TIME SERIES ANALYSIS

PART A (25 Points)

1. Explain Autocorrelation and Partial Autocorrelation in the case of Time Series? **(5 points)**
2. Why does a Time Series require to be Stationary? What test do we use to confirm if the Time Series is stationary? What are the Null Hypothesis and Alternative Hypothesis considered in that test? **(5 points)**
3. What are the criteria we use to compare ARIMA models? **(5 points)**
4. Explain ARIMAx with all its components. **(5 points)**
5. Discuss Simple Moving Average, Cumulative Moving Average, and Exponential Moving Average. **(5 points)**

PART B (30 Points)

1. The plastics data set (see plastics.csv) consists of the monthly sales (in thousands) of product A for a plastics manufacturer for five years. Discuss the insights that we can glean using the time series exploratory data analysis from this data. Take advantage of data preprocessing techniques, where applicable. **(10 points)**

2. Consider usmelec data set (see usmelec.csv), the total net generation of electricity (in billion kilowatt hours) by the U.S. electric industry (monthly for the period January 1973 – June 2013). In general, there are two peaks per year: in mid-summer and mid-winter. Answer the following questions using this data. **(Total: 20 points)**

   a. Are the data stationary? If not, find an appropriate differencing which yields stationary data. **(2 points)**
   b. Discuss several ARIMA models that might be useful in describing the time series. Which of your models is the best according to their AICc values? (DO NOT USE auto.arima() to answer this question) **(10 points)**
   c. Estimate the parameters of your best model and do diagnostic testing on the residuals. Do the residuals resemble white noise? **(3 points)**
   d. Forecast the next 15 years of electricity generation by the U.S. electric industry using your best ARIMA model. **(2 points)**
   e. Eventually, the prediction intervals are so wide that the forecasts may not be particularly useful. Discuss the how the prediction interval affects the accuracy of the forecast in general. **(3 points)**