MA-374 Lab Assignment 5

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Question 1 (Terminal outputs given at end)

1. Obtain the required weights w using the following relation –

$$w = \frac{\begin{vmatrix} 1 & uC^{-1}M^T \\ \mu_v & MC^{-1}M^T \end{vmatrix} uC^{-1} + \begin{vmatrix} uC^{-1}u^T & 1 \\ MC^{-1}u^T & \mu_v \end{vmatrix} MC^{-1}}{\begin{vmatrix} uC^{-1}u^T & uC^{-1}M^T \\ MC^{-1}u^T & MC^{-1}M^T \end{vmatrix}}$$

where, μ_v = return,
u = [1, 1, 1, ..., 1] (with same dimension as that of number of assets)

Obtain the risk using following relation–

$$\sigma_v^2 = wCw^T$$

and then take square root to obtain the risk in terms of std. deviation. Now, the minimum variance portfolio has weights:

$$w = \frac{uC^{-1}}{uC^{-1}u^T}$$

Using this, we find the corresponding point on the minimum variance curve.
Now, the efficient frontier is the one with higher expected return and lower standard deviation (lower risk). So, the points with higher return than the minimum variance portfolio point shows the efficient frontier on the curve (denoted by yellow).

The equation of CML is obtained using the following formula:

$$\mu = \frac{\mu_M - \mu_{rf}}{\sigma_M}\sigma + \mu_{rf}$$

where,

μ_M = return corresponding to market portfolio
μ_{rf} = risk free return
σ_M = risk corresponding to market portfolio

The Security market line is obtained using the following formula:

$$\mu = (\mu_M - \mu_{rf})\beta + \mu_{rf}$$

where,

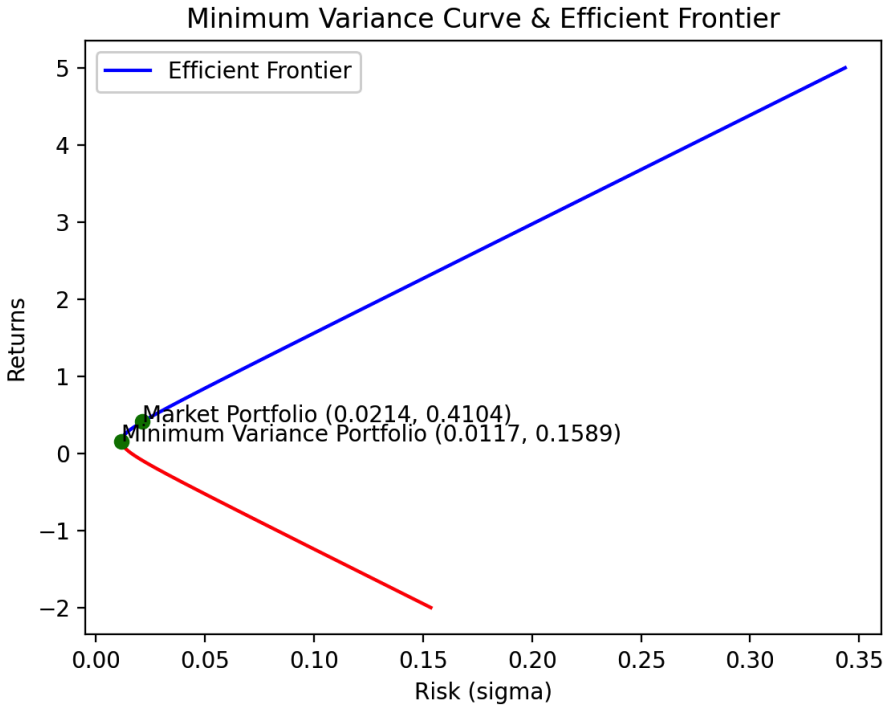
μ_M = return corresponding to market portfolio
μ_{rf} = risk free return

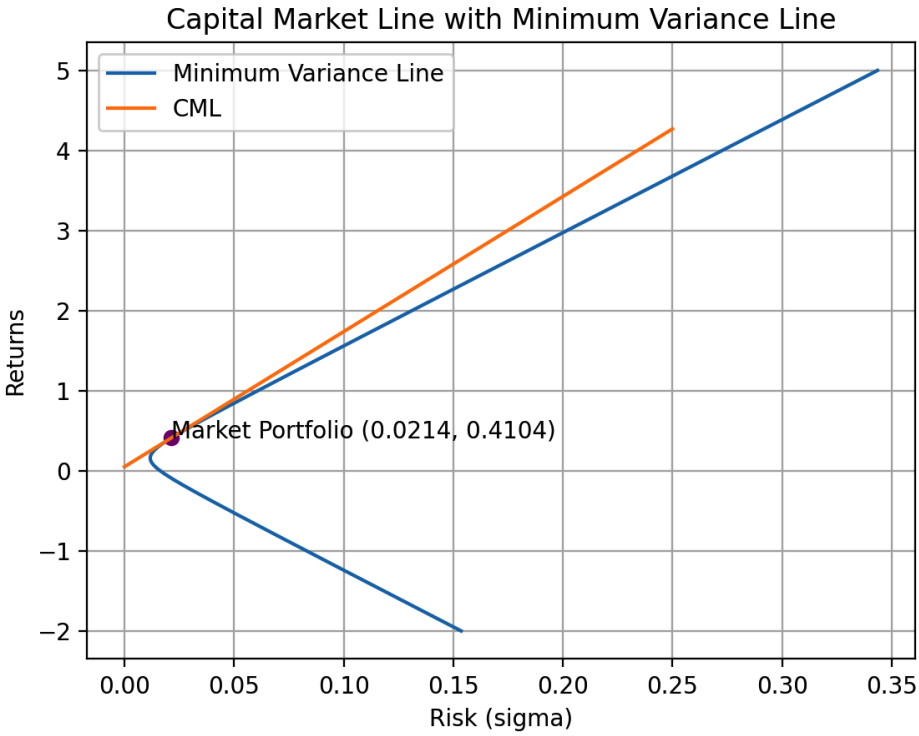
The value of β return corresponding to market portfolio risk free return can be evaluated by using following relation:

