Financial Engineering Laboratory (MA 374)

Lab 04

Naveen Kumar A G 210123075

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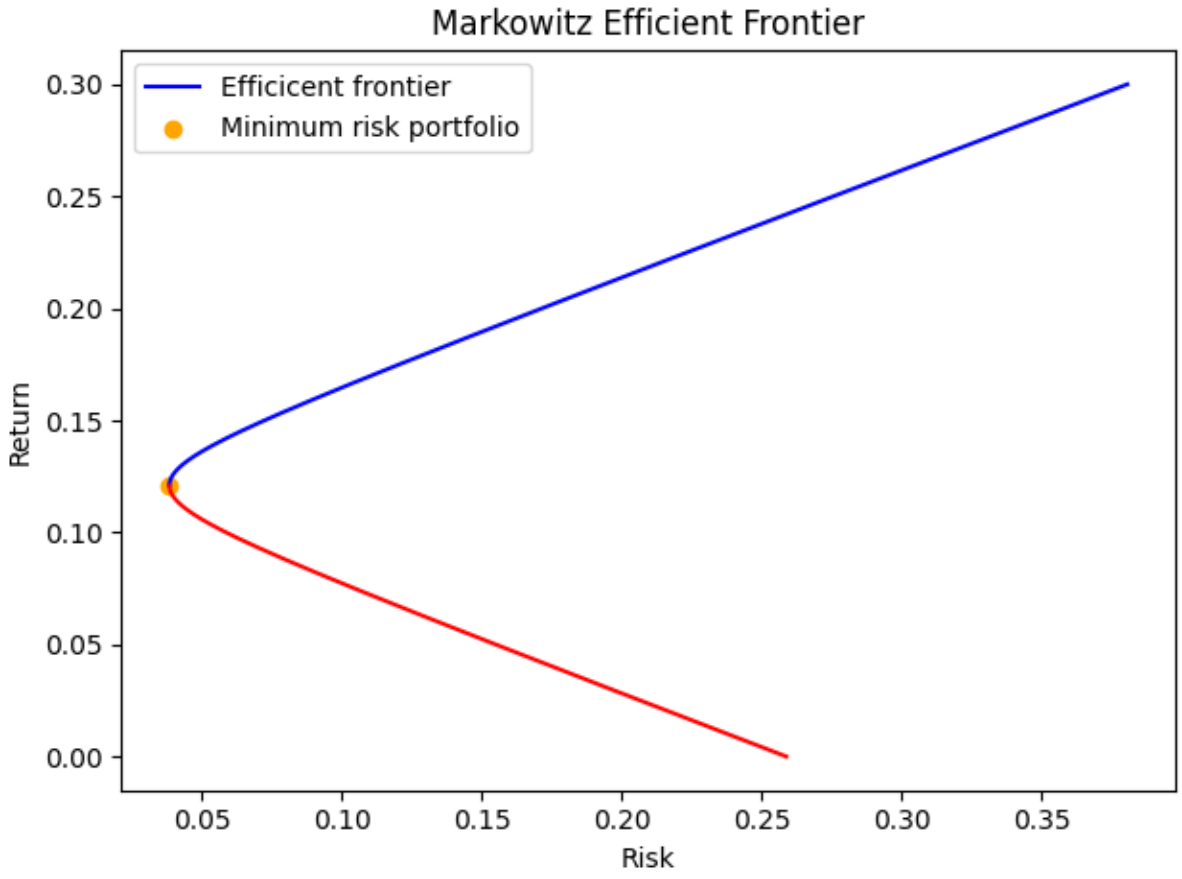
3 assets with the following mean returns and dispersion matrix.

$$\boldsymbol{\mu} = \begin{bmatrix} 0.1 & 0.2 & 0.15 \end{bmatrix}$$

$$\Sigma = \begin{bmatrix} 0.005 & -0.010 & 0.004 \\ -0.010 & 0.040 & -0.002 \\ 0.004 & -0.002 & 0.023 \end{bmatrix}.$$

