ISYE 6227 Summer 2019

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Midterm Project

Portfolio construction and optimization

Consider the problem of investing a total of $1,000,000 in 21 stocks in the U.S. stock market. The tickers of the 21 stocks are: CVS, KO, PG, DWDP, GE, COP, CVX, MSFT, CSCO, CAH, MCK, JPM, BAC, VLO, TGT, HD, ADM, BA, F, VZ, KR.

1. Download the monthly adjusted close prices of the 21 stocks from finance.yahoo.com. Compute the monthly net-returns in percentage terms (as explained in lecture) and prepare a data input file consisting of the net returns of the 21 stocks using the template data input file for the time period of Jan. 1999 to May 2019.

2. Write a computer program (using Matlab, Python, or VBA) to obtain the mean-variance optimal portfolio $x = (x_1, x_2, \ldots, x_{21})$, where x denotes the non-negative portfolio weight vector, for any given target mean rate of return r using data file over the period from Jan. 1999 to Dec. 2014. Suppose you decide to invest $1,000,000.00 in the 21 stocks according to the mean-variance efficient portfolio weight x obtained in Dec. 2014. The investment horizon is from Jan. 2015 to May 2019. Compute the expected net return and the volatility of the net returns of this portfolio over the period of Jan. 2015 to May 2019. For example: the net-return of the portfolio x in Jan. 2015 is equal to the portfolio weight vector x multiplying the net-return vector of the 21 stocks in Jan. 2015, the net-return of the portfolio x in Feb. 2015 is equal to the portfolio weight vector x multiplying the net-return vector of the 21 stocks in Feb. 2015, and so on so forth. Also, consider the equal-weight portfolio y = (1/21, 1/21, ... , 1/21) and compute the 53 monthly returns of the portfolio y over the period of Jan. 2015 to May 2019.
    a. Compute the mean value and the standard deviation of the 53 monthly returns of portfolios x and y, respectively.
    b. Comment on which one of the portfolios x and y is the better performing one and why?

3. You now select 10 stocks out of the 21 stocks in Dec. 2014 based on the following criterion.

- Criterion: Computing M-score for each stock i:
  Pick a value from {1, 2, 3, 4, 5, 6} for n and a value from {3, 4, 5, 6, 7, 8, 9} for m. Say, n = 2, m = 7.

  Let C_t denote the price of stock i in month t (for example, t = Dec 2014)
  Ratio 1: $\ln(C_{t-1}/C_{t-n})$; (n = 2). The meaning of the time index (t-n) is n months before t. For example, if t = Jan. 2015, n = 2, then (t-2) is Nov. 2014 and C_{t-n} refers to the stock price in Nov. 2014. As the value of t changes, C_t and C_{t-n} refer to the stock prices in the respective months t and (t-n).
  Ratio 2: $\ln (C_{t-m}/C_{t-1})$; (m = 7)
  Define weights: b_1 = 1/2, b_2 = 1/2
  for stock i = 1, 2, ..., N
    compute ratios R(1, t), R(2, t)
    compute M_i = b_1*R(1,t) + b_2*R(2,t)
  End i-loop

  Now sort the M-scores of all stocks in the month of Dec. 2014 from largest to smallest and pick the 10 stocks with the highest M-scores.

  Prepare a data input file consisting of the monthly returns of the 10 chosen stocks for the time period of Jan. 1999 to Dec. 2014. Use your program to obtain the mean-variance efficient portfolio x_s in Dec. 2014. Compute the mean and the standard deviation of the net returns of portfolio x_s over the time period of Jan. 2015 to May 2019. Next, compute the mean and standard deviation of the net returns of the equal weight portfolio y_s = (1/10, 1/10, … , 1/10) over the same time period of Jan. 2015 to May 2019.

  - Try different values for (n, m) and find the best performing mean-variance efficient portfolio x_s and the corresponding performance of equal-weighting portfolio y_s.
  - Which one of x_s and y_s in a) performs better? Provide your explanation.

4. For the chosen pair of n and m. Repeat problem 3 for two different cases of (b_1, b_2) in forming the M-score:

	b_1	b_2
Case 1	3/4	1/4
Case 2	1/4	3/4

Based on your results in problem 3 and problem 4, which pair of (b_1, b_2) provides the best stock-selection criterion M-score among the three pairs of values (0.75, 0.25), (0.5, 0.5) and (0.25, 0.75)?