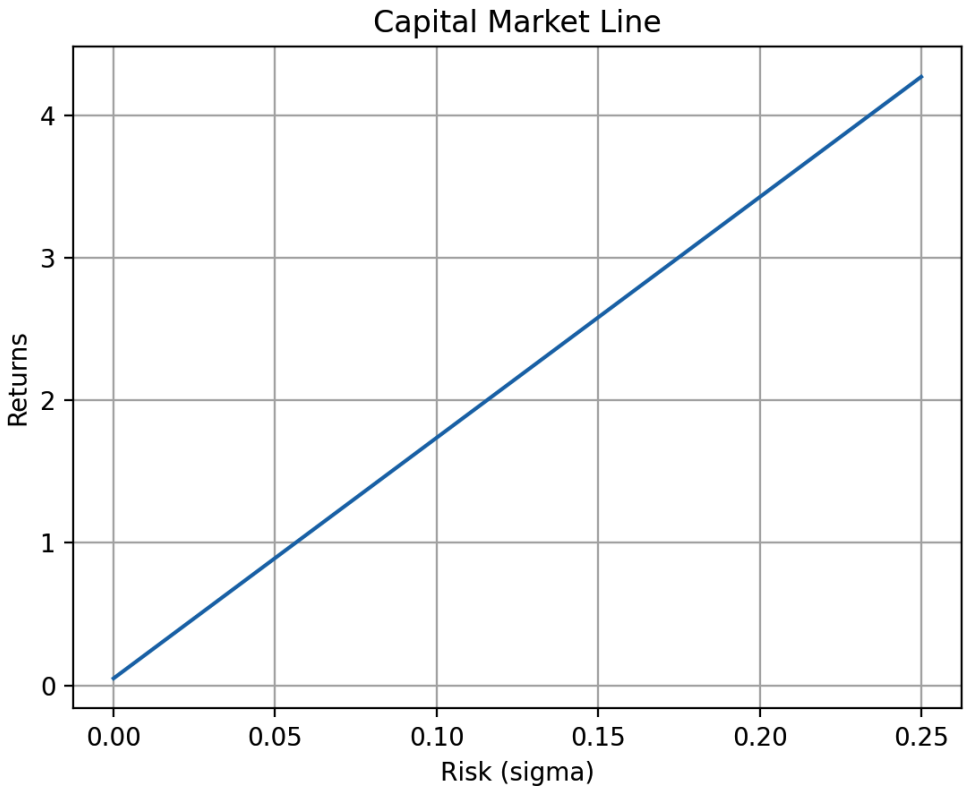
$$\beta_k = \frac{Cov(R_k, R_M)}{\sigma_M^2}$$

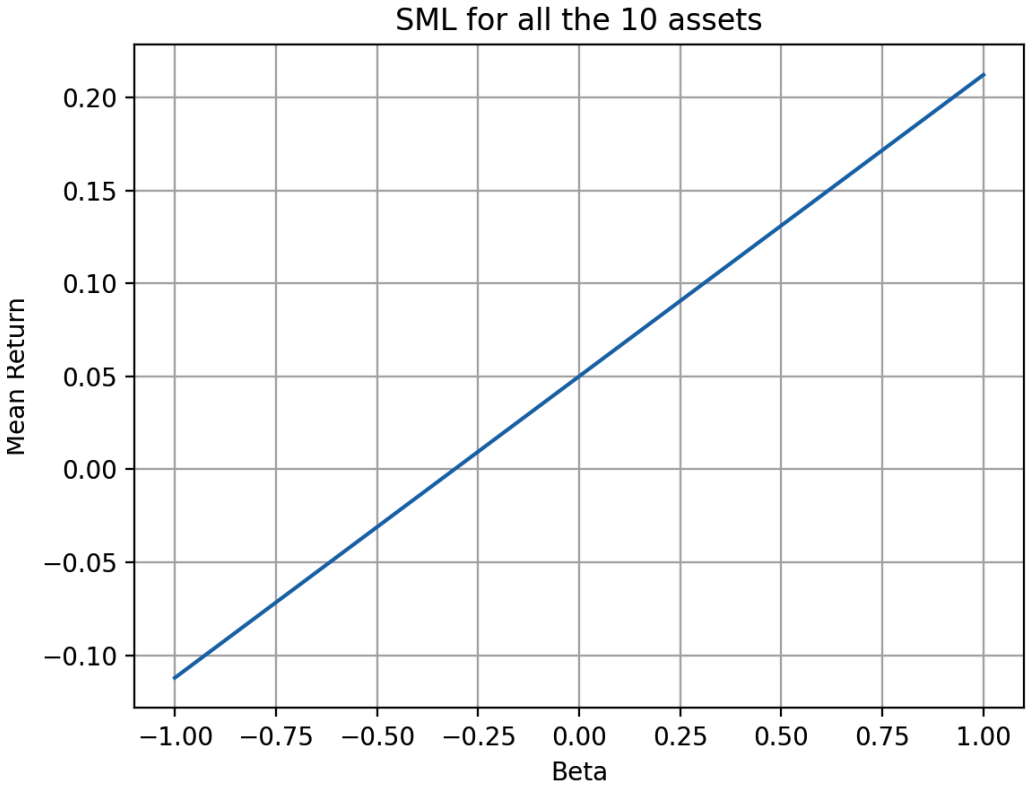
where, β_k = beta of the asset k
R_k = return of the asset k
R_M = return of the entire market portfolio
σ_M^2 = variance of the market portfolio

