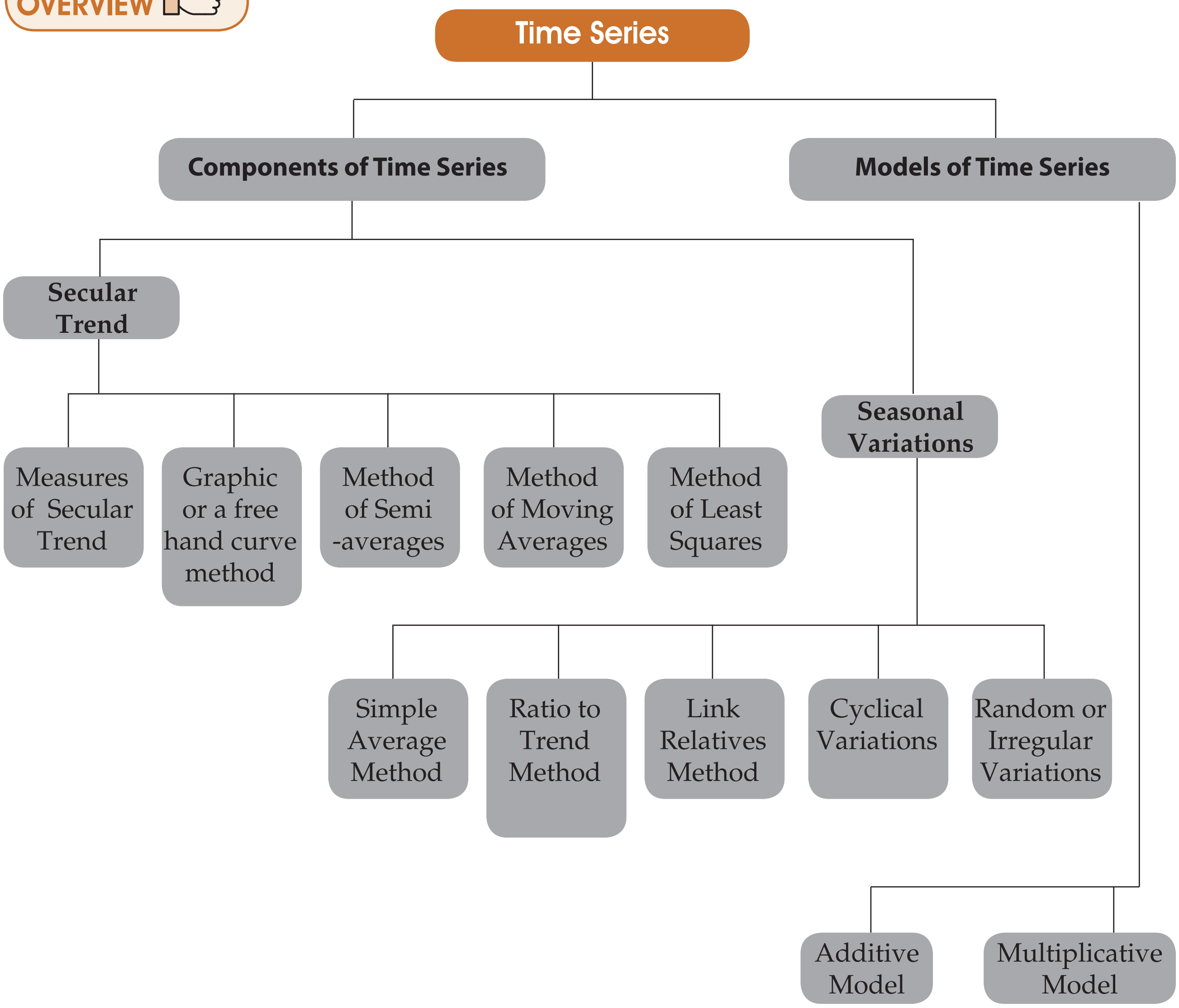
UNIT - II TIME SERIES

LEARNING OBJECTIVES

At the end of this Chapter, you will be able to:

- Understand the components of Time Series
- Calculate the trend using graph, moving averages
- Calculate Seasonal variations for both Additive and Multiplicative models

CHAPTER OVERVIEW



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19.2.1 INTRODUCTION

We came across a data which is collected on a variable/s (rainfall, production of industrial product, production of rice, sugar cane, import/export of a country, population, etc.) at different time epochs (hours, days, months, years etc.), such a data is called time series data. Time series is statistical data that are arranged and presented in a chronological order i.e., over a period of time.

