ISE-5970: Energy Analytics

Homework 4

Due: Sunday October 27th, 11:59 p.m.

Before start, please read the following.

1. The questions in this homework allow you to practice your R skills for Decomposition and Exponential Smoothing models (Chapter 6 and 7).
2. For all questions, you must submit **1) the source file that contains the R commands, and 2) the snapshot of what R outputs after you run your R program.**
3. I strongly prefer if you **electronically submit** your homework through Canvas by putting all files in a zip folder.
4. Please assign numbers for each solutions, so it would be easy for me to read the answers.

Good Luck! ☺

Question 1 (5 credits):

Show that a MA is equivalent to a 7-term weighted moving average with weights of 0.067, 0.133, 0.200, 0.200, 0.200, 0.133, and 0.067.

Question 2 (5+5+5+5+3+2=25 credits):

The plastics data set consists of the monthly sales (in thousands) of product A for a plastics manufacturer for five years.

a. Plot the time series of sales of product A. Can you identify seasonal fluctuations and/or a trend-cycle?
b. Use a classical multiplicative decomposition to calculate the trend-cycle and seasonal indices.
c. Do the results support the graphical interpretation from part a?
d. Compute and plot the seasonally adjusted data.
e. Change one observation to be an outlier (e.g., add 500 to one observation), and calculate the seasonally adjusted data. What is the effect of the outlier?
f. Does it make any difference if the outlier is near the end rather than in the middle of the time series?

Question 3 (5+5+5+5+5+5+5+5+5 = 40 credits):

For this exercise, use the quarterly UK passenger vehicle production data from 1977Q1–2005Q1 (data set ukcars).

a. Plot the data and describe the main features of the series.
b. Decompose the series using STL and obtain the seasonally adjusted data.
c. Forecast the next two years of the series using an additive damped trend method applied to the seasonally adjusted data. (This can be done in one step using *stlf*() with arguments *etsmodel="AAN"*, *damped=TRUE*.)
d. Forecast the next two years of the series using Holt's linear method applied to the seasonally adjusted data (as before but with *damped=FALSE*).
e. Now use *ets()* to choose a seasonal model for the data.
f. Compare the RMSE of the ETS model with the RMSE of the models you obtained using STL decompositions. Which gives the better in-sample fits?
g. Compare the forecasts from the three approaches? Which seems most reasonable?
h. Check the residuals of your preferred model.

Question 4 (5+5+5+5+5+5= 30 credits):

For this exercise, use the monthly Australian short-term overseas visitors data, May 1985–April 2005. (Data set: visitors)

a. Make a time plot of your data and describe the main features of the series.

b. Split your data into a training set and a test set comprising the last two years of available data. Forecast the test set using Holt-Winters' multiplicative method.
c. Why is multiplicative seasonality necessary here?
d. Forecast the two-year test set using each of the following methods:
   i. an ETS model;
   ii. an additive ETS model applied to a Box-Cox transformed series;
   iii. a seasonal naïve method;
   iv. an STL decomposition applied to the Box-Cox transformed data followed by an ETS model applied to the seasonally adjusted (transformed) data.
e. Which method gives the best forecasts? Does it pass the residual tests?
f. Compare the same four methods using time series cross-validation with the tsCV function instead of using a training and test set. Do you come to the same conclusions?