FOR BSE

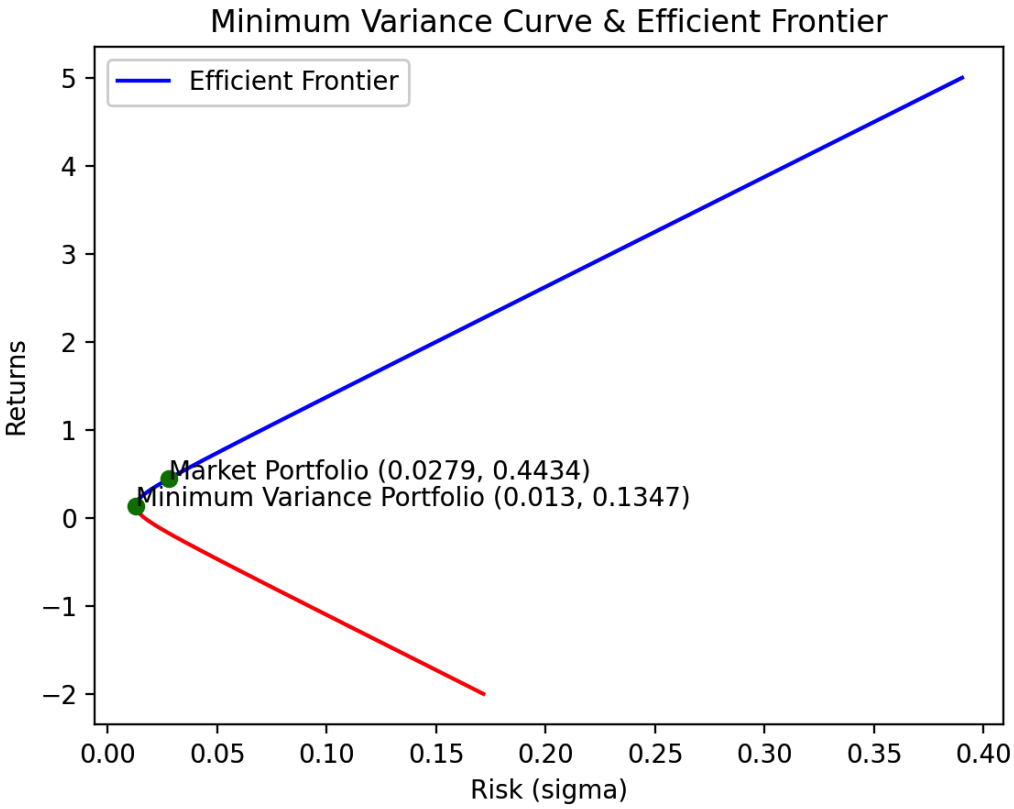

Minimum Variance Curve & Efficient Frontier
Efficient Frontier
Market Portfolio (0.0214, 0.4104)
Minimum Variance Portfolio (0.0117, 0.1589)
Returns
Risk (sigma)
5
4
3
2
1
0
−1
−2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35

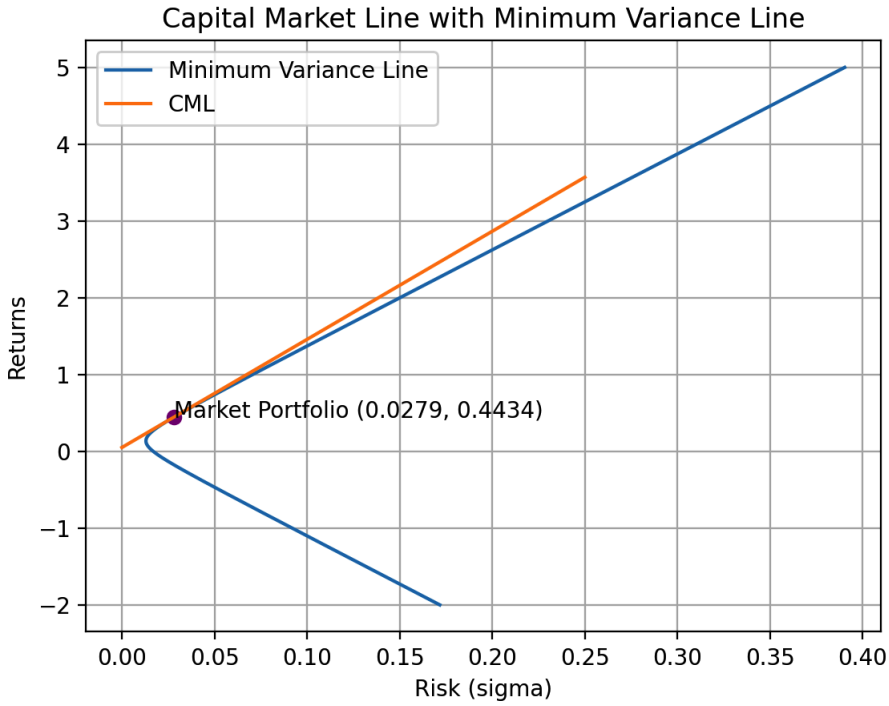

Capital Market Line with Minimum Variance Line
Minimum Variance Line
CML
Market Portfolio (0.0214, 0.4104)
Returns
Risk (sigma)
5
4
3
2
1
0
−1
−2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35

