Methods for Measurement of Secular Trend: A Review

Agin Kumari
agincblu@gmail.com
Department of Mathematics, Ch. Bansi Lal University, Bhiwani-127021

Abstract: In the present paper, various methods for measuring secular trend of a time series have been studied. Graphical or free hand curve method, method of selected points, method of semi-averages, method of moving averages, method of least squares have been discussed in detail and also discussed merits and demerits of these methods.

Keywords: Time Series, Secular Trend, Semi-averages, Moving average.

1. Introduction

A time series is a collection of data that has been gathered and organised through time. Such information may include patient temperature series, series showing the number of suicides in certain months of the year, etc. The analysis of time series entails identifying the various factors that affect the series' values. There are two categories of variations in the time series: long term variations and short term variations. Cyclical fluctuations and Trend or Secular Trend are the two categories under which long-term changes fall. Seasonal variations and irregular variations are the two categories under which short-term variations fall.

The term "secular trend" describes the data's long-term propensity to move in either an upward or downward direction. For instance, changes in productivity, a rise in the rate of capital formation, population growth, etc. all exhibit an upward secular trend, whereas mortality brought on by advancements in sanitation and healthcare exhibit a downward secular trend. All of these factors work slowly and gradually to affect the time series variable.

The secular trend of a time series has been measured using a variety of techniques in the current research. The advantages and disadvantages of the graphical or free hand curve approach, the method of selected points, the method of semi-averages, the method of moving averages, and the method of least squares have all been thoroughly examined.

2. Methods forMeasurement of Secular Trend

In forecasting, it is important to analyse thecharacteristic movements of variations in the given timeseries. The following are the principal methods of measuringtrend from given time series:

2.1 GRAPHICAL OR FREE HAND CURVE METHOD

This is a straightforward approach to trend analysis. This method involves plotting the time series data on graph paper with the other variable on the Y-axis and time on the X-axis. The resulting graph will be erratic since it will include short-run oscillations. When a smooth freehand curve is drawn passing roughly through all of the points of a previously drawn curve, the short-run oscillations (seasonal, cyclical, and irregular variations) are eliminated, revealing the long-period general tendency of the data. Trend definitely has this in mind. Freehand smooth curve drawing is extremely challenging, and it's possible that different people may create different curves from the same data. The following points must be kept in mindin drawing a freehand smooth curve:

1. The smoothness of the curve.
2. That the number of points above and below the line or curve is equal.

A Monthly Double-Blind Peer Reviewed Refereed Open Access International e-Journal - Included in the International Serial Directories.
International Research Journal of Natural and Applied Sciences (IRJNAS)
Website: www.aarf.asia. Email: editoraarf@gmail.com , editor@aarf.asia   Page 256

3. That the sum of the vertical deviations at places above and below the smoothed line is equal to one another. The positive deviations will offset the negative deviations in this manner. These changes, which are caused by seasonal, cyclical, and irregular variations, are reduced by this method.
4. The vertical deviations from the trend line curve have the smallest sum of squares.

The trend values can be read for various time periods bylocating them on the trend line against each time period.
Merits:
1. It is an easy way of trend estimation that doesn't involve any mathematics.
2. It is a more adaptable method than strict mathematical trends, making it a better indicator of the data's trend.
3. This approach is applicable even when the trend is nonlinear.
4. If the observations are reasonably steady, this approach makes it simple to approximating the trend.
5. Since it is not a mathematical procedure, even the average person may use it.
Demerits:
1. It is an arbitrary procedure. Different statisticians might arrive at different trend values, making them unreliable.

2.2METHOD OF SELECTED POINTS
In this approach, two points that are thought to be the most typical or representative are connected by a straight line to produce a secular trend. Again, this is a subjective approach because several people may have different viewpoints on the representative spots. Furthermore, this approach can only identify linear trends.

2.3 METHOD OF SEMI-AVERAGES
As implied by the method's name, semi-averages are computed to determine the trend values. The averages of a series' two halves are referred to as semi-averages. Thus, the arithmetic mean of the values in each of the two equal portions (or halves) of the provided series are computed using this method. Semi-averages are the name given to the computed means. The time period's centre is associated with each semi-average. The trend is then determined by connecting the points on a graph created from the two pairs with a straight line. It should be noticed that data for even numbers of years can be split in half with ease. But if it isfor odd number of years, we leave the middle year of thetime series and two halves constitute the periods on eachside of the middle year.

Merits:
1. It is an easy method of trend measurement.
2. It is an objective method since the trend value would be the same no matter who applied it to the given data.
Demerits:
1. Whether or not there is a linear trend in the data, this method can only show it.
2. Given that we are unsure of the extent to which the impacts of other components have been eliminated, this is merely a primitive approach of trend measurement.

