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Time Series

Arrangement of statistical data in chronological order, that is in accordance with time is known as time series. For example, the index numbers of wholesale prices of rice in India over a period of time arranged in chronological order form a time series. Such series have a unique place in the field of economics and business studies. The series relating to prices, consumption and production of commodities, money in circulation, bank deposites and bank clearance, sales and profit in a departmental store, population of a country in different years, temparature of a place in different days etc are all time-series spread over a long period of time. Thus a time-series depicts the relation between two variables, one of them being time.

Mathematically, a time series is defined by a functional relationship $Y_t = f(t)$, where Y_t is the value of the phenomenon (a variable under study) at time t.

is to isolate or separate the effect of one or more of the forces or causes affecting the given series and to study them separately.

Components of Time series :

A graphical representation of a time series reveals the changes over time. A series which exhibits no change at all will give a horizontal line. However, we come across time series showing continual changes over time giving us a overall impression of haphazard movement. A critical study of the series will however reveal that the changes are not totally haphazard and a part of it, at least can be accounted for. The part which can be accounted for is the systematic one and the remaining part is the unsystematic or irregular one.

The systematic part may be attributed to several broad factors viz. (a) Secular trend
(b) Seasonal variation } Periodic
(c) cyclical variation } trend

Thus we get four components of time series —

(a) Secular trend
(b) Seasonal variation
(c) cyclical variation
(d) Irregular variation.

In a given series, some or all of the above components may be present. An analysis of time series will involve the separation and measurement of different component parts of the series. It is the systematic part of a time series which may be used in forecasting.

In the traditional or classical approach it is assumed that there is a multiplicative relationship among the four components thus

$$Y_t = T_t \times S_t \times C_t \times I_t$$ where

Y_t is the value of variable at time t,

T_t = Secular trend,

S_t = Seasonal variation

C_t = Cyclical variation and

I_t = Irregular variation.

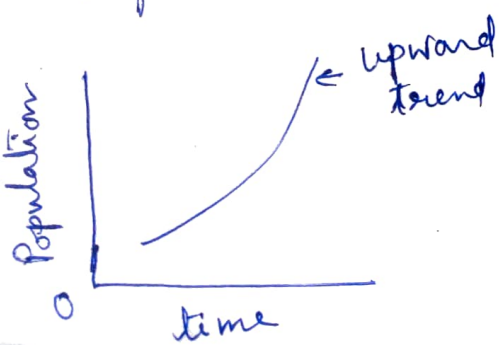
Another approach is to assume Y_t to be the sum of the four components. Thus

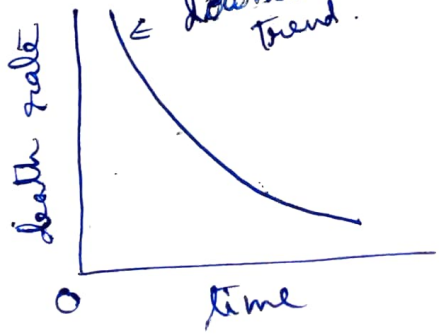
$$Y_t = T_t + S_t + C_t + I_t .$$

This model is not generally used and considered inappropriate for most economic data.

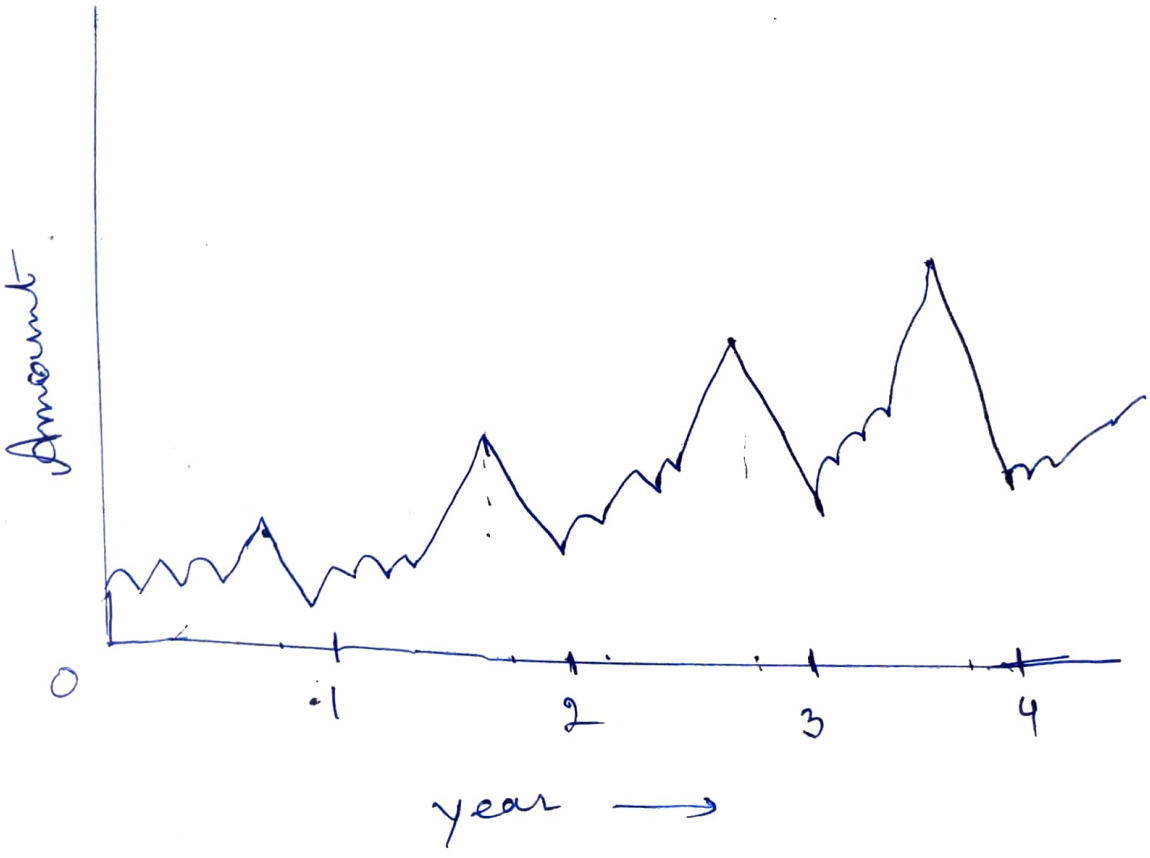
Trend or Secular trend : A study of the series of economic and business statistics would reveal that most of them have a natural tendency to increase or decrease over a period of several years. This general tendency of the data to increase or decrease during a long period of time is referred to as secular trend or simply trend. For example, in India an increasing tendency is noticed in the data relating to population, agricultural and industrial productions, bank deposites, literacy percentage etc. Therefore there is certain growth factor which is affecting a general and gradual rise in the series.

