New Motor Vehicle Sales Survey – Seasonal Adjustment

Time series contain the elements essential to the description, explanation and forecasting of the behaviour of an economic phenomenon: "They are statistical records of the evolution of economic processes through time." Economic time series such as the New Motor Vehicles Sales Survey can be broken down into five main components: the trend-cycle, seasonality, the trading-day effect, the Easter holiday effect and the irregular component.

The trend represents the long-term change in the series, whereas the cycle represents a smooth, quasi-periodical movement about the trend, showing a succession of growth and decline phases (e.g., the business cycle). These two components—the trend and the cycle—are estimated together, and the trend-cycle reflects the fundamental evolution of the series. The other components reflect short-term transient movements.

The seasonal component represents sub-annual, monthly or quarterly fluctuations that recur more or less regularly from one year to the next. Seasonal variations are caused by the direct and indirect effects of the climatic seasons and institutional factors (attributable to social conventions or administrative rules; e.g., Christmas).

The trading-day component originates from the fact that the relative importance of the days varies systematically within the week and that the number of each day of the week in a given month varies from year to year. This effect is present when activity varies with the day of the week. For instance, Sunday is typically less active than the other days, and the number of Sundays, Mondays, etc., in a given month changes from year to year.

The Easter holiday effect is the variation due to the shift of part of April's activity to March when Easter falls in March rather than April.

Lastly, the irregular component includes all other more or less erratic fluctuations not taken into account in the preceding components. It is a residual that includes errors of measurement on the variable itself as well as unusual events (e.g., strikes, drought, floods, major power blackout or other unexpected events causing variations in respondents' activities).

Thus, the latter four components—seasonal, irregular, trading-day and Easter holiday effect—all conceal the fundamental trend-cycle component of the series. Seasonal adjustment (correction of seasonal variation) consists in removing the seasonal, trading-day and Easter holiday effect components from the series, and it thus helps reveal the trend-cycle. While seasonal adjustment permits a better understanding of the underlying trend-cycle of a series, the seasonally adjusted series still contains an irregular component. Slight month-to-month variations in the seasonally adjusted series may be simple irregular movements. To get a better idea of the underlying trend, users should examine several months of the seasonally adjusted series.

Since April 2008, New Motor Vehicle Sales Survey data are seasonally adjusted using the X-12-ARIMA[1] software. The technique that is used essentially consists of first correcting the initial series for all sorts of undesirable effects, such as the trading-day and the Easter holiday effects, by a module called regARIMA. These effects are estimated using regression models with ARIMA errors (auto-regressive integrated moving average models). The series can also be extrapolated for at least one year by using the model. Subsequently, the raw series—pre-adjusted and extrapolated if applicable— is seasonally adjusted by the X-11 method.

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[1] For more information, see X-12-ARIMA Reference Manual Version 0.3 (2007), U.S. Census Bureau.

The X-11 method is used for analysing monthly and quarterly series. It is based on an iterative principle applied in estimating the different components, with estimation being done at each stage using adequate moving averages[2]. The moving averages used to estimate the main components—the trend and seasonality—are primarily smoothing tools designed to eliminate an undesirable component from the series. Since moving averages react poorly to the presence of atypical values, the X-11 method includes a tool for detecting and correcting atypical points. This tool is used to clean up the series during the seasonal adjustment. Outlying data points can also be detected and corrected in advance, within the regARIMA module.

Lastly, the annual totals of the seasonally adjusted series are forced to the annual totals of the original series.

Unfortunately, seasonal adjustment removes the sub-annual additivity of a system of series; small discrepancies can be observed between the sum of seasonally adjusted series and the *direct* seasonal adjustment of their total. To insure or restore additivity in a system of series, a reconciliation process is applied or *indirect* seasonal adjustment is used, i.e. the seasonal adjustment of a total is derived by the summation of the individually seasonally adjusted series.

To assist the user, the Months of Cyclical Dominance number, MCD, is provided. The MCD is the shortest monthly span for which a certain ratio becomes and remains less than one, that is, the ratio for which the absolute average percentage change of the trend-cycle of the seasonally adjusted series becomes greater than the absolute average per cent change of the irregular component. The MCD can be interpreted as the number of months over which a change in the seasonally adjusted series must move in a given direction before one can be reasonably certain that the trend-cycle of that series also has moved in the given direction. Clearly small MCD's are desirable and indicative of a smooth series. Applying a moving average to the seasonally adjusted data of MCD length tends to smooth irregular movements which may obscure the underlying trend-cycle. The MCD moving average provides a method of reducing all types of series to approximately the same degree of smoothness, whatever the size of the irregular component in the original series.

[2] Ladiray, D. and Quenneville, B. (2001). Seasonal Adjustment with the X-11 Method. New York: Springer-Verlag, Lecture Notes in Statistics #158.