Homework Assignment 8

Deadline: April 12, 11:59 pm

1. Consider the `hare` data in the `TSA` package. Fit an AR(3) model to the square root of the data using maximum likelihood estimation.

   (a) Use the four different Bootstrap resampling methods to get the 95% confidence intervals for the five parameters: $\phi_1, \phi_2, \phi_3, \mu, \sigma_e^2$.

   (b) Construct a time series plot and a sample ACF plot of the residuals. Perform the Ljung-Box test for all values of K between 4 and 20 inclusive. Based on these 3 things does it seem like an AR(3) is a suitable model?

   (c) Perform a runs test on the standardized residuals from this model. Comment on your findings.

   (d) Do a Normal Quantile plot of the residuals and perform the Shapiro-Wilk test for Normality. Comment on your findings.

   (e) Look at the model fit, are there any parameters that are not significantly different from zero? If so, refit the model with those parameters fixed to be zero. In terms of AIC, does this model fit better? Check the model diagnostics, and comment on your findings.

2. At the end of Chapter 6 we looked at fitting an ARIMA model to the log of the `oil.price` data. It was suggested that three possible models for the first difference of the log of the oil price would be an AR(1), an AR(4), and a MA(1).

   (a) Estimate all of these models using maximum likelihood and compare them using AIC.

   (b) Are all parameters in each model significantly different from zero? (An easy check, are they at least 2 standard deviations away from 0)? If there are parameters that are not significantly different from zero, fit a new model with those parameters removed. Compare to the three models in part (a).

   (c) Does it seem like the AR(4) is an overfit? If so, fit a more appropriate model instead.

   (d) Perform the diagnostics on the AR(1), AR(4), MA(1), and any additional model fit in part (c).

   (e) Which of the models you considered in (d) would you prefer?

3. Recall the `days` dataset from homework assignment 6, and again replace the 63rd, 106th, and 129th observations with 35.

   (a) Fit an AR(2) and an MA(2) model. Compare them using AIC.

   (b) Use the four different Bootstrap resampling methods to get the 95% confidence intervals for $\theta_1, \theta_2, \mu, \sigma_e^2$ in the MA(2) model.

   (c) Use the diagnostics discussed in Chapter 8 to analyze the suitability of the AR(2) and MA(2) models.