

Karan Garg - 210123076

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 = $[1, 1, 1, \dots, 1]$ (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,

$$\begin{aligned} \mu_M &= \text{return corresponding to market portfolio} \\ \mu_{rf} &= \text{risk free return} \\ \sigma_M &= \text{risk corresponding to market portfolio} \end{aligned}$$

The Security market line is obtained using the following formula:

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

where,

$$\begin{aligned} \mu_M &= \text{return corresponding to market portfolio} \\ \mu_{rf} &= \text{risk free return} \end{aligned}$$

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

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

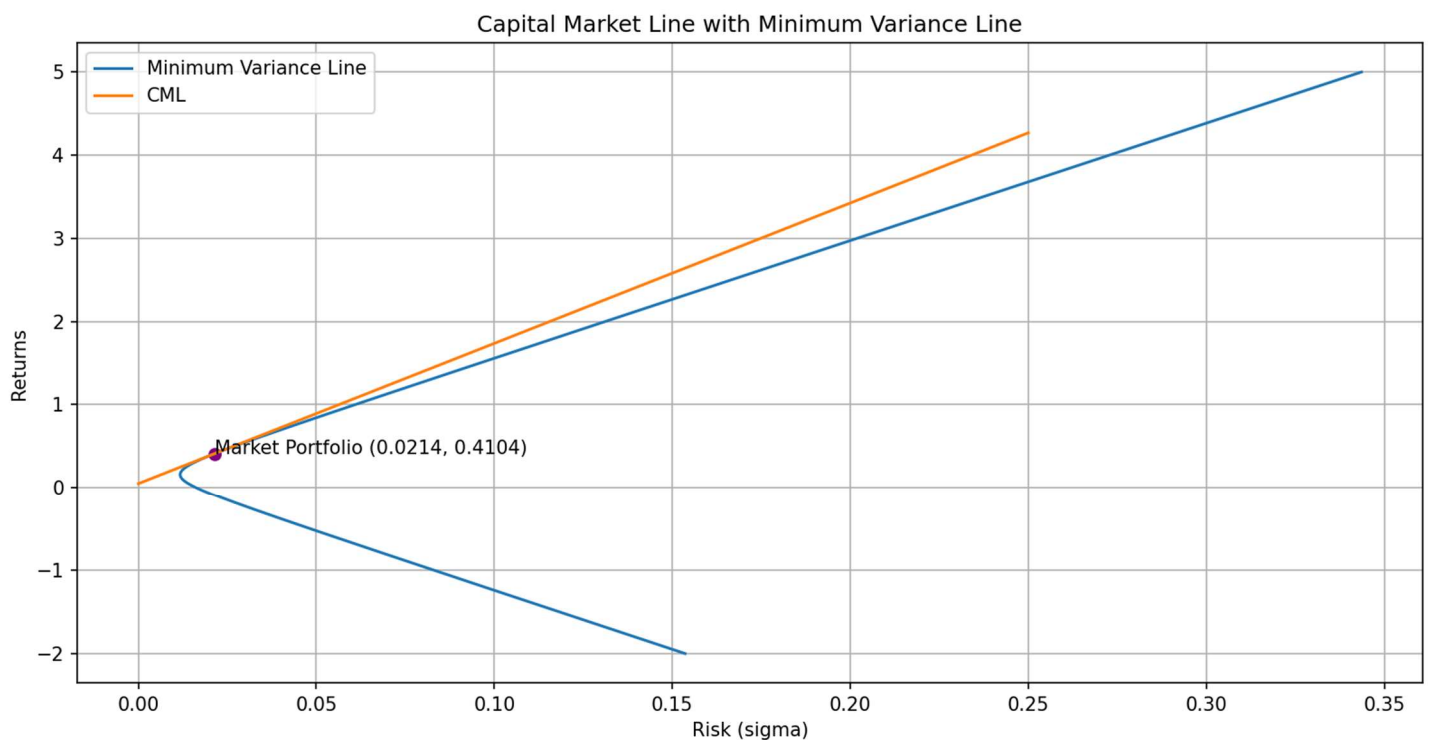
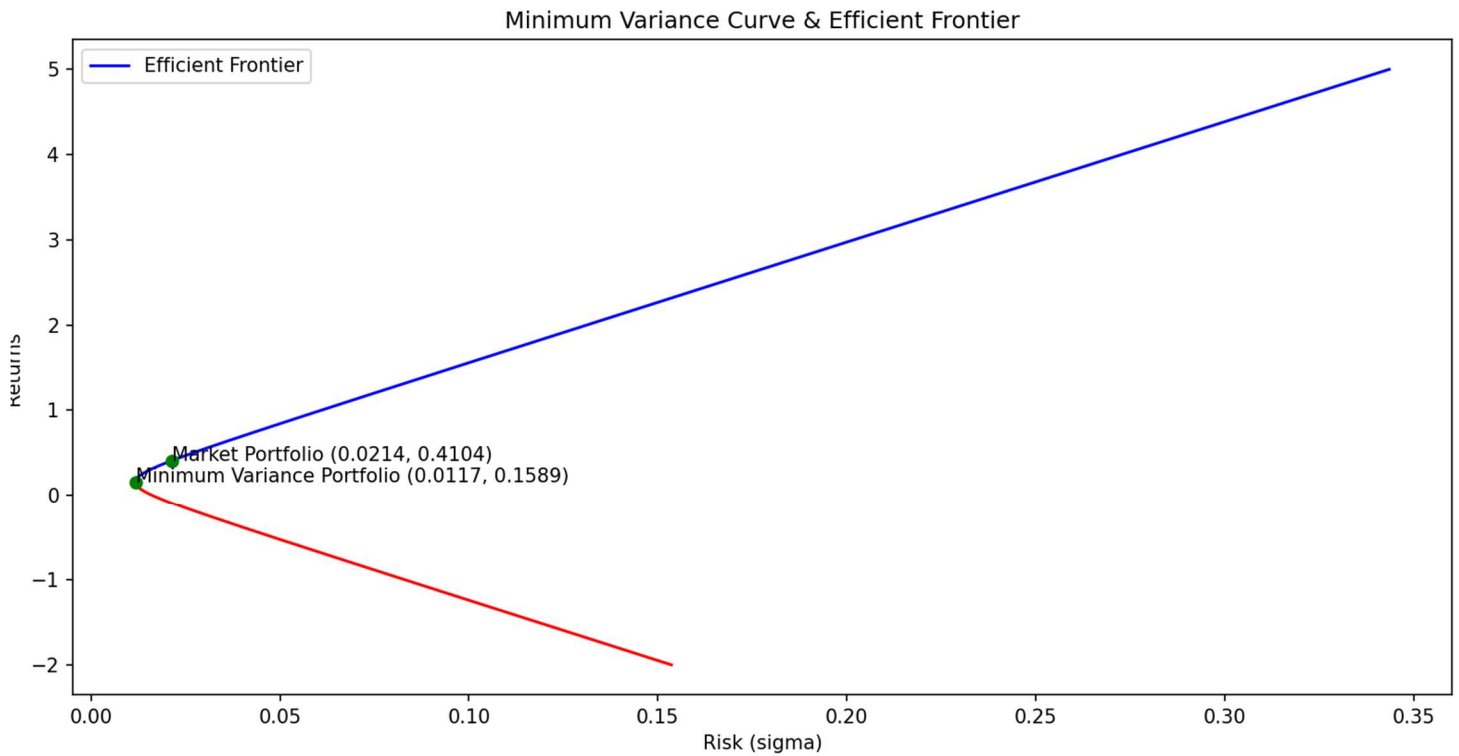
$$\begin{aligned} \text{where, } \beta_k &= \text{beta of the asset k} \\ R_k &= \text{return of the asset k} \\ R_M &= \text{return of the entire market portfolio} \\ \sigma_M^2 &= \text{variance of the market portfolio} \end{aligned}$$

