

# Master SMT

## Sustainable and Entrepreneurial Finance

### Assignment 2 – ESG Score

**Due date: March 31, 2025 at the beginning of the class**

#### Objectives

The objectives of this homework are the following:

- Evaluate the E/S/G score of a business-as-usual (BAU) portfolio
- Build portfolios of stocks with a higher score based on the mean-variance criterion (efficient frontier)
- Evaluate the relative performance of BAU and ESG-improved portfolios

#### 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 the solution per group, with the code in an independent file.
- For each homework you can get a maximum of 100 points.
- All assignments turned in late will not be graded (zero points).

Take the same data from Assignment 1 and answer the following questions:

### Portfolio allocation with extra-financial constraints

1. Report summary statistics (mean, median, min, max, standard deviation) on the cross-sectional distribution of the score that has been assigned to you. Draw the histogram of the cross-sectional distribution of the score and comment on the summary statistics and the histogram. (10 points)

2. In Question 3 of Assignment 1, you calculated the efficient frontier based on portfolios associated with various target returns  $\tilde{\mu}_p$ . Compute the weighted-average E/S/G score of each of these portfolios. Proceed as follows: Start with the E, S, or G score ( $Sc_i$ ) of all firms in your investment set, averaged over the sample period. MSCI scores are between 0 and 10. The weighted-average score of the portfolio is defined as follows:

$$Sc^{(p)} = \sum_{i=1}^N \alpha_i^* Sc_i$$

where  $\alpha^*$  is the optimal portfolio weight vector associated with a target return  $\tilde{\mu}_p$  (calculated in Question 3 of Assignment 1).

Comment on the E/S/G score of the portfolios. Which firms drive the E/S/G score down (e.g., top 10; report firm names along with ISIN codes)? Plot in the E/S/G score-return space the various portfolios (i.e., make a plot similar to the efficient frontier except that E/S/G score replaces the volatility on the x-axis). (25 points)

3. This question is a follow-up of Question 4 of Assignment 1. Take again all firms in your dataset for which you have a E/S/G score. Calculate the temporal evolution of E/S/G score of the minimum variance portfolio as follows:

$$Sc_Y^{(gmV)} = \sum_{i=1}^N \alpha_{i,Y}^* Sc_{i,Y}$$

where  $\alpha_Y^*$  is the minimum variance portfolio weight vector determined at the end of year  $Y$  (portfolio  $P_{oos}^{(gmV)}$ ).

Reallocate the portfolio composition in order to improve the E/S/G score by 20% as follows

$$\begin{aligned} \min_{\{\alpha_Y\}} \quad & \sigma_{p,Y+1}^2 = \alpha_Y' \Sigma_{Y+1} \alpha_Y \\ \text{s.t.} \quad & \alpha_Y' e = 1 \\ \text{s.t.} \quad & \alpha_{i,Y} \geq 0 \quad \text{for all } i \\ \text{s.t.} \quad & \alpha_Y' Sc_Y \geq 1.2 \times (\alpha_Y^* Sc_Y^{(gmV)}) \end{aligned}$$

We call this portfolio “ $P_{oos}^{(gmV)}(0.2)$ ”. Comment on the changes necessary to improve the E/S/G score (e.g., how many and which firms (firm names) must be excluded in the most recent year of your sample in order to achieve these objectives). (30 points)

4. An interesting alternative strategy to improve the score consists in designing the portfolio that is as close as possible to the benchmark, while improving the E/S/G score

by 20% (*otherwise passive investor*). This is done by solving the minimum variance criterion for the tracking error every year:

$$\begin{aligned}
\min_{\{\alpha_Y\}} \quad & (TE_{p,Y})^2 = (\alpha_Y - \alpha_Y^{(vw)})' \Sigma_{Y+1} (\alpha_Y - \alpha_Y^{(vw)}) \\
s.t. \quad & \alpha_Y' e = 1 \\
s.t. \quad & \alpha_{i,Y} \geq 0 \quad \text{for all } i \\
s.t. \quad & Sc_Y^{(p)} \geq 1.2 \times Sc_Y^{(vw)}
\end{aligned}$$

where  $Sc_Y^{(vw)} = \sum_{i=1}^N w_{i,Y} Sc_{i,Y}$  denotes the score of the value-weighted portfolio, with  $w_{i,Y} = Cap_{i,Y} / \sum_{j=1}^N Cap_{j,Y}$  denotes the relative market capitalization of firm  $i$  at the end of year  $Y$ .

We call this portfolio “ $P_{oos}^{(vw)}(0.2)$ ”. Compute the characteristics of the portfolio over the sample. Again, plot the cumulative return series of both strategies and compare summary statistics.

5. Comment on the trade-off between the financial performance of the portfolio and the improvement in the extra-financial performance. Elaborate on the difference between portfolios “ $P_{oos}^{(mv)}$ ” and “ $P_{oos}^{(mv)}(0.2)$ ” and between portfolios “ $P_{oos}^{(vw)}$ ” and “ $P_{oos}^{(vw)}(0.2)$ ”. (35 points)
6. Prepare approx. 10 slides in order to present the key results from this homework with an emphasis on your area of focus (sectoral or geographical). Each group has 15 minutes to present. Presentations will count as separate points.