

# Time Series Analysis

A time series may be defined as collection of readings belonging to different time periods of some variable.

Time series has an important and significant place in business and economics.

Mathematically time series is defined by the functional relationship  $y = f(t)$ . where  $y$  is the value of the variable under consideration at time ' $t$ '.

For example.

- 1) population ' $y$ ' of a country in different years ' $t$ '.
- 2) The temperature ' $y$ ' of a place on different days ' $t$ ' of the week.

Thus the values of a phenomenon (or) variable at times  $t_1, t_2, \dots, t_n$  are  $y_1, y_2, \dots, y_n$  respectively, then the

series	$t :$	$t_1$	$t_2$	$t_3$	$\dots$	$t_n$
	$y :$	$y_1$	$y_2$	$y_3$	$\dots$	$y_n$

constituted a time series.

## Components of Time series :-

The various forces affecting the values of a phenomenon in a time series may be broadly classified into the following four categories.

- a) Secular trend (or) long term movement (T)
- b) Periodic movements (or) short-term fluctuations
  - (i) Seasonal variation (S)
  - (ii) Cyclical variation (C)
- c) Regular or Irregular variations (R or I).

### Secular Trend :-

Trend is also called secular (or) long term trend, is the basic tendency of a series to grow or decline over a period of time.

The concept of trend does not include short-range oscillations. It is a long term change.

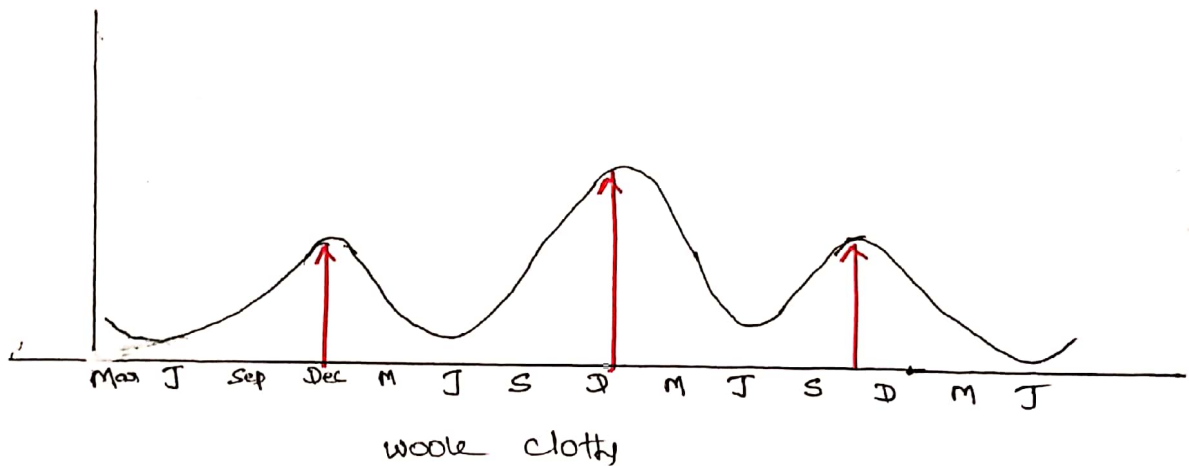
Example of trend are: Increase in prices, Increase in population etc.

### Seasonal Variations:

These variations in a time series are due to the rhythmic forces which operate in a regular and periodic manner over a span of less than a year.

Ex. Increase in sale of ice creams in summer

Increase " " " Tea in winter. etc.



### Cyclical Variations:

Oscillatory movements in time series with period of oscillation greater than one year are termed as cyclical variations.

The cyclical fluctuations, though more or less regular but may not follow exactly similar patterns.

Example: Business cycles that record periods of economic recession and inflation.

## Random (or) Irregular Variation

The variation occur due to sudden cause and unpredictable forces are called irregular variation

These powerful variations are usually caused by factors like floods, earthquakes, strikes and lockouts etc.

measurement of trend by

Semi - Average method :-

Ex 1) Apply the method of semi-averages for determining trend of the following data and estimate the value for 2000.

Year	1993	1994	1995	1996	1997	1998
Sales	20	24	22	30	28	32
(thousand units)						

Solution :

Here  $n = 6$ .

