ECON90033 – QUANTITATIVE ANALYSIS OF FINANCE I

Second Semester, 2023

Assignment 1

Due date and time: Thursday 31 August, 11:00AM

Please read the following instructions carefully before starting to work on the assignment.

- **There is a total of 15 marks for this assignment. It is worth 15% of the final grade for QAF1.**
- **This assignment must be submitted online via the LMS by 11:00AM on Thursday 31 August. Any assignment not submitted by the due date and time will incur a 10% penalty of available marks for each full hour late until zero mark.**
- **Students may work alone and submit their own assignment answers if they wish to do so, or they can work on the assignment in pairs. In the latter case, each assignment pair must submit only one set of assignment answers and both students of the pair will receive the same mark for their assignment. It is not allowed to form assignment groups of more than two students.**
- **Please note that the assignment submission process has two stages:**

  1. Registering your assignment group (only if you work in a pair), and

  2. Submitting the assignment online via the LMS.

  Students who intend to work on the assignment in pairs must register their groups. To do so, click the "People" link and then the Groups tab in the Canvas course navigation menu. The group names (set by default) are QAF1 Assignment 1 1, QAF1 Assignment 1 2, QAF1 Assignment 1 3, etc. Every assignment pair MUST register as one of these created groups for submitting the assignment and not create a new group. The deadline for registering your group is 5:00PM on Wednesday 23 August. If a pair fails to register their group before the deadline for group registration, both students will need to make an individual, i.e., sufficiently different, submission.

  Students making individual submissions do not need to register.
- **You can answer the assignment questions using Microsoft Word, LaTeX, R markdown, Scientific Work, etc. Make sure to include a cover page in the document with the student ID, the name, and the tutorial group of each group member.**
- **If a task involves some manual calculations, use your calculator (not *R*, *Excel,* or any other software), the relevant statistical table(s), and show the major steps, including the formulas in the document. Otherwise, use only *R***

/ RStudio **and paste your scripts, screenshots, and printouts (graphs, output tables, etc.) into the document.**

- **Once you complete the assignment, convert the whole file to PDF before submitting it online via the LMS. Please note that only PDF files can be uploaded to the LMS.**
- **Do not forget to preview your assignment after uploading it on the LMS to ensure that you have indeed uploaded the correct and complete assignment and that its formatting is in order as in the original document. Submissions that are late because of formatting issues or because a version is incomplete, will not be accepted.**

Assignment Tasks and Questions

There are three exercises in this assignment, each consisting of several parts. Perform all your calculations with *R*. Download the *a1e2.xlsx* and *a1e3.xlsx* files.

Exercise 1 (1 + 1 + 1 + 1 + 1 = 5 marks)

(a) This exercise is based on the Hang Seng Index, a freefloat-adjusted market-capitalization-weighted[1] stock-market index in Hong Kong.

Go to the Yahoo Finance website (https://au.finance.yahoo.com/) and search for Hang Seng Index (^HSI). Choose *Historical data*, *Frequency: Monthly*, *Show: Historical prices*, *Time period: 1 July 2018 - 1 July 2023*. Click *Apply* and then *Download*. The data will be saved as *^HSI.csv* on to your computer.

Locate this file on your computer - most likely it will be in your Download folder. Open this file in *Excel* and save it as *a1e1.xlsx*.

(b) Launch *RStudio*, create a new project and script, and name both *a1e1*. Import the data from the *a1e1.xlsx* file to *RStudio*, save it as *a1e1.RData*, and attach this data set to your *R* project.

Take a picture of your *RStudio* window and insert the picture in your document.[2]

[1] Free float market capitalization means that the valuation of a company depends only on the shares held publicly and thus can be traded.
[2] On a Windows PC you can use the *Snipping Tool* to take a picture of the *RStudio* window, or you can take a picture of your whole screen by pressing the *PrintSc* (maybe *PrtScn*) key.

Create a *ts* object of the *Adj Close* series[3], name it *HSI* and illustrate it with a nicely customised (title, label, colour) time-series plot. What does this plot tell you about the historical data pattern of the adjusted closing price of the Hang Seng Index during the last five years?

(c) Compute the monthly simple returns and logarithmic returns of the Hang Seng Index and plot them. Comment on the plots.

(d) Express the monthly simple and logarithmic returns in annualized form and plot the resultant series. Comment on the plots.

(e) Compute the returns to holding *HSI* over the entire sample period (i.e., the holding period return[4]) in both simple and logarithmic forms. Comment on the results.

Exercise 2 (1 + 1 + 1 = 3 marks)

The *a1e2.xlsx* file contains monthly observations from December 1946 to February 1987 on US zero coupon bond[5] yields for maturities of 2 months (*r2*), 3 months (*r3*), 4 months (*r4*), five months (*r5*), six months (*r6*) and 9 months (*r9*).

