ISE 337/447: Active Management Project

(Based in Case Study 6.10 in Textbook)

Due Date: Wednesday, May 15, by 11:59pm on Coursesite

Note: Under otherwise stated, all textbook references are for"Optimization Methods in Finance", Cornuéjols, Peña, Tütüncü, 2nd edition, Cambridge, 2018.

The goal of this project is to apply mean-variance optimization as a tool for active portfolio management (if you are well versed with the Bloomberg terminal, you may use Bloomberg's portfolio analytics capabilities `PORT`).

1. Chose **at least** 20 assets within a universe of assets (for example, assets in the S&P500, S&P100, Dow Jones 30, NASDAQ, Rusell 3000, etc.) and find their weekly and monthly historical returns over a meaningful horizon. Collect also relevant additional data necessary for alpha estimation (see Section 6.6 in the textbook and in particular the estimation alpha section in page 111 or use a methodology you research). For instance, Fama-French factors (book-to-market ratio, size and momentum), or any other factors that you can use to rank your stocks. Briefly discuss and present your selection of assets and the data you obtained.

2. Choose a suitable "benchmark portfolio" (to compare with the one you will be finding). For instance, if you choose stocks from the S&P 500, a reasonable benchmark would be a value-weighted portfolio of the set of selected assets. If you use assets from the Dow Jones 30, you could consider the "Dogs of the Dow" portfolio.

3. Use the first 67% portion of your historical data for "model calibration" (in sample data); that is, to estimate all the parameters that will be involved in the solution of the mean-variance optimization model (estimates of covariance matrix, betas, alphas, etc.). For estimation, look at Section 6.6 in the textbook. It is highly preferable that you avoid using simple historical estimates of the parameters. Use the last 33% portion of your historical data for out-of-sample testing.

4. Use the in-sample data to estimate the covariance matrix, betas and alphas of your stocks. The most straightforward way to estimate the betas of your stock is via linear regression (see Section 6.6 textbook). This would also give you a rudimentary estimate of the alphas.

5. Set up an optimization model with the goal of constructing portfolios that outperform the benchmark. Discuss your selection of objectives and constraints.

6. Test the results of your model using the out-of-sample data. If you are using portfolios obtained with different ad-hoc parameters (e.g., μ_0, upper and lower bounds on assets, rebalancing constraints), test different values of those parameters. The most interesting way of doing out-of-sample testing is by using a "rolling-time window" approach. To that end, proceed as follows:

   (a) Partition the out-of-sample data into m-equally sized time intervals; for example, month-long intervals.

   (b) Using the estimates from question (4), find the optimal portfolio. Assume you hold this portfolio over the first of the m out-of-sample intervals.

   (c) Next, shift the in-sample time window used in step (b), maintaining the length of the in-sample window, and capturing the out-of-sample window in which you just tested the portfolio. Use this new in-sample data to re-estimate all the problem parameters. Find a new optimal portfolio (in going from the previous to the new portfolio it might be interesting to set rebalancing constraints). Assume that you will hold this portfolio over the next out-of-sample interval.

   (d) Repeat until you go over all the out-sample data.

7. Compare the performance of your portfolio with the performance of the benchmark portfolio. As an alternative to comparing with a benchmark portfolio, you can compare the man-variance portfolio with one that is constructed using the mean-mean absolute deviation, the mean-downside semivariance, the mean-VaR, or the mean-CVaR approach. There are many ways to compare the portfolios. Some interesting ones are explained in Section 6.7 of the textbook.