Homework Assignment 7

Deadline: March 29, 11:59 pm

1. Consider the AR(2) model: $Y_t = c + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + e_t$. If we have a series of length 100, with $r_1 = 0.5,\ r_2 = -0.2,\ r_3 = 0.1,\ \bar{y} = 4$ and $s^2 = 6$, use the method of moments estimators to calculate estimates of c, ϕ_1, ϕ_2 and σ_e^2 manually.

2. Assume that the following data arise from a stationary process: $8, 7, 6, 9, 7$. Calculate method-of-moments estimates of μ, γ_0, and ρ_1.

3. Simulate (use your NUID as the seed) an MA(1) series with $\theta = 0.7$ and $n = 36$. Read pages 443-444 of the textbook to learn the R functions that compute the following estimators.

   (a) Find the method of moments estimator of θ. (Hint: the user-created function `estimate.ma1.mom`)

   (b) Find the (conditional) least squares estimator of θ. (Hint: the `arima` function with `method="CSS")`

   (c) Find the maximum likelihood estimator of θ. (Hint: the `arima` function with `method="ML"`)

   (d) Compare the three estimators, which is closest to the actual θ?

   (e) Generate 1000 simulated series and repeat parts (a) - (d). Make three histograms for the three estimators respectively. Comment on the results.

4. Three data files `deere1`, `deere2`, `deere3` from the `TSA` package contains different number of consecutive values for the amount of deviation from some specific target values by three machining process. For each of the three data sets, do the following:

   (a) Plot the time series and comment on its appearance. Would a stationary model seem to be appropriate?

   (b) Discuss if any log or power transformation should be applied to the series to improve the normality.

   (c) Perform the (augmented) Dickey-Fuller test on the series. Decide if the series should be differenced to get a stationary model.

   (d) Display the sample ACF, PACF and EACF for the series, and select tentative orders for an ARMA model.

   (e) Use the best subsets ARMA approach to specify a model for the series. Compare the result with what you discovered in part (d).