ISE 337/447: Passive Management Project
(Based in Case Study 6.10 in Textbook)
Due Date: Wednesday May 17, 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 construct an index fund that would track a pre-specified market index.

1. Choose a stock market index with **at least** 25 assets to be tracked. Some possible choices are the Dow Jones Industrial Average, the S&P100, and the NASDAQ 100. If you feel ambitious, you may choose a larger index.

   Collect recent historical data over a meaningful horizon. Make sure to include more observations (ideally many more) than the number of stocks in the index. A reasonable choice is a few years (two or three) of weekly data, or a few more (six or seven) of monthly data. For larger indices, you might want to use daily data.

   Use the first 70% of your data for calibrating your model; that is, for paramater estimation, choice of stocks, choice of weights, etc. Use the remaining 30% for out-of-sample testing.

2. Use an Index Fund construction technique to construct a portfolio of a small number of stocks to track the index. Or better yet, construct different potential index funds with different techniques.

3. Compare the performance of the constructed fund and that of the actual stock market index. To this end, test the results of your model(s) on out-of-sample data (not that in class we tested using in-sample data). This is more interesting if done via a rolling-time window approach.

   To that end, proceed as follows:

   (a) Partition the out-of-sample data into m-equally sized time intervals. Since our approach is "passive" for example consider windows of a quarter of a year (that is, we will rebalance the index only four times a year) or half a year.

   (b) Compute the index fund estimating the model parameters using the current in-sample window of data. Assume you hold this index fund 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 index fund. Use this new in-sample data to re-estimate all the problem parameters. Find a new optimal index fund (in going from the previous to the new portfolio it might be interesting to set rebalancing constraints). Assume that you will hold this index over the next out-of-sample interval.

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

4. Repeat what you did in the previous question but using a different number of assets in your index fund. Compare what happens to the performance of the index fund as the number of assets in the fund changes to different values. Or repeat what you did in the previous question but changing the times at which you rebalance the index fund.

5. Propose some alternative way to produce and index fund, and compare how that index fund performs against the one(s) computed using the techniques discussed in class. Be as creative as you wish.