Most of the time series relating to Economic, Business and Commerce might show an upward tendency in case of population, production & sales of products, incomes, prices; or downward tendency might be noticed in time series relating to share prices, death, birth rate etc. due to global melt down, or improvement in medical facilities etc.

Definition: According to Spiegel, "A time series is a set of observations taken at specified times, usually at equal intervals."

According to Ya-Lun-Chou, "A time series may be defined as a collection of reading belonging to different time period of same economic variable or composite of variables."

Components of Time Series: There are various forces that affect the values of a phenomenon in a time series; these may be broadly divided into the following four categories, commonly known as the components of a time series.

(1) Long term movement or Secular Trend

(2) Seasonal variations

(3) Cyclical variations

(4) Random or irregular variations

In traditional or classical time series analysis, it is ordinarily assumed that there are:

1. Secular Trend or Simple trend:

Secular trend is the long: Term tendency of the time series to move in an upward or down ward direction. It indicates how on the whole, it has behaved over the entire period under reference. These are result of long-term forces that gradually operate on the time series variable. A general tendency of a variable to increase, decrease or remain constant in long term (though in a small time interval it may increase or decrease) is called trend of a variable. E.g. Population of a country has increasing trend over a years. Due to modern technology, agricultural and industrial production is increasing. Due to modern technology health facilities, death rate is decreasing and life expectancy is increasing. Secular trend is be long-term tendency of the time series to move on upward or downward direction. It indicates how on the whole behaved over the entire period under reference. These are result of long term forces that gradually operate on the time series variable. A few examples of theses long term forces which make a time series to move in any direction over long period of the time are long term changes per capita income, technological improvements of growth of population, Changes in Social norms etc.

Most of the time series relating to Economic, Business and Commerce might show an upward tendency in case of population, production & sales of products, incomes, prices; or downward tendency might be noticed in time series relating to share prices, death, birth rate etc. due to global melt down, or improvement in medical facilities etc. All these indicate trend.

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2. Seasonal variations:

Over a span of one year, seasonal variation takes place due to the rhythmic forces which operate in a regular and periodic manner. These forces have the same or almost similar pattern year after year.

It is common knowledge that the value of many variables depends in part on the time of year. For Example, Seasonal variations could be seen and calculated if the data are recorded quarterly, monthly, weekly, daily or hourly basis. So if in a time series data only annual figures are given, there will be no seasonal variations.

The seasonal variations may be due to various seasons or weather conditions for example sale of cold drink would go up in summers & go down in winters. These variations may be also due to man-made conventions & due to habits, customs or traditions. For example, sales might go up during Diwali & Christmas or sales of restaurants & eateries might go down during Navratri's.

The method of seasonal variations are

(i) Simple Average Method

(ii) Ratio to Trend Method

(iii) Ratio to Moving Average Method

(iv) Link Relatives Method

3. Cyclical variations:

Cyclical variations, which are also generally termed as business cycles, are the periodic movements. These variations in a time series are due to ups & downs recurring after a period from Season to Season. Though they are more or less regular, they may not be uniformly periodic. These are oscillatory movements which are present in any business activity and is termed as business cycle. It has got four phases consisting of prosperity (boom), recession, depression and recovery. All these phases together may last from 7 to 9 years may be less or more.

4. Random or irregular variations:

These are irregular variations which occur on account of random external events. These variations either go very deep downward or too high upward to attain peaks abruptly. These fluctuations are a result of unforeseen and unpredictably forces which operate in absolutely random or erratic manner. They do not have any definite pattern and it cannot be predicted in advance. These variations are due to floods, wars, famines, earthquakes, strikes, lockouts, epidemics etc.

19.2.2 MODELS OF TIME SERIES

The following are the two models which are generally used for decomposition of time series into its four components. The objective is to estimate and separate the four types of variations and to bring out the relative impact of each on the overall behaviour of the time series.

(1) Additive model

(2) Multiplicative model

Additive Model: In additive model it is assumed that the four components are independent of one another i.e. the pattern of occurrence and magnitude of movements in any particular component does not affect and are not affected by the other component. Under this assumption the four components are arithmetically additive ie. magnitude of time series is the sum of the separate influences of its four components i.e. $Y_t = T + C + S + I$

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Where,

Y_t = Time series

T = Trend variation

C = Cyclical variation

S = Seasonal variation

I = Random or irregular variation

Multiplicative Model: In this model it is assumed that the forces that give rise to four types of variations are interdependent, so that overall pattern of variations in the time series is a combined result of the interaction of all the forces operating on the time series. Accordingly, time series are the product of its four components i.e.

