Introduction to Computational Finance Spring 2021, Lab 1

Due April 8th, 2021

1/4/2021

Part I: Return calculations (by hand)

Consider the following (actual) monthly adjusted closing price data for Starbucks stock over the period December 2004 through December 2005

Table 1: End of Month Price Data for Starbucks Stock

Date	Price
December, 2004	31.18
January, 2005	27.00
February, 2005	25.91
March, 2005	25.83
April, 2005	24.76
May, 2005	27.40
June, 2005	25.83
July, 2005	26.27
August, 2005	24.51
September, 2005	25.05
October, 2005	28.28
November, 2005	30.45
December, 2005	30.51

Do all calculation by hand. That is, give the appropriate formula and evaluate the result. Answers without a formula will not be given credit. Take a photo of your hand written answers, and submit it via canvas. Alternatively, if you know LaTex then you can embed the LaTex equations in the notebook (The solutions are written this way).

1. Using the data in the table, what is the simple monthly return between the end of December, 2004 and the end of January 2005? If you invested $10,000 in Starbucks at the end of December 2004, how much would the investment be worth at the end of January 2005?

2. Using the data in the table, what is the continuously compounded monthly return between December, 2004 and January 2005? Convert this continuously compounded return to a simple return (you should get the same answer as in part a).

3. Assuming that the simple monthly return you computed in part (1) is the same for 12 months, what is the annual return with monthly compounding?

4. Assuming that the continuously compounded monthly return you computed in part (2) is the same for 12 months, what is the continuously compounded annual return?

5. Using the data in the table, compute the actual simple annual return between December 2004 and December 2005. If you invested $10,000 in Starbucks at the end of December 2004, how much would

the investment be worth at the end of December 2005? Compare with your result in part (3).

6. Using the data in the table, compute the actual annual continuously compounded return between December 2004 and December 2005. Compare with your result in part (4). Convert this continuously compounded return to a simple return (you should get the same answer as in part 5).

Part II. Excel exercises

The file `sbuxPrices.csv` on Canvas is a "comma separated value" text file contains monthly data on Starbucks (ticker symbol sbux) over the 15 year period March 1993 to March 2008. This file can be directly read into Excel by double clicking on it. After opeing the file save it as an Excel file and name it `econ424Lab1_spring2021.xlsx`. In the file you will see two columns: "Date" giving the end-of-month date; and "Adj.Close" giving the end-of-month adjusted closing price (price adjusted for dividends and stock splits, see https://www.investopedia.com/terms/a/adjusted_closing_price.asp).

1. Make a time plot (line plot in Excel) of the monthly price data over the period (end of March 1993 through (end of) March 2008. Please put informative titles and labels on the graph. Place this graph in a separate tab (spreadsheet) from the data. Name this tab "graphs". Briefly comment on what you see (e.g. price trends, etc.). Put these comments in a text box next to the graph.

2. If you invested $1,000 at the end of March 1993, what would your investment be worth at the end of March 2008?

3. What is the compound annual rate of return over this period assuming annual compounding? (Hint: what is the geometric average annual rate for the 15 year investment?)

4. Make a time plot of the natural logarithm of monthly price data over the period March 1993 to March 2008 and place it in the "graph" tab. Comment on what you see and compare with the plot of the raw price data.

5. Why is a plot of the log of prices informative? (Hint: what is the slope between two time periods?)

6. Using the monthly price data over the period March 1993 to March 2008 in the ** data** tab, compute simple monthly returns (Starbucks does not pay a dividend). When computing returns, use the convention that P_t is the end of month closing price. Make a time plot of the monthly returns, place it in the "graphs" tab and comment. Keep in mind that the returns are percent per month and that the annual return on a US T-bill is about 0.5 right now.

7. Compute simple annual returns for the years 1993 through 2008 (note: there are easy and hard ways to do this). Make a time plot of the annual returns, put them in the "graphs" tab and comment. Note: You may compute annual returns using overlapping data or non-overlapping data. With overlapping data you get a series of annual returns for every month (sounds weird, I know). That is, the first month annual return is from the end of March, 1993 to the end of March, 1994. The second month annual return is from the end of April, 1993 to the end of April, 1994 etc. With non-overlapping data you get a series of 15 annual returns for the 15 year period 1993:March-2008:March. That is, the annual return for 1993:March - 1994:March is computed from the end of March 1993 through the end of March 1994. The second annual return is computed from the end of March 1994 through the end of March 1995, etc.

8. Using the monthly price/return data over the period March 1993 to March 2008, compute continuously compounded (cc) monthly returns and place then in the ** data** tab. Make a time plot of the monthly cc returns, put them in the "graphs" tab and comment.

9. Briefly compare the continuously compounded returns to the simple returns. Which ones are bigger?

10. Compute continuously compounded annual returns for the years 1993 through 2008 (Again, there are easy and hard ways to do this). Make a time plot of the annual returns and comment. Briefly compare the continuously compounded returns to the simple returns.

Part III. R Exercises

Start Rstudio and open the Rstudio notebook file `econ424Lab1Notebook_spring2021.Rmd`. This file will walk you through the exerciese. Execute the commands in the "code chunks" of this file. Note: you may have to edit a few lines of code in some cases. After finishing going through the notebook, save it as a .pdf file and submite in Canvas.