Assignment 4

3 Possible Points

This assignment's due date is Saturday, June 24th by 8:00 PM. The grading policy for late assignments can be found in the syllabus. You are strongly encouraged to work in groups of up to 4 students, but each of you must submit his/her own version of the assignment. Please put the names of your group members in a comment in the program.

Write a single text file that contains all of your work for this assignment. Name it ps4_[yourlastname].txt - for example, mine would be ps4_hoff.txt The text file should submit all of the commands necessary to answer the questions. Please put the answers to the **bold questions** in a comment line in your text file, even if you think the answer is readily apparent.

This assignment is designed to be the first foray into autoregressive models. Each variable in this dataset is a function of past values of itself and a random error component. The data can be found on the course website in a CSV file titled "ps4".

Time Series $\{x_{1,t}\}$

Suppose that there exists a time series, $\{x_{1,t}\}$, which is defined by

$$x_{1,t} = \alpha_1 x_{1,t-1} + w_{1,t}$$

where $\alpha_1 = 1$ and $w_1 \sim WN$.

Identifying the Time Series.

- **What is the root of the characteristic equation? Is this variable stationary?**
- Plot $\{x_{1,t}\}$ and its ACF function.
- Do the plots confirm what the root told you? Explain.
- **What is one way to transform $\{x_{1,t}\}$ into a stationary series?**

Forecasting the Time Series.

- Use the best forecasting method, as suggested in the lecture, to forecast this type of time series.
- **Calculate and report the MAPE for this forecast.**
- **Provide a 1 period ahead forecast for this time series.**

Time Series $\{x_{2,t}\}$

Suppose that there exists a time series, $\{x_{2,t}\}$, which is defined by

$$x_{2,t} = \sigma + \alpha_1 x_{2,t-1} + w_{2,t}$$

where $\alpha_1 = 1$ and $w_2 \sim WN$.

Identifying the Time Series.

- Plot $\{x_{2,t}\}$ and its ACF function.
- **Do you suspect that this variable is stationary? Explain.**
- Try demeaning the time series by subtracting an estimate of σ from $\{x_{2,t}\}$. Call this variable `x.tilde`.
- **Is `x.tilde` stationary? Provide evidence.**

Forecasting the Time Series.

- Use the best forecasting method to forecast this type of time series. *Hint*: it's very similar to the one used above.
- **Calculate and report the MAPE for this forecast.**
- **Provide a 1 period ahead forecast for this time series.**

Time Series $\{x_{3,t}\}$

Suppose that there exists a time series, $\{x_{3,t}\}$, which is defined by

$$x_{3,t} = \alpha_1 x_{3,t-1} + \alpha_2 x_{3,t-2} + w_{3,t}$$

where $\alpha_1 = 5/6$, $\alpha_2 = -1/6$ and $w_3 \sim WN$.

Identifying the Time Series.

- **What are the roots of the characteristic equation? Is this variable stationary?**
- Plot $\{x_{1,t}\}$ and its ACF function.
- Do the plots confirm what the root told you? Explain.

Forecasting the Time Series.

- Use R's `ar()` function to estimate the time series $\{x_{3,t}\}$.
- **What do you notice about the order of the autoregressive procedure that R has estimated by default? Why did it choose this order instead of the actual order?**
- Force the autoregression model to use the correct autoregressive order. To do this use the following code:
- `arima(<data name>, order=c(<AR order>, 0 ,0), include.mean=FALSE)`
- here <`data name`> is the name of the data and <`AR order`> is the order of the autoregressive process
- DO THIS FOR BOTH AR MODELS.
- **Calculate the MAPE for both the suggested and correct order models. Which is model is better?**
- **Calculate AIC_C, the correction of the AIC, for the suggested and corrects order models. Which model is better?**
- Use the `predict()` function to create a 1 period ahead forecast with the model of your choice.
- **What is the prediction?**