$Y_t = T \times C \times S \times I$

As regards to the choice between the two models, it is generally the multiplication model which is used more frequently. As the forces responsible for one type of variation are also responsible for other type of variations, hence it is multiplication model which is more suited in most business and economic time series data for the purpose of decomposition.

Example 19.2.1: Under the additive model, a monthly sale of ₹ 21,110 explained as follows:

The trend might be ₹ 20,000, the seasonal factor: ₹ 1,500 (The month question is a good one for sales, expected to be ₹ 1,500 over the trend), the cyclical factor: ₹ 800 (A general Business slump is experienced, expected to depress sales by ₹ 800 (per month); and Residual Factor: ₹ 410 (Due to unpredictable random fluctuations).

The model gives:

$Y = T + C + S + R$

$21{,}110 = 2{,}000 + 1{,}500 + (-800) + 410$

The multiplication model might explain the same sale figure in similar way.

Trend = ₹ 20,000, Seasonal Factor: ₹ 1.15 (a good month for sales, expected to be 15 per cent above the trend)

Cyclical Factor: 0.90 (a business slump, expected to cause a 10 per cent reduction in sales) and

Residual Factor: 1.02 (Random fluctuations of + 2 Factor)

$Y = T \times S \times C \times R$

$21114 = 20{,}000 \times 1.15 \times 0.90 \times 1.02$

19.2.3 MEASUREMENT OF SECULAR TREND

The following are the methods most commonly used for studying & measuring the trend component in a time series -

(1) Graphic or a Freehand Curve Method

(2) Method of Semi Averages

(3) Method of Moving Averages

(4) Method of Least Squares

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Graphic or Freehand Curve Method:

The data of a given time series is plotted on a graph and all the points are joined together with a straight line. This curve would be irregular as it includes short run oscillation. These irregularities are smoothened out by drawing a freehand curve or line along with the curve previously drawn.

This curve would eliminate the short run oscillations and would show the long period general tendency of the data. While drawing this curve it should be kept in mind that the curve should be smooth and the number of points above the trend curve should be more or less equal to the number of points below it.

Merits:

(1) It is very simple and easy to understand

(2) It does not require any mathematical calculations

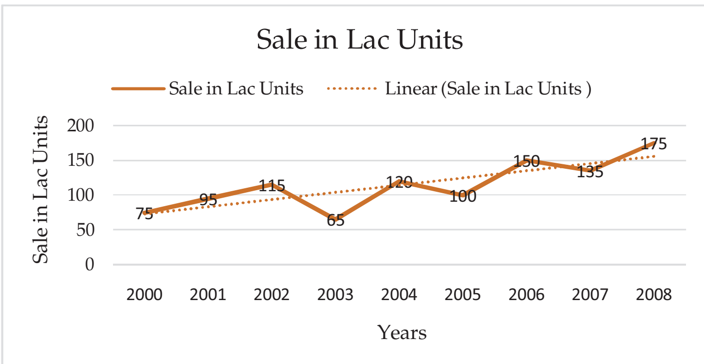
Disadvantages:

(1) This is a subjective concept. Hence different persons may draw freehand lines at different positions and with different slopes.

(2) If the length of period for which the curve is drawn is very small, it might give totally erroneous results.

Example 19.2.2: The following are figures of a Sale for the last nine years. Determine the trend by line by the freehand method.

Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Sale in lac Units	75	95	115	65	120	100	150	135	175



The trend line drawn by the freehand method can be extended to predicted values. However, since the freehand curve fitting is too subjective, the method should not be used as basis for predictions.

Methods of Semi averages: Under this method the whole time series data is classified into two equal parts and the averages for each half are calculated. If the data is for even number of years, it is easily divided into two. If the data is for odd number of years, then the middle year of the time series is left and the two halves are constituted with the period on each side of the middle year.

The arithmetic mean for a half is taken to be representative of the value corresponding to the midpoint of the time interval of that half. Thus we get two points. These two points are plotted on a graph and then are joined by straight line which is our required trend line.