Q1:

a) Markowitz Efficient Frontier



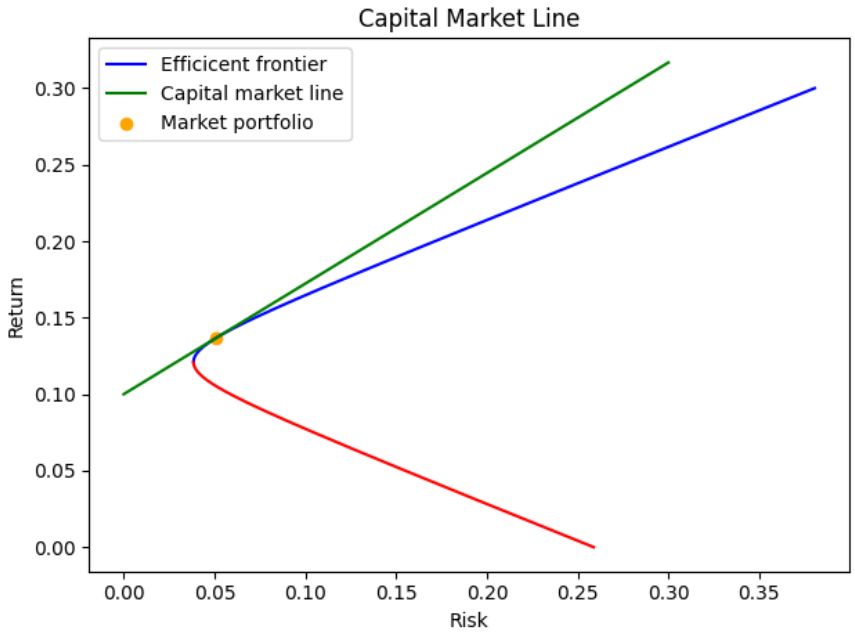
b) Weights, return and risk for 10 different values on the efficient frontier.

	Weight 1	Weight 2	Weight 3	Returns	Risks
1	0.818415	0.238835	-0.057250	0.121021	0.038427
2	0.534755	0.351572	0.113673	0.140841	0.056899
3	0.251095	0.464308	0.284597	0.160661	0.092265
4	-0.036863	0.578753	0.458109	0.180781	0.132147
5	-0.320522	0.691490	0.629033	0.200601	0.172686
6	-0.604182	0.804226	0.799956	0.220420	0.213759
7	-0.887842	0.916963	0.970879	0.240240	0.255107
8	-1.175800	1.031408	1.144392	0.260360	0.297245
9	-1.459459	1.144144	1.315315	0.280180	0.338857
10	-1.743119	1.256881	1.486239	0.300000	0.380536

c) Maximum return for portfolio with 15% risk: 0.19
Weights: [-0.16, 0.63, 0.53]
Minimum return for portfolio with 15% risk: 0.053
Weights: [1.80, -0.15, -0.65]

d) Minimum risk portfolio for 18% return has risk: 0.13
Weights: [-0.026, 0.57, 0.45]

e) Market return: 0.13671875
Market risk: 0.05081128919221592
Market weights: [0.59375 0.328125 0.078125]
Capital market line equation: return = 0.1 + 0.7226494462892934 * risk