A Monthly Double-Blind Peer Reviewed Refereed Open Access International e-Journal - Included in the International Serial Directories.
International Research Journal of Natural and Applied Sciences (IRJNAS)
Website: www.aarf.asia. Email: editoraarf@gmail.com , editor@aarf.asia   Page 257

2.4METHOD OF MOVING AVERAGE

This approach is founded on the idea that throughout periods of cyclical fluctuations, the overall impact of periodic variations at various points in their cycle becomes totally neutralised. In the moving average approach, overlapping sets of subsequent data from a time series are used to calculate successive arithmetic averages. Each group consists of all observations made within a specific time period known as the moving average period. The oldest value is swapped out for the following value in the series to create the following group. Moving averages are the averages of these categories. A group's moving averages are always displayed in the middle of its term.

The oscillations in the time series data are smoothed out throughout the moving average computation procedure. Because the average of several observations must be between the smallest and biggest observation, it can be demonstrated that if the trend is linear and the oscillatory fluctuations are regular, the moving average with a period equal to the period of oscillatory variations would minimise. It should be noted that the effect of random components would be reduced more as the moving average's period increased, but more information would be lost at the endpoints of the data.i.e., it makes curve-linear trends less curved.When the trend is nonlinear, the moving averageswould give biased rather than the actual trend values.

Merits:
1. Because there are no complicated mathematical concepts involved, this method is simple to comprehend and utilise.
2. It is an objective method in that anyone using it to solve a problem would obtain the same trend numbers. It is superior to the free hand curve approach in this regard.
3. It is a flexible method in that the results are unaffected if a few additional observations are provided. This is not the situation with the semi-average technique.
4. These fluctuations are entirely eliminated when the oscillation period is equal to the moving average period.
5. It is also possible to identify seasonal, cyclical, and random components by using this strategy in an indirect manner.

Demerits:
1. All elements in the series cannot have trend values calculated for them. At its endings, some knowledge is always lost.
2. Only if the oscillatory and random fluctuations are homogeneous in terms of period and amplitude and the trend is, at the very least, roughly linear, can this method find reliable values of trend. In actuality, these prerequisites are not frequently met. Moving averages will not provide accurate trend values when the trend is not linear.
Inability to establish a functional relationship between the values of X(time) and Y(values) means that the trend values acquired by moving averages cannot be used for forecasting, which is likely the primary goal of any time series analysis.
4. Choosing the period of the moving average is a challenging operation that requires careful consideration.
5. Similar to the arithmetic mean, extreme values have a significant impact on moving averages.

A Monthly Double-Blind Peer Reviewed Refereed Open Access International e-Journal - Included in the International Serial Directories.
International Research Journal of Natural and Applied Sciences (IRJNAS)
Website: www.aarf.asia. Email: editoraarf@gmail.com , editor@aarf.asia   Page 258

2.5 METHOD OF LEAST SQUARES

One of the most used techniques for fitting a mathematical trend is this one. The best fitted trend is one where the sum of squares of observations' departures from it is kept to a minimum. The least squares method can be used to match both linear and nonlinear trends (such as exponential and parabolic trends).

Merits:

1. The least squares approach is an objective method given the mathematical structure of the trend to be fitted.
2. In contrast to the moving average method, it is feasible to compute trend values for all periods and forecast the value for a period outside the range of the observed data.

Demerits:

1. It is a laborious process when compared to the moving average method.
2. It is not as adaptable as the moving average approach. If additional observations are made, the complete set of calculations must be redone.
3. It can only forecast or estimate values for the recent past or present.
4. The determination of trend values based on this method is unreliable because it ignores the other elements of a time series.
5. The procedure is not strictly objective because a specific trend was arbitrarily chosen.
6. Growth curves, the pattern utilised by the majority of economic and corporate time series, cannot be fitted using this method.

3. Discussion

A "secular trend" is a long-term tendency for the data to move upwards or downwards. For instance, shifts in productivity, an increase in the rate of capital formation, population expansion, etc. all show an upward secular trend, whereas mortality caused by improvements in sanitation and healthcare show a downward secular trend. Each of these elements gradually and slowly changes the time series variable.In the current research, a number of methods have been discussed to measure the secular trend of time series. The benefits and drawbacks of the graphical or free hand curve technique, the selected points method, the semi-averages method, the moving averages method, and the least squares method have all been carefully analysed.

References

R S Bhardwaj, Business statistics;Excel Books India, 2009; ISBN8174466797, 9788174466792.
D N Elhance, Fundamentals of Statistics;Kitab Mahal, Wholesale Division, 1964.
V K Puri, Elements of business Statistics; Himalaya publishing house,*ISBN139789353673802.*
Ajay Goel, Mathematics and Statistics;Taxmann Publications Private Limited, 2014.

A Monthly Double-Blind Peer Reviewed Refereed Open Access International e-Journal - Included in the International Serial Directories.
International Research Journal of Natural and Applied Sciences (IRJNAS)
Website: www.aarf.asia. Email: editoraarf@gmail.com , editor@aarf.asia   Page 259