MIE 1622 Computational Finance and Risk Management – Winter 2022

Group Course Project

Deadline: Sunday, April 17, 11:59pm

Background

Robo-advisors are online digital platforms that provide automated, algorithm-driven investment services with little human supervision. A typical robo-advisor asks questions about your financial situation and future goals through an online survey, it then uses financial data to offer advice and automatically invest for you. Robo-advisors provide more accessible investing options at low cost as compared to human wealth advisors.

In this project, your team will create a robo-advisor chatbot. You can learn how robo-advisors work in more detail by exploring online courses, e.g., Coursera course "Innovations in Investment Technology: Artificial Intelligence" http://www.coursera.org/learn/invest-tech. Moreover, feel free to register and explore Canadian robo-advising platforms such as Wealthsimple http://www.wealthsimple.com.

Instead of an individual investor interacting with an online robo-advising platform via a graphical user interface, you will create a chatbot that allows a user to express her/his preferences towards asset allocation. Based on a user interaction with the chatbot, you need to formulate and solve a portfolio optimization problem and communicate back to the user an optimal portfolio allocation (number of units to buy or sell for each asset). Visualizations of your optimal portfolio need to be communicated to the user to explain why it makes sense to invest in the selected portfolio and how that portfolio performed in the past and may perform in the future.

You are suggested to use Watson Assistant chatbot platform on IBM Cloud http://www.ibm.com/ca-en/products/watson-assistant, and are required to use Python to interface with the Watson Assistant and with your portfolio optimization solver. You can explore Watson Assistant courses on Coursera and other platforms. Feel free to use other chatbot platforms on Google Cloud, Microsoft Azure Cloud, Amazon AWS Cloud, instead of Watson Assistant, if you decide to do so. The front-end to your chatbot can be Python, any messenger (Facebook Messenger, Slack, Telegram, etc.) or a web-site chat-window (Wordpress plug-in, etc.).

Learning Objectives

- Develop the ability to work in a team on a financial consulting project. (You are required to work on the project in the same group as for your in-class presentation. Check the Quercus portal for the list of your group members.)

- Improve on skills and competencies required for performing a full cycle of financial engineering workflow, i.e., data collection and pre-processing, applying algorithms to analyze data, interfacing with users via a chatbot, storytelling based on financial analytics (writing a consulting report and delivering an oral presentation).

Tools Allowed

- You can use Python libraries mentioned in-class as well as any other Python libraries you find during your research. Note that you can only use Python 3.
- You can use Watson Assistant chatbot platform on IBM Cloud, or any other cloud chatbot platform.
- Using any optimization solvers from Python, e.g., CVXPY, CPLEX, IPOPT, is allowed.
- For visualizing results in your report and presentation you may use Python or any other outside tool, e.g., Excel, Tableau, Power BI, etc.

Asset Universe

- You can use ETFs, stocks and bonds as your asset universe for portfolio selection.
- You may decide to select a new portfolio or to rebalance an existing portfolio.
- You can use historical timeseries from Yahoo Finance or other data sources, historical timeseries of any length are allowed but make sure that those end on the current date.

Investment Strategies

- You can use investment strategies that you implemented in Assignment 1 and Assignment 2.
- You can use mean-variance Markowitz model, or re-sampled mean-variance model by Michaud.
- You can use passive investment strategies (benchmark/index tracking) described in Lecture 5.
- You can use Black-Litterman model.
- You can use any other investment strategies that you find appropriate.

Note: the scope of the project is quite wide, and it is advised that you narrow it down based on your interests and expertise. Make the work truly yours.

Project Presentations

- Project presentations are scheduled for **Monday, April 18, 6:00-9:00pm, online via Zoom**, those are open to the public via Zoom guest link.
- **Do not make your presentation overly technical**. Your audience is business-oriented and may know little about computational finance, people are interested in the insights that you got from your analysis and why your results can and should be implemented in practice for financial decision-making.

What to Submit via Quercus:

1. Your Jupyter notebook with appropriate documentation for every step as well as the relevant data files. Comment out any data retrieval processes if necessary (e.g., from Yahoo Finance, downloading, etc.) in your code and replace it with code for reading the corresponding data from files. (**Submit all those data files together with your Jupyter notebook**). Make sure that your Jupyter notebook runs on Google Colab https://colab.research.google.com portal and that all needed data files are included in your submission. If the size of the data files exceeds Quercus's capacity, those should be stored on a cloud drive (e.g., Dropbox, Google Drive), and the link to the directory should be included in the notebook. Include IBM Cloud credentials to interface with the Watson Assistant in your Python code. Also include JSON workspace file that contains Watson Assistant setup.
2. A 3 to 6-page consulting report in PDF and DOCX formats that summarizes your findings and results (all graphs should have axes appropriately labelled, all visual materials should be understandable and the graphics of sufficient quality to be easily readable.) This report should be business oriented and cover your problem more extensively than your presentation.
3. Your business-oriented presentation slides in PowerPoint and PDF formats. (Each group will present their findings and results during a 8-minute presentation with 1-2 minutes for questions live on Zoom. Presentations will be timed and stopped after 8 minutes.) It is up to you how many group members present (one, two or all).

Marking

- The project is worth 16 points (8 points for your analysis and report and 8 points for your business-oriented presentation).
- The presentation will be graded as follows (8 total marks):
  - 2 marks for organization and delivery (e.g. clarity, enthusiasm, poise)
  - 3 marks for content (e.g. proper visuals, high-level ideas, answering questions)
  - 3 marks for the business pitch (e.g. recommendations, solution to the problem)
- The analysis in Jupyter notebook and the report will be graded as follows (8 total marks):
  - 1 mark for identifying the problem and searching the relevant data
  - 5 marks for the analysis (e.g. cleaning the data, visualizations, applying algorithms)
  - 2 marks for discussion and insight (e.g. how your analysis contributes to the problem, making a decision, storytelling)
- Every group member gets the same mark for the project. It is your responsibility to determine how you split the work inside your group. At least half of your group needs to be present during the online project presentations to answer questions.

Notes

- For the deliverables, consider the Jupyter notebook as what you would report to senior quantitative analysts and financial engineers, and the consulting report and the presentation as what you would report to CEOs, VPs, project managers and non-quantitative financial professionals.
- The presentation would be a visual representation of the executive summary of your report.
- The audience for your presentation and report in particular is business-oriented and includes people who are interested in the insights you gathered from your analysis and how your results should be used for decision-making to implement your robo-advisor chatbot in production for clients.