Eurostat Nowcasting: Methodological Note

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This is the abstract. It consists of two paragraphs.

Introduction

The September submission is based on the combination/ensemble of three statistical forecasting methods, namely, Autoregressive Integrated Moving Average (ARIMA), Error-Trend-Seasonality (ETS) and Theta model.

Statistical Methods

Autoregressive Integrated Moving Average

Autoregressive integrated moving average models (ARIMA) has three components, namely,

- The autoregressive component p,
- The number of nonseasonal differences needed for stationarity d
- Moving average or lagged forecasted error q

To begin with, the time series is required to be stationary. One way to make the series stationary is to compute the differences between consecutive observations. The procedure is called *differencing*. This can be written as,

$$y'_t = y_t - y_{t-1} \tag{1}$$

If the series is differenced with one lag, it is called *first difference*, or *first-order differencing* i.e. $d = 1$. In case the series is still non-stationary, further differencing is needed. For example, the second-order differencing looks like this,

$$y''_t = y'_t - y'_{t-1} \tag{2}$$

Differencing the data twice means, $d = 2$.

The next component in ARIMA model is called *autoregressive component*. An autoregressive model of order p can be written as,

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + ... + \phi_p y_{t-p} + \epsilon_t \tag{3}$$

where, ϵ_t is white noise. Here we are predicting the series using its past values. We can refer the form Equation 1 as $AR(p)$.

Instead of using past values to predict the future values, it is possible to use past forecast errors,

$$y_t = c + \epsilon_t + \theta_1 \epsilon_{t-1} + \theta_2 \epsilon_{t-2} + \theta_p \epsilon_{t-q} \tag{4}$$

where ϵ_t is white noise. The Equation 4 is called $MA(q)$ model or moving average model of order q.

If we combine differencing (d) with autoregressive (p) and moving average (q) component, we get the full Autoregressive Integrated Moving Average (ARIMA) model, which can be expressed as,

$$y'_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + ... + \phi_p y_{t-p} + \theta_1 \epsilon_{t-1} + \theta_2 \epsilon_{t-2} + \theta_p \epsilon_{t-q} + \epsilon_t \tag{5}$$