London School of Economics and Political Science
FM321 – Risk Management and Modelling
Department of Finance - Michaelmas Term 2022

Course Project

1. General Instructions:

Date Assigned: Friday 9 November 2022

Date Due: Friday 20 January 2023, **4pm**

Materials Provided: The following materials are provided via the course page on Moodle:

- This document with guidelines and instructions;

Submission Instructions: All project materials will be submitted through the appropriate links in Moodle. The following materials must all be submitted by the deadline:

- One Portable Document Format file (.pdf) with your project write-up, which will contain the description of your work and methodology, your results, and your analysis and conclusions;
- One R file (.Rmd) with the code used to produce the results in the presentation.
- Your submission files must be named with your Exam Candidate Number. Thus, if your Exam Candidate Number is 00000, your Rmd file should be 00000.Rmd and your pdf file should be 00000.pdf.

Please be sure to observe the following important submission notes:

- Late submissions incur a penalty of 5% of final mark for each late day. Submissions can only be made up to five days after the deadline. Thereafter, no submissions will be accepted;
- Students who have not submitted their work by the end of the five-day period after the deadline will receive a mark of zero for the assignment;
- The course project is a summative assignment, and it is marked anonymously. Therefore, **you MUST NOT use your name anywhere on any materials you submit**. This applies to your .pdf file with your write-up, the comments included your R files, your file names or anything else in your submissions. Instead, use your exam candidate number to identify yourself.

2. Project Topic

- Choose six stocks from the list below to work with. Download their stock prices from Yahoo Finance for a sample period from 4 January 2010 to 31 December 2019. Form a portfolio of the six stocks with an equal weight (1/6 each).

  Microsoft (MSFT), Exxon (XOM), Facebook (META), Chevron (CVX), Apple (AAPL), Pfizer (PFE), Johnson & Johnson (JNJ), Wells Fargo & Co (WFC), JP Morgan (JPM), Vmoto (WMT), Bank of America (BAC), Verizon (VZ), AT&T (T), Home Depot (HD), Amazon (AMZN), Alphabet (GOOGL), Mastercard (MA), UnitedHealth Group (UNH), Visa (V).

- First, estimate a multivariate conditional variance model for your selected stocks, using PCA to estimate the factor structure of the stock returns and univariate volatility models of your choice to model the factor variance(s). On the basis of these estimates, produce the portfolio's conditional volatility estimate for the first trading day of 2020 (2 Jan 2020).

- Next, use the portfolio's conditional volatility estimates to compute the VaR estimate for the portfolio at 5% level using the parametric method in Lecture 8 for the first trading day of 2020 (2 Jan 2020).

- Finally, use the unconditional coverage ratio test and the conditional coverage ratio test to backtest the ability of your multivariate model and the parametric VaR method to produce an accurate VaR estimates at 5% level.

  - Do this by selecting an appropriate initial estimation window, re-estimating the volatility model to generate a VaR estimate for the first day following the estimation window, and repeating this in each sample based on a moving window to obtain the hit sequence.

  - Comment on what the outcomes from backtesting implies about your VaR estimate for 2 Jan 2020.

3. General Notes:

- In your .pdf file, please indicate clearly which stocks you are working with.

- You will note that the instructions in the project are general, rather than specific. This is done to allow you to have control over all methodological aspects to the project. For instance, which versions of univariate models you may consider may depend on features of the data and your personal preferences. Likewise, what data

sample to use in each case may depend on features of the data: availability is one obvious consideration, but other factors may need to be taken into account (the presence of outliers that affects estimation results). You can make the choices you deem appropriate in these cases, and be sure to explain and defend them in your write-up.

- Your write-up is limited to 13 pages (including tables and figures, if any). Please aim to make the analysis comprehensive yet concise.

- All of the material you present in your course project must be produced in your R code. As part of the assessment, your R code will be executed with the data file you provide to check it for correctness, and to verify that it produces the data, tables, statistics and charts you use in your write-up.

4. Project Assessment

The elements of the assessment are:

- The correctness of your understanding of the course techniques, and your implementation of these techniques in R;
- Whether your methodological choices, interpretation of results and conclusions are sensible;
- The quality of your presentation.

Excessively bad coding style receive mark deductions. This will be the case if the code is excessively messy, making it very hard to figure out where an error is made in the calculations. Good programming practice always makes it easier to understand and to work with code, for yourself and anyone who reads it. Thus, I suggest that you take the time to indent your code appropriately, provide helpful comments, and choose meaningful variable names. We plan to check for plagiarism using Turnitin.