What Time Series is ?

Introduction

- It is a **collection of observation** of well defined **data items** obtained through **repeated measurement over time.**

- A order sequence of values of a variable at **equally spaced time and intervals**.

- It established relationship between **cause** and **effect**.

Examples

- Financial time Series.
- Meteorological Time Series.
- Demographic Time series.

IMPORTANCE OF TIME SERIES ANALYSIS

- Understand the past.

  What happened over the last years, months?
- Forecast the future.

  Government wants to know future of unemployment rate, percentage increase in cost of living etc.

  For companies to predict the demand for their product etc.

Uses of Time Series

- To study the past behavior of the variable
- To formulate policy decisions and planning of future operations.
- To predict or estimate or forecast the behavior of the phenomenon in future which is very essential for business planning
- To compare the changes in the values of different phenomenon at different times

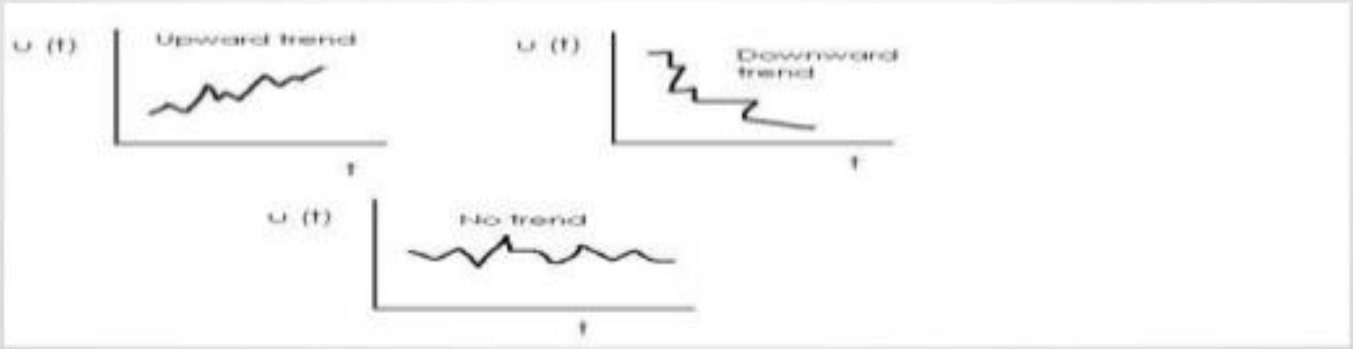
Time series components

- Time series patterns can be described in terms of four basic classes of components: Trend, Seasonal, Cyclical, and Irregular.

Time series components (Cont)

Trend Component

- Simply, Trend is the long term direction of a time series.
- A trend exists when there is a long-term increase or decrease in the data. It does not have to be linear. Sometimes we will refer to a trend "changing direction" when it might go from an increasing trend to a decreasing trend.



Time series components (Cont)

❑ Seasonal Component

- ➢ A regular patterns of variability within certain time periods, such as a year.

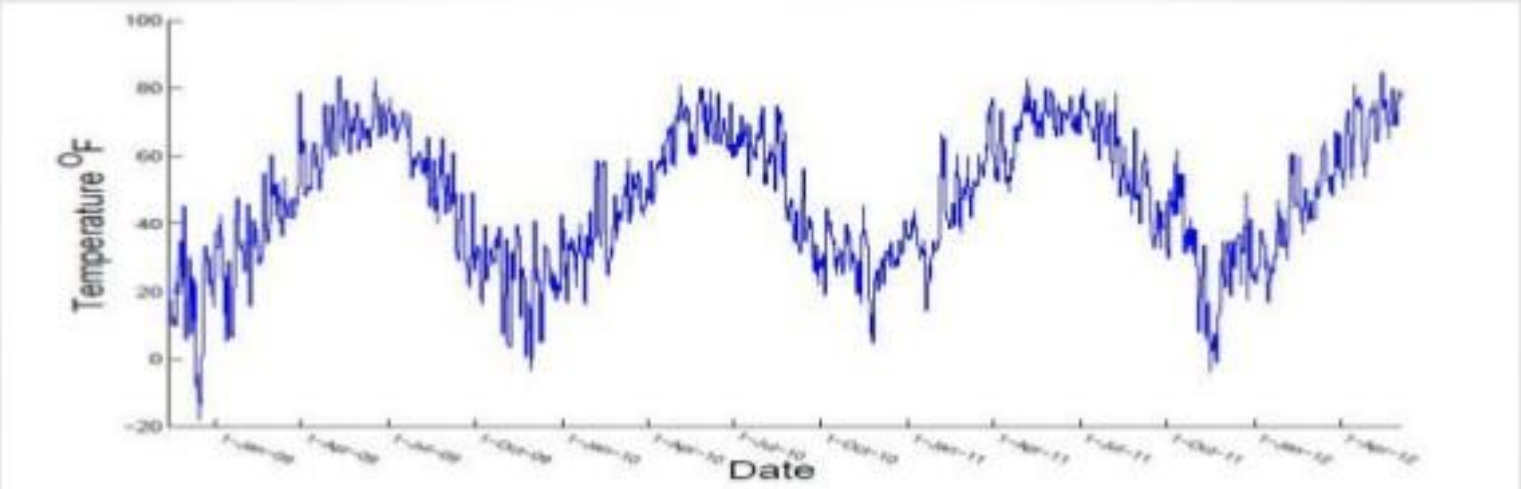


Figure 1.1: Temperature time series plot.

