Quantitative Portfolio Management

Assignment #4

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Instructions for each assignment . . . I

- Assignment #1 should be done individually.
- The other assignments are to be done in groups of 4 or 5 students.
  - This means that groups of 1, 2, 3, 6, etc. are not allowed.
  - Diversity in groups is strongly encouraged
    (people from different countries, different genders, different finance knowledge, and different coding ability, etc.)

Instructions for each assignment . . . II

- Each assignment should be emailed as a Jupyter file
  - To Raman.Uppal@edhec.edu
  - The subject line of the email should be: "QPM: Assignment n," where $n = \{1, 2, \ldots, 8\}$.
  - Assignment n is due before Lecture n, where $n = \{1, 2, \ldots, 8\}$.
  - Assignments submitted late will not be accepted (grade $= 0$), so please do not email me assignments after the deadline.

Instructions for each assignment . . . III

- The Jupyter file should include the following (use Markdown):
  - Section "0" with information about your submission:
    - Line 1: QPM: Assignment *n*
    - Line 2: Group members: listed alphabetically by last name, where the last name is written in CAPITAL letters
    - Line 3: Any comments/challenges about the assignment
  - Section "*k*" where $k = \{1, 2, \ldots\}$.
    - First type Question *k* of Assignment *n*.
    - Then, below the question, provide your answer.
    - Your code should include any packages that need to be imported.

Initial step to prepare the data for this assignment

- The data we will be using is the same that we used for the previous assignment. For convenience, I have typed again the instructions.
  - Make sure you have already imported "pandas" and "yfinance."
  - Download from Wikipedia (or any other source) a table that lists the companies that comprise the S&P 500. (See "Helpful links" provided at the end of the assignment.)
  - From this table, extract the list of ticker symbols.
  - Set the start date and end date to be
    - start_date = "2000-01-01"
    - end_date = "2022-12-31"
  - Build a dataframe that contains the stock prices for the S&P 500 companies. (If there are errors for some company names, it is fine to ignore the company names with errors.)
  - Drop the columns that have only "NaN" entries.
  - Drop also the companies with more than 100 missing observations.

Questions for Assignment 4 . . . I

Q4.0 From the data that we used for the previous assignment, select the following 10 companies (these are the first 10 companies with no missing data):
"MMM","AOS","ABT","ADM","ADBE","ADP","AES","AFL","A","AKAM"

- So, our "new" dataset for this assignment will consist of monthly returns you had computed in the last assignment, but just for these 10 companies.
- To reduce the work required for this assignment, please assume that the risk-free rate of return is zero.

Questions for Assignment 4 . . . II

Q4.1 Choose the estimation window to be $T^{\text{est}} = 60$ months of monthly returns. Call this the estimation sample. Use the estimation sample to compute the following two portfolio strategies:

a. mean-variance portfolio (MVP) without constraints on the size of the weight (assume that a risk-free rate is available, with the risk-free rate equal to zero);

b. global minimum variance (GMV) portfolio without constraints on the size of the weight.

Questions for Assignment 4 . . . III

Q4.2 Now use a rolling window of $T^{\text{est}} = 60$ months to estimate the portfolio weights for the two strategies listed above for each of the $T - T^{\text{est}}$ months. That is, repeat the calculations of the previous question for all the dates *after* the first 60 months.

Q4.3 Use the time-series of portfolios weights for each of the two portfolio strategies, to compute the out-of-sample portfolio returns. That is, for each of the two portfolio strategies that you estimate at each date t, compute its out-of-sample return in month $t + 1$.

Q4.4 Now, compute the Sharpe ratio of the out-of-sample returns for the two portfolio strategies. Which strategy has the higher Sharpe ratio?

Helpful hints

- Helpful links for information on downloading S&P 500 ticker symbols.
  - from Danny Groves
  - from GitHub
- Finally, please save the data you have downloaded and created for these ten companies because we will be using it again.

End of questions