Financial Engineering Lab (MA374)

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Lab - 03

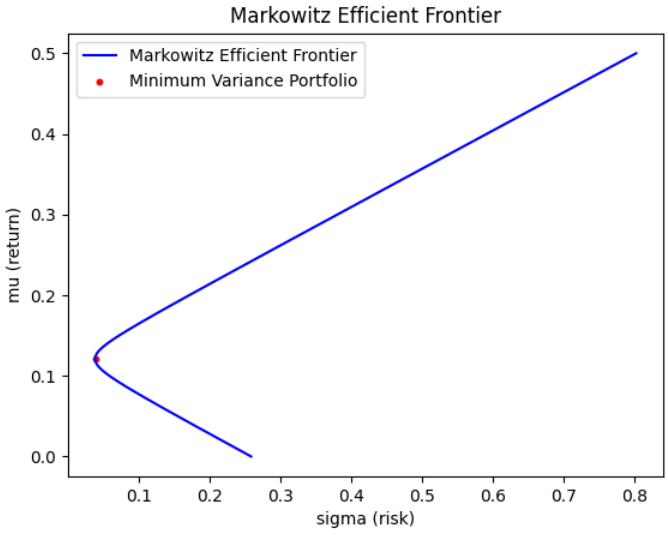
To run the code for q1 type **python3 180123021_Kartikeya_Singh_q1.py** into the terminal (similarly for other questions as well).

Question - 1

A) The Markowitz efficient frontier is constructed using the given data. The minimum variance portfolio obtained is -

- *Weights : [0.81870386, 0.23872026, -0.05742412]*
- *Return (mu) : 0.12100082034454472*
- *Risk (sigma): 0.03842681590342608*

The Markowitz Efficient Frontier is -



B) The Weight, Risks and Return of 10 different portfolios is -

- *mu = 0.00, sigma = 0.258790,*
  weights = [2.55045872 -0.44954128 -1.10091743]
- *mu = 0.05, sigma = 0.155008,*
  weights = [1.83486239 -0.16513761 -0.66972477]
- *mu = 0.10, sigma = 0.058733,*
  weights = [1.11926606 0.11926606 -0.23853211]
- *mu = 0.15, sigma = 0.072378,*
  weights = [0.40366972 0.40366972 0.19266055]
- *mu = 0.20, sigma = 0.171448,*
  weights = [-0.31192661 0.68807339 0.62385321]
- *mu = 0.25, sigma = 0.275531,*
  weights = [-1.02752294 0.97247706 1.05504587]
- *mu = 0.30, sigma = 0.380536,*
  weights = [-1.74311927 1.25688073 1.48623853]
- *mu = 0.35, sigma = 0.485864,*
  weights = [-2.4587156   1.5412844   1.91743119]
- *mu = 0.40, sigma = 0.591344,*
  weights = [-3.17431193 1.82568807 2.34862385]
- *mu = 0.45, sigma = 0.696907,*
  weights = [-3.88990826 2.11009174 2.77981651]

(Here mu represents return and sigma represents risk)

C) For a 15% risk, the minimum and maximum return portfolios are -

- *Minimum Return = 0.052553*
  for the portfolio = [1.79833044, -0.15061851 -0.64771193]
- *Maximum Return = 0.189690*
  for the portfolio = [-0.1643662   0.62942759 0.53493861]

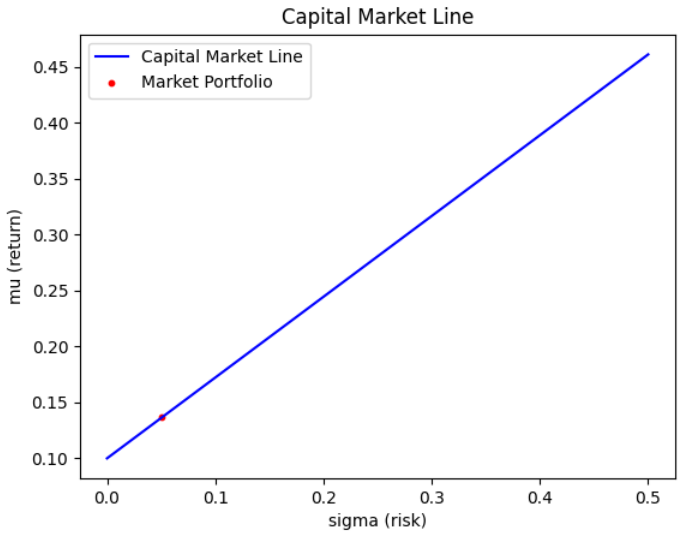
D) For 18% return the minimum risk portfolio is -

