

**THE UNIVERSITY OF CHICAGO**  
**Graduate School of Business**  
Business 41202, Spring Quarter 2008, Mr. Ruey S. Tsay

**Homework Assignment #2**

**Due Date:** before class

- Campus class: April 15, 2008
- Evening class: April 15, 2008

**Notes:**

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

**Assignment:**

1. Consider the monthly simple returns of the CRSP Decile 1 and 10 portfolios from January 1988 to December 2007. The portfolios consist of NYSE/AMEX/NASDAQ stocks based on market capitalization and rebalanced annually. See CRSP (via WRDS) for more information. The data are in “m-dec1n10.txt” with date, Decile-1 return, and Decile-10 return in three columns.
  - (a) Compute the first 24 lags of ACF and PACF of the simple return series of Decile 1 portfolio.
  - (b) Test the hypothesis that the first 12 lags of ACF are zero. That is,  $H_o : \rho_1 = \dots = \rho_{12} = 0$  versus  $H_a : \rho_i \neq 0$  for some  $1 \leq i \leq 12$ . Draw your conclusion.
  - (c) Focus on the ACF at lag 12, i.e.,  $\rho_{12}$ . Test the hypothesis  $H_o : \rho_{12} = 0$  versus the alternative hypothesis  $H_a : \rho_{12} \neq 0$ . Draw your conclusion.
  - (d) Focus on the PACF at lag 1, i.e.,  $\phi_{1,1}$  (see page 40 of the text). Test the hypothesis  $H_o : \phi_{1,1} = 0$  versus the alternative hypothesis  $H_a : \phi_{1,1} \neq 0$ . Draw your conclusion.

**Remark:** The serial correlation at lag 12 of decile returns leads to the discussion of *January effect* of small-cap stocks in finance.
2. Consider the monthly simple returns of the CRSP Decile 10 portfolio in Problem 1.
  - (a) Test the hypothesis that the first 12 ACFs are zero. That is,  $H_o : \rho_1 = \dots = \rho_{12} = 0$  versus the alternative hypothesis  $H_a : \rho_i \neq 0$  for some  $i$ ,  $1 \leq i \leq 12$ . Draw your conclusion. **Remark:** Comparing with Problem 1, we see that there is no January effect in the large-cap stocks.

- (b) Consider the absolute simple returns of Decile 10 portfolio. Test the hypothesis that the first 12 ACFs are zero. That is,  $H_o : \rho_1 = \dots = \rho_{12} = 0$  versus the alternative hypothesis  $H_a : \rho_i \neq 0$  for some  $i$ ,  $1 \leq i \leq 12$ . Draw your conclusion.
3. Consider the daily open, high, low and closing prices of Apple stock from January 4, 1999 to November 20, 2007. The data are in the file `d-aapl9907.txt`, which contains column headings as Month, Day, Year, Open, High, Low, Close, Volume, and Adjusted Closing Price. Compute the daily log price range as  $r_t = \ln(H_t) - \ln(L_t)$ , where  $H_t$  and  $L_t$  denote daily high and low prices, respectively. Daily range can be used to measure volatility of the stock log price. Answer the following questions:
- (a) Compute the first 10 lags of ACF of  $r_t$ . Test the null hypothesis that the first 10 lags of ACF are zero. Draw your conclusion. [Note: 10 lags correspond to the number of trading days in two weeks.]
- (b) Compute the first 25 lags of PACF of  $r_t$ . Suppose you like to fit an AR model for  $r_t$ . What order would you use based on the PACF? Why? [You do not need to fit the model.]
4. The U.S. unemployment rate went up recently. We shall consider the quarterly series, which is the average of monthly rates within the quarter, from 1948 to 2007. The data are in `q-unrate4807.txt`. The monthly rates are available from the Federal Reserve Bank at St Louis.
- (a) Plot the quarterly unemployment rate series and its ACFs (16 lags).
- (b) Identify an AR model for the series, fit the model, and write down the result.
- (c) Does the fitted AR model indicate existence of business cycles? Why?
- (d) Compute 1-step to 4-step ahead forecasts of the fitted model at the end of the data, i.e. the fourth quarter of 2007. Write down the forecasts and their standard errors.
5. Consider the monthly simple return of CRSP Decile 1 portfolio from January 1988 to December 2007 of Problem 1.
- (a) Fit an MA(1) model to the series. Write down the fitted model. [We shall discuss ways to handle the serial correlation at lag 12 later.]
- (b) Compute 1-step to 4-step ahead forecasts of the fitted MA(1) model using the last observation as the forecast origin. Write down the forecasts and their standard errors. Why are the 2-step to 4-step forecasts the same?

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