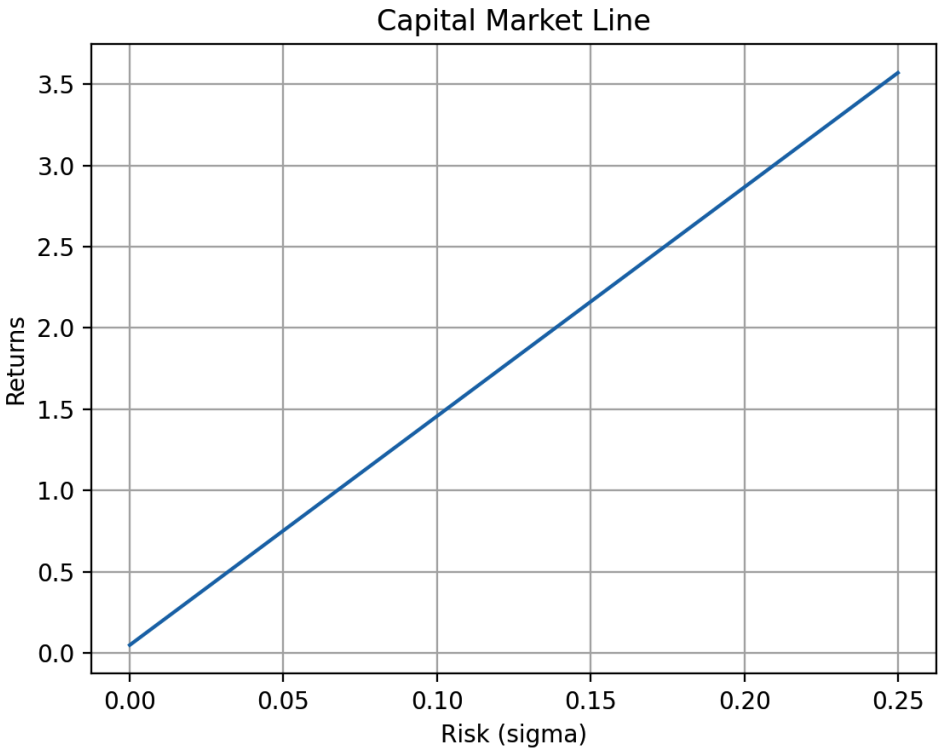

Capital Market Line
Returns
Risk (sigma)
0
1
2
3
4
0.00
0.05
0.10
0.15
0.20
0.25

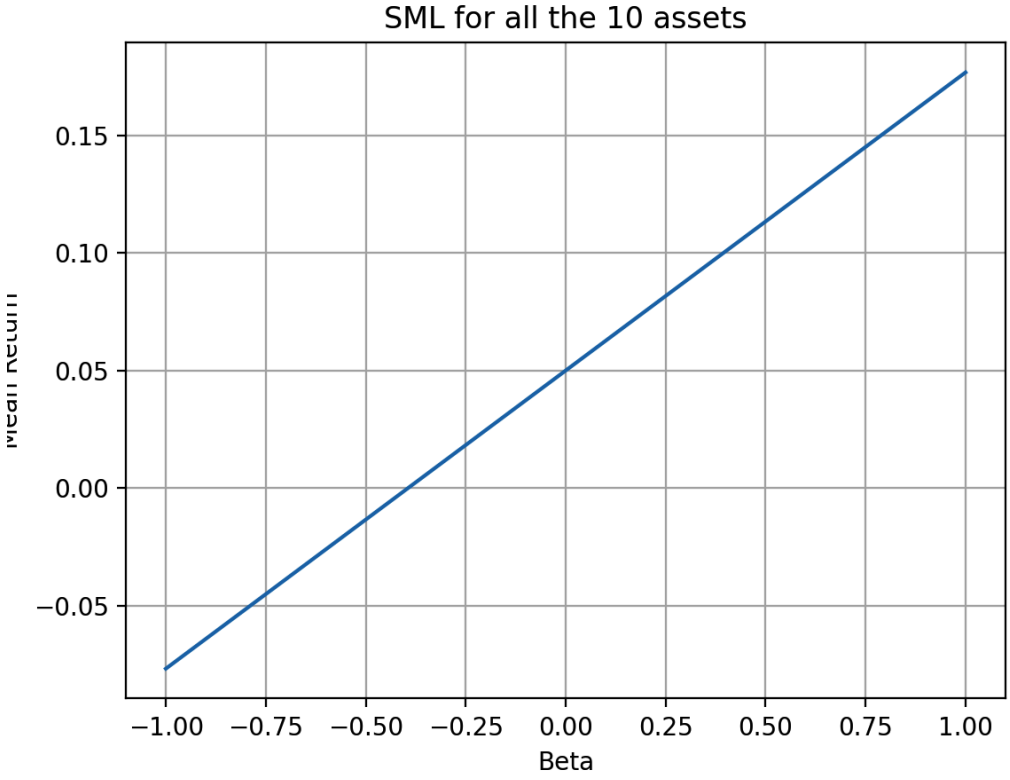

SML for all the 10 assets
Mean Return
Beta
0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00

FOR NSE

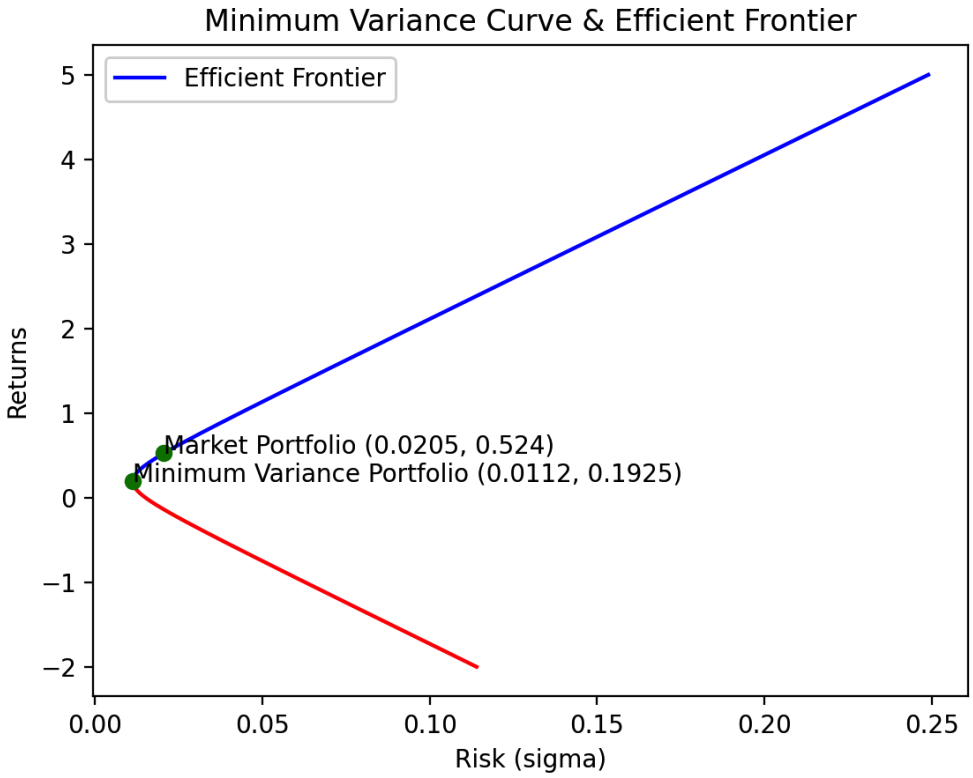

Minimum Variance Curve & Efficient Frontier
Efficient Frontier
Market Portfolio (0.0279, 0.4434)
Minimum Variance Portfolio (0.013, 0.1347)
Returns
Risk (sigma)
5
4
3
2
1
0
−1
−2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40