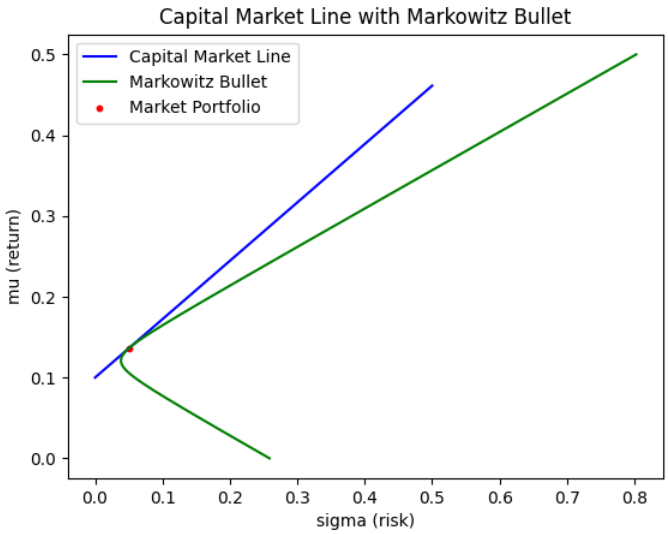
- *mu (return) = 0.18*
- *sigma(risk) = 0.130568*
- *weights = [-0.02568807 0.57431193 0.45137615]*

E) Assuming $\mu_{rf} = 10\%$, The market portfolio is -

- *Return (mu) = 0.136719*
- *Risk (sigma) = 0.050811*
- *Weights = [0.59375 0.328125 0.078125]*

The Capital Market Line is plotted below -





Equation of Capital Market Line:

mu = 0.10 + 0.7226*sigma

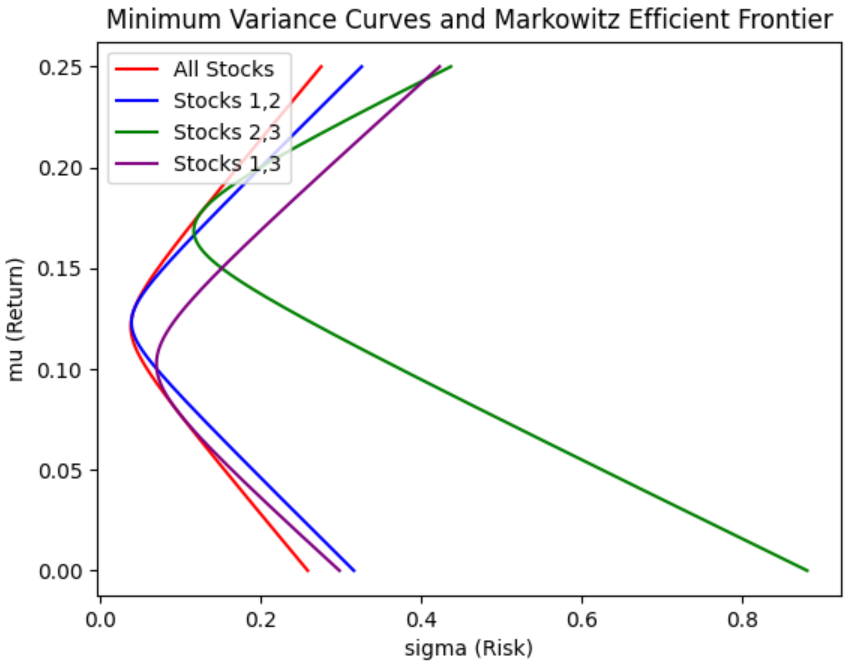
F) Two portfolios with risk 10% and 25% are constructed.