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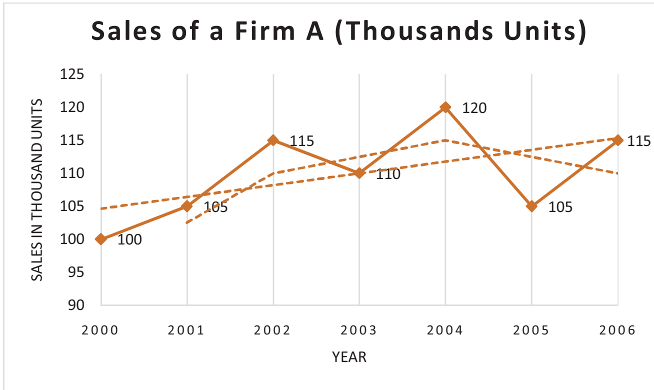
Example 19.2.3: Fit a trend line to the following data by the method of Semi-averages.

Year	2000	2001	2002	2003	2004	2005	2006
Sale in lac Units	100	105	115	110	120	105	115

Solution: Since the data consist of seven Years, the middle year shall be left out and an average of the first three years and last three shall be obtained. The average of first three years is $\frac{100+105+115}{3}$ or $\frac{320}{3}$ or 106.67 and the average of last three years $\frac{120+105+115}{3}$ or $\frac{340}{3}$ or 133.33.



Moving average method: A moving average is an average (Arithmetic mean) of fixed number of items (known as periods) which moves through a series by dropping the first item of the previously averaged group and adding the next item in each successive average. The value so computed is considered the trend value for the unit of time falling at the centre of the period used in the calculation of the average.

In case the period is odd: If the period of moving average is odd for instance for computing 3 yearly moving average, the value of 1st, 2nd and 3rd years are added up and arithmetic mean is found out and the answer is placed against the 2nd year; then value of 2nd, 3rd and 4th years are added up and arithmetic mean is derived and this average is placed against 3rd year (i.e. the middle of 2nd, 3rd and 4th) and so on.

In case of even number of years: If the period of moving average is even for instance for computing 4 yearly moving average, the value of 1st, 2nd, 3rd and 4th years are added up& arithmetic mean is found out and answer is placed against the middle of 2nd and 3rd year. The second average is placed against middle of 3rd & 4th year. As this would not coincide with a period of a given time series an attempt is made to synchronise them with the original data by taking a two period average of the moving averages and placing them in between the corresponding time periods. This technique is called centring& the corresponding moving averages are called moving average centred.

Example 19.2.4: The wages of certain factory workers are given as below. Using 3 yearly moving average indicate the trend in wages.

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
Wages	1200	1500	1400	1750	1800	1700	1600	1500	1750

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Solution:

Table: Calculation of Trend Values by method of 3 yearly Moving Average

Year	Wages	3 yearly moving totals	3 yearly moving average i.e. trend
2004	1200	–	–
2005	1500	4100	1366.67
2006	1400	4650	1550
2007	1750	4950	1650
2008	1800	5250	1750
2009	1700	5100	1700
2010	1600	4800	1600
2011	1500	4850	1616.67
2012	1750	–	–

Example 19.2.5: Calculate 4 yearly moving average of the following data.

Year	2005	2006	2007	2008	2009	2010	2011	2012
Wages	1150	1250	1320	1400	1300	1320	1500	1700

Solution: (First Method):

Table: Calculation of 4 year Centred Moving Average

Year (1)	Wages (2)	4 yearly moving total (3)	2 year moving total of col. 3 (centred) (4)	4 yearly moving average centred (5) [col. 4/8]
2005	1,150	–	–	–
2006	1,250	–	–	–
		5,120		
2007	1,320		10,390	1,298.75
		5,270		
2008	1,400		10,610	1,326.25
		5,340		
2009	1,300		10,860	1,357.50
		5,520		
2010	1,320		11,340	1,417.50
		5,820		
2011	1,500			
2012	1,700			

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Second Method:

Table: Calculation of 4 year Centred Moving Average

Year	Wages	4 yearly moving total (3)	4 yearly moving average (4)	2 year moving total of col. 4 (centered) (5)	4 year centered moving average (col. 5/2)
2005	1,150	–	–	–	–
2006	1,250	–	–	–	– –
		5,120	1,280	–	–
2007	1,320			2,597.75	1,298.75
		5,270	1,317.5	–	–
2008	1,400			2,652.5	1,326.25
		5,340	1,335	–	–
2009	1,300			2,715	1,357.50
		5,520	1,380		
2010	1,320			2,835	1,417.50
		5,820	1,455	–	–
2011	1,500				
2012	1,700				

Example 19.2.6: **Calculate five yearly moving averages for the following data.**

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Value	123	140	110	98	104	133	95	105	150	135

Solution:

Table: Computation of Five Yearly Moving Averages

Year	Value ('000 ₹)	5 yearly moving totals ('000 ₹)	5 yearly moving average ('000 ₹)
2003	123	–	–
2004	140	–	–
2005	110	575	115
2006	98	585	117
2007	104	540	108
2008	133	535	107
2009	95	587	117.4
2010	105	618	123.6
2011	150	–	–
2012	135	–	–

The method of least squares as studied in regression analysis can be used to find the trend line of best fit to a time series data.

