Master SMT
Sustainable and Entrepreneurial Finance

Homework 1

Objectives

The objectives of this homework are the following:

- Evaluate the impact of diversification in portfolio construction

- Build portfolios of stocks based on the mean-variance criterion (efficient frontier)

- Evaluate the effect of imposing restriction on the set of assets

Instructions

- Assignments should be done in groups of 4 students.

- You should work with the same group through the entire course.

- Submit on Moodle only one copy of solutions per group with the code.

- For each homework you can get a maximum of 100 points.

- All assignments turned in late will not be graded (zero points).

Due date
March 10, 2022.

Each group will pick firms to analyze for Homework 1 and Homework 3 as follows:

1. **Group 1**: U.S. firms with available **environmental** scores (MSCI)

2. **Group 2**: U.S. firms with available **social** scores (MSCI)

3. **Group 3**: U.S. firms with available **governance** scores (MSCI)

4. **Group 5**: U.S. firms with available scope 1, scope 2, and scope 3 emissions (Trucost)

5. **Group 7**: European firms available scope 1 to 3 emissions (Trucost)

6. **Group 8**: Firms from Emerging countries with available scope 1 to 3 emissions (Trucost)

7. **Group 9**: Utilities firms with available scope 1 to 3 emissions (Trucost)

8. **Group 10**: Energy firms with available scope 1 to 3 emissions (Trucost)

9. **Group 11**: Materials firms with available scope 1 to 3 emissions (Trucost)

10. **Group 12**: European firms with available **environmental** scores (MSCI)

11. **Group 13**: European firms with available **social** scores (MSCI)

12. **Group 14**: European firms with available **governance** scores (MSCI)

13. **Group 15**: Firms from Emerging countries with available **environmental** scores (MSCI)

14. **Group 16**: Firms from Emerging countries with available **governance** scores (MSCI)

All data will be available on Moodle. Once you have selected your set of firms, answer the following questions:

Portfolio allocation

1. Compute and report the annualized average return and annualized volatility for all individual assets. Compute the correlation between individual average returns and volatility and comment on the observed correlation. (5 points)

2. Form an equally-weighted and value-weighted portfolio with monthly rebalancing. Report the following statistics for both portfolios: annualized average return, annualized volatility, minimum return, maximum return, and Sharpe ratio. Plot the time series of returns for both portfolios. (10 points)

3. Supposed that you invested 100% of your wealth in the asset with the highest annualized average return computed in point 1. Compare the annualized average return and annualized volatility of this one-asset portfolio with the equally-weighted and value-weighted portfolios? What explains the differences between a one-asset portfolio and a portfolio composed of many stocks? What if you invest 100% of your wealth in the asset with the highest average return computed over the first 2 years? (10 points)

4. For this question, limit your set of firms to 50 randomly selected firms. Build an optimal portfolio with minimum variance with monthly rebalancing. Report the following statistics: annualized average return, annualized volatility, minimum return, maximum return, and Sharpe ratio. Comment on the reported statistics in comparison with the equally-weighted and value-weighted portfolio. (15 points)

5. For this question, keep the same randomly selected firms from the previous point. Build an optimal portfolios with various target portfolio returns (e.g., from 2% to 16% with 2% increments). Plot the efficient frontier as well as the individual assets. Which portfolio is the most efficient in terms of Sharpe ratio? (15 points)

6. Choose an appropriate benchmark, which should correspond to the region of your dataset. Compare the performance of your portfolios (equally-weighted, value-weighted, and minimum variance) with the benchmark. Comment on the differences. (10 points)

7. Compute and comment on the simple correlation between returns, volatility, size. (5 points)

8. For this question, take the same 50 selected firms. You now create a minimum variance portfolio with monthly rebalancing with an additional constraint: you exclude the smallest firms (bottom tercile of the distribution of the firms' market capitalization in month $t-1$). Report summary statistics on the performance of this portfolio and comment on the differences with the minimum variance from point 4. (15 points)

9. For each time period, sort firms based on size into quintiles. Create equally-weighted and value-weighted portfolios for each time period and each size quintile. Report the average returns for each quintile portfolio as well as a portfolio that goes long in the lowest quintile and short the highest quintile. Comment on your results. What can explain the relationship between returns of your portfolio and firms' size? Repeat this exercise but sorting firms based on past stock returns. Compute past returns in month t as the cumulated return of a firm between months $t-13$ and $t-1$. (15 points)