Dr Mariamma Antony
Asst.Professor in Statistics
Little Flower College,Guruvayur
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- TIME SERIES

DEFINITION

- Time Series can be defined as a set of statistical observations arranged in chronological order

TIME SERIES ANALYSIS

The study of movement of quantitative data through time is referred as **T**ime **S**eries **A**nalysis

UTILITY OF TIME SERIES

- **The analysis of time series helps to know the past**
- **It helps in assessing present achievements**
- **Helps to predict future (Helps to forewarn)**
- **Enables comparison**

Components of Time series

- **Secular trend**
- **Seasonal variations**
- **Cyclic variations**
- **Irregular variations**

- Secular Trend

  Changes that have occurred as a result of general tendency of the data to increase or decrease over a long period of time.

Also called **Long Term Trend** or **Simply Trend**

SEASONAL VARIATIONS

Changes that have taken place within a year as a result of change in climate,weather,festivals etc…

e.g. : sales of umbrella is more during rainy season

Factors that enumerate seasonal variation are:

1) Climate and weather conditions
2) Customs , traditions and habits

- Cyclic variations :

  Changes that have taken place as a result of booms and depressions

Normally the period of cyclic variations is more than a year.

If changes take place periodically and if the period is more than one year the variation is Cyclical.

- **IRREGULAR VARIATIONS**
- Changes that have taken place as a result of forces that could not be predicted like floods , droughts , earthquakes etc...
- Eg: Sometime during Onam season there is a poor sale in textile shop.

TIME SERIES MODELS

When the changes in data are result of combined impact of 4 components we can write the original data as the sum , product of the four components.

- **Additive Model**

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

- **Multiplicative Model**

$$Y=T*S*C*I$$

T : Secular trend

S :Seasonal variations

C :Cyclic variations

I : Irregular variations

MEASUREMENT OF TREND

There are 4 Method to estimate the secular trend they are:

- Graphic Method
- Semi-Average Method
- Method of Moving Averages
- Method of Least Squares

Graphic Method

- Simplest method of measuring trend of a time series.
- Firstly we have to draw times series graph that is the independent variable time is taken along X-axis and on Y axis the variable which is depending is marked.
- Plot the time values against the corresponding values of the dependent variable. Join these points by means of a smooth line. This is called Time Series Graph.
- Then to depict the trend behavior line is drawn through the points.

SEMI AVERAGES METHOD

- The data is divided in two equal halves and the arithmetic mean of the two sets of values of Y is plotted against the center of the relative time span.

- The 2 points so plotted are joined by a straight line and the line is extended on either side till the line end of graph sheet.
- If the number of observations is odd, then the middle most item, i.e (n+1/2)th, is dropped. The two points so obtained are joined through a straight line which shows the trend .

Method of Moving Averages

Suppose there are Y1, Y2, Y3,...Yn , n observations

First of all we have to decide the period of the moving averages. For a time series of period 3:

The average of the first 3 values is Y1+Y2+Y3 /3 and is written against the second time point which is the middle most of first, the second and the third points. The process is carried out to calculate the remaining moving averages.

In case of Even period :

Firstly the moving averages with period m are found. Then moving averages with period 2 of these moving averages are found.

The second set of moving average can be associated with given time points. This procedure is called centering.

However for finding trend values when m is even firstly moving totals with period m are obtained then moving totals with period 2,of these moving totals are obtained and the resulting totals are divided by 2m

METHOD OF LEAT SQUARES

PRINCIPLE OF LEAT SQUARES

Sum of Squares of error between the observed values and the corresponding estimated values should be the least

LINEAR (STRAIGHT LINE)

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

- $Y = a + b X$
- **To estimate the constants a and b, the following two equations have to be solved simultaneously:**
- $\Sigma Y = na + b \Sigma X$
- $\Sigma XY = a\Sigma X + B\Sigma x^2$
- **$\Sigma X = 0$. In this case, the above two normal equations will be as follows:**
- $\Sigma Y = na$
- $\Sigma XY = b\Sigma X^2$

QUADRATIC {PARABOLIC}

- Here the secular trend line is defined by equation $Y=a+bx+cx^{2}$.

- **To estimate the constants a,b and c the following 3 equations have to be solved:**

- $\sum Y = na + b\sum X + c\sum X^2$
- $\sum XY = a\sum X + b\sum X^2 + c\sum X^3$
- $\sum X^2Y = a\sum X^2 + b\sum X^3 + c\sum X^4$

Exponential Trend by Method of Least Squares

- Here the secular trend line is defined by equation $y = a.b^x$
- Thus by taking logarithm the above equation reduces to : log y = log a +log b
- That is Y=A+Bx where Y=log y, A=log a

B=log b

The normal equations are $nA + B\sum x = \sum Y$

$$A\sum x + B\sum X^2 = \sum XY$$

On Solving we get A &B the values of a & b are

a=antilog A b=antilog B.

Substituting the values of a & b in given equation we get required trend

Thank You