```

***** Inference about stocks taken from BSE *****
Market return  = 0.21218926808253924
Market risk    = 0.9985215748556788 %
Market Portfolio Weights = [-0.09680332  0.65215315 -0.29131434 -0.32424168  0.20993477  0.34298
23
0.26457249 -0.44468436  0.2772742  0.41012679]
Return        = 0.41042486711926407
Risk          = 2.1357759887470706 %

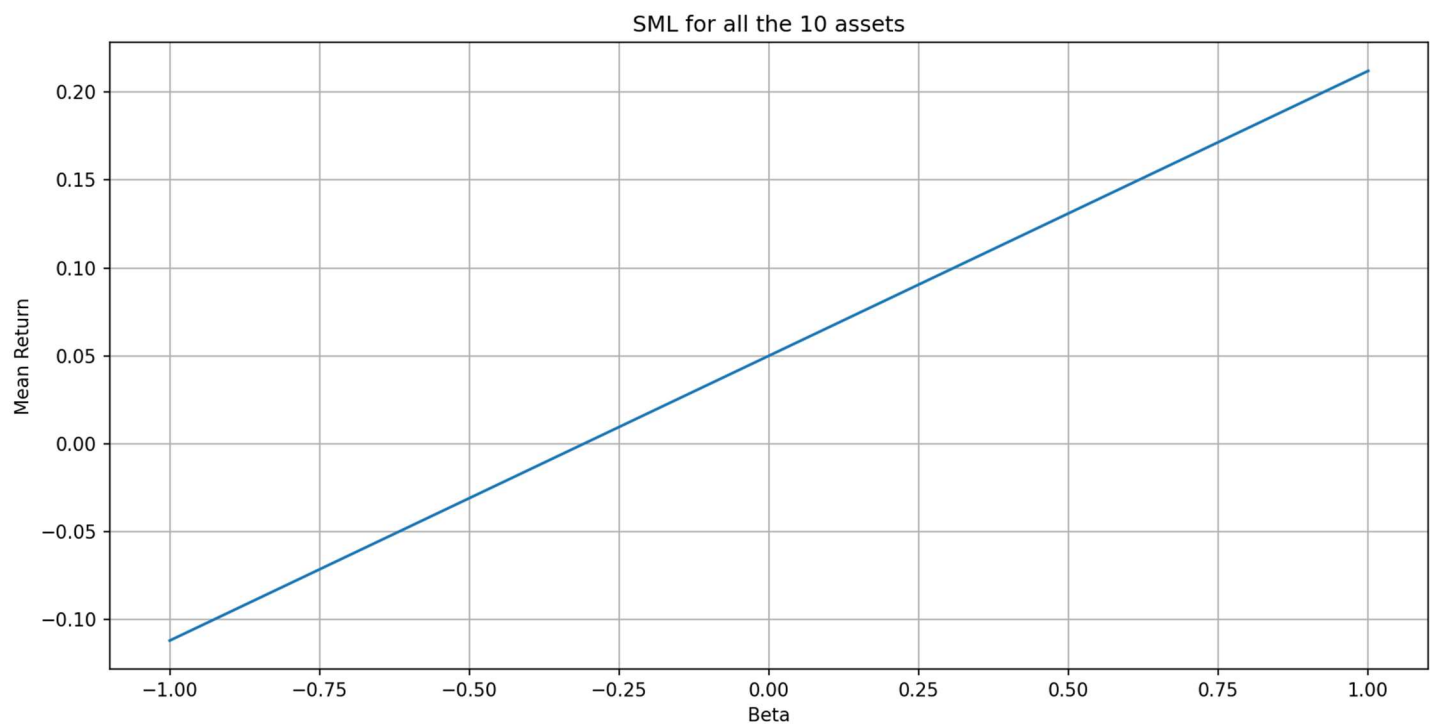
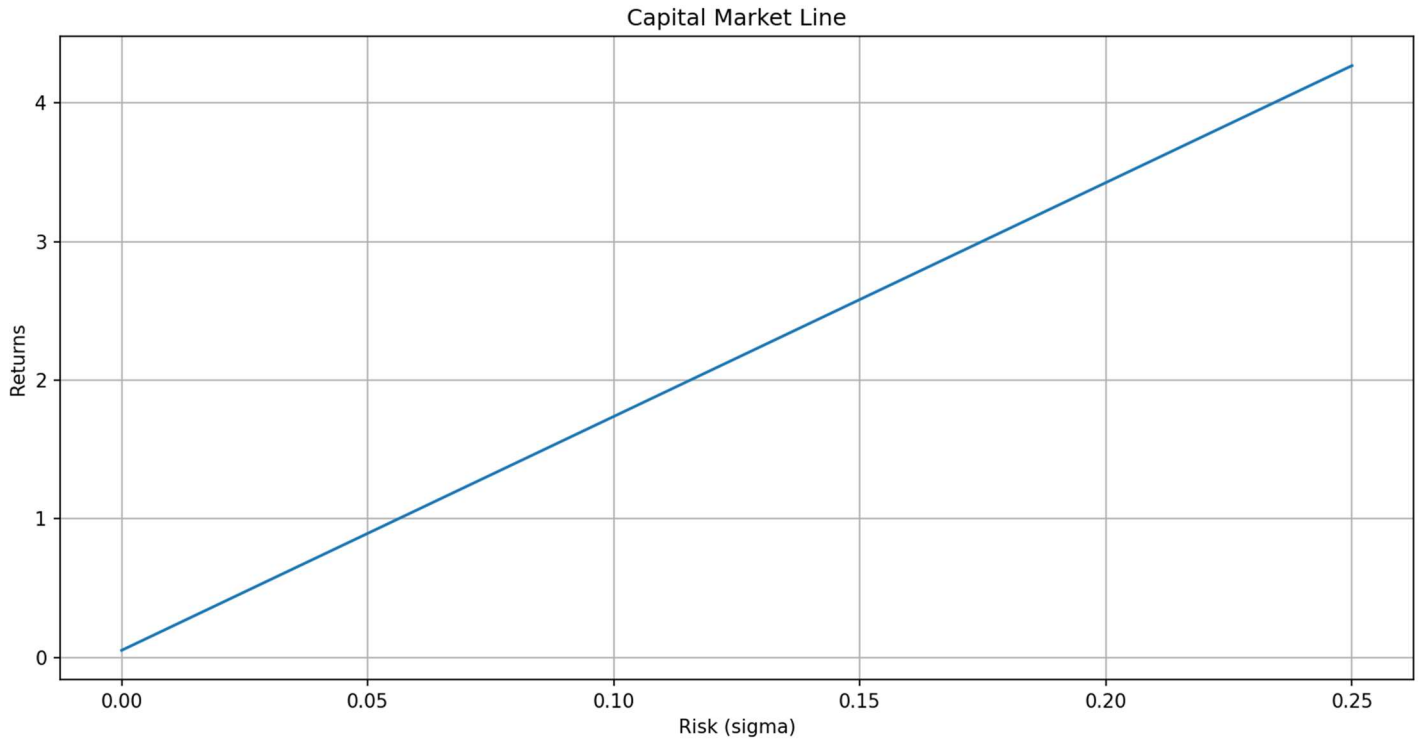
Equation of Capital Market Line is:
y = 16.8756 x + 0.0500