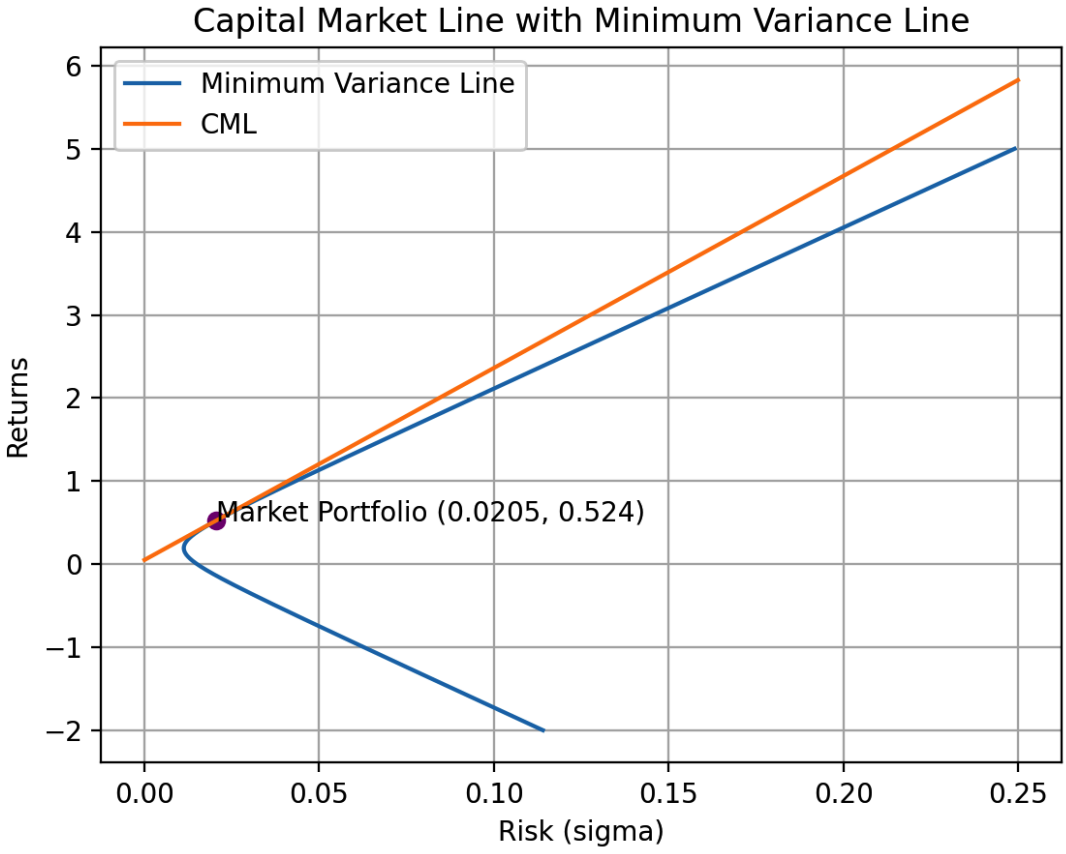

Capital Market Line with Minimum Variance Line
Minimum Variance Line
CML
Market Portfolio (0.0279, 0.4434)
Returns
Risk (sigma)
5
4
3
2
1
0
−1
−2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40

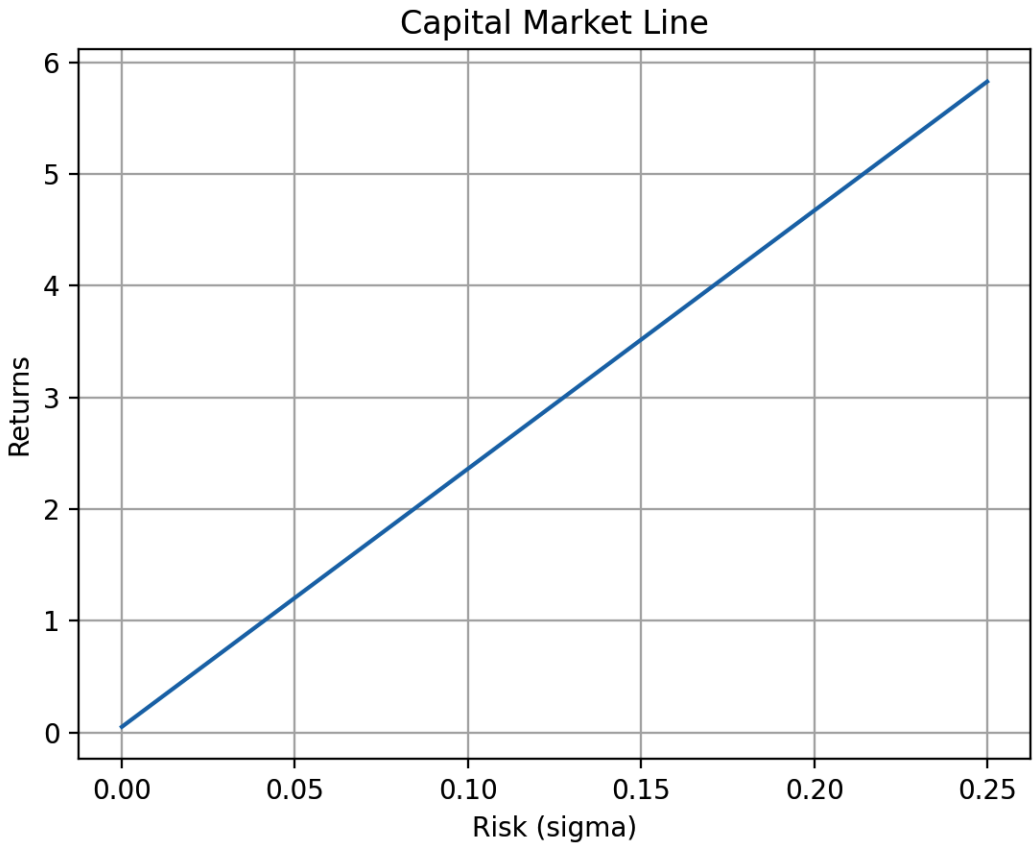

Capital Market Line
Returns
Risk (sigma)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0.00
0.05
0.10
0.15
0.20
0.25

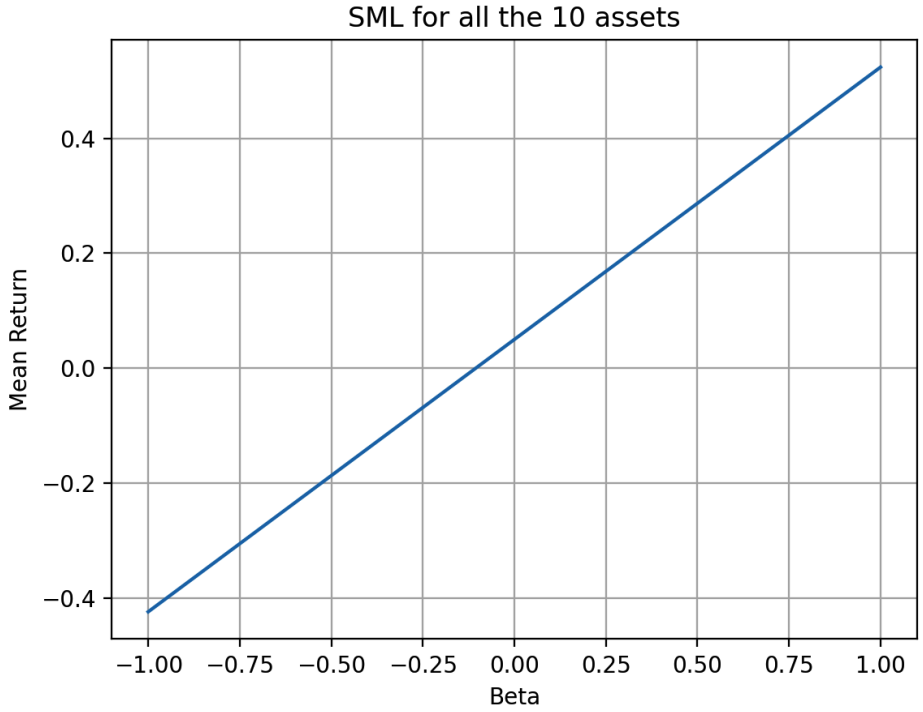

SML for all the 10 assets
Beta
0.15
0.10
0.05
0.00
−0.05
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00

