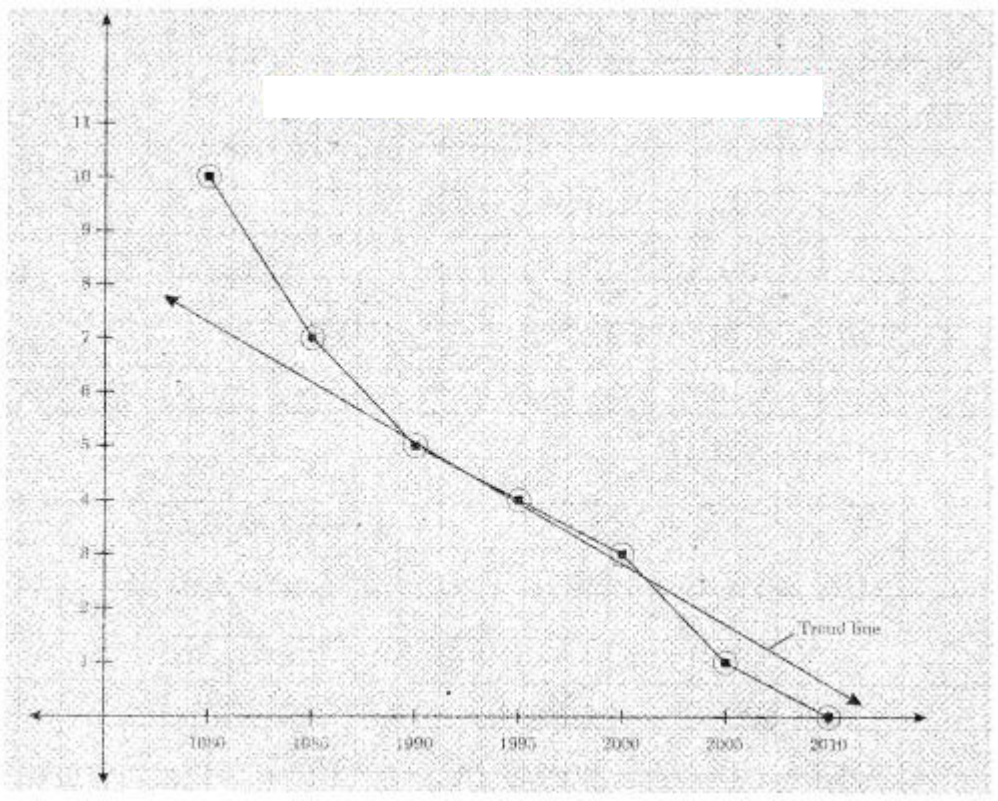
Solution:

Year t	No. of deaths	4 yearly moving total	4 yearly moving average
(1)	(2)	(3)	(4) = (3)/4
1975	0		
1976	6		
		17	4.25
1977	3		
		19	4.75
1978	8		
		22	5.5
1979	2		
		23	5.75
1980	9		
		20	5
1981	4		
		28	7
1982	5		
1983	10		

Question 16.
The following table shows the all India infant mortality rates (per '000) for the years 1980 to 2000.

Year	1980	1985	1990	1995
IMR	10	7	5	4
Year	2000	2005	2010	
IMR	3	1	0	

Fit a trend line to the above data by graphical method.
Solution:



Question 17.
Fit a trend line to data in Problem 16 by the method of least squares.
Solution:

Year t	IMR y	u	u^2	uy
1980	10	−5	25	−50
1985	7	−3	9	−21
1990	5	−1	1	−5
1995	4	0	0	0
2000	3	1	1	3
2005	1	3	9	3
2010	0	5	25	0
	30	0	70	−70

u = $t-19955$, Σy = 30, Σu = 0, Σu^2 = 70, Σuy = -70, n = 7
Let the equation of the trend line be
Y = a + bu Where u = $t-19955$ .....(i)
Σy = na + bΣu ......(ii)
$\Sigma uy = a\Sigma u + b\Sigma u^2$ ....(iii)
Substituting values of Σy, n, Σu, Σuy & Σu^2 in (ii) & (iii) we get
30 = 7a + 0 ∴ a = 4.2857
-70 = 0 + 6(70) ∴ b = -1
∴ by (i) the equation of the trend line is
y = 4.2857 – 1(u) Where u = $t-19955$

Question 18.
Obtain trend values for data in Problem 16 using 3-yearly moving averages.
Solution:

Year t	IMR y	3 yearly moving total	3 yearly moving average
(1)	(2)	(3)	(4) = $\frac{(3)}{3}$
1980	10	—	—
1985	7	22	7.3333
1990	5	16	5.3333
1995	4	12	4
2000	3	8	2.6667
2005	1	4	1.3333
2010	0	—	—

Question 19.
the following table shows the wheat yield ('000 tonnes) in India for the years 1959 to 1968.

Year	Yield	Year	Yield
1959	0	1964	0
1960	1	1965	4
1961	2	1966	1
1962	3	1967	2
1963	1	1968	10

Fit a trend line to the above data by the method of least squares.
Solution:

Year t	Yield y	u	u^2	uy
1959	0	−9	81	0
1960	1	−7	49	−7
1961	2	−5	25	−10
1962	3	−3	9	−9
1963	1	−1	1	−1
1964	0	1	1	0
1965	4	3	9	12
1966	1	5	25	5
1967	2	7	49	14
1968	10	9	81	90
	24	0	330	94

u = $t-1963.5_{12}$, Σy = 24, Σu = 0, Σu^2 = 330, Σuy = 94, n = 10
Let the equation of the trend line be
y = a + bu where u = $t-1963.5_{12}$ .....(i)
i.e. u = 2t – 3927
Σy = na + bΣu .....(ii)
$\Sigma uy = a\Sigma u + \Sigma u^2$ .....(iii)
Substituting values of Σy, n, Σu, Σuy & Σu^2 in (ii) & (iii) we get
24 = 10a + 0 ∴ a = 2.4
94 = 0 + 6.330 ∴ b = 0.2848
∴ Equation of the trend line is
y = 2.4 + (0.2848)u where u = 2t – 3927

Question 20.
Obtain trend values for data in problem 19 using 3-yearly moving averages.
Solution:

Year t	Yield y	3 yearly moving total	3 yearly moving average
(1)	(2)	(3)	$(4) = \frac{(3)}{3}$
1959	0	—	—
1960	1	3	1
1961	2	6	2
1962	3	6	2
1963	1	4	1.3333
1964	0	5	1.6667
1965	4	5	1.6667
1966	1	7	2.3333
1967	2	13	4.3333
1968	10	—	—