CORRECTION AND DESEASONALISATION OF SHORT-TERM SERIES. METHODOLOGICAL NOTE.

Introduction

Time series observed at periods of less than one year (quarterly, monthly, etc.) are often affected by seasonal cycles and calendar effects (leap years, holidays, different number of Saturdays and Sundays in each month, etc.). The presence of these effects in the series can hamper the interpretation of short and long term movements by impeding the understanding of the underlying effects on their movements. The main objective of correction and deseasonalisation is to identify calendar and seasonal effects and eliminate them from the series.

The methodology used at EUSTAT for the correction of calendar effects, deseasonalisation and the extraction of the trend-cycle from short-term economic series follows the recommendations established in the EUROSTAT guidelines [3].

In accordance with these guidelines, the use of regARIMA[1] models is recommended to identify and eliminate atypical observations (outliers) prior to estimating the calendar and seasonal effects. The use of regARIMA models is also recommended to calculate the adjustment factors of the calendar effects, which must take the different characteristics of national calendars into account.

The recommended seasonal adjustment methods are parametric methods based on signal extraction using ARIMA models like Seats [5] and semi-parametric methods based on a set of predefined moving averages like the

[1] Also known as transfer function models

X13-ARIMA method, based on the earlier X12 and X11-ARIMA [4].

Since February 2015, EUROSTAT has opted for the use of the JDemetra+ program as the officially recommended software for seasonal and calendar adjustment in the European Union. This software contains the options of the two deseasonalisation methods TRAMO-SEATS and X13-ARIMA. TRAMO is a program for the pre-processing of time series with the following objectives: to detect and correct atypical values, to detect, estimate and adjust calendar effects, to interpolate missing values and to predict. SEATS is a program for the decomposition of series and also for the prediction of future values. In previous years, EUSTAT has used the program TSW (TRAMO/SEATS for Windows). Starting now, and with the aim of maintaining a degree of intertemporal consistency, the TRAMO-SEATS option will be used in the JDemetra+ program by default.

Linearisation of gross series

The TRAMO routine (Time Series Regression with Arima Noise, Missing Observations and Outliers) contained in JDemetra+ is a program for the estimation, prediction and interpolation of regression models with unobserved values and ARIMA errors which allows for the modelling of different types of anomalous values and outliers.

Given the gross series $z = (z_1, \dots, z_T)$, the TRAMO program adjusts the regression model

$$z_t = y_t' \beta + x_t \qquad \forall t = 1, \dots, T \tag{1}$$

where $\beta = (\beta_1, \dots, \beta_K)$ is the regression coefficient vector, $y_{tj}' = (y_{1t}, \dots, y_{kt})$ compiles the *K* regression variables and x_t follows a general ARIMA process of the type

$$\phi(B)\delta(B)x_t = \theta(B)\epsilon_t \tag{2}$$

where B is the lag operator, $\phi(B)$, $\delta(B)$, *and* $\theta(B)$ are polynomials in B and the disturbances ϵ_t are assumed to follow a white noise process $N\,(0, \sigma_\epsilon^2)\ \forall t$.

The polynomial $\delta(B)$ contains the unit roots derived from the differences from both the regular and seasonal parts, $\phi(B)$ is the polynomial with autoregressive seasonal roots and $\theta(B)$ denotes the moving average polynomial (invertible). The polynomials are assumed to be multiplicative in the following way:

$$\delta(B)\ = (1 - B)^d (1 - B^s)^D$$

$$\phi(B)\ = (1 + \phi_1 B + \cdots + \phi_p B^p)(1 + \Phi_1 B^s + \cdots + \Phi_P B^{sP}) \qquad (3)$$

$$\theta(B)\ = (1 + \theta_1 B + \cdots + \theta_q B^q)(1 + \Theta_1 B^s + \cdots + \Theta_Q B^{sQ})$$

where s denotes the number of observations per year. The model can contain a constant μ which compiles the average of the differentiated series $\delta(B)\, z_t$ which, if significant, would be the constant term of the regression (in other words, $y_{1t} = 1\ \forall t = 1, \dots, T$).

The regressors $y_t = (y_{1t}, \dots, y_{Kt})$ can be classified as:

1. Regressors specified by the user to gather intervention variables, highly correlated variables with z_t which improve the adjustment, etc.
2. Regressors specified by the user via the JDemetra+ interface such as holidays and others automatically generated by JDemetra+ to compile working day, Easter and leap year effects. (See chapter 7 of the JDemetra+ manual [7] or EUROSTAT [2])

After specifying the model, the TRAMO program:

1. Estimates by maximum likelihood (or conditional or unconditional least squares) all of the parameters of the selected model (of the regression model as well as the general ARIMA model).
2. Detects and corrects anomalous observations or additive outliers, transitory changes and level shifts.
3. Provides predictions of the series with their corresponding mean squared error.

4. Optimally interpolates unobserved values and calculates mean squared errors.

The TRAMO program automatically identifies the ARIMA model according to the methodology described in Maravall and Gómez [9] and contains an option for the detection and correction of outliers according to a method similar to that of Chen and Liu [1] (See Gómez and Maravall [6]).

Signal extraction of linearised series

The SEATS package (Signal Extraction in Arima Time Series), now also included in JDemetra+, decomposes series using the methodology of models known as UCARIMA (Unobserved components ARIMA). (See, for example, Hillmer and Tiao [8]). The specific method used by SEATS is described in Maravall and Gómez [10].

TRAMO provides SEATS with the original series, the estimated non-stochastic effects (outliers, working day, leap year and Easter effects, intervention variables, etc.), the linearised series (previously interpolated, where appropriate), in other words, x_t in (1), and the estimated ARIMA model in (2). As a result, SEATS produces an estimation of the trend-cycle component, the seasonal component, the transitory change and the irregular component, as well as its predictions.

References

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