TIME SERIES ANALYSIS
SEMESTER II
B. COM CC 204

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INTRODUCTION TO TIME SERIES:

- The first step in making estimates for the future consists of gathering information from the data. In this connection, one usually deals with statistical data which are collected, observed or recorded at successive intervals of time. Such data are generally referred to as time series.

- Time series analysis is a statistical technique that deals with time series data, or trend analysis.

- Time series data means that data is in a series of particular time periods or intervals.

OBJECTIVES OF TIME SERIES:

- Study the past behaviour of data.

- Compact description of data.

- Interpretation of data.

- Forecasting for future.

- Modelling / Hypothesis testing.

SIGNIFICANCE OF TIME SERIES:

(1) Helps in the understanding of past behaviour.

(2) Helps in planning future operations.

(3) Helps in evaluating current accomplishments.

(4) Facilitates comparison.

COMPONENTS OF TIME SERIES:

- (1) Secular Trend

- (2) Seasonal Variations

- (3) Cyclical Variations

- (4) Irregular Variations.

SECULAR 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.

- The tendencies may increase, decrease or are stable in different sections of time. But the overall trend must be upward, downward or stable.

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.

SEASONAL VARIATIONS:

- 2. Seasonal VariationsSeasonal variations are those periodic movements in business activity which occur regularly every year.

- Have their origin in the nature of the year itself.

- These variations repeat during a period of 12 months so they can be predicted fairly accurately.

FACTORS CAUSING SEASONAL VARIATIONS :

- Climate and weather conditions.

- Customs, traditions and habits.

CYCLICAL 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 or not periodic.

- The upswings and the downswings in business depend upon the joint nature of the economic forces and the interaction between them.

IRREGULAR VARIATIONS:

- Irregular variations refer to such variations in business activity which do not repeat in a definite pattern.

- Irregular movements are considered to be largely random.

- These fluctuations are unforeseen, uncontrollable, unpredictable, and are erratic. These forces are earthquakes, wars, flood, famines, and any other disasters.

- Irregular variations are also called 'erratic', 'random' Or 'accidental' variations.

METHODS OF MEASUREMENT:

1. The Freehand or Graphic Method,

2. The Semi-average Method,

3. The Method of Least Squares.

FREEHAND OR GRAPHIC METHOD:

- Simplest method of studying trend.

- The given data are plotted on a graph paper and a trend line is fitted to the data just by inspecting the graph of the series.

- No formal criterion to judge adequacy of the line.

- Attempt should be made to make it conform following conditions:

1. Should be smooth,

2. Sum of the vertical deviations from the trend of the annual observations above the trend line should be equal to the corresponding sum below the trend line,

3. Sum of the squares of the vertical deviations of the observations from the trend should be minimum,

4. Trend should bisect the cycle.

METHOD OF SEMI-AVERAGE:

- Very simple and relatively objective as a freehand **method**.

- In this **method**, we classify the time series data into two equal parts.

- Then calculate **averages** for each half.

- If the data is for even number of years, it is easily divided into two.

- If the data is for an odd number of years, then the year at the middle of the time series is left and the two halves are constituted with the period on each side of the mid-year.

- In this method, we can find the solution of a secular trend.

METHOD OF LEAST SQUARES:

- **Least** Square is the **method** for finding the best fit of a set of data points.

- It minimizes the sum of the residuals of points from the plotted curve. I

- It gives the trend line of best fit to a **time series** data.

- Each point on the fitted curve represents the relationship between a known independent variable and an unknown dependent variable.

- The least squares method uses a straight line in order to fit through the given points which are known as the method of linear or ordinary least squares.

- This line is termed as the line of best fit from which the sum of squares of the distances from the points is minimum.

- Defines the solution for the minimization of the sum of squares of deviations or the errors in the result of each equation.

- The two basic kinds of the least squares methods – ordinary or linear least squares and nonlinear least squares.

METHOD OF LEAST SQUARES CONTINUED...

Mathematical Representation

- It is a mathematical method and with it gives a fitted trend line for the set of data in such a manner that the following two conditions are satisfied.

1. The sum of the deviations of the actual values of Y and the computed values of Y is zero.

2. The sum of the squares of the deviations of the actual values and the computed values is least.

MEASUREMENT OF TREND:

The secular trend line (Y) is defined by the following equation:

$$Y = a + b X$$

Where, Y = predicted value of the dependent variable

a = Y-axis intercept i.e. the height of the line above origin (when X = 0, Y = a)

b = slope of the line (the rate of change in Y for a given change in X)

When b is positive the slope is upwards, when b is negative, the slope is downwards

X = independent variable (in this case it is time)

MEASUREMENT OF TREND CONTINUED...

To estimate the constants a and b, the following two equations have to be solved simultaneously:

$\Sigma Y = na + b \Sigma X$

$\Sigma XY = a\Sigma X + b\Sigma X^2$

To simplify the calculations, if the midpoint of the time series is taken as origin, then the negative values in the first half of the series balance out the positive values in the second half so that $\Sigma X = 0$. In this case, the above two normal equations will be as follows:

$\Sigma Y = na$

$\Sigma XY = b\Sigma X^2$

In such a case the values of a and b can be calculated as under:

Since $\Sigma Y = na$

$A = \Sigma Y/n$

Since, $\Sigma XY = b\Sigma X^2$

THANK YOU