Homework Assignment #2

Due Date: before class

- Campus class: April 22, 2005
- Weekend class: April 23, 2005

Data files: Datasets may be downloaded from the course web site.

Assignment:

1. Consider the quarterly U.S. real gross national product (GNP) from 1947 to 2004. The data are seasonally adjusted and obtained from the Federal Reserve Bank at St Louis, http://research.stlouisfed.org/fred2/. The GNP are in billions of chained 2000 dollars. The file “gnpc96.txt” contains year, month, day, and gnp in four columns.

Compute the percentage growth rate series defined as $100[\ln(X_t) - \ln(X_{t-1})]$, where $X_t$ denotes the $t$th observation of GNP.

(a) Fit an AR(3) model with constant to the growth rate GNP series, and write down the fitted model.

(b) Test the hypothesis that the residuals have no serial correlations, using $5\%$ level and $Q(24)$. Draw your conclusion.

(c) Compute the average period of business cycles if they exist?

(d) Compute 1- to 4-step ahead forecasts of the fitted model using $t = 227$ as the forecasting origin, i.e. October (or the fourth quarter) of 2003.

2. Consider the monthly simple returns of the Decile 2 and Decile 9 of NYSE/AMEX/NASDAQ based on market capitalization. The data span is from January 1960 to December 2004, and the data are obtained from CRSP. The data file is “m-dec29.txt”, which has 3 columns consisting of date, decile 2 return, decile 9 return.

- For each return series, test the null hypothesis that the first 12 lags of autocorrelations are zero at the 5\% level. Draw your conclusion.

- Let $R_t$ be the simple return of Decile 2. Fit the MA model

$$R_t = c + (1 - \theta_1 B - \theta_{12} B^{12}) a_t.$$  

Write down the fitted model and test the hypothesis that the residuals have no serial correlations using $Q(24)$ and 5\% significance level.
• Again, consider the returns of Decile 2. Fit the model

\[(1 - \phi_{12}B^{12})R_t = c + (1 - \theta_1 B - \theta_{12}B^{12})a_t.\]

Write down the fitted model and test the hypothesis that the residuals have no serial correlations using \(Q(24)\) and 5% significance level.

• Why is the lag-12 coefficient statistically significant in both models? [Give your explanation for the possible cause.]


• Let \(R_{9t}\) be the simple return of Decile 9. Fit an MA(1) model and write down the fitted model. In addition, test the hypothesis that the residuals have no serial correlations using \(Q(24)\) and 5% significance level.

• Compare the MA models for Decile 2 and Decile 9. There is no lag-12 in the model for Decile 9. What is the implication?


• Fit the following model for \(R_t\)

\[R_t = c2 + \beta \text{jan}_t + (1 - \theta_1 B - \theta_{12}B^{12})a_t.\]

Write down the fitted model and test the hypothesis that the residuals have no serial correlations using \(Q(24)\) and 5% significance level. Note: In SCA, the above model is specified as
tsm md2. model Rt = c2 + (b)jan(binary) + (1,12)noise.

• Test the hypothesis \(H_0 : \theta_{12} = 0\) vs \(H_a : \theta_{12} \neq 0\) using the 5% significance level. Draw your conclusion.

• The fact that \(\theta_{12} = 0\) and \(\beta \neq 0\) is referred to as the “January” effect in finance. Refine the model as

\[R_t = c2 + \beta \text{jan}_t + (1 - \theta_1 B)a_t.\]

What is the implication of \(\beta\) estimate?

5. Monthly unemployment rate is an important and widely used economic variable. Consider the civilian unemployment rate from January 1948 to March 2005 for 687 observations. The seasonally adjusted data are from U.S. Bureau of Labor Statistics and downloaded from Federal Reserve Bank at St Louis. Let \(U_t\) be the unemployment rate at month \(t\), starting from January 1948. In this exercise, we use the first 680 data points for model fitting and reserve the last 7 data points for forecasting.

• Fit the following model

\[(1 - \phi_{12}B^{12})(1 - B)U_t = (1 - \theta_2 B^2 - \theta_3 B^3 - \theta_4 B^4 - \theta_5 B^5)(1 - \theta_{12}B^{12})a_t.\]

Write down the fitted model and check the residual serial correlations using \(Q(24)\). Is the model adequate?
• Use the fitted model to produce 1- to 7-step ahead forecasts. Comments on the accuracy of the forecasts by comparing them with the actual data.

• Fit the model

\[(1 - B)U_t = (1 - \theta_2 B^2 - \theta_3 B^3 - \theta_4 B^4 - \theta_5 B^5) a_t.\]

Check the fitted model using \(Q(24)\) of the residual series and 5% significance level. Draw your conclusion.

**Remark:** The fact the seasonal coefficients are statistically significant indicates that the seasonal adjustment procedure used is not perfect.

**Reading assignments:** Chapter 2 of the textbook.