MScFE 652 PORTFOLIO MANAGEMENT

Group Work Project # 3

[See grading rubric here](#)

Scenario

Portfolio management is going through a renaissance. Why? Machine learning is changing the way people make decisions under uncertainty. Relying on time-tested, Nobel-Prize winning ideas sounds good, but in fact, these ideas may be outdated. Machine learning has already changed the way statistical analyses are done. When applied to the portfolio optimization process, that improvement could be enough to provide an advantage. Combined with leverage and other factors, these advantages could mean a substantial and significant outperformance over the competition.

Welcome to the 21st century of portfolio management! In this GWP, students will apply machine learning concepts of denoising, clustering, and backtesting to optimize a portfolio. Use the portfolios that were analyzed in the previous GWP.

Tasks

Groups of 3 members complete all the following steps:

Step 1. Each student works on one of these topics independently by writing a 1–2 page report on the features and benefits of each of these topics.

- Improvements using denoising
- Improvements using clustering
- Improvements using backtesting

Step 2. Students work together to apply these to the group's portfolio from GWP2. Specifically, they will pick the best portfolio from GWP2. The 'best' portfolio will prove to have a superior risk reward relationship. They prepare a document explaining the merits of applying one, two, or all of these improvements to the current portfolio.

Step 3. Students show how multiple improvements potentially outperform single improvements. Students show which combination of multiple improvements (if any) outperforms single improvements, according to at least three metrics of the group's

choice. Examples of metrics include return, Sharpe ratio, expected shortfall, variance, maximum drawdown, Sortino ratio, etc.)

Step 4. Students will run these improvements by 'training' on the data up to the date of GWP2. Then students will 'test' the model on the 2 weeks of daily data between GWP2's date and the GWP3 date. They will show how well (or poorly) each of the improvements performed out-of-sample.

Step 5. Students answer the following:

1. What are the differences in performance according to these metrics for the different combination of improvements?
2. What reasons might explain these differences in performances (with specific reference to the financial products, the historical data, the math of the model dynamics, etc.),
3. In which cases, if any, does the incremental gain in performance according to the chosen metrics justify the additional complexity and effort of the improvements?

Step 6: Preparing for a Technical Talk

1. Prepare 3 – 5 slides on a technical talk about how the portfolio methodology addressed and solved problems in 1 of the following 3 areas:
   a. Regularization
   b. Prediction vs. Interpretation
   c. Estimation Error
   d. Regime Shifts
2. Be sure to include definitions, equations, formulas about the term
3. Show a direct connection between the data you analyzed and the challenge selected.
4. Show a direct connection between the method you used and how it addressed the financial challenge (Note: Methods may not necessarily help solve the problems caused by the specific challenge)

Groups of 2 members:

1. Only select 2 items from Step 1
2. Students complete Steps 2, 3, 4 and 5. They do NOT do Step 6.

Submission requirements and format

One team member submits on behalf of the entire group the following:

1. **1 PDF document*** with all written notes and required reports
   1. Use the available Report Template and fill out the required information on the first page, then make sure to include the reports in the PDF along with the template.
2. **1 zipped folder including:**
   1. One (1) 10–15 page Jupyter notebook** that contains clear section headings:
      i. Introduction (1 page)
      ii. 1–2 pages of each individual topic's features and benefits (3–6 pages)
      iii. Executable Code showing the implementation and results of each method (3–5 pages)
      iv. Interpretation that answers the 3 questions in step 4 (1–2 pages)
      v. Conclusion (1 page)

** **Use Google Docs to collaborate**. Start by uploading the Report Template provided in the Course Overview. Once your report is completed, click File → Download → PDF Document (.pdf) to obtain the copy for your submission.*

*** **Use Google Colab or GitHub to collaborate** in completing the executable Python program.*

*The PDF file must be uploaded **separately** from the zipped folder that includes any other types of files. This allows Turnitin to generate a similarity report.*

Rubric

Your instructor will evaluate your group submission for GWP1 using the following rubric:

Quantitative Analysis (open-ended questions) 40 Points	Technical and Non-technical Reports 30 Points	Writing and Formatting 20 Points
The group is able to apply results, formulas, and their knowledge of theory to real-life finance scenarios by doing the following: ● Providing all the necessary information to support their arguments. ● Presenting arguments that reflect group discussion and research. ● Using authoritative references to support a position and provide updated information ● Concluding with practical takeaways for more insightful financial decision-making	Technical Reports contain 3 parts: 1) summary of key results; 2) interpretation of results; and 3) the recommended course of action that can reasonably follow from those results and interpretations. **Note**: Technical reports will include the technicalities of models, such as names, methods of estimation, parameter values, etc. and exclude generalities about the work done. It should NOT include names of Python code that were used.	A submission that looks professional should include: ● The axes, labels, and scales in graphs. ● No significant grammar errors or typos. ● Organized, well-structured, and easy-to-read document. ● Proper citations and bibliography using MLA format.
	Non-technical Reports contain 3 parts: 1) clear explanation of results; 2) the recommended course of action that follows; and 3) the identification of factors that impact each portfolio. **Note**: AVOID all references to model names, algorithms, and unnecessary details. Instead, focus on the investment decision.	