

ECONOMETRIC TECHNIQUES FOR REVENUE FORECASTING USING EVIIEWS

Session 5: Time Series Analysis and Stationarity



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Time Series Analysis

General Introduction

- Econometric forecasters used structural models based on economic relationships.
- Time series analysts used statistical extrapolative techniques.
- Econometric forecasters didn't worry about the non-stationarity of their data which usually grew over time and had no fixed means.
- Time series analysts did and accused econometric forecasters of producing spurious results by running regressions on non-stationary data.
- Time series techniques have now been adopted by econometric forecasters for forecasting, lags and modeling expectations.

Time Series Analysis

Different Models

- ARIMAs
- VARs
- Error Correction Models

Box-Jenkins ARIMA(p,d,q) Model

- $$y_t = \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \dots + \varphi_p y_{t-p} + \varepsilon_t + \theta_{t-1} \varepsilon_{t-1} + \theta_{t-2} \varepsilon_{t-2} + \dots + \theta_{t-q} \varepsilon_{t-q}$$
- where d the number of times y has to be differenced to get an I(0) stationary series, p is the degree of autocorrelation, and q is the number of lagged values of the error term.

Vector Autoregression

- $y_t = B_1 y_{t-1} + B_2 y_{t-2} + \dots + B_n y_{t-n} + \varepsilon_t$
- where y is a vector of endogenous variables and B is a matrix of coefficients.. This is similar to an ARIMA model except that there is more than 1 dependent variables and there is no allowance for a moving average error. As in an ARIMA model the individual series making up the rows of the vectors y should be differenced to be $I(0)$ or stationary.

Error Correction Model

- $\Delta y_t = \beta_0 + \beta_1 \Delta x_t + (\beta_3 - 1) (y_{t-1} - x_{t-1}) + \varepsilon_t$
- where $(\beta_3 - 1) (y_{t-1} - x_{t-1})$ is the error correction term. When y increases more than x , the error correction term exerts pressure to bring it back in line. The error correction model as applied to cointegrated variables is usually estimated with the residual from the cointegrating equation lagged one period in the place of the error correction term i.e. $u_{t-1} = y_{t-1} - \hat{y}_{t-1}$.

Stationary Time Series

- A stationary time series is one that varies around its mean, not one that just grows.
- Most economic time series like revenues, income and GDP that have a pronounced time trend are not stationary.

Unit Roots

- Time series approach is only valid for stationary variables.
- A series is usually made stationary by differencing.
- A variable is integrated of degree d , written $I(d)$, if it must be differenced d times to make it stationary.
- Most economic variables that grow are integrated of degree 1 or $I(1)$ or at most 2 or $I(2)$.

Unit Root Tests

- There are a number of tests for the stationarity of a series called unit root tests.
- They focus on the value of α in the following equation:

$$y_t = \alpha y_{t-1} + \varepsilon_t$$

- If $|\alpha| < 1$, y is stationary.
- The tests of stationarity are tests for $\alpha = 1$ or unit roots.
- $\alpha = 1$ is called a random walk.
- Most common tests are the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests.

Cointegration

- If nonstationary variables are differenced, valuable information about the equilibrium properties of the variables is lost.
- The Error Correction Model allows combination of nonstationary variables to be stationary because disequilibrium forces keep them together.
- Such variables are said to be cointegrated.
- EViews has several tests for cointegration.
- Revenue forecasters need not concern themselves as much with cointegration as economic forecasters because revenue equations rely on less complex relationships than macroeconomic equations.