(a) Launch *RStudio*, create a new project and script, and name both *a1e2*. Import the data from the *a1e2.xlsx* file to *RStudio*, save it as *a1e2.RData*, and attach this data set to your *R* project.

Plot the 2, 3, 4, 5, 6 and 9 months United States zero coupon yields on a single nicely customised (title, label, colour) time-series plot. Comment on the line chart.

(b) Compute the spreads on the 3-month, 5-month and 9-month zero coupon yields relative to the 2-month yield. Plot these spreads using a line chart and comment on their properties.

(c) Compare the graphs in parts (a) and (b) and briefly discuss the time series properties of yields and spreads.

[3] Stock values are stated in terms of the closing price and the adjusted closing price. The closing price is the raw price, which is just the cash value of the last transacted price before the market closes. The adjusted closing price factors in anything that might affect the stock price after the market closes, like e.g. dividend payments or purchasing right offerings to existing shareholders.
[4] These are multi-period returns calculated for the entire sample period.
[5] Zero coupon bonds are issued at a discount to their face values, but they do not pay interest.

Exercise 3 (1 + 2 + 4 = 7 marks)

The *a1e3.xlsx* file contains monthly observations for the period April 1990 to July 2004 on the equity prices of Exxon (*Exxon*), General Electric (*GE*), IBM (*IBM*), Microsoft (*Msoft*), and Walmart (*Wmart*), together with the price of Gold (*Gold*), the S&P 500 index (*SP500*), and a short term interest rate measured by the annual rate of the US 3-month Treasury Bill (*Tbill*).

(a) Launch *RStudio*, create a new project and script, and name both *a1e3*. Import the data from the *a1e3.xlsx* file to *RStudio*, save it as *a1e3.RData*, and attach this data set to your *R* project.

Plot the equity price and log returns of Microsoft and identify the large movements in its share value during the period of the dot-com crisis, which began on 10 March 2000 and led to very large falls in the equity value of Microsoft and technology stocks in general.

(b) Estimate the CAPM model for Microsoft

$$r_{it} - r_{ft} = \alpha + \beta(r_{mt} - r_{ft}) + \varepsilon_t$$

in which r_{ft} and r_{mt} are the risk free and market returns, respectively.

i. Comment on the adjusted R^2 statistic and on the *F*-test for the overall significance.

ii. Interpret the point estimates of the α and β parameters.

iii. Plot the residuals and perform the Jarque-Bera test of normality. What do you conclude?

(c) To capture the effects of the dot-com crisis construct 11 dummy variables for each month of the crisis beginning with March 2000 and ending in January 2001.[6] For example, the first, the second and the last dummy variables are

$$I_{1t} = \begin{cases} 1 \text{ in March 2000} \\ 0 \text{ otherwise} \end{cases}, \quad I_{2t} = \begin{cases} 1 \text{ in April 2000} \\ 0 \text{ otherwise} \end{cases}, \ldots, \quad I_{11t} = \begin{cases} 1 \text{ in January 2001} \\ 0 \text{ otherwise} \end{cases}$$

These dummy variables can be generated in *R* by executing the

```
I1 = ts(ifelse(Date >= "2000-03-01" & Date < "2000-04-01" , 1, 0),
    start = c(1990, 5), end = c(2004, 7), frequency = 12)
```

[6] In January 2001 Microsoft shares had a positive correction.

```
I2 = ts(ifelse(Date >= "2000-04-01" & Date < "2000-05-01" , 1, 0),
     start = c(1990, 5), end = c(2004, 7), frequency = 12)
```

etc.

```
I11 = ts(ifelse(Date >= "2001-01-01" & Date < "2001-02-01" , 1, 0),
     start = c(1990, 5), end = c(2004, 7), frequency = 12)
```

commands.[7]

Now estimate the augmented CAPM regression

$$r_{it} - r_{ft} = \alpha + \beta(r_{mt} - r_{ft}) + \sum_{i=1}^{11} \gamma_i I_{it} + \varepsilon_t$$

i. Comment on the adjusted R^2 statistic and on the *F*-test for the overall significance.

ii. Interpret the point estimates of the α and β parameters.

iii. Interpret the point estimates of the slope parameters of the dummy variables.

iv. Plot the residuals and perform the Jarque-Bera test of normality. How does the outcome of this test compare with the Jarque-Bera test in part (b)?

v. Perform a joint test of the effects of the dot-com crisis on Microsoft by testing the restrictions $\gamma_1 = \gamma_2 = \gamma_3 = \ldots = \gamma_{11} = 0$. Explain in words what the null and alternative hypotheses mean and the conclusion you draw from the test at the 5% significance level.

[7] In these commands the start date is May 1990 because r_{ft} and r_{mt} are not available for April 1990.