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## **FIN 740 – Fall AP1 2020**

### **Homework 3**

**Due: Sunday, September 20, 11:59 PM CST**

※ Using the R script, answer the following questions. Please show all works for full credit.

※ Please install and load the following package as follows.

```
install.packages("astsa")  
library(astsa)
```

1. Consider the following ARMA(2, 1) process.

$$X_t = \phi_1 X_{t-1} + \phi_2 X_{t-2} + \varepsilon_t + \theta_1 \varepsilon_{t-1}$$

$$\varepsilon_t \sim wn(0, \sigma^2),$$

where  $\phi_1$ ,  $\phi_2$ , and  $\theta_1$  are parameters for the model. Note that you **have to** run the following code with your simulation (That is, this code should be followed by your simulation code and run all together.)

```
set.seed(150)
```

- a) [4 points] Using `arima.sim(...)` function with the length of output series  $n = 200$ , simulate the model above with parameters  $\phi_1 = 0.2$ ,  $\phi_2 = 0.35$ ,  $\theta_1 = 0.9$ . Meanwhile, assign the name 'x' to the data generated by the simulation. Show the first five rows of 'x' (You do NOT need to show all results.).
  - b) [6 points] Plot the series you obtained from the simulation
  - c) [10 points] Plot the sample autocorrelation function (ACF) and the sample partial autocorrelation function (PACF), and explain how they look like.
2. Use the data 'x' you have generated in Q #1. Suppose that you do not know that the data 'x' is generated by ARMA(2, 1) simulation. Now, you have to find the best model for the data 'x'. After looking at ACF and PACF, you decided to try to fit the following models: AR(1), AR(2), MA(1), MA(2), ARMA(1, 1), ARMA(1, 2), ARMA(2, 1), and ARMA(2, 2).
- a) [20 points] Fit each model you have decided to run and show AIC and BIC for each model. What model are you going to choose as the best model in terms of AIC and BIC criteria.
  - b) [20 points] Check the residual ACF of the best model you choose in a) and explain about the plots. Are the residuals white noise or not?