THIS IS AN OPEN BOOK PORTFOLIO PROJECT. YOU MAY REFER TO ANY OF THE COURSE MATERIALS, OR ANY OTHER SOURCE OF INFORMATION. YOU CANNOT SUBMIT HAND-WRITTEN ANSWERS. ANSWERS ARE TO BE SUBMITTED ON QMPLUS ONLY.

Part A contains two questions, each worth 20%. Answer all questions.

Part B contains two questions, each worth 20%. Answer all questions.

You are to upload and submit three files in a **zipped** directory on QMPlus. Please go to the ECOM155 module page, to the "Assessment" tab and you may submit under the area titled "Portfolio (80%) 23/01/2023". Please only submit the following file types: "PDF", ".R", ".ipynb", "pptx" and "csv" inside a ".ZIP".

Part A (Suggested internal deadline: January 2, 2023)

Answer all questions

Part A refers to data in two files named "testassets2022-23-exam.csv" and "factors2022-23-exam.csv". The file "testassets2022-23-exam.csv" contain 25 test assets from a 5×5 double-sorted size/value portfolios. The file "factors2022-23-exam.csv" contains the fama-french five factors. Note that this is monthly data with each month referred to in "YYYYMM" format. Only use these two datasets in Part A of your portfolio. The short 2-3 line summary of your findings will be inside the "solutions.R file" and any results generated should be inside the code. You can see an example of this "solutions.R" attached alongside this PDF.

1. Fama-Macbeth Regressions:

   (a) Report average monthly returns on these portfolios over the sample period 1963:07 to 2021:10 (this will be the sample period for Part A of the assignment) in one table with the size-deciles in the rows, and the B/M-deciles in columns. What, if any, are the broad patterns in these average returns across assets? (2-3 lines)

   [2.5 marks]

   (b) Report time-series standard deviations of portfolio returns using the same table format. Also report Sharpe ratios of portfolio returns using the same table format. What, if any, are the broad patterns in these Sharpe Ratios across assets? (2-3 lines)

   [2.5 marks]

   (c) Using "factors2022-23-exam.csv" please run the FF-three factor (Market, SMB, HML) and FF-five factor model (all factors).

      i. Estimate time-series regressions using all 25 portfolios for each of the models above. For each model, compute and report the multivariate Gibbons, Ross, and Shanken (GRS) test statistic for the entire set of portfolios, and check whether these reject the null that each of these factor models holds. Report a total of 2 GRS statistics and associated statistical significance.

      [5 marks]

      ii. Using the 25 portfolios, estimate T cross-sectional regressions of the returns on their estimated factor betas (one regression for each month, where T is the total number of months in the sample) from the previous question. That is, you will run a total of 2T cross-sectional regressions, T for each of the two models.
      Note that, for a given model, each one of the regressions has the same right-hand side variable (the estimated factor betas) and changing left-hand side variables (25 portfolio returns in each time period). Test whether these factor models hold for these 25 portfolios, using the Fama-MacBeth test provided in the lecture notes. Report the results of the test for each factor model, i.e., estimated risk premia (λ) and associated t-statistics ($t(\lambda)$) for each of the factors. How many of these are statistically significant using the usual 5% critical value?

      [10 marks]

2. Predictive Fama-Macbeth Regressions. Once you have set up the code for 1(a–c) above, this question will be straightforward.

   (a) Estimate 3-year rolling factor betas using the FF-three factor model as your first stage.

   [10 marks]

   (b) Using these rolling factor betas, estimate (1.c.ii) cross-section regressions as a predictive regression, i.e., the left-hand side variable will be at $t + 1$ (1 month forward) and the right-hand side variables (estimated rolling factor betas) will end at t. Report the correlation between predicted returns and actual returns for the 25 portfolios. You will report 25 numbers. Do you think you have a good model to predict portfolio returns?

   [10 marks]

Part B (Suggested internal deadline: January 15, 2023)

Answer all questions

Part B refers to data in a file named "prediction-exercise-2022-23.csv'. In this file, the column "return" refers to monthly returns. All other columns are predictors as in Goyal and Welch (2008) and in your lecture notes. Note that this is monthly data with each month referred to in "YYYYMM" format. Only use this dataset in Part B of your portfolio. The short 2-3 line summary of your findings will be inside the "solutions.R file" and any results generated should be inside the code. You can see an example of this "solutions.R" attached alongside this PDF.

3. Predictive Linear Regression: Recall the lecture, and the code that runs predictive linear regressions using historical mean return as a benchmark.

   In this exercise you are expected to run predictive linear regressions, using one or more of the predictors in the data. Divide your dataset into two samples, sample 1 from 192102 until 201901. Start running your regressions with at least 120 months of initial data (i.e., from 192102 to 192602) before rolling forward. The next sample from 201902 until 202112 should serve as your out-of-sample data to estimate model fit.

   (a) Find your best forecasting model for predicting returns at one month forward. This may use single or multiple predictors provided to you in the data. You will have one best model on hand here. Generate 1 graph of cumulative SSE difference between your best model and the benchmark return model in your code.

   [20 marks]

   (b) **(OPTIONAL for certificate)** Estimate best models for different monthly horizons: $(T+1)$, $(T+2)$ and so on until $(T+12)$. You will have 12 models on hand that you have validated and finalized using the methods taught in this course.

   From your best models, using the last data point, i.e., 202112, report whether you will go long ("1"), short ("-1") or stay neutral ("0") for Jan 2022, until Dec 2022, on a monthly basis in a file named "trade-strategy.csv". The two columns in the csv should be:

month	strategy
202201	1 (example only)
202202	0 (example only)
202203	-1 (example only)

   This file will form the basis of the "best sharpe ratio" certificate from me and will *not* count for your grade.

4. Using your findings in (3) above and create a 4-page pitch book for investors to invest in your trading strategy. You may refer to an example pitch book attached with this PDF. However, *note that I do not expect you to generate a pitch book identical to this one.* I expect you to explain with charts and words, why your model is good and why I should invest in your trading strategy. This will *not* include transaction costs, or costings of any kind, only a pitch of trading strategy and its success. Upload this file as "pitch.pdf" (ideally) or "pitch.pptx" (less ideal).

   [20 marks]

End of Paper