THE UNIVERSITY OF CHICAGO
Graduate School of Business
Business 41202, Spring Quarter 2006, Mr. Ruey S. Tsay

Homework Assignment #2

Due Date: before class

- Campus class: April 14, 2005
- Weekend class: April 13, 2005

Notes:

- **Data files**: Datasets may be downloaded from the course web site.
- Use 5% level in all tests.
- The notation ρ_i is the lag-i autocorrelation coefficient.

Assignment:

1. Consider the monthly simple returns of the CRSP Decile 10 portfolio. The portfolio consists of NYSE/AMEX/NASDAQ stocks based on market capitalization and rebalanced annually. See CRSP for more information. The sample period is from January 1960 to December 2005. The data are in "m-dec10.txt" with date and return in two columns.
   (a) Compute the first 10 lags of ACF and PACF of the simple return series.
   (b) Test the hypothesis that the first 10 lags of ACF are zero. That is, $H_o : \rho_1 = \ldots = \rho_{10} = 0$ versus $H_a : \rho_i \neq 0$ for some $1 \leq i \leq 10$. Draw your conclusion.
2. Consider the monthly simple returns of the CRSP Decile 1 portfolio. The portfolio consists of NYSE/AMEX/NASDAQ stocks based on market capitalization and rebalanced annually. See CRSP for more information. The sample period is from January 1960 to December 2005. The data are in "m-dec1.txt" with date and return in two columns.
   (a) Compute the ACF of the simple returns for the first 12 lags. Focus on ρ_{12}. Test the hypothesis $H_o : \rho_{12} = 0$ versus the alternative hypothesis $H_a : \rho_{12} \neq 0$. Draw your conclusion.
   (b) Test the hypothesis that all 12 ACFs are zero. That is, $H_o : \rho_1 = \ldots = \rho_{12} = 0$ versus the alternative hypothesis $H_a : \rho_i \neq 0$ for some i, $1 \leq i \leq 12$. Draw your conclusion.

3. Consider the quarterly U.S. real gross national product (GNP) from 1947 to 2005. 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 "r-gnp05.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 tth observation of GNP. In R or S-Plus, you may use $x = \text{diff}(\log(X_t)) * 100$, where "diff" stands for differencing.

   (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 lag-3 coefficient is different from zero. Draw your conclusion.

   (c) Test the hypothesis that the residuals have no serial correlations, using Ljung-Box statistic $Q(24)$. Draw your conclusion.

4. (**Problem 3 continued.**) Again, consider the growth rate of U.S. real GNP series of Problem 3.

   (a) For the fitted AR(3) model, compute the average period of business cycles if they exist?

   (b) Compute 1-step to 4-step ahead forecasts of the fitted model at the end of the data, i.e. October (or the fourth quarter) of 2005. Write down the forecasts and their standard errors.

   (c) Use AIC to identify an AR model for the growth rate series. Write down the fitted model? Are all coefficient estimates significant at the 5% level?

5. Consider the monthly simple return of CRSP Decile 1 portfolio from January 1960 to December 2005 of Problem 2.

   (a) Fit the model
   $$(1 - \phi_{12}B^{12})R_t = c + (1 - \theta B)a_t,$$
   to the data. Write down the fitted model.

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   [Computing instruction: Use Rt as the name of the time series.

   In R, use the command:

   m1 = arima(Rt,order=c(0,0,1),seasonal=list(order=c(1,0,0),period=12))

   In Splus, use the commands:

   Rtrm = Rt-mean(Rt)
   mdec = list(list(order=c(0,0,1)), list(order=c(1,0,0),period=12))
   m1 = arima.mle(Rtrm, model=mdec) ]
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   (b) Perform 1-step to 12-step ahead forecasts of the portfolio return at the end of the series.

Reading assignments: Chapter 2 of the textbook.