```



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

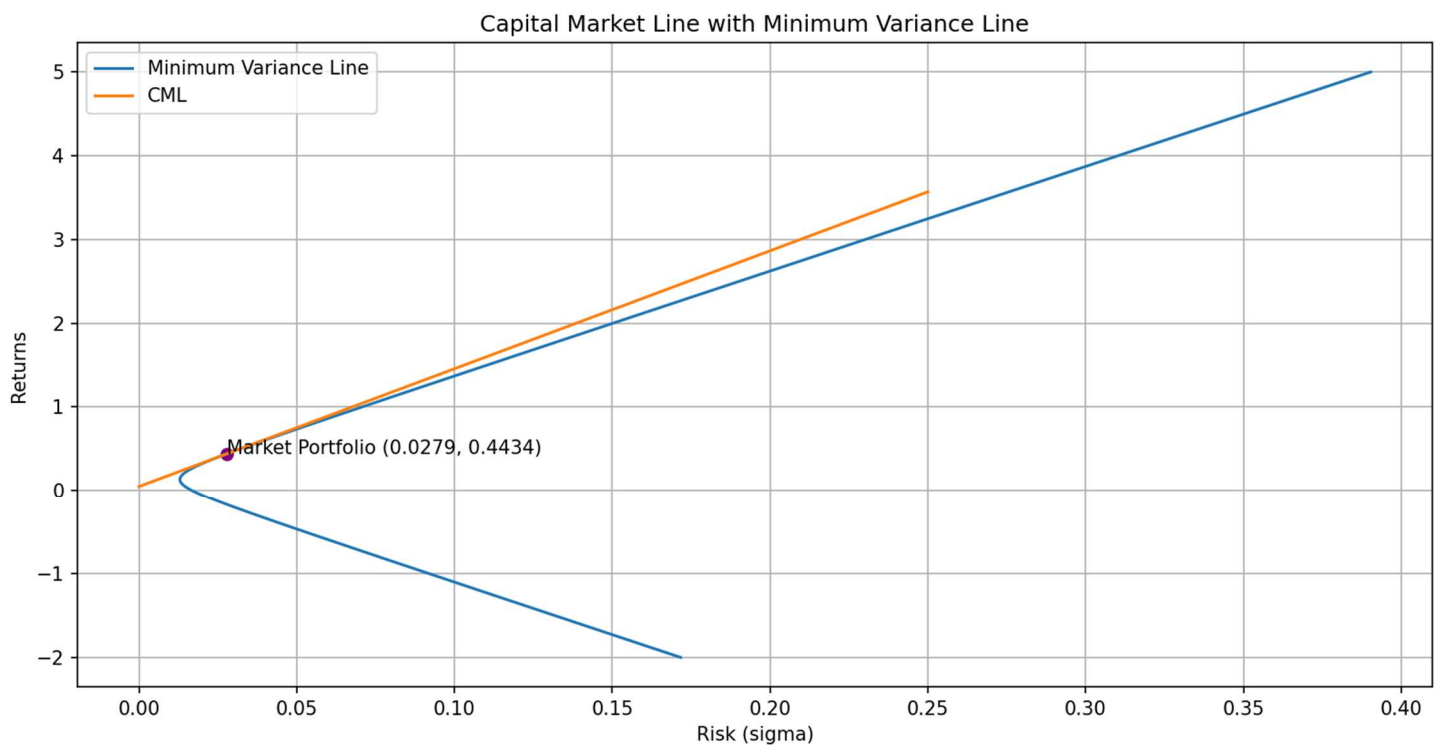
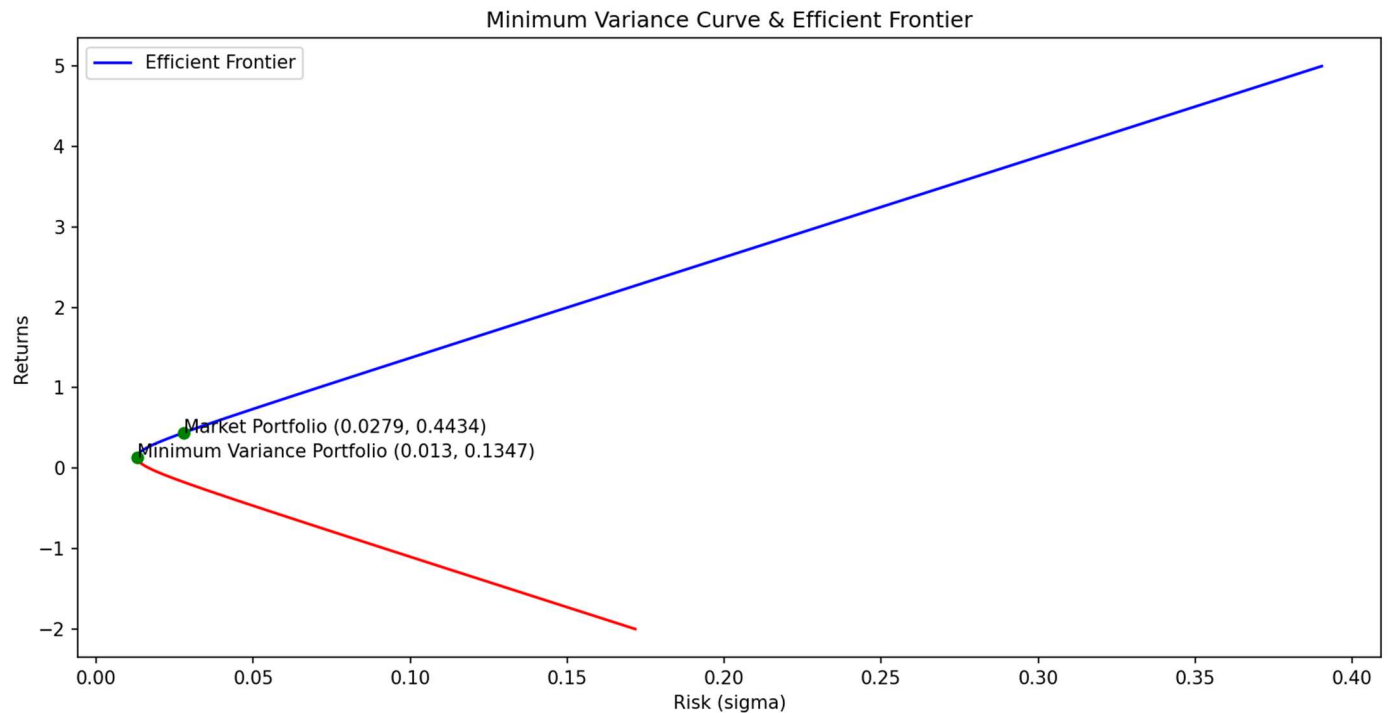
Equation SML:
 $\mu = 0.16 \text{ beta} + 0.05$



```

