Homework on Day 7

January 26, 2019

The data for the problem is in the EXCEL file IndexData.xlsx. The first column of the data matrix lists the year and the following columns list the year end values for the SP500 index, 10-year Treasury Bond index, Money Market Index, and the NASDAQ index. Solve the following problems.

1. Using the raw data calculate the expected rate of yearly returns for each asset class and the covariance matrix of the returns.

2. Formulate and solve for the minimum variance portfolio with target expected return r varying from 5.0% to 20.0% in steps of 0.5% for each of the following two cases:

   (1) no-short sales constraint

   (2) margin constraints with parameter $M = 3.0$

   Plot the efficient frontier, i.e. the expected return vs the standard deviation of the portfolios, for each of the cases.

3. Suppose we are only able to increase leverage by borrowing in the money market at 50 basis points (bp) (1bp is equal to 0.01%) above the money market rate and have to only hold long positions in the other three assets (i.e., the SP500 index, 10-year Treasury Bond index, and the NASDAQ index). Additionally, we can only leverage up to 80%, i.e. total long position in the other three assets is at most 1.8 (i.e. the short position in the money market is at most 0.8). In this case, plot the efficient frontier, i.e. the expected return vs the standard derivation of the return of portfolio.