Not in BSE

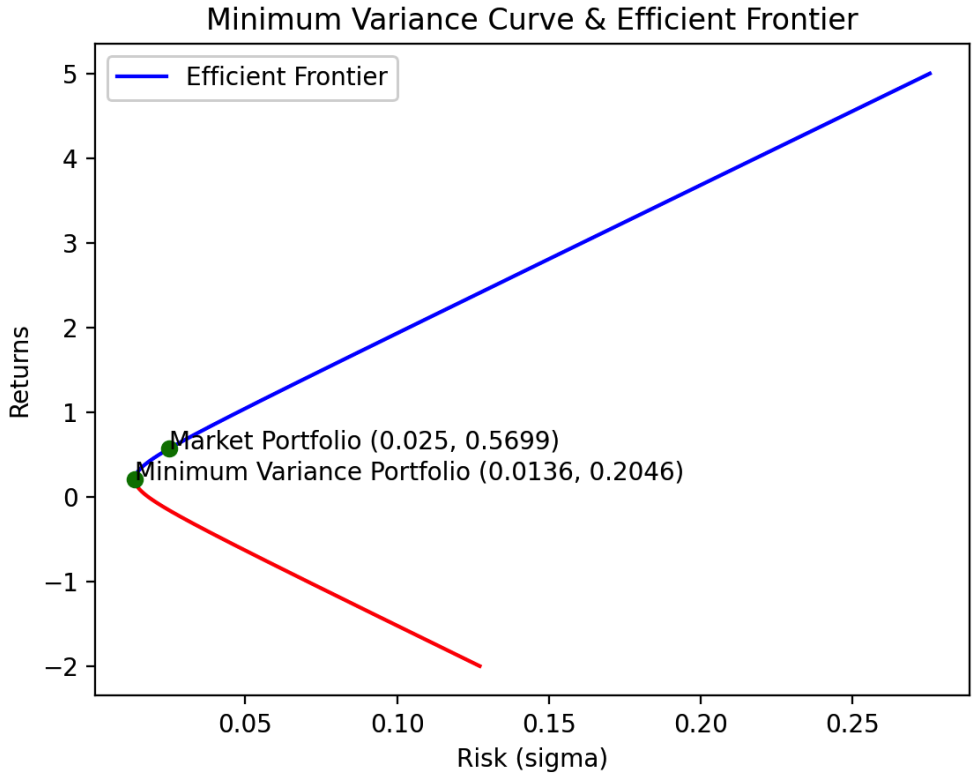

Minimum Variance Curve & Efficient Frontier
Efficient Frontier
Market Portfolio (0.0205, 0.524)
Minimum Variance Portfolio (0.0112, 0.1925)
Returns
Risk (sigma)
5
4
3
2
1
0
−1
−2
0.00
0.05
0.10
0.15
0.20
0.25

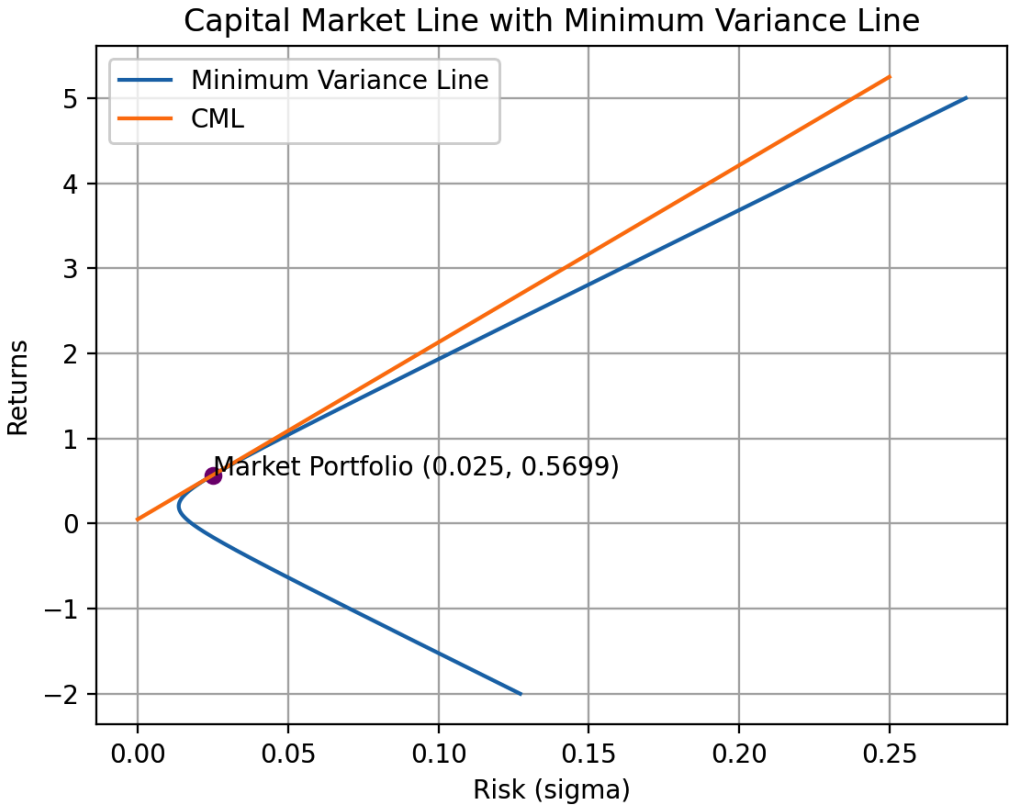

Capital Market Line with Minimum Variance Line
Minimum Variance Line
CML
Market Portfolio (0.0205, 0.524)
Returns
Risk (sigma)
6
5
4
3
2
1
0
−1
−2
0.00
0.05
0.10
0.15
0.20
0.25