The regression trend line (Y) is defined by the following equation – Y = a + bX

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where Y = predicted value of the dependent variable

a = Y axis intercept or the height of the line above origin (i.e. when X = 0, Y = a)

b = slope of the regression line (it gives the rate of change in Y for a given change in X) (when b is positive the slope is upwards, when b is negative, the slope is downwards) X = independent variable (which is time in this case)

To estimate the constants a and b, the following two equations have to be solved simultaneously –

$\sum Y = na + b\sum X$

$\sum XY = a\sum X + b\sum X^2$

To simplify the calculations, if the mid point of the time series is taken as origin, then the negative values in the first half of the series balance out the positive values in the second half so that $\sum x = 0$. In this case the above two normal equations will be as follows -

$\sum Y = na$

$\sum XY = b\sum X^2$

In such a case the values of a and b can be calculated as under -

Since $\sum Y = na$,

Since $\sum XY = b\sum X^2$

$$b = \frac{\sum XY}{\sum X^2}\ ;\ a = \frac{\sum Y}{n}$$

Example 19.2.7: Fit a straight line trend to the following data by Least Square Method and estimate the sale for the year 2012.

Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Sale (in'000s)	70	80	96	100	95	114

Solution:

Table: Calculation of trend line

Year	**Sales Y**	**Deviations from 2007.5**	**Deviations multiplied by 2 (X)**	**X^2**	**XY**
2005	70	-2.5	-5	25	-350
2006	80	-1.5	-3	9	-240
2007	96	-.5	-1	1	-96
2008	100	+.5	+1	1	100
2009	95	+1.5	+3	9	285
2010	114	+2.5	+5	25	570
	$\sum Y = 555$			**$\sum X^2 = 70$**	**$\sum XY = 269$**

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N = 6

Equation of the straight line trend is $Y_o = a + bX$

$$a = \frac{\sum Y}{N} = \frac{555}{6} = 92.5\ ;\ b = \frac{\sum XY}{\sum X^2} = \frac{269}{70} = 3.843$$

Trend equation is $Y_c = 92.5 + 3.843X$

For 2012, X = 9

$Y_{2012} = 92.5 + 3.843 \times 9 = 92.5 + 34.587$

$= 126.59$ (in '000 ₹)

Example 19.2.8:

Fit a straight line trend to the following data and estimate the likely profit for the year 2012. Also calculate the trend values.

Year	2003	2004	2005	2006	2007	2008	2009
Profit (in lakhs of ₹)	60	72	75	65	80	85	95

Solution:

Table: Calculation of Trend and Trend Values

Year	Profit Y	Deviation from 2006	X^2	XY	Trend Values ($Y_c = a + bX$)
		X			[Yc= 76 + 4.85X]
2003	60	-3	9	-180	76 + 4.85 (-3) = 61.45
2004	70	-2	4	-144	76 + 4.85 (-2) = 66.30
2005	75	-1	1	-75	76 + 4.85 (-1) = 70.15
2006	65	0	0	0	76 + 4.85 (0) = 76
2007	80	1	1	80	76 + 4.85(1) = 80.85
2008	85	2	4	170	76 + 4.85 (2) = 85.70
2009	95	3	9	285	76 + 4.85 (3) = 90.55
	$\sum y = 532$		$\sum X^2 = 28$	$\sum XY=136$	

N = 7

The equation for straight line trend is $Y_c = a + bX$

Where

$$a = \frac{\sum Y}{N} = \frac{555}{6} = 92.5$$

$$b = \frac{\sum XY}{\sum X^2} = \frac{269}{70} = 3.843$$

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The trend equation $Y_c = 92.5 + 3.843.X$

2012, x = 6 (2012 - 2006) $Y_c = 76 + 4.85(6) = 76 + 29.10$

= 105.10

The estimated profit for the year 2012 is ₹ 105.10 lakhs.

Example 19.2.9: Calculate Seasonal Indices for each quarter from the following percentages of whole sale price indices to their moving averages.

