Note: Problem 3 is mandatory for graduate students and extra credit for undergraduates.

1) A data set of 57 consecutive measurements from a machine tool are in the `deere3` object in the TSA package. Type `library(TSA); data(deere3); print(deere3)` in R to see the data set.
   (a) Fit an AR(1) model and use it to forecast the next ten values of the series, and list the forecasted values. Also plot the series along with the forecasted values and 95% prediction limits for the next ten values of the series.

2) A data set of durations until payment for 130 consecutive orders from a Winegrad distributor are in the `days` object in the TSA package. Type `library(TSA); data(days); print(days)` in R to see the data set.
   (a) Fit an MA(2) model and use it to forecast the next ten values of the series, and list the forecasted values. Also plot the series along with the forecasted values and 95% prediction limits for the next ten values of the series.
   (b) There are three clear outliers (at times 63, 106, and 129) which can be seen from the time series plot. Replace these outliers with a “typical duration” value of 35. To do this, you can use the code `days.adj=days; days.adj[c(63,106,129)]=35; print(days.adj)`
   Fit an MA(2) model to this adjusted series, and use it to forecast the next ten values of the series, and list the forecasted values. Also plot the series along with the forecasted values and 95% prediction limits for the next ten values of the series.
   (c) Comment on any differences between the forecasts based on the original data and the forecasts based on the adjusted data.

3) A data set of 324 measurements of an industrial robot’s positions are in the `robot` object in the TSA package. Type `library(TSA); data(robot); print(robot)` in R to see the data set.
   (a) Fit an IMA(1,1) model and use it to forecast the next five values of the series, and list the forecasted values. [You can verify that for this data set, you do NOT need to include a constant (intercept) term in the IMA model.] Also plot the last ten observed values of the series along with the forecasted values and 95% prediction limits for the next five values of the series. [Hint: type `help(plot.Arima)` and look at the `n1` argument of the `plot` function.]
   (b) Fit an ARMA(1,1) model and use it to forecast the next five values of the series, and list the forecasted values. Also plot the last ten observed values of the series along with the forecasted values and 95% prediction limits for the next five values of the series.
   (c) Compare the results from parts (a) and (b).

4) A data set of monthly electricity generation values are in the `electricity` object in the TSA package. Type `library(TSA); data(electricity); print(electricity)` in R to see the data set.
   (a) Fit a seasonal means model which also contains a linear time trend on the (natural) logarithms of the data. [Some Chapter 10 example R code on the course web page may help with this.] Use it to forecast the next three months of the series (January 2006, February 2006, and March 2006), and list the forecasted values. [Hint: This is just a deterministic model; no ARIMA-type forecasting is needed.]
   (b) Give the forecasted values for the next three months in terms of the original data, i.e., not in logged values.