THE UNIVERSITY OF CHICAGO
Booth School of Business
Business 41202, Spring Quarter 2010, Mr. Ruey S. Tsay

Homework Assignment #1

Due Date: before class

- Campus class: April 9, 2010
- Weekend class: April 10, 2010

Data files: Datasets are available from the course web at http://faculty.chicagobooth.edu/ruey.tsay/teaching/bs41202/sp2010.

Notes:

- All tests are based on the 5% significance level.
- Do not hand in computer output. Use cut-and-paste to summarize the output. There is no need to keep many digits in an answer.
- Each student needs to write his/her own solutions, even though discussions of the assignments between students are encouraged.

Assignment:

1. Consider the daily stock return of the Caterpillar Inc. (tick symbol CAT) and the Standard and Poor’s 500 Composite index from January 2005 to December 2009. The data are simple returns and in the file d-catsp0509.txt (three columns, namely Date, CAT, SP).
   
   (a) Express the simple returns of Caterpillar stock in percentages. Compute the sample mean, standard deviation, skewness, excess kurtosis, minimum, and maximum of the percentage simple returns.
   
   (b) Transform the simple returns of Caterpillar to log returns and express the log returns in percentages. Compute the sample mean, standard deviation, skewness, excess kurtosis, minimum, and maximum of the percentage log returns.
   
   (c) Compare the summary statistics between simple and log returns. Is there any difference?
   
   (d) Obtain an empirical density function for the daily log returns of CAT stock.
   
   (e) Let $\mu$ be the mean return of CAT stock. Test $H_0 : \mu = 0$ versus $H_a : \mu \neq 0$. Compute the test statistic, its p-value and draw your conclusion.

2. Consider the monthly simple returns for the stock of Coca Cola Company (tick symbol KO) and the S&P 500 composite index from January 1960 to December 2009. The returns include dividend distributions, and the data file is m-kosp6009.txt. Transform the simple returns to log returns and express the log returns in percentages. (1) Compute the sample mean,
standard deviation, skewness, excess kurtosis, minimum, and maximum of each percentage logarithm return series. (2) Based on the summary statistics, is there any difference between individual stock returns and the returns of market index? (3) Compute the correlation coefficient between the two logarithm return series.

3. Consider the monthly 3-month Treasury Bill rates on the secondary market from January 1934 to February 2010. The data file consists of four columns (year, month, day, and rate). The rates are in percentages. Answer the following questions:

(a) Compute the mean, standard deviation, skewness, and kurtosis of the interest rate series.
(b) Compute the change series of interest rate, i.e. \( x_t = y_t - y_{t-1} \) with \( y_i \) being the \( i \)th observation of the interest rate. Compute the mean, standard deviation, skewness, and kurtosis of the change series.
(c) Compare the skewness of \( y_t \) and \( x_t \). Are they close? Why?
(d) Let \( \mu_x \) be the mean of the series \( x_t \). Test \( H_0 : \mu_x = 0 \) versus \( H_a : \mu_x \neq 0 \). Compute the test statistic, its \( p \)-value and draw your conclusion.

4. Consider the daily logarithm returns of Caterpillar stock from January 2005 to December 2009 as in Problem 1. Conduct the following tests by (a) stating the null and alternative hypotheses, (b) performing the test, and (c) drawing your conclusions:

(a) Test the null hypothesis that the skewness measure of the returns is zero;
(b) Test the null hypothesis that the excess kurtosis of the returns is zero;
(c) Test the null hypothesis that the logarithm returns is normally distributed. You may use the Jarque-Bera test.

5. Again, consider the monthly simple returns of KO stock and the S&P 500 composite index from January 1960 to December 2009 and the 3-month Treasury Bill rates from the same period. The latter can be obtained from Problem 3. Since the Treasury Bill rates are annualized, we can approximate the monthly rates by dividing the rates by 12. Compute the monthly simple excess returns of the CAT stock and the S&P 500 index. [For simplicity, ignore the fact that the interest rates were reported on the first day of each month.] Answer the following questions:

(a) Are the mean excess returns of KO stock and S&P 500 index significantly different from zero? Why?
(b) Is the mean excess return of the S&P 500 index positive? [In R, use the command \( \text{t.test(rt,alternative=c(‘’greater’’))} \), where rt denotes the excess return.] What is the \( p \)-value of the test? Draw your conclusion.
(c) Are the monthly excess returns of KO stock symmetric with respect to the mean return?
(d) Do the monthly simple excess returns of KO stock have heavy-tails? Why?

**Reading assignment**: Chapter 1 and Chapter 2 (Sections 1 to 5) of the text.