**Homework Rules (Read carefully)**

1. PLEASE READ THE QUESTIONS!!!
2. You must do your assignment alone
3. You can consult with me for help on the homeworks, but please don’t get help anyone else.
4. NO late homeworks will be accepted since the answers of this homework will be shared with you at the same day by e-mail.
5. No additional time will be given
6. Please show all the details of your solutions and interpret all results
7. You are expected to upload the solution of Question 1 as pdf file to ODTUCLASS. Also, you are expected to upload the question 2 solution as both html and Rmarkdown file. Consequently, YOU SHOULD SUBMIT THREE FILE (pdf, html, Rmarkdown)INTO ODTUCLASS.
8. If you don’t submit ANY OF THEM, you will lose a point

**QUESTIONS**

1. *(25 pts)* Consider the following process



where 

1. *(5 pts)* Show whether or not the process is stationary. If it is not stationary, please obtain the stationary series.
2. *(10 pts)* Let’s assume that we have a time series from the process at part a with a sample size of 100. After preparing data for the estimation the mean of the new series is -0.066 and the variance is 1.594. Then, the following sample ACF values are obtained.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Lag k | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|  | -0.132 | 0.539 | -0.164 | 0.162 | -0.148 | 0.081 | -0.051 | 0.057 |

Obtain the Yule-Walker estimates of all unknown parameters.

1. *(10 pts)* Using the estimated parameters that you obtained in part c), find the minimum MSE forecasts for *Y101* and *Y102* with the 95% prediction intervals. The last five time series observations are *Y100=*1178.77,*Y99*=1190.31,*Y98*=1202.19,*Y97* =1213.79, *Y96* =1227.63.
2. In this question, you are expected to use “debitcards” datasets in “fpp2” package. The debitcards data are about Monthly retail debit card usage in Iceland (million ISK). January 2000 - August 2013.
3. *(7.5 pts)* Draw time series plot , ACF and PACF ; and examine carefully the trend and seasonal phenomenon contained in the data. Interpret your results
4. *(3 pts)* Split data into train and test **(Keep last 12 observations as test data set).**
5. *(3 pts)* If it needs any transformation, apply Box-Cox transformation. Interpret your results
6. *(12.5 pts)* Check the existence of unit roots (both regular and seasonal) via appropriate test. If you detect unit root, take the necessary action to make your series stationary and verify whether your action works.
7. *(3 pts)* **After obtaining stationary series, suggest a model (or models) using appropriate way. Write the model name with their order.**
8. *(10 pts)* **Fit the models that you decided in the previous part. Also, fit a model using auto.arima(). Then, check the significance of the models and find the best model.**
9. *(10 pts)* **Apply Diagnostic Checking. Interpret the results**
10. *(5 pts)* After deciding S/ARIMA model, obtain 12 steps ahead forecast from the model and calculate accuracy.
11. *(15 pts)* **Obtain 12 steps ahead forecasts from ETS, TBATS, NN, and calculate their accuracy values.**
12. *(6 pts)* **Compare the results in part h and part i and write the name of the model showing the best forecasting performance.**