

Applied stat (Time Series)

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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, is called Time Series.

Components of Time Series

The four components of Time Series are

- (i) Secular Trend
- (ii) Seasonal Variations
- (iii) Cyclic Variations and
- (iv) Irregular variations.

(i) Secular Trend:

A trend is the general tendency of the data to increase or decrease during a long period of time.

For example; an upward tendency would be seen in data pertaining to population, currency in circulation etc. while a downward tendency will be noticed in data of births and deaths, epidemics etc.

It may be noted that trend is the general, smooth, long term, average tendency. It should not be inferred that all the series must show an upward or downward trend. If the time series values plotted on graph cluster more or less, round a st. line, then the trend exhibited is termed as linear otherwise non linear (curve linear).

(ii) Seasonal Variation:

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, i.e., during a period of 12 months, and have a

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, monthly, weekly, daily, hourly and so on. Most of economic time series are influenced by seasonal swings (e.g) prices, production and consumption of commodities; sales and profits in a dept. store etc are all affected by seasonal variation.

(iii) Cyclic Variations:

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, otherwise called four phase cycle composed of prosperity, recession, depression and recovery. (e.g) Series related to prices, production and wages etc. are affected by business cycles.

(iv) Irregular Variations:

Apart from the regular variations, almost all the series contains another factor called the random or irregular or residual fluctuations which are not accounted by secular trend, seasonal and cyclic variations. These fluctuations are purely ~~random~~ due to earthquakes, wars, floods, etc.

Analysis of Time Series:

The main problems in the analysis of time series are

- (i) To identify the forces or components at work, the net effect of whose interaction is exhibited by the movement of time series, and

- (iii) To isolate, study, analyse and measure them independently, i.e., by holding other things constant. (2)

Mathematical Models

- (i) Decomposition by Additive Hypothesis (Additive Models)

The additive model can be expressed as

$$Y_t = T_t + S_t + C_t + R_t \rightarrow \textcircled{1}$$

where

Y_t is the time series value at time t

T_t represents the trend value

S_t , C_t and R_t represents the seasonal, cyclic and random fluctuations at time t .

The additive model implies that seasonal forces (in different years), cyclic forces (in diff. cycles) and irregular forces (in diff. long term period) operate with equal absolute effect irrespective of the trend value. As such C_t (and S_t) will have +ve or -ve values, according as whether we are in an above normal or below normal phase of the cycle (and year) and the total of +ve and -ve values of any cycle (and any year) will be zero. R_t will also have +ve or -ve values and in the long term ($\sum R_t$) will be zero.

This model assumes that all the four components of the time series operate independently of each other so that none of these components has any effect on the remaining three.