12.2.2024

Seasonal adjustment with the Tramo/Seats method

What is seasonal variation and why should it be eliminated?

Many economic phenomena are measured at regular intervals. The interest in these measurements not only lies in the value a given variable receives at each point in time but also in how the time series of data on this variable develops from one measurement to the next.

Many time series behave almost predictably over the period of one year. The reasons for this are the regular cycle of seasons and the other phenomena that follow this calendar rhythm, such as holidays, public holidays and consumption habits. This almost regular, repetitive variation in a time series within one year is known as seasonal variation.

Because of this seasonal variation comparisons of two successive observations are not meaningful as the change from the previous observation mainly describes the seasonal aspect rather than the trend in development. The interpretation of visual graphs is also challenging if a time series contains seasonal variation. Then, for instance, the pinpointing of turns in economic trends is difficult.

What are the components of a time series?

It has generally been though that time series on economic trends are made up of different elements, or components:

1. Trend cycle (trend in brief) describes the long-term development and the movements caused by economic cycles in a time series.

2. Seasonal variation (caused by e.g. changes of season) describes annually recurring, almost regular changes.

3. As its name implies, irregular random variation occurs totally randomly. It cannot be included in the aforementioned components.

Seasonal adjustment means the estimation of seasonal variation and the elimination of its impact from a time series. The obtained outcome from this is a seasonally adjusted time series. The trend of a time series is obtained if both seasonal variation and irregular random variation are eliminated from it.

Phenomena associated with long-term development and cyclical changes are more easily observable from a seasonally adjusted time series and a trend of a time series. For instance, the detection of turning points in economic cycles becomes easier. The figures of a seasonally adjusted series are comparable with each other, which makes the comparing of two successive observations meaningful. The same also applies to the values of the trend of a time series.

Sometimes the number of working days in an observation period influences the value a time series receives. The Tramo/Seats method makes it possible to calculate a time series adjusted for working days in which the observations are comparable with regard to the weekly structure. This refers to

making allowances for the impact of weekends, public holidays (e.g. Independence Day, Epiphany, May Day, Easter) and the Leap Day.

Functioning principles of the Tramo/Seats method

The Tramo/Seats method has two phases. The first phase consists of pre-adjustment of a time series. This comprises adjustment for working days, i.e. allowing for the impact of weekends, public holidays and the Leap Day. In the Tramo/Seats method the adjustment for working days is based on a regression model.

Extreme observations (*outlier*s) in the data are also addressed at the pre-adjustment phase. The Tramo/Seats method is capable of observing three types of outliers. These are distinguished by the way the time series returns to the level prior to the outlying observation. In the case of an isolated *additive outlier*, the time series returns back to it starting level immediately after the outlying observation. In the case of a *transitory change* the level of the time series changes abruptly but then gradually returns to its starting level over the next few observations. A *level shift* is concerned when the level of the time series changes but does not return to the level prior to this change over the next few observations.

The purpose of the pre-adjustment of a time series is to make different observations comparable with regard to their working day structure. Outlying observations caused by strikes or similar exceptional situations are also separately handled. The seasonal component of a time series is easier to identify if the data contain no movements caused by working days or outlying observations.

Once the time series has been pre-adjusted a linear time series model is fitted to it. The purpose of the time series model is to describe the interdependency apparent on the time axle of observations by means of a mathematical equation. The fitting of the model is comprised of the selection of the right model and the estimation of parameters.

The seasonal adjustment proper is performed in the second phase of the Tramo/Seats method. The idea is to calculate the seasonally adjusted value and the value of the trend series at each given point in time *t* as a weighted sum. In addition to the observation at point in time *t*, values prior to it (*t-1*, *t-2*,...) and after it (*t+1*, *t+2*,...) are taken into account in this. Because the used weighting coefficients are determined by the time series model, an individual seasonal adjustment formula becomes tailored for each time series that is to be seasonally adjusted.

If the latest observations of a time series are being seasonally adjusted, figures subsequent to point of time *t* do not yet necessarily exist. These figures must then be substituted by their forecasts which can be calculated with the time series model formed for the data.

It should be emphasised that all forecasts contain statistical uncertainties. Because of this the latest figures of a seasonally adjusted time series and a time series trend, which are thus partly based on forecasts, should be approached with reservations.

Seasonal adjustment practices at Statistics Finland

In the Tramo/Seats method, pre-adjustment is based on a regression model (which allows for outlying observations, public holidays and the weekday structure), and the seasonal adjustment proper on an ARIMA model constructed for the time series. The main principle is that the models used in seasonal

adjustments performed during one year are kept fixed but the parameters in them are re-estimated during each calculation round.

The aforementioned procedure complies with the recommendations of the European Statistical System (ESS). On the one hand it endeavours to keep changes in the values of the trend and the seasonally adjusted time series reasonable in each calculation round and, on the other, to exploit data on the latest observations in a time series in the seasonal adjustment.

The appropriateness of the models used in seasonal adjustment is checked once a year and changes are made to them if necessary. Details of the seasonal adjustment models are freely available to anybody.

Particular discretion is used in the searching of outlying observations in a time series if they appear toward the end of the series. In such cases, the identification of the type of outlier is made by utilising both the information contained in the data and knowledge about the theory behind the measured phenomenon. Further information about the classification of outlying observations as a level shift can be found in the following release of Statistics Finland:
http://tilastokeskus.fi/ajk/tiedotteet/2009/tiedote_019_2009-12-08_en.html

Further reading:

Findley (2005): *Some Recent Developments and Directions in Seasonal Adjustment*, Journal of Official Statistics, vol. 21, no. 2, 343-365.

Kokkinen Alsuhail (2005): *Aikasarjan ARIMA-mallipohjaisesta kausitasoituksesta*, Kansantaloustieteellinen aikakauskirja, no. 4, 469-483.

Kaiser and Maravall (2000): *Notes on Time Series Analysis, ARIMA Models and Signal Extraction*,Banco de España Working Papers, no. 0012.

Bell and Hillmer (1983): *Modelling Time Series With Calender Variation*, Journal of the American Statistical Association, vol. 78, no. 383, 526-534.

Bell and Hillmer (1984): *Issues Involved With the Seasonal Adjustment of Economic Time Series*, Journal of Business & Economic Statistics, vol. 2, no. 4, 98-127.