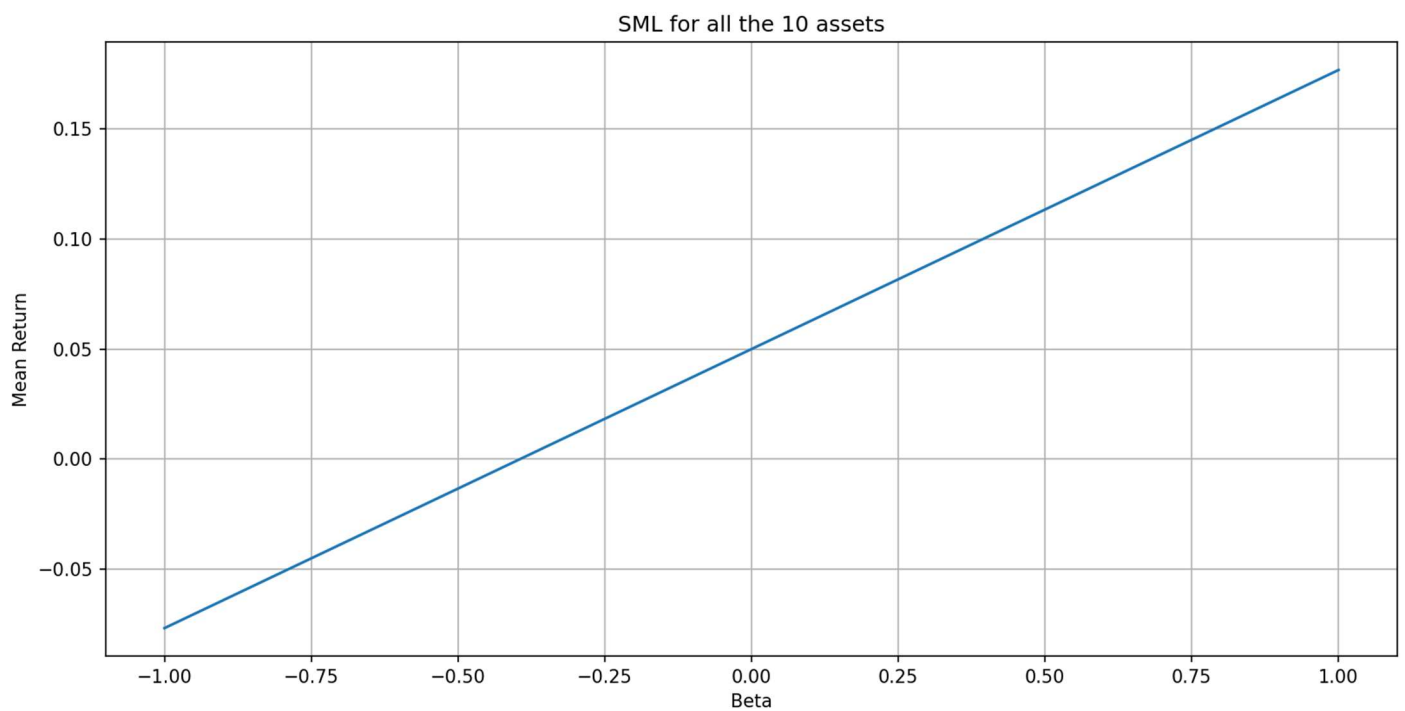
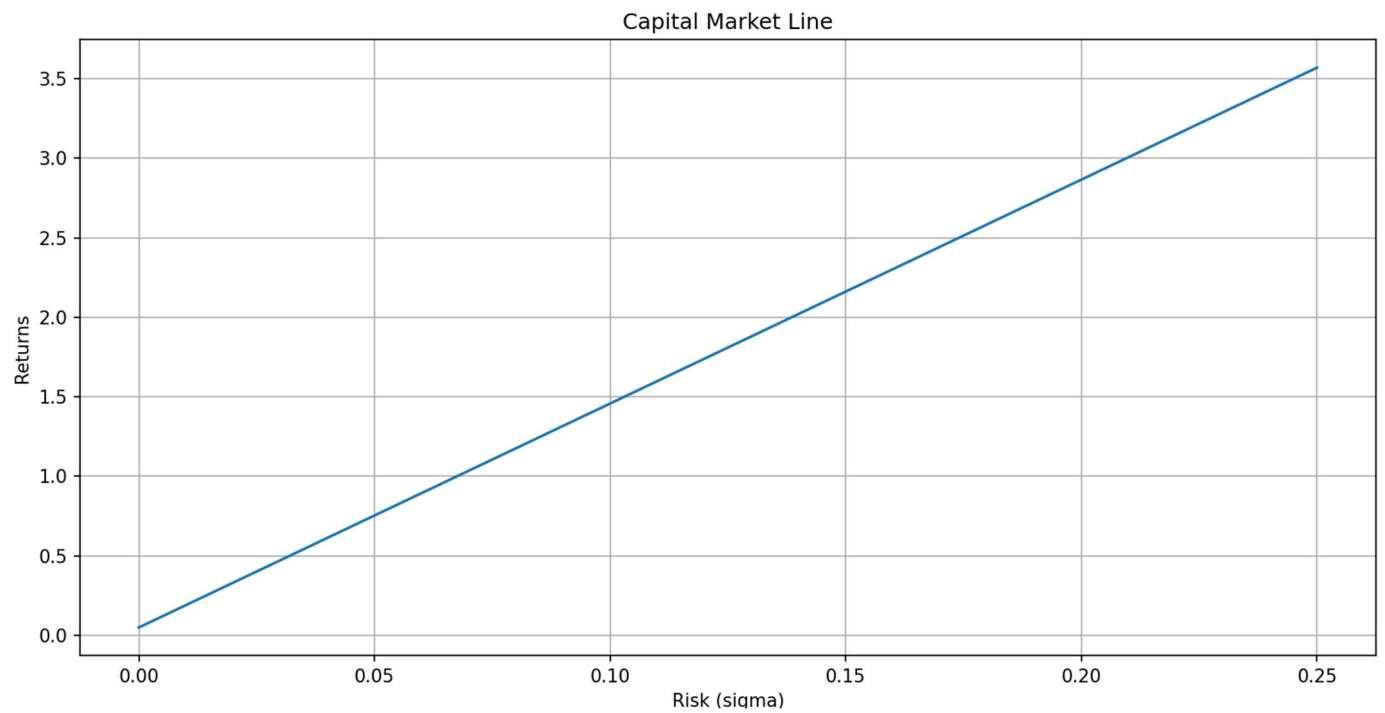
***** Inference about stocks taken from NSE *****
Market return = 0.17679467861513648
Market risk = 0.9611371595084666 %
Market Portfolio Weights = [-0.16773169 -0.1179504 -0.26967665 0.0459976 0.13222492 0.16602
305
0.40681389 -0.29580554 0.07989279 1.02021202]
Return = 0.44343834687996764
Risk = 2.794621272462441 %