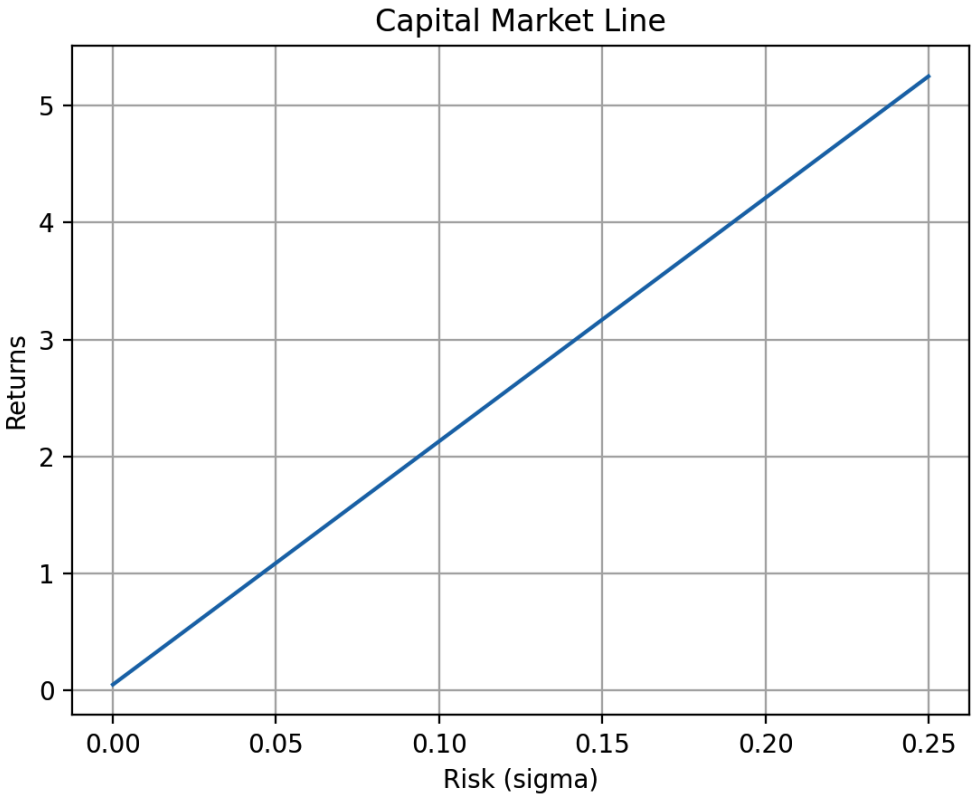

Capital Market Line
Returns
Risk (sigma)
0
1
2
3
4
5
6
0.00
0.05
0.10
0.15
0.20
0.25

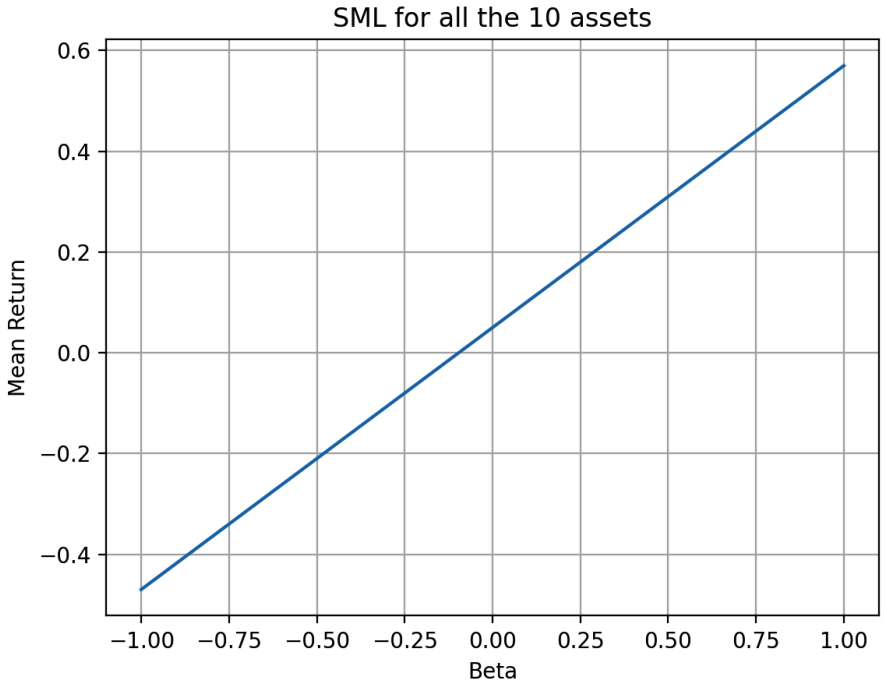

SML for all the 10 assets
Mean Return
Beta
0.4
0.2
0.0
−0.2
−0.4
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00

Not in NSE


Minimum Variance Curve & Efficient Frontier
Efficient Frontier
Market Portfolio (0.025, 0.5699)
Minimum Variance Portfolio (0.0136, 0.2046)
Returns
Risk (sigma)
5
4
3
2
1
0
−1
−2
0.05
0.10
0.15
0.20
0.25


Capital Market Line with Minimum Variance Line
Minimum Variance Line
CML
Market Portfolio (0.025, 0.5699)
Returns
Risk (sigma)
5
4
3
2
1
0
−1
−2
0.00
0.05
0.10
0.15
0.20
0.25


Capital Market Line
Returns
Risk (sigma)
0
1
2
3
4
5
0.00
0.05
0.10
0.15
0.20
0.25


SML for all the 10 assets
Mean Return
Beta
0.6
0.4
0.2
0.0
−0.2
−0.4
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00