- ➢ Portfolio for Risk = 10 % is:
  - Return = 0.17226494462892933
  - Risk = 0.1
  - Weight of Risk-Free Asset = -0.9680665771282883
  - Weights of Risky Assets = [1.16853953 0.64577185 0.1537552]

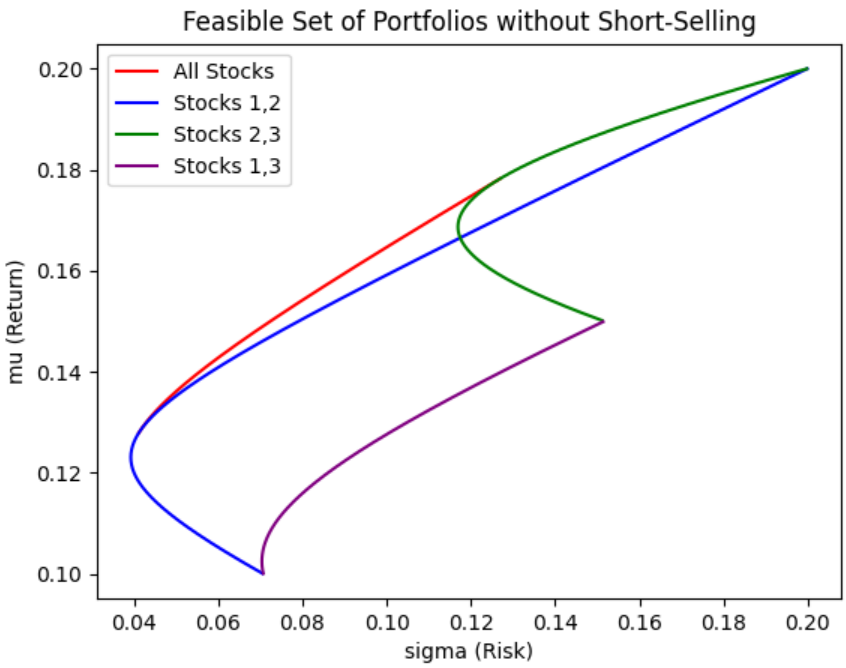
- ➢ Portfolio for Risk = 25 % is:
  - Return = 0.2806623615723233
  - Risk = 0.25
  - Weight of Risk-Free Asset = -3.920166442820721
  - Weights of Risky Assets = [2.92134883 1.61442961 0.384388]

Question - 2

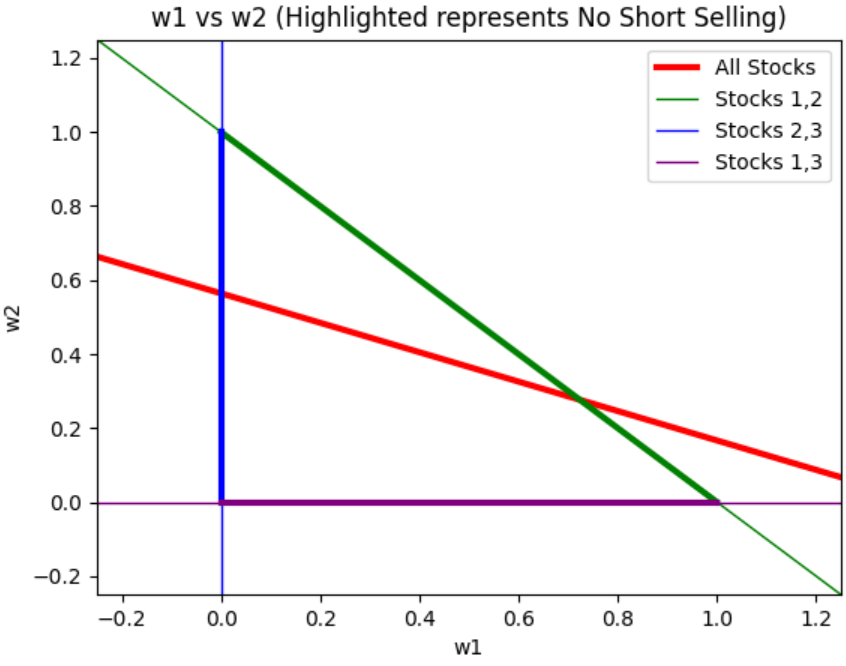
The minimum variance curve and efficient frontier assuming ***short sales allowed*** is-