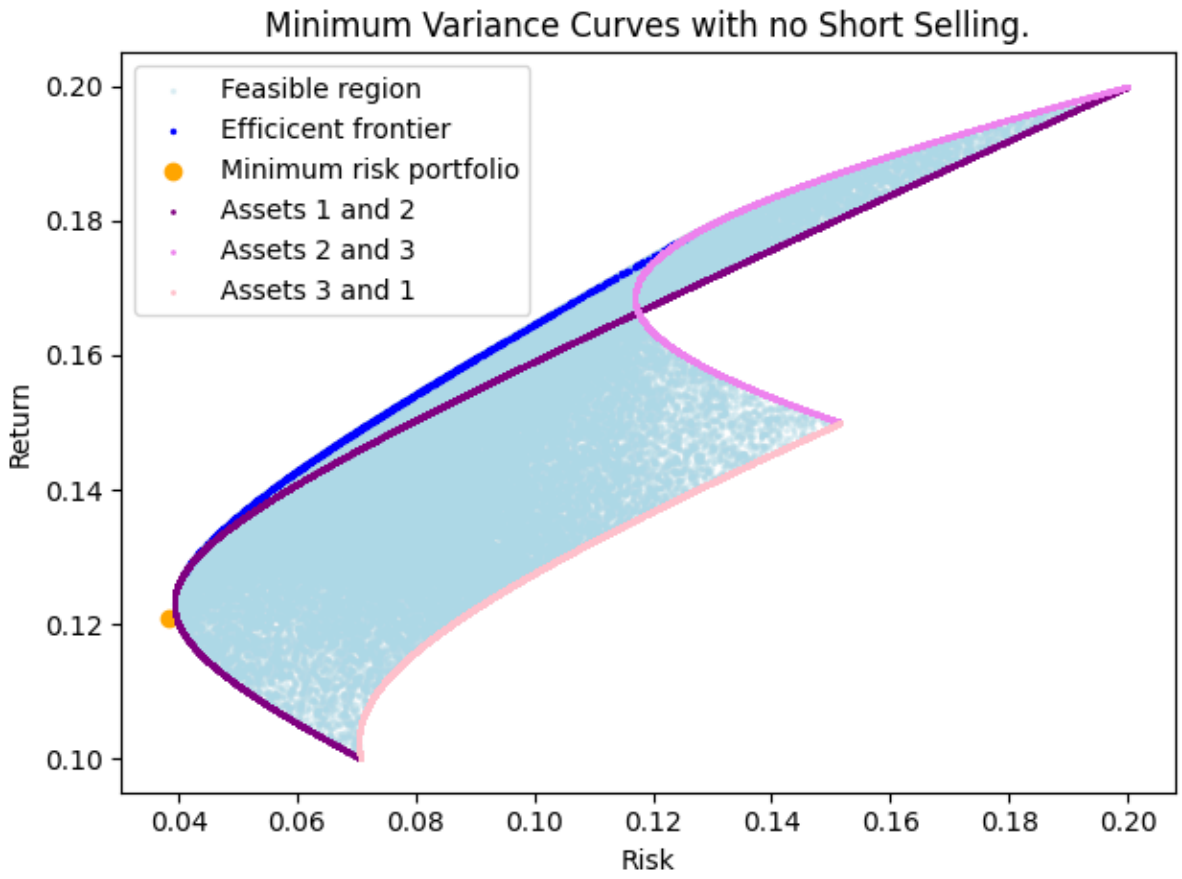


f) Portfolio having both risk and risk-free asset with 10% risk:
Risk free asset weight: -0.97
Risky asset weights: [1.17, 0.65, 0.15]

Portfolio having both risk and risk-free asset with 25% risk:
Risk free asset weight: -3.92
Risky asset weights: [2.92, 1.61, 0.38]

Q2:

a) Minimum Variance Curve and the feasible region assuming no short selling. The plot also contains minimum variance curves with two securities considered at a time.

