Time Series Forecasting

Armine Hayrapetyan

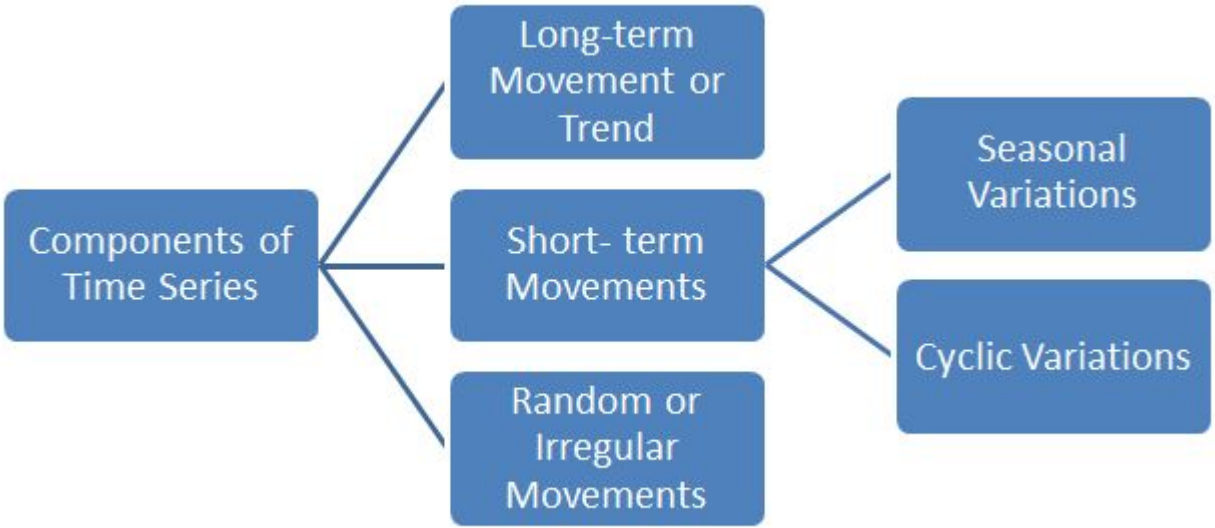
Components for Time Series Analysis

The various reasons or the forces which affect the values of an observation in a time series are the components of a time series. The four categories of the components of time series are:

- Trend
- Seasonal Variations
- Cyclic Variations
- Random or Irregular Variations

Components graph

Seasonal and Cyclic Variations are the periodic changes or short-term fluctuations.



Trend

- The trend shows the general tendency of the data to increase or decrease during a long period of time. A trend is a smooth, general, long-term, average tendency. It is not always necessary that the increase or decrease is in the same direction throughout the given period of time.
- It is observable that the tendencies may increase, decrease or are stable in different sections of time. But the overall trend must be upward, downward or stable. The population, agricultural production, items manufactured, number of births and deaths, number of industry or any factory, number of schools or colleges are some of its example showing some kind of tendencies of movement.

Linear and Non-Linear Trend

If we plot the time series values on a graph in accordance with time t. The pattern of the data clustering shows the type of trend. If the set of data cluster more or less round a straight line, then the trend is linear otherwise it is non-linear (Curvilinear).

Periodic Fluctuations

There are some components in a time series which tend to repeat themselves over a certain period of time. They act in a regular spasmodic manner.

Seasonal Variations

These are the rhythmic forces which operate in a regular and periodic manner over a span of less than a year. They have the same or almost the same pattern during a period of 12 months. This variation will be present in a time series if the data are recorded hourly, daily, weekly, quarterly, or monthly.

Cyclic Variations

The variations in a time series which operate themselves over a span of more than one year are the cyclic variations. This oscillatory movement has a period of oscillation of more than a year. One complete period is a cycle. This cyclic movement is sometimes called the ‘Business Cycle’.

It is a four-phase cycle comprising of the phases of prosperity, recession, depression, and recovery. The cyclic variation may be regular are not periodic. The upswings and the downswings in business depend upon the joint nature of the economic forces and the interaction between them.

Random or Irregular Movements

There is another factor which causes the variation in the variable under study. They are not regular variations and are purely random or irregular. These fluctuations are unforeseen, uncontrollable, unpredictable, and are erratic. These forces are earthquakes, wars, flood, famines, and any other disasters.

Additive Model for Time Series Analysis

If y_t is the time series value at time t. T_t, S_t, C_t, and R_t are the trend value, seasonal, cyclic and random fluctuations at time t respectively. According to the Additive Model, a time series can be expressed as

$$y_t = T_t + S_t + C_t + R_t.$$

This model assumes that all four components of the time series act independently of each other.

Multiplicative Model for Time Series Analysis

The multiplicative model assumes that the various components in a time series operate proportionately to each other. According to this model

$$y_t = T_t \times S_t \times C_t \times R_t$$

Mixed models

Different assumptions lead to different combinations of additive and multiplicative models as

$y_t = T_t + S_t + C_t R_t.$

The time series analysis can also be done using the model $y_t = T_t + S_t \times C_t \times R_t$ or

$y_t = T_t \times C_t + S_t \times R_t$ etc.

Question

For which type of data the seasonal fluctuations do not appear in a time series?

Solution

The seasonal variations do not appear in a series of annual data.

Question

What does the term ‘long period of time’ in a trend depict?

Solution

The term ‘long period of time’ is a relative term. It cannot be defined exactly. For some cases, a period as long as a few years may not be enough while in some cases a period as small as a week is considered a long period of time. It is totally dependent on the variable under study.

References

components-of-time-series