FIN309 Investments Group Assignment

AY2025/26 Semester 1

Due: 26 December 2025, 11:59pm

Requirements:

- Students should first attempt to form their own groups of six or seven, with the remaining students randomly sorted into groups. Individual submissions (i.e., group of one) are also acceptable and will be treated equally to group submissions.
    - List all members' full name and ID on the cover page.
- Submission of a report (in .pdf format) that is no longer than 15 pages (1 inch margins, 12 point font size, 1.5 line spacing, Times New Roman), including tables, figures, and references (if applicable). Shorter reports will **not** be penalized. Late submissions will **not** be accepted.
- Submission of your codes used for analysis, including data cleaning and manipulation where applicable. Dataset files are also required. There is no restriction on the statistical software or programming language.
- You will be marked on quantitative rigor, depth of conceptual analysis, and clarity and professionalism of your report.
- The use of generative AI is permitted. You must disclose the AI tool's name and version, as well as its role in your report.

Tips:

- In addition to the usual assumptions, state any additional assumptions you deem necessary in solving the problem.
- Data sources include, but is not limited to, CSMAR, Wind, Bloomberg, and WRDS.

Your current portfolio consists of equities and bonds. Large-, mid-, and small-cap stocks are respectively represented by CSI 300 (30%), CSI 500 (20%), and CSI 1000 (20%) indices. CSI Aggregate Bond and SSE Government Bond indices each represent 15% of your portfolio.

1. Calculate the expected return, volatility (standard deviation), and Sharpe ratio of this baseline portfolio using historical data between 2015 and 2024 (i.e., 10 years). *(3 marks)*

2. Reallocate the weights of the existing assets to optimize the portfolio under a mean-variance framework. What is the global-minimum variance portfolio's expected return, volatility, and weight in each asset, if short positions are permitted? And if short positions are not permitted? *(6 marks)*

3. Plot two efficient frontiers: one assuming short positions are permitted and the other assuming short positions are not permitted. Overlay the two frontiers on a single graph. What does the graph tell you? *(3 marks)*

4. Using China's ten-year tresury bond yield as a proxy for the risk-free rate. What is the tangency portfolio's Sharpe ratio and relative weight in each risky asset if shorting is allowed (i.e., assume weights of all risky assets add up to one)? And if shorting is not allowed? *(8 marks)*

You are considering the inclusion of international assets. Specifically, you are exploring the S&P 500, the Hang Seng, and the Hang Seng REIT indices.

5. Assuming you are free to invest in all of the above assets, what is the new tangency portfolio's Sharpe ratio and relative weight in risky asset? Assume short positions are permitted and the risk-free rate is 0. Does the availability of these new assets improve the portolio's expected performance? Why? *(5 marks)*

6. Plot the efficient frontier with the new assets included, overlay it with the original efficient frontier with only five assets. Assume short positions are permitted in both cases. What does this new graph tell you? *(3 marks)*

7. The risk-free asset is no longer available. If you are required to achieve an expected return of at least 8% p.a. based on the new portfolio, what is the

lowest possible volatility of your portfolio, assuming short positions are allowed? What are the weights in each risky asset? *(4 marks)*

8. Based on the new portfolio, does the CAPM holds? Provide empirical evidence. Describe your methodology precisely and in detail. You may choose any reasonable empirical methodology. Interpret your results. State any assumptions you are making. *(12 marks)*

9. Portfolio optimization relies on historical data and several strong assumptions. What are some of these assumptions and to what extent are they realistic in the Chinese market? Discuss potential limitations of applying mean-variance optimization in practice and propose at least one alternative approach (conceptual or methodological) that might address these limitations. *(6 marks)*