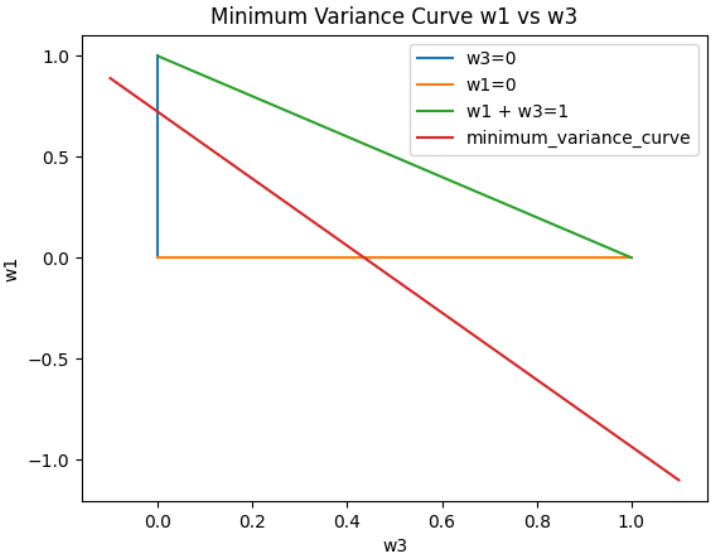


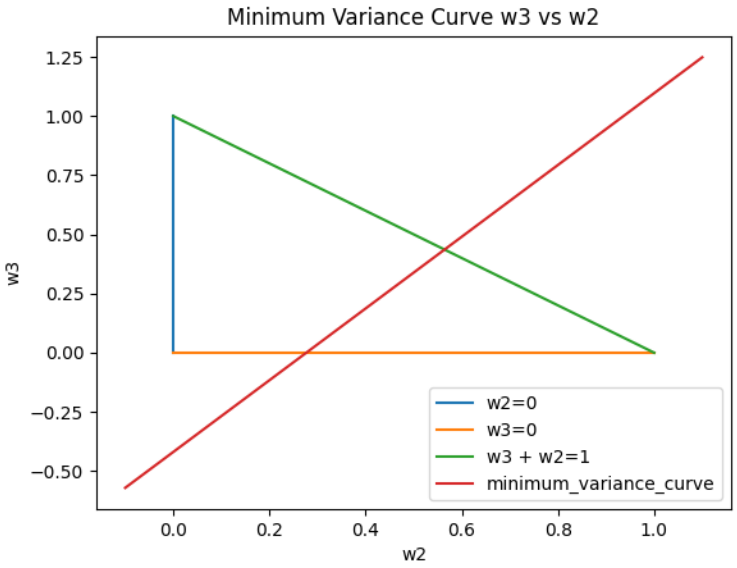
b) Weights plot corresponding to the minimum variance curve.

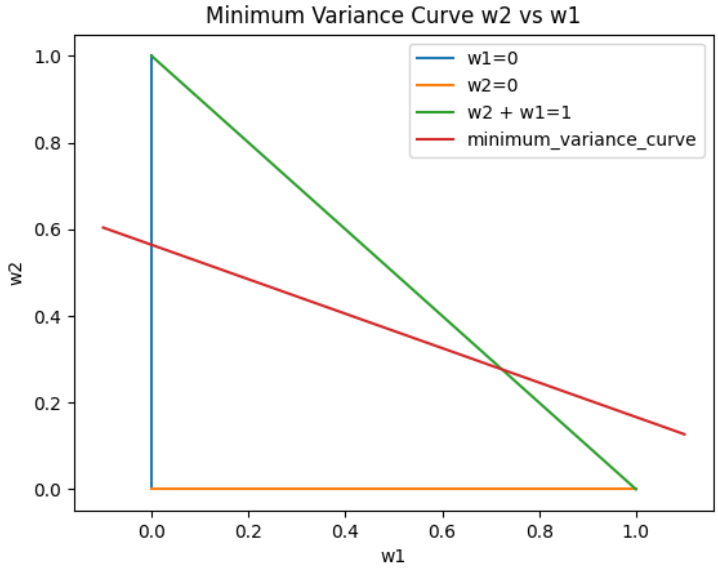
Minimum portfolio line: w2 = -0.40 * w1 + 0.56

