

# Assignment Instruction

Deadline: Feb 11, 2024, 23:59PM

## 1 Setup the assignment

Please follow the instruction step by step very carefully. The assignment will be evaluated in an automated way. Failing to follow this instruction may result in a zero grade from the automated evaluation procedure!!

1. Download from Canvas two Excel files “DataGenerator.xlsm” and “AnswerSheet.xlsx” to your computer.
2. Change the name of the file “AnswerSheet.xlsx” to xxxxxx\_yyyyyy.xlsx where “xxxxxx” and “yyyyyy” are the student numbers of each member of the group. If you decided to do it alone (not encouraged), the file name will then be in the format of “xxxxxx.xlsx”.  
**The file name consists of only numbers and underline (no letters or spaces)!**  
This file will be referred to as your **result Excel** file.
3. Open the Excel file “DataGenerator.xlsm” while enabling Macro. You may achieve this by allowing this file to be a Trusted file.
4. Click the button “Generate Series” and see whether the numbers in the first two columns change.
5. Copy the first two columns (Column L and M), then “Paste Values” to the first two columns in the sheet “Data” in your **result Excel** file  
Double check that in Column A and B there are **numbers** in A2:B2001 (two columns, 2000 rows), leave A1 and B1 as “Stock 1” and “Stock 2”.  
Do not worry if the numbers in “DataGenerator.xlsm” change.
6. Save your **result Excel** file and do not repeat this procedure!

## 2 Problem description

You are the head of market risk management of a bank. The bank plan to invest 100 million USD on two stocks, 30 million in Stock 1 and 70 million in Stock 2. The **loss returns (unit: percentage)** of the two stocks in the last 2000 trading days are available in the “Data” sheet in your **result Excel** file. To calculate the economic capital of this portfolio, you need to forecast the one-day VaR(99%) of the **portfolio loss returns**. You decided to conduct six different analyses using the following methods:

**Method 1:** Variance–covariance approach based on the two series

**Method 2:** Historical Simulation based on the portfolio loss returns

**Method 3:** A normal mixture model mixing two normal distributions

Hint: Conduct a JB test to check the normality of the portfolio loss return.

**Method 4:** An EVT approach

Hint: Use the same  $k$  for estimating the tail index and the VaR.

**Method 5:** Fitting a GARCH model with normal innovations (QMLE) and then predict the next day VaR using the dynamic historical simulation method

**Method 6:** Fitting the two series to a bivariate distribution with the marginals following (different) Student–t distributions and the dependence is modeled by a reverse Clayton copula. Here the reverse means that  $(1 - F_1(X_1), 1 - F_2(X_2))$  follows the Clayton copula. In that way,  $(X_1, X_2)$  possesses upper tail dependence.

Hint:

- 1) To fit the Clayton copula, use the moment method based on the Kendall’s  $\tau$ ;
- 2) Estimate the upper tail dependence from the data to validate the model.

Report the results of the six analyses (**unit: percentage**) in the **colored** cells on the sheet “Result”. Do not change the structure or format of any cell in this sheet. Fill in **numbers**, not text or formula. All numbers should be rounded to 4 significant digits (e.g. 3.142, 0.002574), except for two cases where the selected  $k$  should be reported as integers.

**Be aware that the data series are loss returns. We are interested in the right tail!**

### 3 Hand in the assignment

You need to hand in the assignment consisting of two parts: the [result Excel](#) file and your program(s). Here are the instructions for each part.

#### 3.1 The result Excel file

- a) Check that the filename gives the student numbers of both group members.
- b) Make sure that after generating the data series as in Section 1, you **consistently use these two series in all analyses**. Do not re-generate the series!
- c) All your results must be reported according to the instructions in Section 2.

#### 3.2 The program(s)

- a) The program can be written in any program language you prefer.
- b) The main file of the program should be clearly indicated, such as “main.R”.
- c) List the required packages at the beginning of the program.
- d) When running the main file, there should be no error and the results for each analysis should be displayed on the screen directly.
- e) The program should have a clear division for the six analyses: each part should be able to run independently.
- f) **A plagiarism check will be performed across different groups.**

#### 3.3 The successful submission

Once the two parts are ready, bundle the two parts in one ZIP file with the same file name as the [result Excel](#) file, i.e.

**xxxxxx\_yyyyyy.zip**

One member submits this file through Canvas, before the deadline.

An assignment will be graded, only if all conditions below are met.

- a) The ZIP file submitted to the Canvas before the deadline can be unzipped;
- b) The filename of the [result Excel](#) file identifies both group members;
- c) The [result Excel](#) file can be successfully opened in Excel;
- d) The program(s) satisfies all requirements in Section 3.2. **There is no plagiarism issue. If program plagiarism is detected, it will be directly reported to the examination board without prior notice.**