



1. Estimating MA

Consider an invertible moving average $y_t = \mu + \varepsilon_t + \theta_1 \varepsilon_{t-1}$, $\varepsilon_t \sim iid WN(0, \sigma^2)$. Suppose that we know ε_0 (shock), and have three observations on y_t , ie, $\{y_1, y_2, y_3\}$. Express ε_t in terms of the parameters (μ, θ_1) and $(\varepsilon_0, y_1, y_2, y_3)$ for $t = 1, 2, 3$. As we can use $\mu + \theta_1 \varepsilon_{t-1}$, which is in the information set Ω_{t-1} , to forecast y_t , what is the interpretation for the shock ε_t ? Further, how do you apply the "least squares" principle to estimate the parameters (μ, θ_1) ? Just specify the objective function. The minimisation operation (first order derivatives) is not required. Now assume that the shocks ε_t are normally distributed. Write down the log-likelihood function in terms of (μ, θ_1) and y_1, y_2, y_3 and simplify removing all terms not influencing the optimization problem. Compare the objective function for the least squares and the MLE.

2. Find the unconditional variance of ARMA(1,1) model

$$y_t = \mu + \theta_1 \varepsilon_{t-1} + \phi y_{t-1} + \varepsilon_t, \varepsilon_t \sim iid WN(0, \sigma^2)$$

Note that ε_{t-1} and y_{t-1} are now linearly dependent. Therefore you also need to consider covariance between these terms when you compute the variance.

3 Computing Exercise. Box-Jenkins methodology

This question is based on the data in the Excel file [fisher_update.XLS](#). The file contains 171 quarterly observations, from 1969Q4 to 2012Q2, on the Australian Consumer price Index (P) and on the yield to maturity of 90-day bank accepted bills (R).

(a) Generate the inflation rate as: $INF = 400 * (\log(P(1)) - \log(P))$. When we construct the inflation rate this way, we lose the last observation, namely, 2012Q2. We change the sample to 1984Q1 to 2012Q1, which is the post-float period of the exchange rate.

Perform an ADF test for a unit root for inflation over the period 1984Q1-2012Q1. Comment on the results. Would you conclude that INF is stationary?

(b) Generate the correlogram of INF (16 lags). Comment on which ARMA models would fit the data.

- (c) Estimate the models you considered in (b). Then select one model by using AIC/BIC.
- (d) Perform diagnostic checks on the model of your choice. Comment on whether or not the model fits the data well.

(e) Now you are ready for a forecasting exercise, using the model you are happy with (the output of (d)). Re-estimate the model over the sample period 1984Q1-2009Q4, thereby keeping the last nine observations as out-of-sample forecasting exercise.

- First, change the sample period to 1984Q1-2009Q4. Then estimate your model. I
- Then perform (pseudo out of sample) forecast for **2010Q1 2012Q1**; generate both
 - **Static forecast** (meaning 1-step ahead forecast based on most recent available observations for each t).
 - **Dynamic Forecast.**
- Compare these forecasts with actuals Inflation series.



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