❖ Concept of Time Series

A set of ordered observations of a quantitative variable taken at successive points in time is known as ‘Time Series'. In other words, arrangement of statistical data in chronological order, i.e., in accordance with occurrence of time, is known as ‘Time Series'. Time, in terms of years, months, days, or hours, is simply a device that enables one to relate all phenomenon to a set of common, stable reference points.

Such series have a unique important place in the field of Economic and Business Statistics since the data relating to prices, consumption and production of varioy commodities, money in circulation, sales and profits in departmental store etc., are all time series data spread over a long period of time. A time series depicts the relationship between two variables, one of them being time, e.g., the population (y_t) of a country in different years (t); temperature (y_t) of a place on different days (t), etc. Mathematically, a time series is defined by the functional relationship

$$y_t = f(t)$$

where, y_t is the value of the phenomenon (or variable) under consideration at time t.

Thus, if the values of a variable at times $t_1, t_2, ..., t_n$ are $y_1, y_2, ..., y_n$ respectively, then the series

$$t : t_1, \quad t_2, \quad ..., \quad t_n$$
$$y_t : y_1, \quad y_2, \quad ..., \quad y_n$$

constitute a time series. Thus, a time series invariably gives a bivariate distribution, one the two variables being time (t) and the other being the value (y_t) of the phenomenon at different points of time.

❖ Components of Time Series

The various factors that affect the values of a variable in a time series can be broadly classified into the following four categories, commonly known as the components of a time series, some or all of which are present in varying degrees-

- Secular Trend or Long-term Movement.
- Periodic Changes or Short-term Fluctuations.
  - Seasonal variations, and
  - Cyclic variations.
- Random or Irregular Movements.

➢ Trend

By secular trend or simply trend we mean the general tendency of the data to increase or decrease during a long period of time. This is true of most of series of Business and Economic Statistics. For example, an upward tendency would be seen in data pertaining to population, agricultural production etc., while a downward tendency will be noticed in data of births and deaths, epidemics etc. It may be clearly noted that trend is the general, smooth, long-term, average tendency. It is not necessary that the increase or decline should be in the same direction throughout the given period. It may be possible that different tendencies of increase, decrease or stability are observed in different sections of time. However, the overall tendency may be upward, downward or stable. For example, the change in the population, tastes, habits and customs of the people in a society etc. It should come not across be inferred certain series that all whose the series values must fluctuate show round an upward a constant or downward reading trend.

If the time series values plotted on graph cluster more, or less, round a straight line, then the trend exhibited by the time series termed as Linear otherwise Non-linear (curvi-linear).

- **Periodic Changes**

It would be observed that in many social and economic phenomena, apart from the growth factor in a time scries there are forces at work which prevent the smooth flow of the series in a particular direction and tend to repeat themselves over a period of time. The resultant effect of such forces may be classified as:

- Seasonal variations, and
- Cyclic variations.

Seasonal 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, i.e., during a period of 12 months and have the same or almost same pattern year after year. Thus seasonal variations in a time series will be there if the data are recorded quarterly (every three months), monthly, weekly, daily, hourly, and so on. Thus, in a time series data where only annual figures are given, there are no seasonal variations. Most of economic time series are influenced by seasonal swings, e.g., prices, production and consumption of commodities etc., are all affected by seasonal variations.

Again, the oscillatory movements in a time series with period of oscillation more than one year are termed as cyclic fluctuations. One complete period is called a 'cycle'. The cyclic movements in a time series are generally attributed to the so-called 'Business Cycle', which may also be referred to as the 'four-phase cycle' composed of prosperity (period of boom), recession, depression and recovery, and normally lasts from seven to eleven years. The upswings and downswings in business depend upon the cumulative nature of the economic forces (affecting the equilibrium of demand and supply) and the interaction between them. Most of the economic and commercial series, e.g., series relating to prices, production and wages, etc., are affected by business cycles. Cyclic fluctuations, though more or less regular, are not periodic.

- **Irregular (or Random) Component**

Apart from the regular variations, almost all the series contain another factor called the random or irregular or residual fluctuations, which are not accounted for by secular trend and seasonal and cyclic variations. These fluctuations are purely random, erratic, unpredictable and are due to numerous non-recurring and irregular circumstances which are beyond the control of human hand but at the same time are a part of our system such as earthquakes, wars, floods, epidemics etc.