# Quantitative Portfolio Management

Assignment #2
(based on Lectures 3 and 4)

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# Instructions for each assignment

- 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 and will be assigned a grade of 0.
  - Diversity in groups is strongly encouraged
    (people from different countries, different genders, different finance knowledge, and different coding abilities, etc.)
- Each assignment should be emailed as a Jupyter file
  - To Raman.Uppal@edhec.edu
  - The subject line of the email should be: "QPM-2025-2026: Assignment $n$," where $n = \{1, 2, 3, 4\}$.

# Instructions for each assignment

- The Jupyter file should include the following (use Markdown):
  - Section "0" with information about your submission:
    - Line 1: Submission date
    - Line 2: QPM-2025-2026: Assignment *n*
    - Line 3: Group members: listed alphabetically by last name, where the last name is written in CAPITAL letters
    - Line 4: Explain along which dimensions your group is diverse
    - Line 5: Any other comments about the assignment (e.g., if you think your Python code is particularly beautiful, you can mention this)
    - The same instructions apply to each assignment, so you can re-use the same Section 0 for all four assignments.
  - 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.

# Help for downloading the data

- Helpful links for information on downloading S&P 500 ticker symbols.
  - from Danny Groves
  - from GitHub

# Questions for Assignment 2

Note that this assignment has two questions. Both questions have five parts. The second question is very similar to the first: in the first question, we study portfolio weights in the *absence of constraints*, while in the second question, we study portfolio weights *with non-negativity constraints*.

Q1.1 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 2

Q1.2 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.

- For each of the two portfolios, rescale the weights in the risky assets so that they sum to 1; that is, you are "fully invested" in just the risky assets.

Q1.3 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.

# Questions for Assignment 2

Q1.4 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 $t + 1$.

Q1.5 Now, compute the Sharpe ratio of the out-of-sample returns for the two portfolio strategies. Which strategy has the higher Sharpe ratio? Why?

# Questions for Assignment 2

Q2.1 Using the estimation window of $T^{\text{est}} = 60$ months of monthly returns, now compute the following two portfolio strategies:

a. mean-variance portfolio with nonnegativity constraints on the weights (when a risk-free rate is available, and set this rate to 0); we will refer to this portfolio as "MVP-C."

b. global minimum variance (GMV) portfolio with nonnegativity constraints; we will refer to this portfolio as "GMV-C".

- For each of the two portfolios, rescale the weights in the risky assets so that they sum to 1; that is, you are "fully invested" in just the risky assets.

Q2.2 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.

# Questions for Assignment 2

Q2.3 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 $t + 1$.

Q2.4 Now, compute the Sharpe ratio of the out-of-sample returns for the two portfolio strategies, "MVP-C" and "GMV-C." Which strategy has the higher Sharpe ratio?Why?

Q2.5 Finally, out of the four strategies you have considered in the two questions, "MVP", "GMV, ", "MVP-C" and "GMV-C," which strategy has the highest Sharpe ratio. Why do you think this strategy performs the best?

End of questions