**Economics of Financial Markets (ECON30024/ECON90024) - Assignment 1**

* *The time and attendants for each group meeting you have had in the process of completing the assignment (you can, but not required to, include a brief description of the tasks for each meeting).*
  + *We compiled the answers to Question 1 and Question 2 into this document and completed Question 3 together on Sunday 30th arch 14:00 to 16:00.*
* *The role of each group member in completing this assignment, such as collecting data, writing report for Question 1, etc. (you can, but not required to, give a percentage of each member’s contribution to the assignment)*
  + *Question 1:* Shashwat Bharadwaj and Arjuna Bhattacharya.
  + *Question 2: Josh Copeland and Oliver van Druten.*
  + *Question 3:* Shashwat Bharadwaj, Arjuna Bhattacharya, *Josh Copeland and Oliver van Druten.*
* The signatures of all group members to indicate an agreement to what’s being stated on the page (sign and scan, or using electronic signatures).
  + Electronic signatures:
    - Olivier van Druten
    - Shashwat Bharadwaj
    - Arjuna Bhattacharya
    - Josh Copeland.

**Question 1 (5-page limit)**

1. **Ratio of total financial assets to GDP, where ’total financial assets’ refers to total financial assets owned by Australian households and private nonfinancial businesses or corporations.**
2. **The financial sector’s contribution to GDP (i.e., its value added share of GDP), where the financial sector refers to the financial and insurance services industry in Australia.**
3. **The financial sector’s average wage relative to the average wage in all industries, where ‘average wage’ is usually measured by a full time male adult’s average weekly earnings.**

**Question 2 (5-page limit)**

1. **Find monthly data series for All Ordinaries and S&P/ASX 200 indices. Clearly state your data source and sample period in your report, but please do not include the observations of the data series in your report.**

We have used the *tidyquant* package to directly retrieve timeseries for the All Ordinaries and ASX200 series from January 2000 to February 2025. By default, the function we have used to retrieve this data *(getSymbols())* retrieves its data from Yahoo Finance, as noted on page 50 of the [*quantmod* documentation](https://d.docs.live.net/https:/cran.rproject.org/web/packages/quantmod/quantmod.pdf).

The tickers used were: ASX 200: Data sourced via Yahoo Fiancé S&P/ASX 200 ETF and All Ordinaries: Data sourced via Yahoo finance S&P/ASX Small Ordinaries ETF

See Appendix for R Code.

1. **For each price index, calculate the corresponding return series. Do this using the exact formula for calculating rates of return on a price index or use the log-difference approximation. Then use the Box-Ljung test (also called Ljung-Box test) to test the joint significance of the first 12 autocorrelations of each return series.**

Returns were calculated using the log-difference of prices:

We create returns using the exact formula on both price indices and conduct the Box-Ljung test on both returns separately. The null hypothesis of the Box-Ljung test is there there are no significant autocorrelations up to lag 12 (you can use any number of lags, but that’s what we’re using in this assignment). More formally:

Our result for this test is summarised on both indices is summarised in Table 1. As both these p-values are greater than 0.1, we are unable to reject the null hypothesis of these tests, even at the 10% significance level. This means neither time series has no significant autocorrelation up to lag 12 at any reasonable significance level.

This is consistent with the weak form of the Efficient Market Hypothesis (EMH): the past prices (and therefore returns) are assumed to contain no useful information on future prices. If there was, there would be significant autocorrelation in this return series.

However, we need to consider these results in context of the joint hypothesis problem. Our failure to reject the null hypothesis, and therefore confirm the EMH, is actually conditional the assumption the data follows a random walk model. If our data does not follow a random walk (which we can’t confirm using this test), then our results are invalidated. However, conditional on the series being a random walk, we confirm the weak form of the EMH.

*Table 1: Ljung-Box test results*

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Ljung-Box test statistic | Degrees of freedom | P-value |
| S&P/ASX 200 | 16.063 | 12 | 0.1884 |
| All Ordinaries | 18.311 | 12 | 0.1066 |

Note: refer to R code appendix for further information.

