Due Date: April 26 (before class)

Note: Unless specifically assigned, all tests are based on the 5% significance level. All data are on the course web. Also, you should write down the fitted time series model for each question.

1. The subprime financial crisis greatly affected U.S. housing market. This can easily be seen from the U.S. monthly housing starts. The dataset m-Starts.txt contains the monthly U.S. total housing starts, in thousands of unit, from January 1959 to February 2010. Take the log transformation and build a time series model for the series. Check the adequacy of the fitted model. Use the model to predict 1-step to 10-step ahead prediction for the log series of housing starts. Finally, compute the 95% interval forecasts for 1-step to 10-step ahead predictions.

2. Consider the monthly simple returns of Deciles 1 to 10 portfolios for NYSE/AMEX/NADSAQ from 1951 to 2010 for 60 years. The data are obtained from CRSP. In finance, there is the well-known fact of January effect for small cap stocks. We investigate this fact in this study. First, consider the Decile 2 (CAP2RET).

   (a) Build a regression model with time series errors for the return series. Here the explanatory variable is the January dummy variable, which can be created by the command
   \[
   \text{Jan} = \text{rep}(c(1,\text{rep}(0,11)),60)
   \]
   where \text{rep} stands for \text{repeat}, \text{c(1,rep(0,11))} creates the January dummy for a year, and 60 indicates the dummy variable for 60 years. Check the adequacy of the fitted model.

   (b) Build a time series model for the return series. That is, build a model that does not use explanatory variable. Check the fitted model using Q(12), Q(24), and Q(36) of the residuals.

   Compare the two models. Which one do you prefer? Why?
   [You can find a similar phenomenon in Decile 1 to Decile 5 returns. But the January effect is decreasing as the market cap increases.]

4. In economics, there is interest in studying the relationship between consumption expenditures and disposable income. You can download monthly personal consumption expenditures and disposable personal income from the Federal Reserve Bank at St. Louis (PCE and DSPI). The data are also available from the course web. [The sample period is from January 1959 to February 2011.] Take the log transformation of the two series, then take the first difference of both series. Thus, we employ growth rates of the two series. Build a time series model for the PCE growth rates using that of DSPI as an explanatory variable. Check the adequacy of the fitted model. Does PCE depend on DSPI? Why?

5. Consider the monthly growth rates of PCE of Problem 4. Denote the model built in Problem 4 by \( M_1 \). Here we build a pure time series model for the series. Refer to the model as \( M_2 \). Using the last 96 observations as the backtesting subsample to compare the two models. For 1-step ahead prediction, which model is preferred? For 2-step ahead prediction, which model is preferred? Why?