FINM3133 Time Series for Finance and Macroeconomics

Chapter 7 Exercises

1. From a series of length 100, we have computed $r_1 = 0.8, r_2 = 0.5, r_3 = 0.4, \overline{Y} = 2$, and a sample variance of 5. If we assume that an AR(2) model with a constant term is appropriate, how can we get (simple) estimates of ϕ_1, ϕ_2, θ_0, and σ_e^2?

2. If $\{Y_t\}$ satisfies an AR(1) model with ϕ of about 0.7, how long of a series do we need to estimate $\phi = \rho_1$ with 95% confidence that our estimation error is no more than ± 0.1?

3. Consider an ARMA(1,1) model with $\phi = 0.5$ and $\theta = 0.45$.

   (a) For $n = 48$, evaluate the variances and correlation of the maximum likelihood estimators of ϕ and θ using Equation (7.4.5) on page 38 of lecture notes. Comment on the results.

   (b) Repeat part (a) but now with $n = 120$. Comment on the new results.

4. Simulate an ARMA(1,1) series with $\phi = 0.7, \theta = 0.4$, and $n = 72$.

   (a) Find the method-of-moments estimates of ϕ and θ.

   (b) Find the conditional least squares estimates of ϕ and θ and compare them with part (a).

   (c) Find the maximum likelihood estimates of ϕ and θ and compare them with parts (a) and (b).

   (d) Repeat parts (a), (b), and (c) with a new simulated series using the same parameters and sample size. Compare your new results with your results from the first simulation.

5. Simulate an ARMA(1,1) time series of length $\phi = 0.7, \theta = -0.6, n = 48$ but with error terms from a chi-square distribution with 9 degrees of freedom.

   (a) Display the sample EACF of the series. Is an ARMA(1,1) model suggested?

   (b) Estimate ϕ and θ from the series and comment on the results.

   (c) Repeat parts (a) and (b) with a new series under the same conditions.

6. The data file 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.

(a) Estimate the parameters of an AR(1) model for this series.

(b) Estimate the parameters of an AR(2) model for this series and compare the results with those in part (a).

7. The data file 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.

(a) Estimate the parameters of an AR(1) model for these data.

(b) Estimate the parameters of an IMA(1,1) model for these data.

(c) Compare the results from parts (a) and (b) in terms of AIC.