Time series analysis

Time series analysis is a statistical technique that deals with the time series data, or trend analysis. Time series data simply means that the data is in a series of particular time periods or intervals. It is defined as the chronological arrangement of successive values of a variable, for example the production figures of a commodity from year to year, annual rainfall, and decennial population figures plotted on the graph will give time series graphs. More clearly it can be stated that series of successive observations of the given phenomenon over a period of time are to as time series. The overall change in the figures may be due to variety of factors which cannot be easily discovered and analyzed.

From the comparison of past data with current data, we may seek to establish what development may be expected in future. The analysis of time series is done mainly for the purpose of forecasts and for evaluating the past performances.

According to Croxon and Cowden, "A time-series consists of data arranged chronologically".

According to Weasel and Wellet, "When quantitative data are arranged in order of their occurrence, the resulting statistical series is called a time series".

Components of time series: The analysis can be done in four general ways which are called as the components of time series.

i) Secular trend or long term: Secular trend that shows the direction of the series in a long period of time. The effect of trend is gradual but extends more or less consistently throughout the entire period of time under consideration. For example, fertility of land.
ii) Cyclic variation: Regular fluctuation after a particular period is known as cyclic variation. For example, annual rainfall figures for stations in India.
iii) Seasonal variation: Seasonal variations are of short duration occurring in a regular sequence at specific intervals of time. Such fluctuations are the result of changing season. For example, water discharge of a river.
iv) Irregular variation: Also known as Random fluctuation, are variations which take place in a completely unpredictable fashion. For example occurrence of earthquake.

Its applicability in geographical studies:

A time series is a sequence of observations measured at successive times. Time series are monthly, trimestrial or annual, sometimes weekly, daily or hourly, or biennial or decennial. Such data are of particular interest in geographical studies, where the values of a variable show changes with time. Discharge, gauge height, insolation, air temperature, rainfall, humidity, atmospheric pressure, crop production, industrial output, sex ratio, population density etc., show diurnal, seasonal, annual variations with time and are regarded as time series data.

In conclusion, the analysis of time series is done to understand the dynamic conditions for achieving and long term impacts of geographical phenomena. The past trend can be used to evaluate the present situation of any geo-phenomenon and also predicted the future pattern of any phenomenon. The knowledge of seasonal variations will be of great help to us in taking decision and policymaking. Thus analysis of time series is important in context of long term forecasting and is considered a very powerful tool for geographers and researchers.

Basic techniques of time series data analysis:

There are four techniques can be used in time series analysis viz. graphic method, semi-average method, moving average method and least squares method. Among them, **method of moving average and method of least squares and semi average methods** are important.

i) Semi-average method: In this method, the data is divided into two parts, and then the averages for these two parts are computed. These are then plotted as points on a graph paper against the mid-point of the time interval covered by each part. The straight line joining theses two points gives the trend line, and its distances from the horizontal line gives the trend values for different time periods. This method produces quite satisfactory results if the actual trend is straight line.

ii) Moving average method: In moving average method the average value for a number of years or months or weeks is taken into account and is placed at the centre of the time span. It is the normal or trend value for the middle period. It is calculated from overlapping groups of successive time series data. It is also called as moving mean or rolling mean. It simplifies the analysis and removes periodic variations. Moving average can be

calculated for 3, 4, 5, 6, 7, 8, or 9 yearly period. The formula calculating 3 yearly moving average is as follows:

$\frac{X_1 + x_2 + x_3}{3}$ $\frac{X_2 + x_3 + x_4}{3}$ and so on….

iii) Method of least square: The method of least squares assumes that the best fit curve of a given type is the curve that has the minimal sum of deviations, i.e. least square error from a given set of data. It is the most popular method used to determine the position of the trend line of a given time series. The trend line is technically called the best fit. In this method a mathematical relationship is established between the time factor and the variable given.

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