

TIME SERIES ANALYSIS

Time Series

1. A time series consists of statistical data which are collected, recorded or observed over successive increments.

11. A time series is a set of observations taken at specified times usually at equal intervals.

Mathematically a time series is defined by the values $y_1, y_2, y_3, \dots, y_n$ of the variable y at time $t_1, t_2, \dots, t_n$.
Symbolically $y = f(t)$ i.e. y is a function of time.

Components of time Series

- 1) Secular Variations (Trend) (T)
- 2) Seasonal variations (S)
- 3) Cyclical Variations (C)
- 4) Irregular Variations (I)

1. SECULAR TREND (T)

Refers to long term variations where the variable tends to increase or decrease over a long period of time.

Time period can be as short as few days or as long as fifty years depending on nature of event under consideration.

e.g. National income, Agricultural production -

Exports, imports in these situations time series could be of longer duration say 9 to 10 years.

- (2) Studying the effect of medicine to regulate human pulse rate — Reading done every 15 minutes we have the actual report.

2) SEASONAL VARIATIONS (S)

- i.) Short term Periodic Movements and regular in nature.
- ii.) Involve patterns of change within a year that tend to be repeated from year to year.
- iii.) forces responsible for seasonal variations are varying seasons, weather conditions, changing social customs and ceremonies.

Example

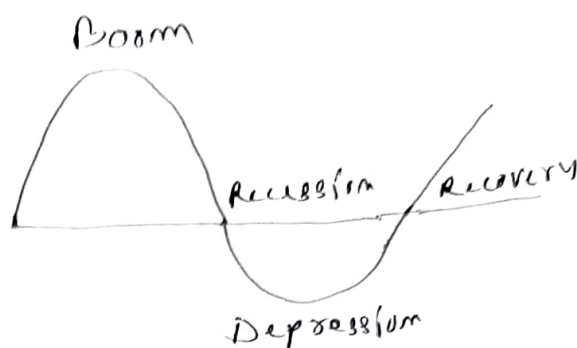
- a) Effect of festival on sale of departmental store.
- b) Agricultural Production
- c) sale of cold drinks during summers.
- d) sale of construction material going down during rainy ~~season~~ season.

3) Cyclical Variations

- i. Periodic Movements in Time series around the trend line.
- ii. Does not follow any regular pattern, move in somewhat unpredictable manner.

Example : Business Cycle which has four phases :

Boom / Prosperity
 Recession
 Depression
 Recovery



Cyclical Variations will take positive or negative signs depending on whether they are above or below the trend line.

The positive values of cyclical variations during upswing cancel the negative values during downswing so that the net effect over the period of cycle will be zero.

A businessman with the knowledge of cyclical variations can prepare himself for facing a period of recession by taking appropriate actions in advance. Similarly he can proactively be ready to take advantage of the recovery and boom in the business.

4) Irregular Variations (I)

this is the residual factor that accounts for deviations of actual time series from what we would expect from trend, cyclical and seasonal components.

(4)

these accounts for random variability in the time series.

they are caused by short term, unanticipables and non recurring forces.

Example

- i. Strikes and Lockouts
- ii. floods, famines etc.
- (iii) Wars, earthquake etc etc.

Analysis of Time Series
models of Decomposition.

① Additive Model

It is assumed that four components are independent of one another. i.e. when pattern of occurrence and magnitude of movement in any particular component are not affected by other components.

$$Y = T + C + S + I$$

Magnitude of Time

Series

= Trend Variations + Cyclical variations + Seasonal variations + Irregular variations.

All four components are expressed in their original units and can take positive or negative values.

② Multiplicative Model

It is assumed that the forces giving rise to four types of variations are interdependent.

$$Y = T \times C \times S \times \hat{I}$$

Only trend is
expressed in terms of
original values

Are expressed as
ratios or percentages.