Exam: Version C

Description of files:

- "prices_fin.xlsx" contains the prices of the constituents of the S&P100 from 11/05/2021 to 24/10/2023
- "sectors_fin.xlsx" contains the sector index to which each company belongs
- "market_cap_fin.xlsx" contains the market capitalization for each company

The objective of this report is to build portfolios using different allocation strategies and discuss their performances, using as investment universe the constituents of the S&P100 index.
You must send me via email all the matlab codes and a report of 10-15 pages (maximum) in which you discuss your results with the help of tables and plots.

Part A: Use prices from 11/05/2021 to 11/05/2022.

1. Compute the efficient frontier under the standard constraints, i.e. $\sum_i^N w_i = 1$ and $0 \leq w_i \leq 1 \; \forall i \in [1, .., N]$. Compute the Minimum Variance Portfolio, named Portfolio A, and the Maximum Sharpe Ratio Portfolio, named Portfolio B, of the frontier.

2. Compute the efficient frontier under the following constraints (to be considered all at once):

   - Standard constraints,
   - The overall exposure of the companies belonging to the sector "Consumer Discretionary" has to be greater then 15%,
   - The overall exposure of the companies belonging to the sector "Industrials" has to be less then 5%
   - The weights of the companies belonging to sectors that are composed by less than 5 companies has to be null.

   Compute the Minimum Variance Portfolio, named Portfolio C, and the Maximum Sharpe Ratio Portfolio, named Portfolio D, of the frontier.

3. Compute the frontiers in step 1 and 2 using the resampling method in order to obtain 2 robust frontier. For each frontier save the Minimum Variance Portfolios, named Portfolios E and F, and the Maximum Sharpe Ratio Portfolios, named Portfolios G and H, of the frontiers.

4. Compute the portfolio frontier, under standard constraints, using the Black-Litterman model with the following views (to be considered all at once):

   - The companies belonging to the sector "Consumer Staples" will have an annual return of 7%,
   - The companies belonging to the sector "Healthcare" will have an annual return of 3%,
   - The companies belonging to the sector "Communication Services" will outperform the companies belonging to the sector "Utilities" of 4%

   Compute the Minimum Variance Portfolio, named Portfolio I, and the Maximum Sharpe Ratio Portfolio, named Portfolio L, of the frontier.

5. Compute the Maximum Diversified Portfolio (Portfolio M) and the Maximum Entropy (in asset volatility) Portfolio (Portfolio N), under the following constraints (to be considered all at once):

   - Standard constraints,
   - The weights of the companies belonging to the sector "Financials" are $0.001 \leq w_i \leq 0.02$,
   - The weights of the companies belonging to the sector "Industrials" are $0.005 \leq w_i \leq 0.01$

6. Compute the portfolio (Portfolio P), using the Principal Component Analysis (10 factors), that maximizes its expected return under the following constraints (to be considered all at once):

   - Standard constraints,
   - The volatility of the portfolio has to be equal or less than a target volatility of $\sigma_{tgt} = 0.007$

7. Compute the Portfolio that maximizes, under standard constraints, the Expected Shortfall-modified Sharpe Ratio (i.e. the risk in the formula of Sharpe Ratio is the Expected Shortfall), named Portfolio Q, using the Variance-Covariance method.

8. Discuss the characteristics of all the portfolios you have computed in steps 1-7 in terms of performance, risk and diversification using performance and diversification metrics, with the help of plots and tables. Use as benchmark the equally weighted Portfolio. Discuss the results.

Part B: Use the portfolio allocations computed from steps 1 to 7 (from portfolio A to Q) to evaluate the performance of the portfolios in the period 12/05/2022-12/05/2023. Discuss how the results are changing from the ones calculated in point 8.