Financial Econometrics I

Problem Set 1: Warm-up

November 23, 2018

Learning objectives: After solving the following questions you should be able to

(a) Get yourself familiar with the basic usage of R.

(b) Know stylized features in financial returns data.

(c) Understand the efficient markets hypothesis and test its validity using data.

1. **Getting Started with R**

   The point of this question is to get you started using the programming language R. This is a pure reading assignment, and so you do *not* need to hand in anything for this question.

   (a) I prepared a series of R tutorials for (absolute) beginners. To view and/or download the tutorial materials, visit R tutorial. At this stage, reading Tutorial 1-5 will suffice[1].

   (b) Read Section 1.6 and 2.10 of Fan and Yao (2017) (referred to as FY hereafter).

   (c) Read Chapter 4-6 of "R Programming for Data Science" by Roger Peng.

2. **Behavior of Financial Return Data**

   You are given historical data (1995-2017) of the Nasdaq index[2]. See `nasdaqd`, `nasdaqw`, and `nasdaqm` respectively for daily, weekly, and monthly data. For this question, you will need to use *only* the "adj close" (adjusted closing) data, which is the closing index adjusted for all splits and dividends.

   (a) Compute the (log) daily, weekly, and monthly returns of the Nasdaq index.

   (b) Use the index and return data from Part (a) to reproduce Figures 1.3, 1.5, and 1.7 in the textbook. Hint: You will need to install the `TSA` package and use its `acf` function.

   (c) Read Section 1.5.2. Perform the Jarque-Bera test to the daily, weekly, and monthly return data you obtained in Part (a). Hint: You will need to first install the `tseries` package, and then use its `jarque.bera.test` function.

3. **FY Exercise 1.2**

   Hint: Recall that $\widehat{Var}(\gamma_t, ..., \gamma_{t+k})$ is positive semi-definite by construction.

4. **FY Exercise 1.3**

   Hint: You may use R functions `pnorm` and `pt`.

5. **FY Exercise 1.9**

   Hint: Read Section 1.4.1 and 1.4.2 first.

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[1]You may find that these notes are not very reader-friendly as they are supposed to be lectured in a couple of tutorial sessions. Therefore, starting from a well-written book (like Part (c)) may be a better strategy for getting a quick start-up, especially for those whose have 0 coding experience.

[2]These CSV data are downloaded from *Yahoo!Finance*

6. **FY Exercise 1.10 & 1.11**

   This question tests the finite sample performance of the Ljung-Box statistic via a small scale Monte Carlo experiment. Monte Carlo methods have a wide range of applications in many fields. From this question, you can learn the general procedure for conducting a Monte Carlo simulation. To solve this question, you may need to use a series of R functions for density (PDF), distribution (CDF), quantile/percentile, and random number generating functions[3] as well as compute a histogram of the given data.

7. **FY Exercise 1.13 (Optional)**

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[3]For normal distribution, they are `dnorm`, `pnorm`, `qnorm`, and `rnorm`, respectively. To compute empirical quantile/percentile and histogram of the data, you may use `quantile` and `hist`, respectively.