1. **Use a unit root test or a regression to test whether the logarithm of each price index follows a random walk. For the regression analysis, you can estimate a simple regression as discussed on slide 11 of Topic 2 (if you don’t have much experience in Econometrics), or try to estimate the regression of Groenewold and Kang (1993) as given in Eq. (3) of the paper, or estimate an alternative regression that you think suitable.**

Rather than using the regression of the form given in Groenewold and Kang (1993) we instead use the Augmented Dicky-Fuller (ADF) test to for the presence of a unit root in the logarithm of our stock market indices. We think this is reasonable for two reasons:

* It is a very popular unit root test in empirical economic papers.
* It allows us to test for the two different hypotheses tested by Groenewold and Kang (1993): the process is random walk with a trend and drift; the process is a random walk with a drift.

Consistent with Groenewold and Kang (1993) our results test for the presence of a unit root with a drift, as well as a drift and a trend. When testing for the case of there being just a drift the regression we are estimating is:

To evaluate the presence of a unit root, the hypothesis test we would impose is if . Rejecting this hypothesis would allow us to conclude the time series is stationary.

In the instance of testing for the presence of a unit root with a drift and trend, we are estimating the following regression

To evaluate the presence of a unit root, the hypothesis test we would impose is if . Rejecting this hypothesis would allow us to conclude the time series is stationary.

Our results for these ADF tests are presented in Table 2. As these are left-tailed tests, we need the test statistics to be lower than the relevant critical value at a given significance level. The lower the test statistic, the stronger the evidence against the null hypothesis. As neither of the test statistics are below the 10% critical value, we cannot reject the null hypothesis of there being a unit root in either stock market index even at the 10% significance level.

These results support the weak form of the EMH, which says share prices reflect all past information, meaning future price movements are unpredictable base on past price data. Our failure to reject the null hypothesis of a random walk confirms this weak form of the EMH.

However, it’s important to be aware of the fact the testing EMH with a unit root test is not independent of the underlying model of asset prices. Failing to reject the null hypothesis doesn’t necessarily confirm EMH by itself as this test implicitly assumes it follows a random walk. If this is incorrect it could affect our conclusion. Therefore, our initial conclusion of confirming EMH is conditional on us assuming the data follows a random walk.

*Table 2: ADF test results*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Index | Drift test statistic | Drift critical value | Drift + trend test statistic | Drift + trend critical value |
| All ordinaries | -0.66 | -2.57 | -2.73 | -3.13 |
| ASX 200 | -0.72 | -2.57 | -2.71 | -3.13 |

Note: All critical values are given at the 10% significance level. Refer to the R code appendix for further information.

**Question 3**

1. **Are you going to play the game in scenario 1)? Are you going to play the game in scenario 2)? Based on your decisions, comment on your degree of risk aversion in terms of absolute risk aversion (ARA) and relative risk aversion (RRA). That is, do you think you have increasing, decreasing or constant ARA, and increasing or decreasing RRA?**

My decisions are to play the game in scenario 1 and play the game in scenario 2.

Absolute risk aversion (ARA),

Relative risk Aversion (RRA),

The implications of my decisions, are that:

* I have a constant or decreasing ARA, as I do not have a decreasing willingness to take risk as the size of the risk increases in absolute terms. This is because I am willing to accept both gambles, regardless of the size of the bet.
* I have a constant RRA, as I do not have a decreasing willingness to take risk regardless of what share of my wealth is at stake. This is because I am willing to accept both gambles, regardless of what proportion of my wealth the bet accounts for.

1. **Choose a utility function that may describe your attitude toward risk (refer to Topic3 slides for some examples of utility function, but you are not restricted to choose from this list), and calculate your expected utilities from playing the game or staying away from it in both scenarios. Are your decisions in (a) justifiable by this utility function? If not, try different value(s) for parameter(s) in your utility function or try a different utility function until the utility function you choose to work with implies the decisions you have chosen in part (a). By doing this exercise, you somehow uncover your own utility function from your decisions.**

I will use a Constant Relative Risk Aversion utility function to represent both gambles.

As you can see this function has decreasing Absolute Risk Aversion as,

Therefore, as , as my wealth increases, my ARA must decrease, which matches with my choice to play both gambles and shows that my decisions to take risks doesn’t change much although my wealth increases.

