Tutorial Sheet 8 Solutions

Q8.1

Simulate an AR(1) model with $n = 30$ and $\phi = 0.5$.

(a) Fit the correctly specified AR(1) model and look at a time series plot of the residuals. Does the plot support the AR(1) specification?

(b) Display a normal QQ plot of the standardised residuals. Does the plot support the AR(1) specification?

(c) Display the sample acf of the standardised residuals. Does the plot support the AR(1) specification?

(d) Calculate the Ljung-Box statistic summing to $K = 8$. Does this statistic support the AR(1) specification?

Q8.2

Simulate an MA(1) model with $n = 36$ and $\theta = -0.5$.

Remember, when simulating an MA process using an inbuilt R function, we use the negative of the given θ value.

(a) Fit the correctly specified MA(1) model and look at a time series plot of the residuals.

Does the plot support the MA(1) specification.

(b) Display a Normal QQ plot of the standardised residuals.

Does this plot support the MA(1) process?

(c) Display the sample acf of the residuals. Does the plot support the MA(1) specification?

(d) Calculate the Ljung-Box statistic summing to $K = 6$.

Does this statistic support the MA(1) specification?

Q8.3

Simulate an AR(2) model with $n = 48$, $\phi_1 = 1.5$ and $\phi_2 = -0.75$.

(a) Fit the correctly specified AR(2) model and look at a time series plot of the residuals.

Does the plot support the AR(2) specification?

(b) Display a Normal QQ plot of the standardised residuals.

Does this plot support the AR(2) specification?

(c) Display the sample acf of the residuals.

Does this plot support the AR(2) specification?

(d) Calculate the Ljung-Box statistic summing to $K = 12$.

Does this statistic support the AR(2) specification?

Q8.4

(a) Fit an AR(3) model by maximum likelihood to the square root of the 'hare abundance' data series.

(b) Plot the sample acf of the residuals and comment on the size of the auto-correlations.

(c) Calculate the Ljung-Box statistic summing to $K = 9$.

Does this statistic support the AR(3) specification?

(d) Perform a runs test on the residuals and comment on the results.

(e) Display the QQ Normal plot of the residuals and comment on the plot.

(f) Perform the Shapiro-Wilk test of Normality on the residuals.

Q8.5

We met the 'oilfiters' data series in TSLecture1.

(a) Fit an AR(1) model to this series.

Is the estimate of the ϕ parameter significantly different from zero statistically?

(b) Display the sample acf of the residuals from the AR(1) fitted model and comment on the display.

Q8.6

The datafile named 'robot' contains a time series obtained from an industrial robot. The robot was put through a sequence of maneuvers, and the distance from a desired ending point was recorded in inches. This was repeated 324 times to form the time series.

Compare the fits of an AR(1) model and an IMA(1,1) model for these data in terms of the diagnostic tests discussed in the lecture.

Q8.7

The datafile named 'deere3' contains 57 consecutive values from a complex machine tool at Deere & Co.

The values given are deviations from a target value in units of ten millionths of an inch. The process employs a control mechanism that resets some of the parameters of the machine tool depending on the magnitude of deviation from target of the last item produced.

Diagnose the fit of an AR(1) model for these data.

Fit the model including and excluding a mean or intercept term.

Q8.8

In TSLecture6 page 48, using best subset regression on the difference of the log of oil price, the pictorial output suggested either an AR(1) model or an AR(4) model.

Plot the first difference of the log of the oil price for reference.

(a) Estimate both of these models using maximum likelihood and compare the results using the diagnostic tests considered in this chapter.

(b) Try an ARIMA(2,1,0) model for comparison.

(c) TSLecture6 page 30 suggested specifying an MA(1) model for the difference of the logs.

Estimate this model by maximum likelihood and perform the diagnostic test.

(d) Which of the three models, AR(1), AR(4) or MA(1) would you prefer, given the results of parts (a) and (b).

(e) Look at the Normality of the error terms for Model 4.