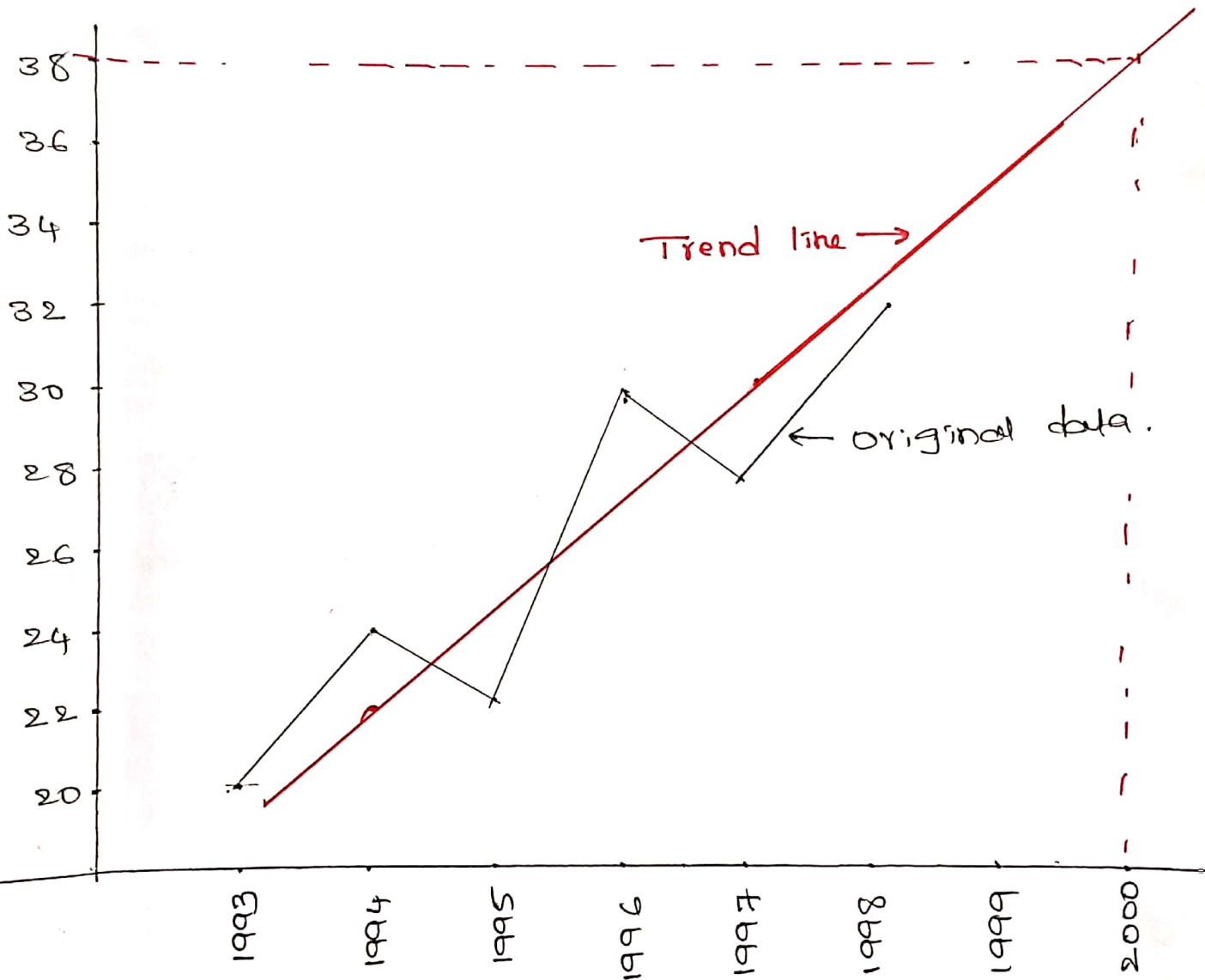
Hence the two parts will be 1993 to 1995  
and 1996 to 1998.

Year	Sales in thousands	3-yearly semi total	Semi Average
1993	20	66	$\frac{66}{3} = 22$
1994	24		
1995	22		
1996	30	90	$\frac{90}{3} = 30$
1997	28		
1998	32		

← The semi-average 22 is to be plotted against the mid-year of the first part i.e. - 1994.

The semi-average 30 is to be plotted against the mid year of the second part i.e. - 1997.

and joining 22 and 30 we get the Trend line as shown in the fig.