The minimum variance curve and efficient frontier assuming ***short sales not allowed*** is-



The weights corresponding to the minimum variance curve is -



The equations of the weights satisfy are -

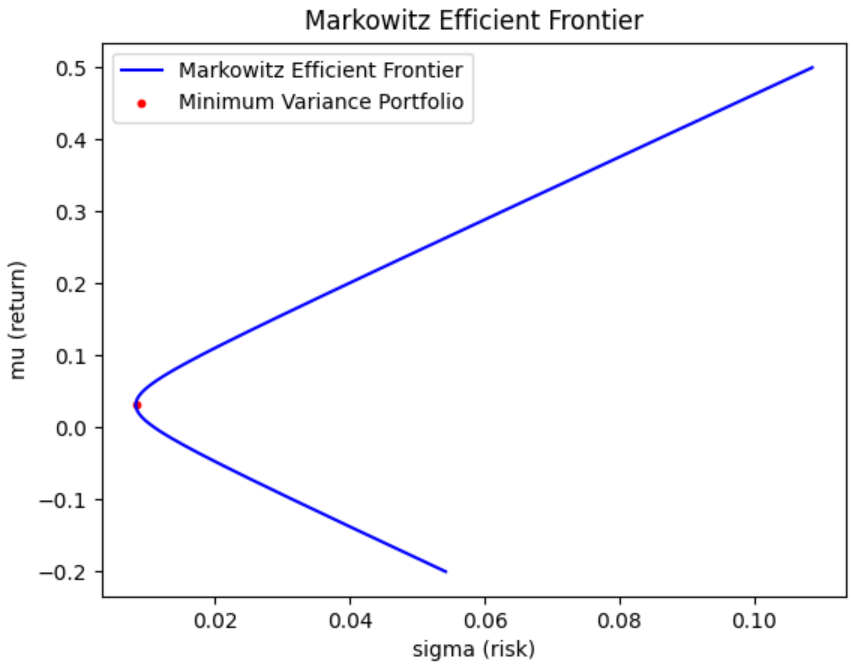
$$0.40w_1 + w_2 = 0.56$$
$$1.52w_2 - w_3 = 0.42$$
$$0.60w_1 + w_3 = 0.44$$