This function has a constant Relative Risk Aversion as,

Therefore, as , means my RRA is positive and remains constant. This also means my tolerance to risk relative to my wealth remains unchanged. This means that it aligns with my choice to play both gambles.

Expected utility calculations

* Game 1,
* Game 2

As the, CRRA function has decreasing ARA and constant RRA, it represents my risk preference correctly, as seen by the positive EU values for both gambles. Since both EU’s are large numbers and positive, it indicates that the potential gains from playing the games outweigh the losses, making it a rational choice in relation to my risk preference. The choice of the CRRA utility function with is rightly assumed appropriate because it correctly accurately reflects my mild risk aversion. A low positive value of indicates that I am not very cautious and very willing to take risks, especially when the potential reward significantly outweighs the loss. potential loss.

The decreasing ARA implies that as my wealth increases, my willingness to take risks does not decline much, which matches my decision to take part in both gambles. Alongside, the constant RRA indicates that my risk-taking behaviour remains constant even when the proportion of wealth in the gamble rises. Therefore, the CRRA utility function with captures my decisions well to engage in both games.

**Appendix – R Code**

* **Note: This code only applies to Question 2. for Question 1, please refer to Excel spreadsheet which has also been submitted.**

library(quantmod)

library(tidyverse)

library(RColorBrewer)

library(urca)  
*########################################################### Question 2a*

*getSymbols(c("^AXJO", "^AORD"), from = "2000-01-01", to = Sys.Date())*

*# Reformatting data into tidy format*

*data <- tibble(*

*date = as.Date(index(AXJO)),*

*ASX200\_Close = as.numeric(AXJO$AXJO.Close),*

*AllOrds\_Close = as.numeric(AORD$AORD.Close)*

*) %>%*

*select(date, asx200 = ASX200\_Close, allords = AllOrds\_Close) %>%*

*pivot\_longer(-date)*

*# Creating monthly observations from daily data*

*data <- data %>%*

*mutate(year\_month = floor\_date(date, "month")) %>%*

*group\_by(name, year\_month) %>%*

*summarise(value = mean(value, na.rm = TRUE)) %>%*

*select(date = year\_month, value) %>%*

*ungroup() %>%*

*filter(date < "2025-03-01")*

*########################################################### Question 2b*

*# Calculating monthly returns*

*data <- data %>%*

*group\_by(name) %>%*

*mutate(returns = ((value - lag(value)) / value) \* 100) %>%*

*na.omit()*

*ggplot(data, aes(date, returns, colour = name)) +*

*geom\_line() +*

*labs(title = "Australian stock market indice returns",*

*y = "Returns",*

*x = "Date") +*

*theme\_minimal() +*

*scale\_color\_brewer(palette = "Set1")*

*# Conducting Box-Ljung test on allords*

*data %>%*

*filter(name == "allords") %>%*

*pull(returns) %>%*

*Box.test(lag = 12, type = "Ljung-Box")*

*# Conducting Box-Ljung test on asx200*

*data %>%*

*filter(name == "asx200") %>%*

*pull(returns) %>%*

*Box.test(lag = 12, type = "Ljung-Box")*

*########################################################### Question 2c*

*# Turning price indexes into logarithms*

*data <- data %>%*

*mutate(value\_log = log(value))*

*ggplot(data, aes(date, value\_log, colour = name)) +*

*geom\_line() +*

*labs(title = "Logarithms of Australian stock market indices",*

*y = "Value",*

*x = "Date") +*

*theme\_minimal() +*

*scale\_color\_brewer(palette = "Set1")*

*# Producing ADF tests for the allords series*

*data %>%*

*filter(name == "allords") %>%*

*pull(value) %>%*

*ur.df(type = "drift", selectlags = "AIC") %>%*

*summary()*

*data %>%*

*filter(name == "allords") %>%*

*pull(value) %>%*

*ur.df(type = "trend", selectlags = "AIC") %>%*

*summary()*

*# Producing ADF tests for the asx200 series*

*data %>%*

*filter(name == "asx200") %>%*

*pull(value) %>%*

*ur.df(type = "drift", selectlags = "AIC") %>%*

*summary()*

*data %>%*

*filter(name == "asx200") %>%*

*pull(value) %>%*

*ur.df(type = "trend", selectlags = "AIC") %>%*

*summary()*