Hence the estimate value for 2000 is 38



2 From the following series of annual data find the trend line by method of semi averages also estimate the value for 1999.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
Actual Value	170	231	261	267	278	302	299	298	340

Solution: Here  $n = 9$  (odd)

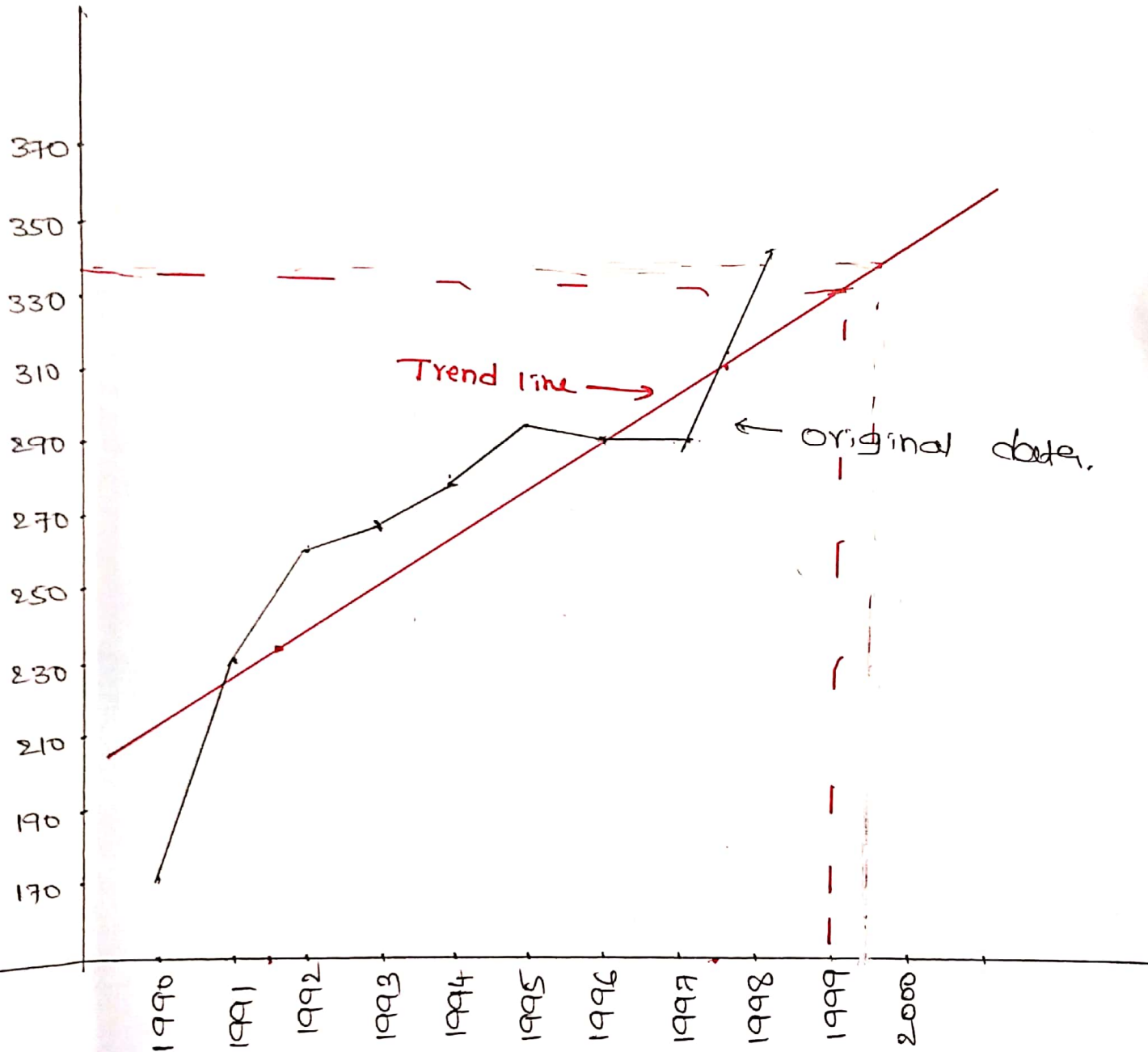
The two middle parts will be 1990 to 1993 and 1995 to 1998 (1994 being ignored).

Year	Actual Value	4 yearly semi total	Semi-Average
1990	170	929	$\frac{929}{4} = 232.25$ $\approx 232$
1991	231		
1992	261		
1993	267		
1994	278	1239	$\frac{1239}{4} = 309.75$ $\approx 310$
1995	302		
1996	299		
1997	298		
1998	340		

The value 232 is plotted against middle of the year 1991 & 1992.

8

The value 310 is plotted against the middle of the years 1996 and 1997.  
Join 232 and 310 to get the trend line.



From the graph we see that trend value for 1999 is 340.