Univariate Analysis

Applied Econometrics

Estimation

- The estimation of an autoregressive model can be done by OLS.
- However, assuming that the rest of the classical assumptions hold, we should note that the OLS estimator is biased but consistent
- Thus, standard t-ratios go towards Normal distributions.

Estimation

- If the model includes a MA part, then the model is non-linear
- Then, we have to use non-linear estimation techniques (non-Linear ML, Kalman Filter)
- The estimators are biased but consistent, under very general circumstances (not always)

IDENTIFICATION

- Given that the values of p and q are unknown, we have to determine them.
- We can follow several strategies to that end;
  - ➢ Analyze the ACF and the PACF (Box-Jenkins identification method)
  - ➢ Let data talk (select the best estimated model)

Box-Jenkins

- We have to analyze the ACF and the PACF JOINTLY.
- Most of the times, if we observe 3 large peaks, this is roughly equivalent to infinity.
- It is quite arguable the use of some well-known methods for testing whether a coefficient is 0.
- You can approximate the s.d. of the coefficients by 1/T (rule-of-thumb).
- I DO NOT LIKE IT

Empirical selection

- Try to estimate the best model
- Use a relatively large value of p and q (p=q=2)
- Be sure that there not exist autocorrelation problems
- Then, use some criteria to select between the feasible model

Box-Pierce

- It tests for the joint null hypothesis that the m first coefficients of the ACF of the perturbation are jointly 0

$$H_o : \rho_u(1) = \rho_2(2) = \ldots = \rho_u(m) = 0$$

- M should be selected by the researcher
- LB statistic is defined as:

$$BP = T\sum_{i=1}^{m} \hat{\rho}_u^2(i) \overset{asymp}{\rightarrow} \chi_m^2$$

Ljung-Box statistic

- In order to improve the finite sample properties, some modifications are included:

$$LB = T\left(T+2\right)\sum_{i=1}^{m}\frac{\hat{\rho}_u^2(i)}{T-i}\xrightarrow{asymp}\chi_m^2$$

- m – (p+q) degrees of freedom are sometimes used in finite samples.

Model Selection

Schwarz criterion is defined as follows:

$$SBIC_i = \ln\left(\tilde{\sigma}_i^2\right) + \ln\left(T\right)\frac{k_i}{T}$$

k_i = estimated parameters of the ith model

T = effective sample

$\tilde{\sigma}_i^2$ = ML estimator of the ith model perturbation

Model Selection

Akaike criterion is defined as follows:

$$AIC_i = \ln\left(\tilde{\sigma}_i^2\right) + 2\frac{k_i}{T}$$

k_i = estimated parameters of the ith model

T = effective sample

$\tilde{\sigma}_i^2$ = ML estimator of the ith model perturbation