Components of Time Series

SEASONAL VARIATION (S)

- Regular periodic fluctuations that occur within year.

Examples:

- Consumption of heating oil, which is high in winter, and low in other seasons of year.
- Demand of cold drinks, juices etc. in summers tends to be greater in comparison to other months
- Gasoline consumption, which is high in summer when most people go on vacation.

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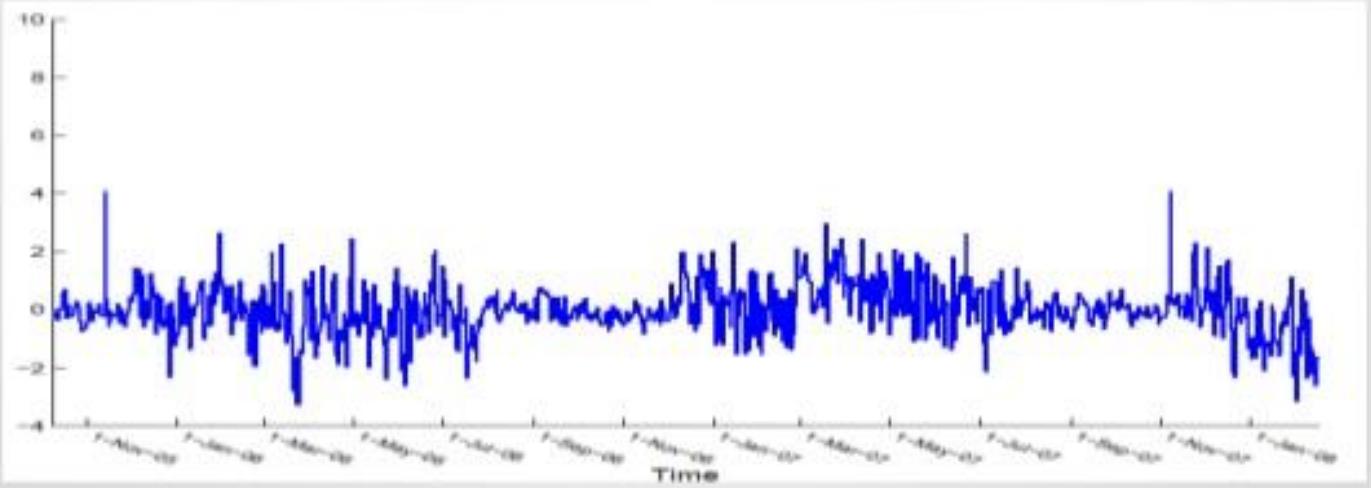
Time series components (Cont)

Cyclical Component

- Any regular pattern of sequences of values above and below the trend line lasting more than one year.
- Regularly occur but may vary in length.



Time series components (Cont)

- Irregular Component (Random Component)
  - The variability that is contained within a process that cannot be determined. These fluctuations and variations are caused by erratic and irregular actions that are the result of random chance.
  - Caused by irregular and unpredictable changes in a times series that are not caused by other components.
  - Unpredictable, random, "residual" fluctuations.
  - Noise in the time series.

❑ Measurement of Secular trend:-

- The following methods are used for calculation of trend:

  - ❑ FREE HAND CURVE METHOD:
  - ❑ SEMI – AVERAGE METHOD:
  - ❑ MOVING AVERAGE METHOD:
  - ❑ LEAST SQUARE METHOD:

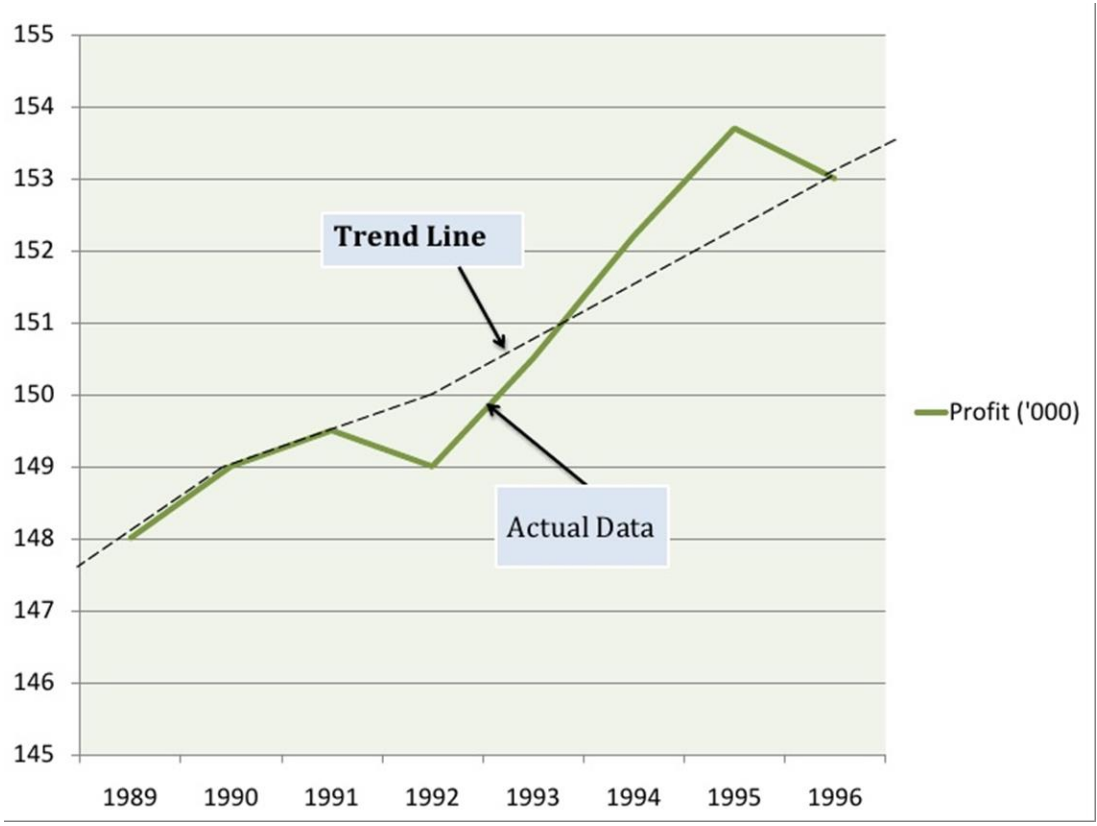
Free hand Curve Method:-

- In this method the data is denoted on graph paper. We take "Time" on 'x' axis and "Data" on the 'y' axis. On graph there will be a point for every point of time. We make a smooth hand curve with the help of this plotted points.

Example:

Draw a free hand curve on the basis of the following data:

Years	1989	1990	1991	1992	1993	1994	1995	1996
Profit (in '000)	148	149	149.5	149	150.5	152.2	153.7	153



Semi – Average Method:-

- In this method the given data are divided in two parts, preferable with the equal number of years.

- For example, if we are given data from 1991 to 2008, i.e., over a period of 18 years, the two equal parts will be first nine years, i.e.,1991 to 1999 and from 2000 to 2008. In case of odd number of years like, 9, 13, 17, etc.., two equal parts can be made simply by ignoring the middle year. For example, if data are given for 19 years from 1990 to 2007 the two equal parts would be from 1990 to 1998 and from 2000 to 2008 - the middle year 1999 will be ignored.

