

TIME SERIES ANALYSIS WITH REFERENCE TO THE BUSINESS ACTIVITY INDEX OF SOUTH DAKOTA

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Time series is the term applied to data classified on the basis of intervals of time. Four definite movements exist in such data, namely, secular trend, cyclical movements, seasonal variation, and random fluctuations. Secular trend is the gradual growth, increasing or decreasing over a long period of time. Cyclical movements are fluctuations over a period longer than one year, which tend to recur at irregular periods with varying degrees of severity. Seasonal variations are distinguished from cyclical movements by the remarkable similarity with which they recur at regular intervals. Irregular movements are often due to purely chance factors. They may be minor fluctuations of no importance or importantly episodic in nature, such as earthquakes, wars, or general strikes.

The basic purpose of time series analysis is to provide a method of measuring changes in business and relating these changes to the business environment by providing a factual basis for eliminating irregularities, to permit planning and to judge present results in the light of past experience. Because of the number of different influences regularly affecting the time series, a considerable amount of analysis may be necessary to determine causes of the various changes. Isolation of the types of changes, particularly secular trend, seasonal variation and cyclical movements, becomes the basic problem.

Since a time series is actually a series of changes of some variable, which is in itself a resultant of interdependent variables, a unique method of comparison must be applied. The method usually applied is that of index numbers. We shall define index numbers to be devices which summarize the relative fluctuations in a group of variables. The four most common methods by which index numbers

are computed are the simple average method, link relative method, ratio to moving average method, ratio to trend method.

These four methods of determining seasonal index numbers were applied to data of the General Business Activity Index of South Dakota in a recent study to determine the best method of obtaining seasonal indices for that data. This business index is a composite of ten indicators, bank debits, department store sales, electric power consumption, gross postal receipt, postal money orders, new car registration, new truck registration, telephones in service, building permits, and life insurance sales. The first five were considered in the study. As a result the following conclusions were drawn.

The simple average method does not eliminate enough trend. Results are apparently always below average at the beginning and above average at the end of the year. The link relative method seems to be less affected by extreme values but is more difficult to compute. The moving average method is comparatively simple to compute and explain. It eliminates trend and seasonal fluctuations better than the simple average method. The ratio to trend method actually eliminates more trend than the other method if the proper type of trend curve can be determined. In this method, data must be tested for type of trend before fitting a curve to it. If the wrong type of trend is applied, the random fluctuations are emphasized to an extreme degree.

In the case of postal money orders, the ratio to straight line trend gives an erroneous impression of results because the raw data is obviously not linear. The link relative method seems best in this case. Probably in the final analysis, postal money orders data should not be used in the general business index because of the large random fluctuations present.

Another interesting conclusion pertains to the bank debits data, usually considered a good indicator of business

activity. Comparatively heavy income tax payments during the first three months of the year, distort this data to an unusual degree.

Finally then, if the data is definitely linear or curvilinear it seems that the ratio to trend method would probably eliminate fluctuations better than the other methods. In other types of data, either the link relative method or the ratio to moving average method might prove more satisfactory, with the ratio to moving average being much simpler to compute.