Minimum portfolio line: w3 = 1.52 * w2 + -0.42

Minimum portfolio line: w1 = -1.66 * w3 + 0.72



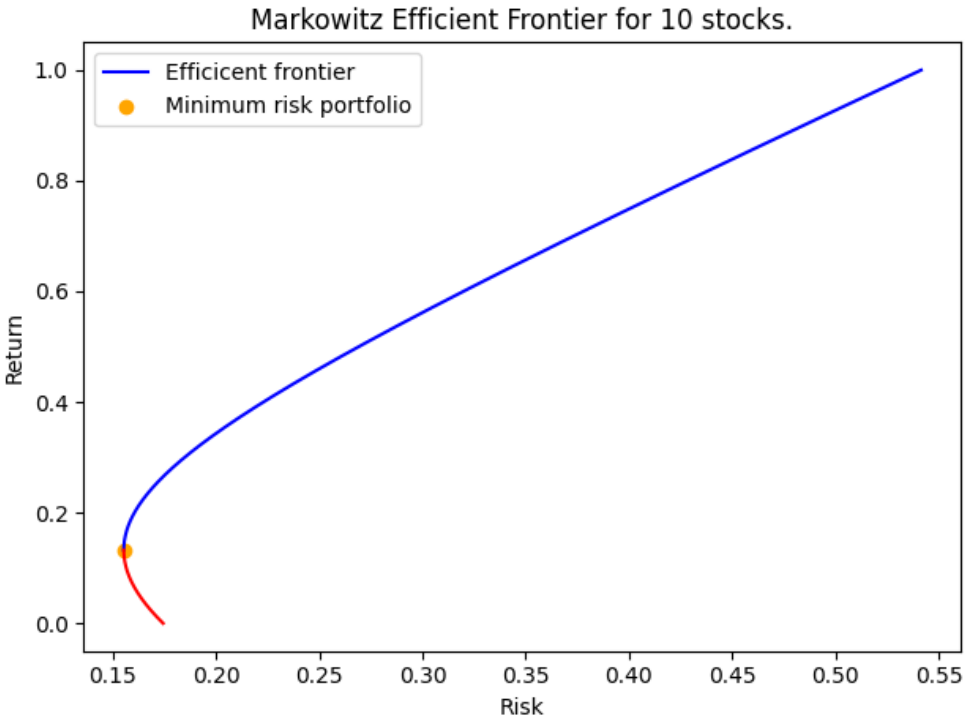




Q3: Stocks considered AAPL, AMZN, FB, GOOG, IBM, INTC, MSFT, NFLX, NKE, TSLA.

Risk-free return: 5%

a) Markovitz Efficient Frontier:

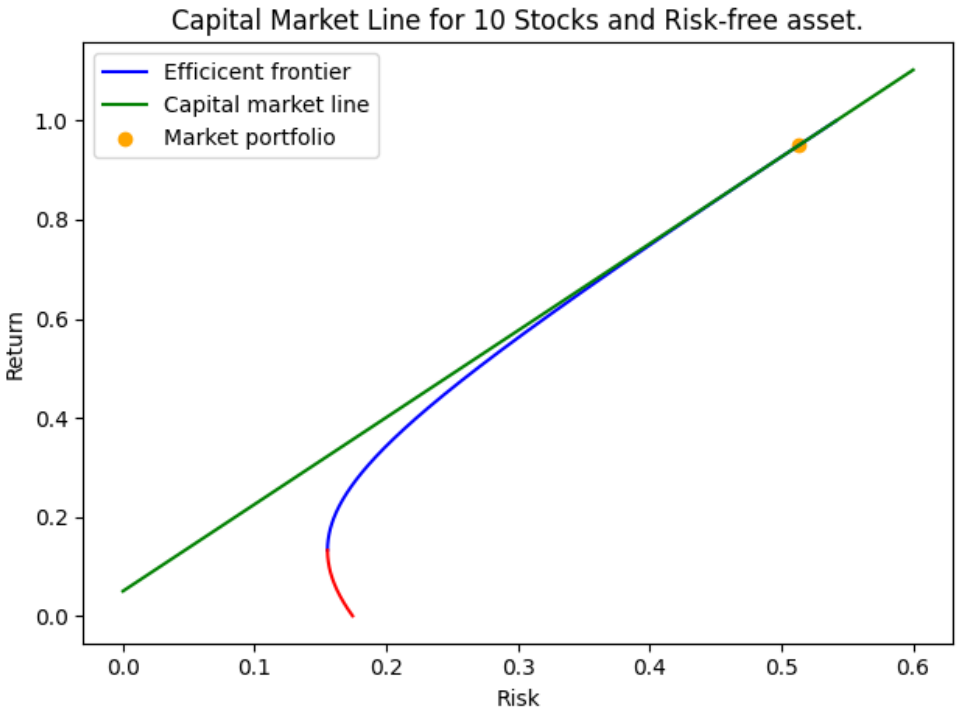


b) Market return: 0.95

Market risk: 0.51

Market weights: [0.23, 1.14, -0.22, -0.27, -1.86, -0.21, 1.09, 0.29, 0.80, 0.017]

c) Capital market line equation: return = 0.05 + 1.75 * risk:



d) Security Market Line: return = 0.90 * beta + 0.05