Year	Quarter			
	I	II	III	IV
2003	-	-	11.0	11.0
2004	12.5	13.5	15.5	14.5
2005	16.8	15.2	13.1	15.3
2006	11.2	11.0	12.4	13.2
2007	10.5	13.3	-	

Solution:

Year	Quarter			
	I	II	III	IV
Quarterly Total	51.0	53.0	52.0	54.0
Quarterly Average	12.75	13.25	13.0	13.5

Average of the Quarterly Averages = $\frac{52.5}{4} = 13.125$

Year	Quarter			
	I	II	III	IV
Seasonal Indices	$\frac{12.75 \times 100}{13.125} = 97.143$	$\frac{13.25 \times 100}{13.125} = 100.952$	$\frac{13.0 \times 100}{13.125} = 97.143$	$\frac{13.5 \times 100}{13.125} = 102.857$

Seasonal Indices are calculated by converting the respective quarterly averages on the basis that the average of the quarterly average = 100

Example 19.2.10: Calculate 5- year weighted moving averages for the following data, using weights 1, 1, 3, 2 respectively:

Year	1	2	3	4	5	6	7	8	9	10
Codded Sales	40	33	72	81	76	68	91	87	98	97

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Solution :

Year I	Sales II	5- Year Weighted Average	IV
1	40	–	–
2	33	–	–
3	72	$\frac{1}{8}(40\times1+33\times1+72\times3+81\times2+76\times1)$	= 65.8
4	81	$\frac{1}{8}(33\times1+72\times1+81\times3+76\times2+68\times1)$	= 71.00
5	76	$\frac{1}{8}(72\times1+81\times1+76\times3+68\times2+91\times1)$	= 76.00
6	68	$\frac{1}{8}(81\times1+76\times1+68\times3+91\times2+87\times1)$	= 78.750
7	91	$\frac{1}{8}(76\times1+68\times1+91\times3+87\times2+90\times1)$	= 86.125
8	87	$\frac{1}{8}(68\times1+91\times1+87\times3+98\times2+97\times1)$	= 89.125
9	98	–	–
10	97	–	–

Example 19.2.11: Assuming no trend, calculate Seasonal variation indices for the following data.

Year	Quarterly Data			
	Q1	Q2	Q3	Q4
2013	3.7	4.1	3.3	3.5
2014	3.7	3.9	3.6	3.6
2015	4.0	4.1	3.3	3.1
2016	3.3	4.4	4.0	4.0

Solution:

	Quarterly Data			
	Q1	Q2	Q3	Q4
	3.7	4.1	3.3	3.5
	3.7	3.9	3.6	3.6
	4.0	4.1	3.3	3.1
	3.3	4.4	4.0	4.0
Quarterly Total	14.7	16.5	14.2	14.2
Quarterly Average	3.675	4.125	3.55	3.55

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Average of Quarterly Averages = $\frac{3.675+4.125+3.55+3.55}{4}=\frac{14.9}{4}=3.725$

Example 19.2.12: **Calculate the Seasonal Indices from the following ratio to moving averages values expressed in percentage.**

Year	Seasons		
	Summer	Rain	Winter
2009	–	101.75	107.14
2010	96.18	92.30	114.00
2011	92.45	95.20	118.18

Solution:

Year	Seasons			
	Summer	Rain	Winter	
2009	–	101.75	107.14	
2010	96.18	92.30	114.00	
2011	92.45.	95.20	118.18	
Total	188.63	289.25	339.832	
Average	94.315	96.417	113.107	303.839
Constructed Seasonal Index	93.127	95.202	111.682	

Correction Factor = $\frac{300}{303.839}=0.9874$

Example 19.2.13: **From the following data, calculate the trend values, using Four yearly moving average.**

Years	2008	2009	2010	2011	2012	2013	2014	2015	2016
Values	506	620	1036	673	588	696	1116	738	663

Solution:

Year	Values	4 Yearly Moving Totals (a)	2 Period Moving Total of (a)	4 Yearly Moving Averages
2008	506	–	–	–
2009	620	–	–	–
2010	1036	2835	5752	719.0
2011	673	2917	5910	738.8
2012	588	2993	6066	758.3
2013	696	3073	6211	776.4
2014	1116	3138	6311	793.9
2015	738	3213	–	–
2016	663	–	–	–

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SUMMARY

1) A time series is set of measurements on a variable taken over some period of time, it has four components.
   (a) Trend (b) Seasonal variations
   (c) Cyclical variations (d) Irregular variations
2) There are two models of time series
   (a) Additive Model (b) Multiplicative Model
3) Trends can be measured in the following measures
   (a) Free hand curve method (b) Semi-averages method
   (c) Moving averages method (d) Least squares method
4) A time series may be determined by eliminating the computed trend values from the given data set. It may done using additive model or multiplicative model.
5) Seasonal variations can be measured in any of the following methods:
   (a) simple averages (b) Ratio to trend method
   (c) Ratio to Moving averages (d) Link relative method
6) Time series data can be deseaonalised by eliminating the effect of seasonal variations from it.
7) Irregular component in a time series is measured as a residue after eliminating all other fluctuations from data.
8) Time Series is useful in forecasting future values.

