Technische Universiteit
Eindhoven
University of Technology

Assignment 2 – Deadline: March 16, 2018

TU/e, Department of Mathematics and Computer Science

2DF40 Financial Mathematics

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General information (read this carefully): For this course, we will give you three assignments. These assignments require the implementation of some of the notions and models discussed during the course. The assignments can be made in groups of at most three persons, and it is also required to submit a report. The assignments will count for 30% of the final grade. There will be also a final exam that counts for 70% of the final grade. All rules of the Bachelor College are applicable.

The solutions of the second assignment should be uploaded to CANVAS in the field of Assignment 2 before 23:59 on the March 16, 2018. Delayed submissions are penalised by 1/2 point (out of 10). To this purpose, you need to create a single pdf file with the solutions to the assignment. If the assignment requires programming, you can use your favourite programming language or mathematical/statistical software or calculation–graphing tool or spreadsheet. However the original source code, in original format, should be submitted together with the report, i.e. in the same CANVAS submission as the solutions of the assignment, and it should be also included in an appropriate format as an appendix to the pdf file of the report. Make sure to zip all source/code files together. At the end, submit the single pdf file and the zipped source/code files to CANVAS.

Create a cover for the solutions of the assignment and include the names and student ID numbers of all the members of the group, the course number and the assignment number. Not having a cover with all the above mentioned information is penalised by 1/2 point (out of 10). Moreover, the submitted pdf cannot exceed the 5 pages (excluding the cover and the code in the appendix, but including all tables and figures). If the submitted pdf file exceeds the 5 pages, then for every additional page 1/2 point (out of 10) will be subtracted from the final grade. The assignment needs to be typed in LaTeX or Word with a font of at least 10pt and regular margins.

The solutions of the assignment should be presented in a clear, concise way and the code should be documented and should provide sufficient information for confirmation and replication of the results. Moreover, all graphs and tables should have a caption explaining what is depicted and all axes (cells, respectively) should be labelled. In the case you use data not provided by the lecturers of the course, these data files should be submitted together with the solutions of the assignment and the source code. *See the next page for a first attempt at a Rubric concerning the grading of assignments.*

Elements	Exemplary	Points (when directly applicable)
Delayed submissions	Submissions submitted on CANVAS before the deadline.	-1/2 point (out of 10) for delayed submission (according to CANVAS)
General structure	The report presents all information in a style that is appealing and appropriate for the intended audience.	
	The report is easy to read. The report is typed in LaTeX or Word. Fonts and type size vary appropriately for headings, sub-headings and text. The font size for the text is at least 10pt.	
	The code is documented, easily replicable, and presented in an appendix.	
Cover page	Contains all information (title page, including names, student ids, course name, project/assignment title) in a style that is appealing, possibly with a picture.	If unsatisfactory -1/2 point (out of 10)
Length of report	5 pages (excluding the cover and the code in the appendix, but including all tables and figures)	-1/2 point (out of 10) per extra page
Report structure & writing style	Explains all ideas clearly and concisely in a logical progression with effective supporting evidence.	
	The appended code is fully documented and there is sufficient information for confirmation and replication of the results.	
	All graphs and tables have a caption explaining what is depicted and all axes/rows & columns are clearly labelled.	
	There are no errors in grammar, capitalization, punctuation, and spelling.	
	(Not all of the topics mentioned below are applicable to all assignments)	
Problem statement & solution	Presents the results in a structured way, using tables and figures. The students interpret all the results. An interpretation should be given below each table or figure.	
	The result/solution is clearly stated and the procedure is explained and is clear, and it is mathematically accurate. The calculations, simplifications and the assumptions are clearly stated.	
	All ideas/concepts are clearly and concisely explained in a logical progression with effective mathematical structure or with supporting evidence.	
	The (mathematical) model/formula is rigorously defined and the notation is clearly stated (e.g., all formula parameters and variables are explained and the support/domain of the variables is given)	
	The students summarise the results and attaches conclusions to them that answer the original questions. The students explicitly refer to the (theoretical/numerical) results when drawing conclusions.	
	All images, media or text created by others are cited with accurate, properly formatted citations.	

Figure 1.1: Rubric for 2DF40 assignments – feedback from students, so as to improve the Rubric, is truly appreciated

Assignment 2 tasks

Preparation: Download the two files from CANVAS titled *history.csv* and *future.csv*. In these files, you will find the daily stock prices of five assets. The first row of the data files (both for *history.csv* and *future.csv*) provides you with the name of the corresponding stock. The first column indicates the date at which the data are collected, while columns 2 to 6 depict the price for each one of the stocks for the dates at hand.

Assume for this assignment that the risk-free interest rate is 0.5% (nominal).

Task 1 Consider the returns of the five stocks, based on the stock prices as they appear on the *history.csv* data file, and estimate

- the expectation,
- the variance,
- and the covariances

of the returns of the five stocks. Describe briefly the procedure of the estimation and present the results in units of years (Note: a year has 252 trading days). ■

Task 2 Based on the estimations performed for Task 1,

- compute the minimum-variance portfolio (weights $(\vec{w}_{\min})$, mean and variance);
- compute the tangency portfolio (weights $(\vec{w}_{\tan})$, mean and variance);
- depict in a (σ,μ)-plot the assets, the minimum-variance portfolio, the tangency portfolio, the efficient frontier, and the capital market line (CML).

■

Task 3 Consider now a portfolio, which is the weighted average of the minimum variance portfolio and the tangency portfolio, i.e., $\frac{1}{2}\vec{w}_{\min}+\frac{1}{2}\vec{w}_{\tan}$, and depict the histograms of both the returns and the gains of the portfolio. What can you say about the underlying distribution? [Hint: Comment on whether the returns and/or the gains are normally distributed.] ■

Task 4 Consider, as in Task 3, the portfolio with weights $\frac{1}{2}\vec{w}_{\min}+\frac{1}{2}\vec{w}_{\tan}$. We invest one million Euro in this portfolio on December 29, 2017. The investment starts on December 29, 2017 and matures on February 23, 2018. For this portfolio,

- compute the Sharpe ratio based on the *history.csv* data; did the portfolio perform as expected in the *future.csv* data?
- compute the value at risk of the investment (from December 29, 2017 to February 23, 2018) to a 99% confidence level, thereafter, put the results in a statement of the form "We are ε percent certain that we will not lose more than V Euros in the next N days" by appropriately substituting the values of ε, V, N.
- compute, based on the *history.csv* data, the probability that the value of the portfolio will increase by at least 3% from December 29, 2017 to February 23, 2018; what was the actual increase of the investment based on the *future.csv* data?

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