

## EMPIRICAL FINANCE 3.2

– GROUP ASSIGNMENT 3 –

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### General Instructions

#### Availability

Each week's coding assignment is available from Friday 00:00.

#### Deadline

The deadline to submit is the following week's Monday 23:59, no exceptions!

#### Tutorials

Each Friday at 13:30, the tutorial session is dedicated to the assignment. Justus will walk you through the assignment. You will receive useful coding tips. You can ask questions and get troubleshooting support.

#### Canvas Submission Requirements

Each group submission must include:

1. A PDF with written answers that includes: (a) a cover page with group number, member names and student ids, (b) answers to questions Q1 and Q2 below, and (c) an Appendix with the printed replication code.
2. A replication code file that is fully self-contained and allows to reproduce all results in R-Studio.

#### Important

If the assignment is not submitted by the deadline, you will receive 0 points.

If the replication code is not submitted by the deadline, you will receive 0 points.

If the code does not replicate the provided answers, the assignment will receive 0 points.

Clear cases of fraud will be reported to the exam commission.

#### Groups

You will work in groups of four. No extensions will be granted. Plan ahead and make it

work. Document your workload division via e-mail or Canvas group page to insure against slacking.

### Weighting

Each assignment counts for 5% of the final grade (total of 30% across all six assignments).

**Grading** Each assignment can earn a maximum of 10 points (see grading rubric below) and the grade is equivalent to the points earned. Any questions about the grading must be asked within 48h of publishing the grade on Canvas.

Table 1: Grading Rubric

Q1(a) - Output	1 point
Q1(a) - Analysis	1 point
Q1(b) - Output	1 point
Q1(b) - Analysis	1 point
Q2(a) - Output	1 point
Q2(a) - Analysis	1 point
Q2(b) - Output	1 point
Q2(b) - Analysis	1 point
Layout and Writing	1 point
Best Coding Practices	1 point

### Preparations

Navigate to the excel file 'Group Assignment Stocks' and identify the stock associated with your group number. For your assigned stock, independently obtain the stock ticker. For the indicated date range, import the stock prices using the tidyquant package. Load the stock prices into R and calculate the log-returns for the indicated years.

*Comment: If you struggle with downloading the data, you may request a csv file with returns from Justus against a 2 point deduction.*

### Questions

#### Q1. GARCH modeling

- (a) Using the first 5 years of the data, estimate an AR(1)-GARCH(1,1) model under the assumption of normally distributed errors. Export the parameter estimates

into a formal table in your pdf. Interpret the parameter estimates and calculate the unconditional volatility.

- (b) Given your parameter estimates, obtain one-step-ahead variance forecasts for the second 5 years of the data. Using these forecasts, standardize the corresponding returns and obtain a qq-plot that indicates whether fat-tailed dynamics are still present.

## Q2. Improving the model

- (a) Fit an AR(1)-GARCH(1,1) model under the assumption of Student's  $t$  distributed returns. Report the estimated degrees of freedom parameter and interpret shortly.
- (b) Perform a Likelihood-Ratio test between the normal and the  $t$  model. Clearly label all inputs, formally report the hypotheses, critical value and test results. Interpret your findings.