ASSIGNMENT 5

STAT 485/685 E100/G100: Applied Time Series Analysis

Fall 2020

Simon Fraser University

This week's assignment will be based on models for non-stationary time series. The topics here have been covered in the Week 7 videos, as well as Chapter 5 of the textbook *Time Series Analysis with Applications in R (2nd ed.)* by Cryer & Chan.[1]

Due date: **Friday, Oct. 30th at 11:59 pm (end of day)** (Pacific Time).

Marks: 10.

Please include your R code for each of the below questions. Some ideas for how you can most easily do this:

- Copy-paste your code/plots into a Word document along with your responses to the questions, and save as a PDF.
- Take images of your code/plots and upload to Crowdmark, along with your responses to the questions.
- Save your code and responses together in an RMarkdown document and save as PDF (if you've worked with RMarkdown before).

Other important policies on assignment submissions:

- Please write each question on a **separate page**!
- Please **show all your code and work**, in order to get full marks.
- Upload your complete answers as PDF files or high-resolution images.
- If you're hand-writing answers, please make sure they are **neat and clearly readable**, and that the photo is high resolution.
- Please **clearly label the question numbers**.

[1] Cryer, J. D., & Chan, K. S. (2008). *Time series analysis: with applications in R.* Springer Science and Business Media.

For this assignment, we will be using some datasets and functions in the `TSA` package in R. For instructions on how to install and load the package, please see the Week 1 module on Canvas.

1. *(3 marks)* Identify each of the following as a specific ARIMA model, along with its values of p, d and q. Show all your work.

   (a) $Y_t = 1.4Y_{t-1} - 0.4Y_{t-2} + e_t - 0.2e_{t-1}$

   (b) $Y_t = 2Y_{t-1} - Y_{t-2} + e_t - 0.6e_{t-1}$

   (c) $Y_t = 1.5Y_{t-1} - 0.6Y_{t-2} + 0.1Y_{t-3} + e_t$ *(This one is a bit tricky!)*

2. *(3 marks)* Using the techniques we practiced in Video 20, write out the differenced equation form of Y_t for each of the following models. Show all your work.

   (a) IMA(1,2)

   (b) ARI(1,2)

   (c) ARIMA(0,1,2)

3. *(4 marks)* The dataset `winnebago` gives a time series of monthly unit sales of recreational vehicles from Winnebago, Inc., from 1966 to 1972.
   Remember to include all code and plots in your answers below.

   (a) Read in this dataset using the function `data()` in the `TSA` package. Create a plot of the dataset.

   (b) Suppose we wish to fit a power transformation to this dataset. Find a value of the parameter λ that approximatley maximizes the log-likelihood (i.e., the value of λ that best "matches" the data).
   (Note: You may obtain an approximate value just by looking at the Box-Cox plot (it doesn't have to be exactly optimal), or if you wish you can extract the exact optimal value using the code in Video 21.)

   (c) Write out the equation for the power transformation, for this value of λ.

   (d) Transform the data using the power transformation you wrote in part (c). Plot the resulting transformed dataset. Make sure you label your axes in an informative way.