Time Series – Tutorial 5

Dr. Kevin Burke

Question 1

a) What is an ARIMA(0,0,0) model better known as?

b) What is an ARIMA(0,1,0) model better known as?

Question 2

By writing the following ARIMA models in the form

$$\phi(B)^* Y_t = \theta(B)\, e_t,$$

and factorising the AR and MA polynomials, identify p, d, q and the values of the AR and MA parameters. Note that $\phi(B)^* = \phi(B)\,(1-B)^d$.

a) $Y_t = Y_{t-1} - 0.25Y_{t-2} + e_t - 0.1e_{t-1}$.

b) $Y_t = 2Y_{t-1} - Y_{t-2} + e_t$.

c) $Y_t = 0.5Y_{t-1} - 0.5Y_{t-2} + e_t - 0.5e_{t-1} + 0.25e_{t-2}$.

d) $Y_t = 1.4Y_{t-1} - 0.35Y_{t-2} + 0.05Y_{t-3} + e_t + 0.1e_{t-1}$. Hint: first show that $B = 1$ is a root of the AR polynomial.

Question 3

Consider two models:

$$\text{A:} \quad Y_t = 0.9Y_{t-1} + 0.09Y_{t-2} + e_t$$
$$\text{B:} \quad Y_t = Y_{t-1} + e_t - 0.1e_{t-1}$$

a) What ARIMA(p, d, q) models are these?

b) What is the key difference between these models?

c) By writing these models in the invertible form, $\pi(B)\, Y_t = e_t$, show that the models are similar.

Question 4

Consider the `winnebago` dataset which contains monthly sales of recreational vehicles from Winnebago Inc. from November 1966 - February 1972.

a) Display and interpret the time series plot.

b) Apply the log transformation and display the time series plot. Describe the effect of the transformation on the series.

c) Why is differencing still required? Apply the difference-log-transformation and comment on the time series plot.

d) Plot the ACF for the difference-log-transformation and comment.

e) Plot monthly boxplots and comment.

Question 5

Consider the `SP` dataset which contains quarterly Standard & Poor's Composite Index stock price values from Quarter 1 of 1936 - Quarter 4 of 1977.

a) Display and interpret the time series plot.

b) Based on part (a), suggest an appropriate transformation and plot the transformed series.

c) Plot the ACF for the transformed series.

Question 6

Consider the `larain` dataset which contains yearly rainfall in Los Angeles.

a) Plot the series and comment on stationarity.

b) Using a QQ-plot and Shapiro-Wilk test, determine whether or not the data is normally distributed.

c) Apply the `BoxCox.ar` function to determine the MLE of λ (to two decimal places) for a power transformation. Comment on the confidence interval.

d) Produce a time series plot of the transformed series.

e) Does the transformed series appear normally distributed?

Question 7

Consider the `JJ` dataset which contains quarterly earnings per share for the Johnson & Johnson Company from 1960 through 1980.

a) Plot the series and comment.

b) Apply the `BoxCox.ar` function to determine an appropriate transformation.

c) Produce a time series plot of the transformed series. Does it look stationary?

d) Difference the power transformation and plot.