Terminal output

```
****  Inference about stocks taken from BSE  ****
Market return   = 0.21218926808253888
Market risk     = 0.9985215748556788 %
Market Portfolio Weights        =  [-0.09680332  0.65215315 -0.29131434 -0.32424168  0.20993477  0.3429823
  0.26457249 -0.44468436  0.2772742   0.41012679]
Return                          =  0.4104248671192644
Risk                            =  2.135775988747072  %

Equation of Capital Market Line is:
y = 16.8756 x + 0.0500

Equaiton SML:
mu = 0.16 beta + 0.05


****  Inference about stocks taken from NSE  ****
Market return   = 0.17679467861513637
Market risk     = 0.961137159508467 %
Market Portfolio Weights        =  [-0.16773169 -0.1179504  -0.26967665  0.0459976   0.13222492  0.16602305
  0.40681389 -0.29580554  0.07989279  1.02021202]
Return                          =  0.44343834687996814
Risk                            =  2.7946212724624417  %

Equation of Capital Market Line is:
y = 14.0784 x + 0.0500

Equaiton SML:
mu = 0.13 beta + 0.05


****  Inference about stocks not listed in BSE  with index taken from BSE values****
Market Portfolio Weights        =  [ 0.19765412  0.23391236 -0.06674379  0.02968716  0.38826395 -0.13880025
 -0.17273922 -0.29072318  0.53256552  0.28692334]
Return                          =  0.5239676196823646
Risk                            =  2.0511368338575915  %

Equation of Capital Market Line is:
y = 23.1076 x + 0.0500

Equaiton SML:
mu = 0.47 beta + 0.05


****  Inference about stocks not taken from any index  with index taken from NSE values****
Market Portfolio Weights        =  [ 0.01441793  0.70670392 -0.05430286 -0.10610037  0.03366853 -0.40454559
  0.38184923  0.154576    0.34841406 -0.07468085]
Return                          =  0.5699295818818381
Risk                            =  2.5001053346762294  %

Equation of Capital Market Line is:
y = 20.7963 x + 0.0500

Equaiton SML:
mu = 0.52 beta + 0.05
```

```
****  Beta for securities in BSE  ****
WIPRO.BO                =               -0.038717868915373405
BAJAJ-AUTO.BO           =               -0.08263867951679772
HDFCBANK.BO             =               0.03667360516592268
HEROMOTOCO.BO           =               0.06548868149041256
TCS.BO          =               -0.05057359019592489
INFY.BO         =               -0.12939242556115385
BAJFINANCE.BO           =               -0.04032551577760429
MARUTI.BO               =               -0.08131257769870523
RELIANCE.BO             =               -0.14130393546465805
TATAMOTORS.BO           =               -0.021215810318978814


****  Beta for securities in NSE  ****
ACC.NS          =               -0.08611510818463429
GODREJIND.NS            =               -0.1787277487006643
HINDZINC.NS             =               -0.16441066977617483
IDEA.NS         =               -0.3730093987371218
IGL.NS          =               -0.14617359083888642
LUPIN.NS                =               -0.18624480872560087
MAHABANK.NS             =               -0.14869679620291004
MGL.NS          =               -0.05321168652690656
PAGEIND.NS              =               -0.08988371030821524
TATACHEM.NS             =               -0.10087824840797581
(base) arushgupta@depressed-guy Lab5Fe2 % python '/Users/arushgupta/Desktop/Lab5Fe2/q1.py'
****  Inference about stocks taken from BSE  ****
Market return   = 0.21218926808253888
Market risk     = 0.9985215748556788 %
Market Portfolio Weights        =  [-0.09680332  0.65215315 -0.29131434 -0.32424168  0.20993477  0.3429823
  0.26457249 -0.44468436  0.2772742   0.41012679]
Return                          =  0.4104248671192644
Risk                            =  2.135775988747072  %

Equation of Capital Market Line is:
y = 16.8756 x + 0.0500

Equaiton SML:
mu = 0.16 beta + 0.05


****  Inference about stocks taken from NSE  ****
Market return   = 0.17679467861513637
Market risk     = 0.961137159508467 %
Market Portfolio Weights        =  [-0.16773169 -0.1179504  -0.26967665  0.0459976   0.13222492  0.16602305
  0.40681389 -0.29580554  0.07989279  1.02021202]
Return                          =  0.44343834687996814
Risk                            =  2.7946212724624417  %

Equation of Capital Market Line is:
y = 14.0784 x + 0.0500

Equaiton SML:
mu = 0.13 beta + 0.05
```

```
****  Inference about stocks not listed in BSE  with index taken from BSE values****
Market Portfolio Weights        =  [ 0.19765412  0.23391236 -0.06674379  0.02968716  0.38826395 -0.13880025
 -0.17273922 -0.29072318  0.53256552  0.28692334]
Return                          =  0.5239676196823646
Risk                            =  2.0511368338575915  %

Equation of Capital Market Line is:
y = 23.1076 x + 0.0500

Equaiton SML:
mu = 0.47 beta + 0.05


****  Inference about stocks not taken from any index  with index taken from NSE values****
Market Portfolio Weights        =  [ 0.01441793  0.70670392 -0.05430286 -0.10610037  0.03366853 -0.40454559
  0.38184923  0.154576    0.34841406 -0.07468085]
Return                          =  0.5699295818818381
Risk                            =  2.5001053346762294  %

Equation of Capital Market Line is:
y = 20.7963 x + 0.0500

Equaiton SML:
mu = 0.52 beta + 0.05
```

```
****  Beta for securities in BSE  ****
WIPRO.BO                =                -0.038717868915373405
BAJAJ-AUTO.BO           =                -0.08263867951679772
HDFCBANK.BO             =                 0.036673605165922 68
HEROMOTOCO.BO           =                 0.06548868149041256
TCS.BO          =               -0.05057359019592489
INFY.BO         =               -0.12939242556115385
BAJFINANCE.BO           =                -0.040325515777 60429
MARUTI.BO               =                -0.08131257769870523
RELIANCE.BO             =                -0.14130393546465805
TATAMOTORS.BO           =                -0.021215810318978814


****  Beta for securities in NSE  ****
ACC.NS          =               -0.08611510818463429
GODREJIND.NS            =                -0.1787277487006643
HINDZINC.NS             =                -0.16441066977617483
IDEA.NS         =               -0.3730093987371218
IGL.NS          =               -0.14617359083888642
LUPIN.NS                =                -0.18624480872560087
MAHABANK.NS             =                -0.14869679620291004
MGL.NS          =               -0.05321168652690656
PAGEIND.NS              =                -0.089883710308215 24
TATACHEM.NS             =                -0.10087824840797581


****  Beta for securities in non-index using BSE Index  ****
HAVELLS.NS              =                -0.062262541234419 06
HAL.NS          =               -0.05900548747188285
ICICIGI.NS              =                -0.04296401729314435
ICICIPRULI.NS           =                 0.005444118379427298
AMBUJACEM.NS            =                -0.08502975013915591
IOC.NS          =               -0.057854085019779226
NAUKRI.NS               =                -0.24392577024557272
INDIGO.NS               =                -0.046783348923229 29
JINDALSTEL.NS           =                 0.013681050502518208
BANKBARODA.NS           =                -0.09927945471081516


****  Beta for securities in non-index using NSE Index  ****
HAVELLS.NS              =                -0.039794460586413 64
HAL.NS          =               -0.06954928131812092
ICICIGI.NS              =                -0.24464449414623282
ICICIPRULI.NS           =                -0.2537881713495372
AMBUJACEM.NS            =                -0.061733091803202 81
IOC.NS          =               -0.1500040492336327
NAUKRI.NS               =                -0.14959303960156473
INDIGO.NS               =                -0.1599566867500443
```

IMPORTANT POINTS:-

1. The beta of a security is a measure of its systematic risk, which cannot be eliminated by diversification.

2. A beta value of one is considered as the overall market average. A beta value which is greater than one represents a risk level greater than the market average, and a beta value of less than one represents a risk level that is less than the market average.

3. Beta less than 1 can also occur when the asset price goes opposite to the market