Unit -II Exercise 1 (a)

1) (a) What is meant by Time Series? Explain its utility.
   (b) Explain clearly the meaning of Time Series Analysis in business.
2) What is a Time Series? What are the different components? Describe briefly each of them.
3) Write Short Notes on:
   (a) Moving average method of measuring Trend
   (b) Seasonal Index
4) Calculate five yearly moving averages for the following data.

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Value ('000 ₹)	123	140	110	98	104	133	95	105	150	135

5) Write Short notes on:
   (i) Seasonal variations and (ii) Cyclical variations

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6) From the following data verify that 5 year weighted moving average with weights 1, 2, 2, 2, 1 respectively is equivalent to the 4 year centred moving average:

(₹ In lakhs)

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Sale	5	3	7	6	4	8	9	10	8	9	9

7) Explain the additive and multiplicative models of Time Series.

8) Calculate the Seasonal Indices by the method of Link Relatives for the following data.

Quarter	Quarterly Figures for Five years				
	2003	2004	2005	2006	2007
I	45	48	49	52	60
II	54	56	63	65	70
III	72	63	70	75	83
IV	60	56	65	72	86

9) Calculate the seasonal Indices for each quarter from the following percentages of whole sale prices indices to their moving averages.

Year	Quarter			
	I	II	III	IV
2003	–	–	11.0	80
2004	12.5	13.5	15.5	14.5
2005	16.8	15.2	13.1	15.3
2006	11.2	11.0	12.4	13.2
2007	10.5	13.3	–	–

10) Assuming no trend in the series, Calculate seasonal indices for the following data.

Year	Quarter			
	I	II	III	IV
2004	78	66	84	80
2005	76	74	82	78
2006	72	68	80	70
2007	74	70	84	74
2008	76	74	86	82

11) The annual production in commodity is given as follows:

Year	2000	2001	2002	2003	2004	2005	2006
Production: (in tonnes)	70	80	90	95	102	110	115

(a) Fit a straight line trend by the method of least squares.

(b) Convert the annual trend equation into monthly trend equation.

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Unit -II Exercise 1(B)

Choose the most appropriate option (a) or (b) or (c) or (d).

1) An orderly set of data arranged in accordance with their time of occurrence is called:
   (a) Arithmetic series (b) Harmonic series
   (c) Geometric series (d) Time series
2) A time series consists of:
   (a) Short-term variations (b) Long-term variations
   (c) Irregular variations (d) All of the above
3) The graph of time series is called:
   (a) Histogram (b) Straight line
   (c) Histogram (d) Ogive
4) Secular trend can be measured by:
   (a) Two methods (b) Three methods
   (c) Four methods (d) Five methods
5) The secular trend is measured by the method of semi-averages when:
   (a) Time series based on yearly values
   (b) Trend is linear
   (c) Time series consists of even number of values
   (d) None of them
6) Increase in the number of patients in the hospital due to heat stroke is:
   (a) Secular trend (b) Irregular variation
   (c) Seasonal variation (d) Cyclical variation
7) The systematic components of time series which follow regular pattern of variations are called:
   (a) Signal (b) Noise
   (c) Additive model (d) Multiplicative model
8) The unsystematic sequence which follows irregular pattern of variations is called:
   (a) Noise (b) Signal
   (c) Linear (d) Non-linear
9) In time series seasonal variations can occur within a period of:
   (a) Four years (b) Three years
   (c) One year (d) Nine years
10) Wheat crops badly damaged on account of rains is:
   (a) Cyclical movement (b) Random movement

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(c) Secular trend
(d) Seasonal movement

11) The method of moving average is used to find the:
(a) Secular trend
(b) Seasonal variation
(c) Cyclical variation
(d) Irregular variation

12) Most frequency used mathematical model of a time series is:
(a) Additive model
(b) Mixed model
(c) Multiplicative model
(d) Regression

13) A time series consists of:
(a) No mathematical model
(b) One mathematical model
(c) Two mathematical models
(d) Three mathematical models