- **Example:**

Find the trend line from the following data by Semi - Average Method:-

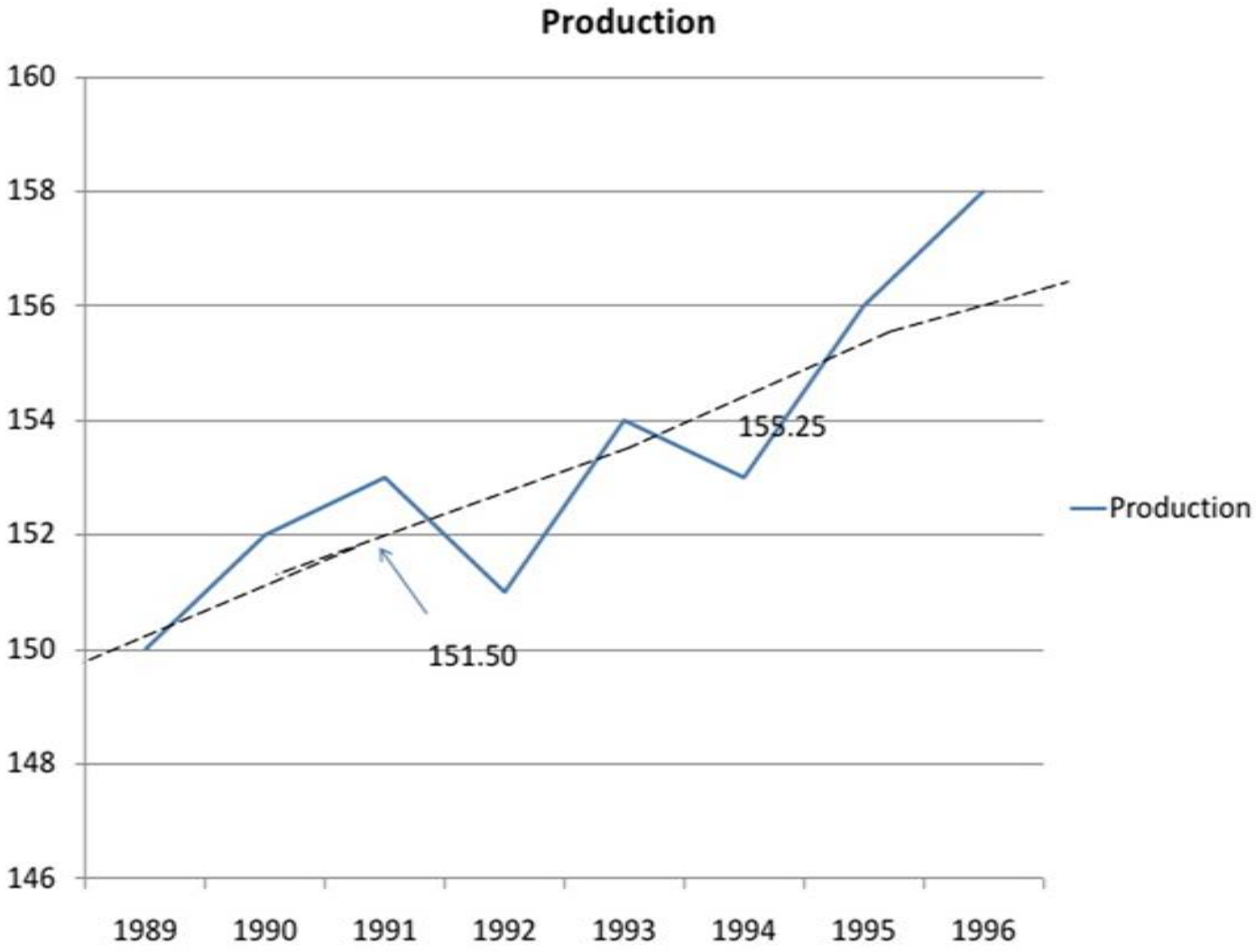
Year	1989	1990	1991	1992	1993	1994	1995	1996
Production (M.Ton.)	150	152	153	151	154	153	156	158

- There are total 8 trends. Now we distributed it in equal part. Now we calculated Average mean for every part.

First Part = $\frac{150 + 152 + 153 + 151}{4} = 151.50$

Second Part = $\frac{154 + 153 + 156 + 158}{4} = 155.25$

Year (1)	Production (2)	Arithmetic Mean (3)
1989	150	
1990	152	
1991	153	151.50
1992	151	
1993	154	
1994	153	
1995	156	155.25
1996	158	


Production
160
158
156
154
152
150
148
146
1989
1990
1991
1992
1993
1994
1995
1996
155.25
151.50
Production

❑ Moving Average Method:-

- It is one of the most popular method for calculating Long Term Trend. This method is also used for 'Seasonal fluctuation', 'cyclical fluctuation' & 'irregular fluctuation'. In this method we calculate the 'Moving Average for certain years.
- For example: If we calculating 'Three year's Moving Average' then according to this method:

$$= \frac{(1)+(2)+(3)}{3}, \quad \frac{(2)+(3)+(4)}{3}, \quad \frac{(3)+(4)+(5)}{3}, \quad \ldots\ldots\ldots\ldots$$

Where (1),(2),(3),..... are the various years of time series.

❑ Example: Find out the five year's moving Average:

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Price	20	25	33	33	27	35	40	43	35	32	37	48	50	37	45

❖ Least Square Method:-

- This method is most widely in practice. When this method is applied, a trend line is fitted to data in such a manner that the following two conditions are satisfied:-

❑ The sum of deviations of the actual values of y and computed values of y is zero.

$$\sum (Y - Y_c) = 0$$

❑ i.e., the sum of the squares of the deviation of the actual and computed values is least from this line. That is why method is called the method of least squares. The line obtained by this method is known as the line of `best fit`.

$$\sum (Y - Y_c)^2 \text{ is least}$$

The Method of least square can be used either to fit a straight line trend or a parabolic trend.

The straight line trend is represented by the equation:-

$$= Y_c = a + bx$$

Where, **Y = Trend value to be computed**

X = Unit of time (Independent Variable)

a = Constant to be Calculated

b = Constant to be calculated

❑ Example:-

Draw a straight line trend and estimate trend value for 1996:

Year	1991	1992	1993	1994	1995
Production	8	9	8	9	16

THANK YOU