Question - 3

The 10 stocks taken are -

1) APPL
2) NOK
3) UBER
4) GE
5) AMD
6) PFE
7) PLTR
8) TWTR
9) PINS
10) AAL

A) The Markowitz Efficient Frontier is plotted below -

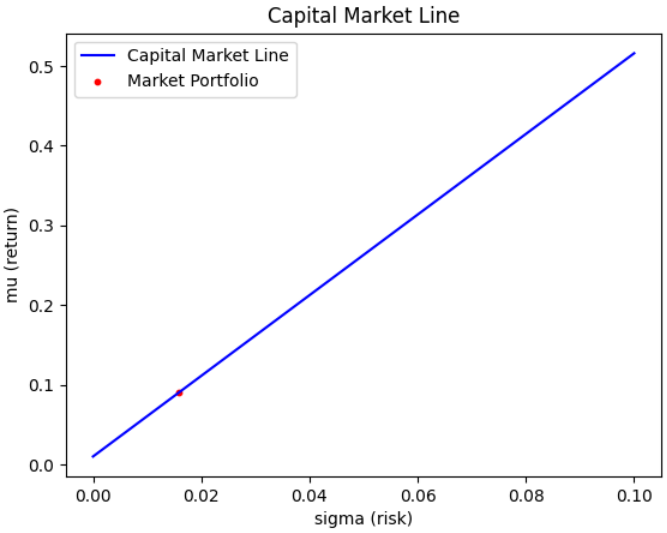


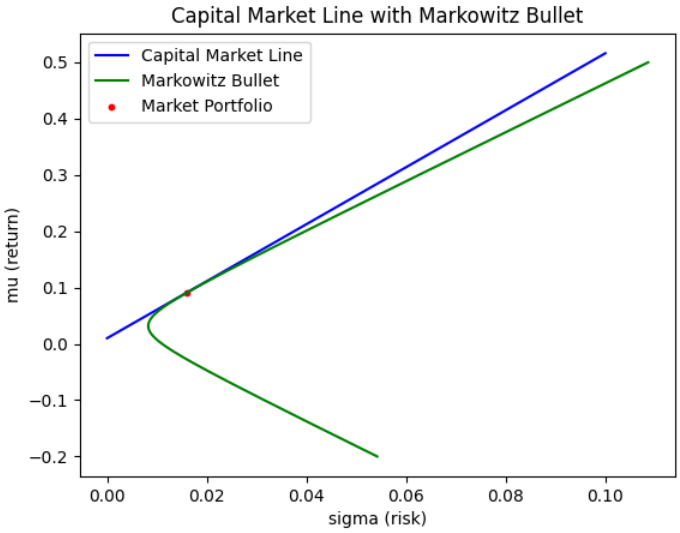
B) The risk-free return is assumed to be 1% because a market portfolio doesn't exist for a risk-free return of 5%.

The Market Portfolio is:

- Return (mu) = 0.0905340770935481
- Risk (sigma) = 0.015912861436324897
- Weights:
  - *(AAL,0.07265883536869072)*
  - *(AAPL,0.31811473288232417)*
  - *(AMD,0.03238766035153146)*
  - *(GE,0.09996116411484884)*
  - *(NOK,-0.028148254215886376)*
  - *(PFE,-0.17605502876698165)*
  - *(PINS,0.10396577464052094)*
  - *(PLTR,0.10665255260616918)*
  - *(TWTR,0.38448882315990307)*
  - *(UBER,0.08597373985887956)*

C) The Capital Market Line is plotted below -

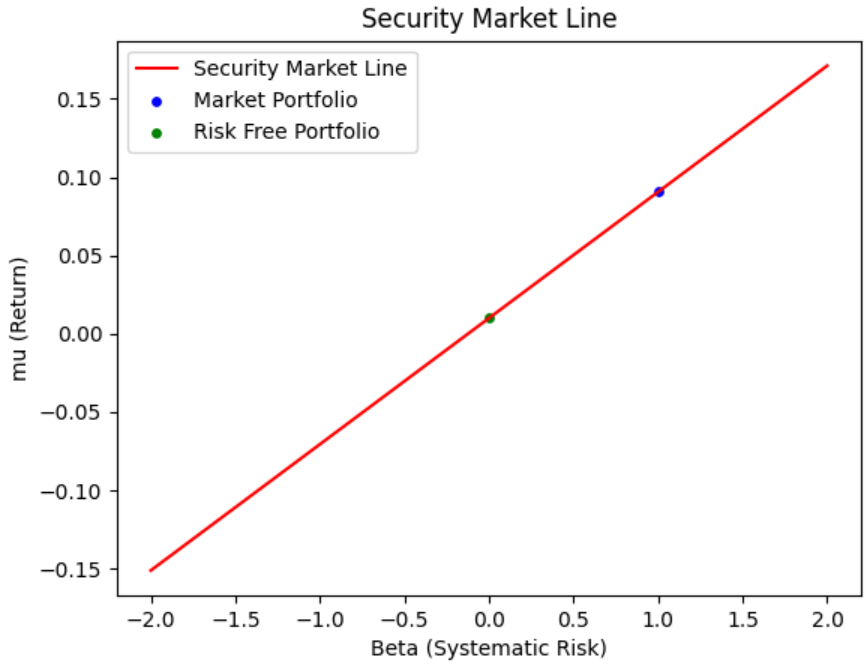




Equation of Capital Market Line:

mu = 0.01 + 5.0609*sigma

D) The Security Market Line is plotted below -



Equation of Security Market Line:

mu = 0.01 + 0.0805*sigma