Not all time series show an upward trend. A declining trend is noticed in the data of epidemics, deaths and births etc owing to better and widely available medical facilities, higher standard of living, literacy etc.





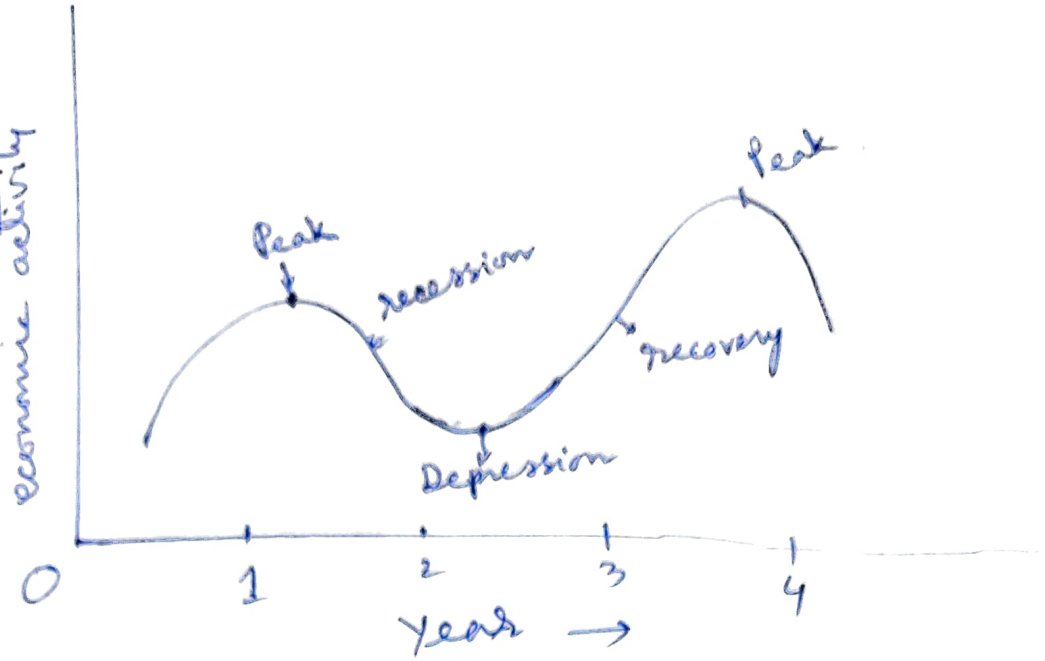
Seasonal Variation : One rhythmic force which is inherent in most of the time-series is what is called seasonal fluctuation. Seasonal variations are the periodic and regular movements in a time series with period not longer than one year. For example, sales and profit in a departmental store, prices and consumption of certain commodities, bank clearance – all exhibit seasonal variation. The very name suggests that weather plays an important role in such variations.



Cyclical Variation : Cyclical variations are the oscillatory movements in a time series whose period of oscillation is more than one year and which in general takes the form of a wave, though the distance from peak to trunk of the waves are unequal. One complete period is called the cycle. Such cycles are generally repeated at intervals ranging from about 3 to 10 years, and are caused by a complex combination of forces affecting the equilibrium of demand and supply. For example, we may consider the case of business cycle which has four phases composed of

I. prosperity or boom
II. Recession
III Depression
IV Recovery

The period of oscillation being 4 to 11 years. Most of the economic and commercial series, eg series relating to prices, production and wages are affected by business cycles.



IV Random or Irregular Variation:

Apart from the regular variation (ie Trend, seasonal and cyclical) almost all time series contain another factor called random or irregular or residual fluctuation which are not accounted for by secular trend, and seasonal and cyclical variations. These fluctuations are purely random, irruptive, unforseen, unpredictable and are due to numerous non-recurring and irregular circumstances which are beyond control of human hand. But at the same time are a part of our system — such as earthquakes, wars, floods, strikes, famines, revolutions, epidemics etc.

In some cases the involvements of such irregular fluctuations may not be significant while in others they may very effective and might give rise to cyclical fluctuations.