14) In semi-averages method, we decide the data into:
(a) Two parts
(b) Two equal parts
(c) Three parts
(d) Difficult to tell

15) Moving average method is used for measurement of trend when:
(a) Trend is linear
(b) Trend is non-linear
(c) Trend is curvi linear
(d) None of them

16) When the trend is of exponential type, the moving averages are to be computed by using:
(a) Arithmetic mean
(b) Geometric mean
(c) Harmonic mean
(d) Weighted mean

17) The long term trend of a time series graph appears to be:
(a) Straight-line
(b) Upward
(c) Downward
(d) Parabolic curve or third degree curve

18) Indicate which of the following an example of seasonal variations is:
(a) Death rate decreased due to advance in science
(b) The sale of air condition increases during summer
(c) Recovery in business
(d) Sudden causes by wars

19) The most commonly used mathematical method for measuring the trend is:
(a) Moving average method
(b) Semi average method
(c) Method of least squares
(d) None of them

20) A trend is the better fitted trend for which the sum of squares of residuals is:
(a) Maximum
(b) Minimum
(c) Positive
(d) Negative

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21) Decomposition of time series is called:

(a) Historigram (b) Analysis of time series

(c) Histogram (d) Detrending

22) The fire in a factory is an example of:

(a) Secular trend (b) Seasonal movements

(c) Cyclical variations (d) Irregular variations

23) Increased demand of admission in the subject of computer in Uttar Pradesh is:

(a) Secular trend (b) Cyclical trend

(c) Seasonal trend (d) Irregular trend

24) Damages due to floods, droughts, strikes fires and political disturbances are:

(a) Trend (b) Seasonal

(c) Cyclical (d) Irregular

25) The general pattern of increase or decrease in economics or social phenomena is shown by:

(a) Seasonal trend (b) Cyclical trend

(c) Secular trend (d) Irregular trend

26) In moving average method, we cannot find the trend values of some:

(a) Middle periods (b) End periods

(c) Starting periods (d) Between extreme periods

27) Moving-averages:

(a) Give the trend in a straight line (b) Measure the seasonal variations

(c) Smooth-out the time series (d) None of them

28) The rise and fall of a time series over periods longer than one year is called:

(a) Secular trend (b) Seasonal variation

(c) Cyclical variation (d) Irregular variations

29) A time series has:

(a) Two Components (b) Three Components

(c) Four Components (d) Five Components

30) The multiplicative time series model is:

(a) $Y = T + S + C + I$ (b) $Y = TSCI$

(c) $Y= a + bx$ (d) $y = a + bx + C x 2$

31) The additive model of Time Series

(a) $Y = T + S + C + I$ (b) $Y = TSCI$

(c) $Y= a + bx$ (d) $y = a + bx + C x 2$

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32) A pattern that is repeated throughout a time series and has a recurrence period of at most one year is called:
   (a) Cyclical variation (b) Irregular variation
   (c) Seasonal variation (d) Long term variation

33) If an annual time series consisting of even number of years is coded, then each coded interval is equal to:
   (a) Half year (b) One year
   (c) Both (a) and (b) (d) Two years

34) In semi averages method, if the number of values is odd then we drop:
   (a) First value (b) Last value
   (c) Middle value (d) Middle two values

35) The trend values in freehand curve method are obtained by:
   (a) Equation of straight line (b) Graph
   (c) Second degree parabola (d) All of the above

ANSWERS

Unit-II

Exercise 1(a)

4) 115, 117, 108, 107, 117.4, 123.6

6) 5.125, 5.625, 6.500, 7.250, 5.475, 5.700

8) 82.86, 98.45, 114.60, 104.08

11) a) $y = 94.6 + 7.39x$ (b) Monthly trend equation is $y = 7.88 + 0.05x$

Exercise 1(b)

1. (d)	**2.** (d)	**3.** (c)	**4.** (c)	**5.** (b)	**6.** (c)	**7.** (a)	**8.** (a)	**9.** (c)	**10.** (b)
11. (a)	**12.** (c)	**13.** (d)	**14.** (b)	**15.** (a)	**16.** (d)	**17.** (b)	**18.** (c)	**19.** (b)	**20.** (b)
21. (d)	**22.** (a)	**23.** (d)	**24.** (c)	**25.** (d)	**26.** (c)	**27.** (c)	**28.** (c)	**29.** (c)	**30.** (b)
31. (b)	**32.** (c)	**33.** (c)	**34.** (c)	**35.** (b)					

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