

Seminar - Markowitz Portfolio Optimization

PUJOL Martin
RAMPONT Martin
THOMASSIN Pablo
STRIEBIG Maximilien

December 4, 2023

Theoretical Part

Problem Description

In the realm of financial portfolio management, the Markowitz portfolio optimization problem is a classical and essential topic. The primary objective is to allocate weights to different assets in a portfolio to maximize the expected return while minimizing the overall portfolio risk. Let's consider a portfolio with n assets. The goal is to find the optimal set of weights for these assets.

Formalization

Let:

r_i : Expected return of asset i
 σ_i : Volatility (risk) of asset i
 w_i : Weight of asset i in the portfolio

The objective is to find the vector of weights $\mathbf{w} = [w_1, w_2, \dots, w_n]$ that maximizes the expected portfolio return μ while minimizing the portfolio risk σ_p :

$$\begin{aligned}
& \text{Maximize} && \mu = \sum_{i=1}^n r_i w_i \\
& \text{Subject to} && \sigma_p = \sqrt{\sum_{i=1}^n \sum_{j=1}^n w_i w_j \sigma_i \sigma_j \rho_{ij}} \quad (\text{Portfolio risk}) \\
& && \sum_{i=1}^n w_i = 1 \quad (\text{Sum of weights equals 1}) \\
& && w_i \geq 0 \quad (\text{Non-negativity constraint})
\end{aligned} \tag{1}$$

Where:

ρ_{ij} : Correlation coefficient between assets i and j

Numerical Part

Selected Optimization Methods

For solving the Markowitz portfolio optimization problem, we have chosen two numerical optimization methods:

1. Method 1: [Insert Method 1 Name]
2. Method 2: [Insert Method 2 Name]

Algorithm Implementation

Below are the basic functions describing the two chosen algorithms:

Method 1: [Insert Method 1 Name]

[Insert code or pseudocode for Method 1 implementation]

Method 2: [Insert Method 2 Name]

[Insert code or pseudocode for Method 2 implementation]

Results and Analysis

We have applied both methods to the Markowitz portfolio optimization problem and obtained the following results:

[Insert results, tables, or graphs]

Interpretation

[Provide interpretation of the results]

Comparison

To compare the two methods, we analyze factors such as computational time and the number of iterations:

[Insert comparison results]