Convex Optimization

Lab 7: Portfolio Problem

Lecturer: *Dr*. Wan-Lei Zhao

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Contact: wlzhao@xmu.edu.cn

- Given three financial products, and 10,000$
- Given we buy in three products on the first day of this month, and sell out on the first of next month
- Please work out an investment strategy that minimizes the investment risk, while keeping the return above 500$

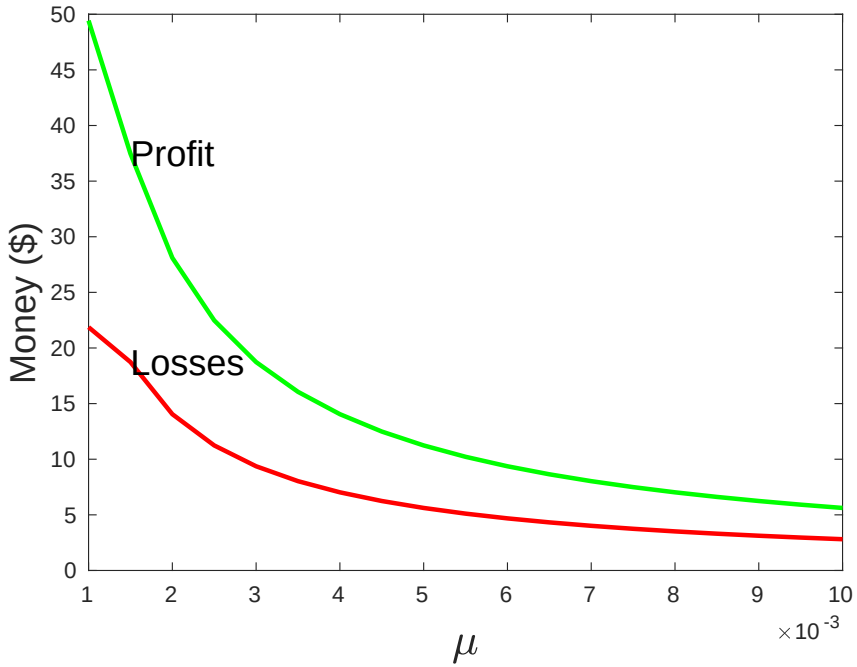
Price of three Financial Products

Table: Price of three Financial Products ($)

Date	MouTai	Gold	NVIDIA
2022.10	251.06	1672.0	120.76
2022.11	209.14	1676.6	141.56
2022.12	229.69	1815.2	171.35
2023.01	243.66	1846.1	143.15
2023.02	259.85	1942.8	209.43
2023.03	258.95	1845.4	226.98
2023.04	253.81	2000.4	279.65
2023.05	246.48	1992.2	289.10
2023.06	230.41	1995.5	397.70
2023.07	242.83	1929.5	424.13
2023.08	266.06	1978.8	465.07
2023.09	260.71	1967.1	485.09
2023.10	250.28	1847.2	447.82
2023.11	250.84	1987.5	423.25

Solve the problem

1. Build out a model to minimize the Risk, while keeping the return above $500
2. Build out a model to minimize the risk while maximizing the return, try with different μs



The models

$$\text{s.t.} \begin{cases} Min.\ \ x^T \Sigma x \\ x^T \bar{r} \geq P_0 \\ x^T \mathbf{1} \leq M \\ x \succeq 0 \end{cases} \quad (1)$$

$$\text{s.t.} \begin{cases} Min.\ \ \mu x^T \Sigma x - x^T \bar{r} \\ \sum_i x_i \leq 10000 \\ x \succeq 0 \end{cases} \quad (2)$$

Codes for reference

$$\min.\ \alpha^t H\alpha + c^t\alpha$$

$$\min.\ \frac{1}{2}\alpha^t 2\cdot H\alpha + c^t\alpha \Longrightarrow \min.\ \frac{1}{2}\alpha^t H_0\alpha + c^t\alpha$$

$$H=\begin{bmatrix}40 & 18 & 20\\ 18 & 13 & 9\\ 20 & 9 & 10\end{bmatrix} \Longrightarrow H_0=2\cdot H=2\cdot\begin{bmatrix}40 & 18 & 20\\ 18 & 13 & 9\\ 20 & 9 & 10\end{bmatrix}$$

$$c^t=\begin{bmatrix}-80 & -50 & -40\end{bmatrix} \Longrightarrow c^t=\begin{bmatrix}-80 & -50 & -40\end{bmatrix}$$

$$\alpha_1+\alpha_2+\alpha_3=1 \Longrightarrow A^t=\begin{bmatrix}1 & 1 & 1\end{bmatrix}\quad r=[1]$$

$$\alpha_1,\alpha_2,\alpha_3\geq 0 \Longrightarrow lb=\begin{bmatrix}0 & 0 & 0\end{bmatrix}$$

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%filling your code here
[x, fval]=quadprog(H, C0, B,b, A, a, lb, ub)
%filling your code here
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