```

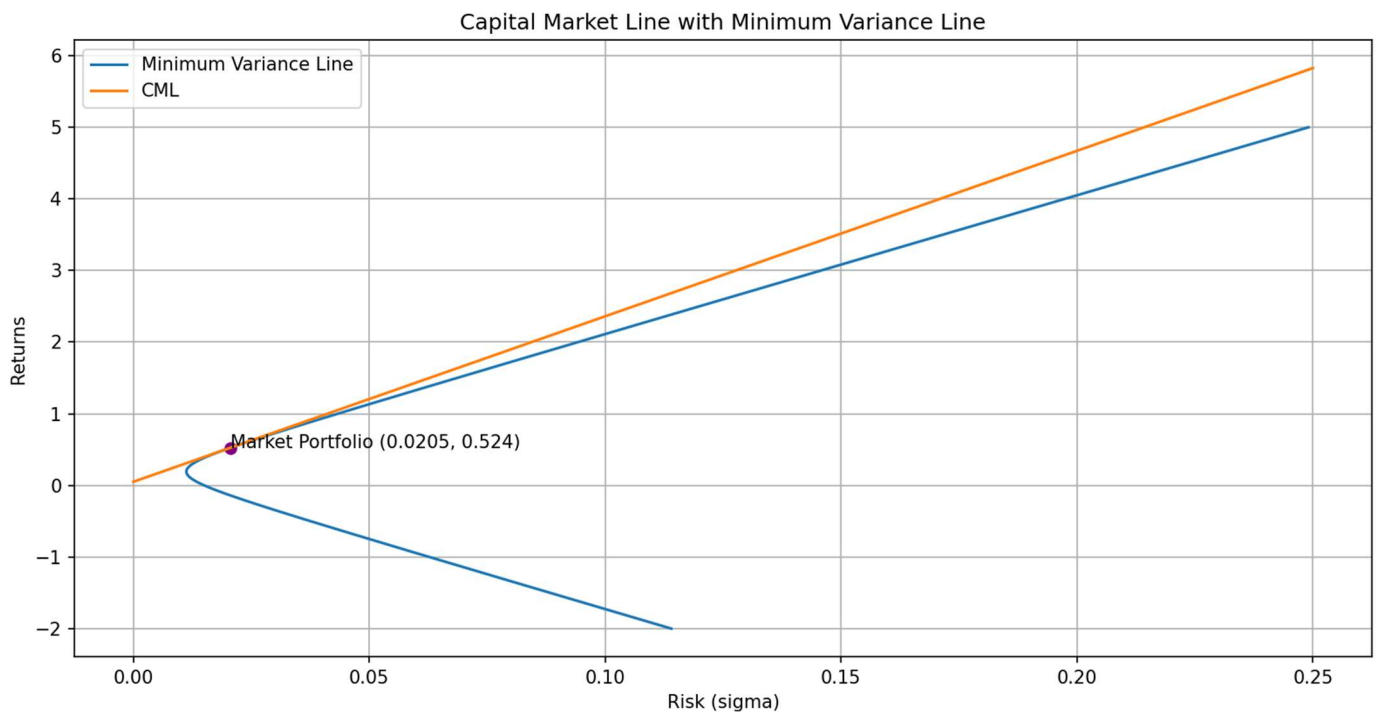
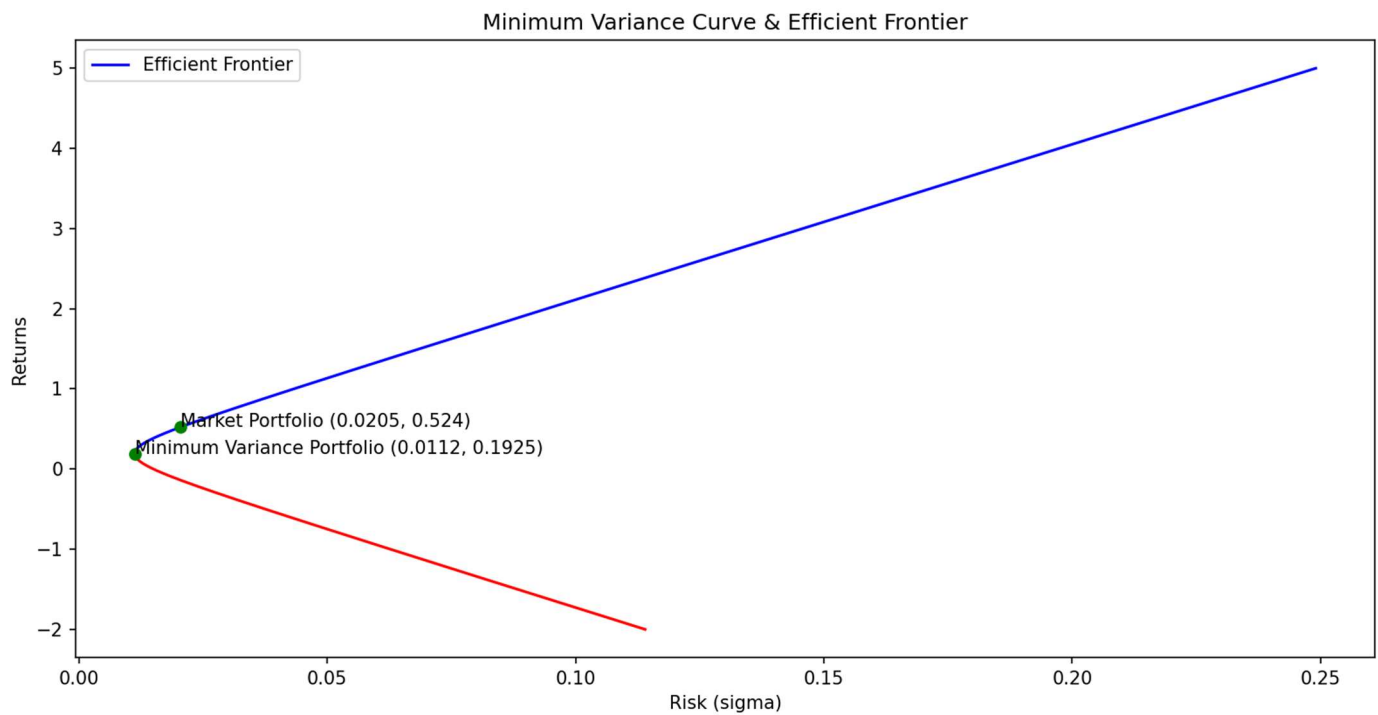


Equation of Capital Market Line is:
 $y = 14.0784 x + 0.0500$

Equation SML:
 $\mu = 0.13 \text{ beta} + 0.05$

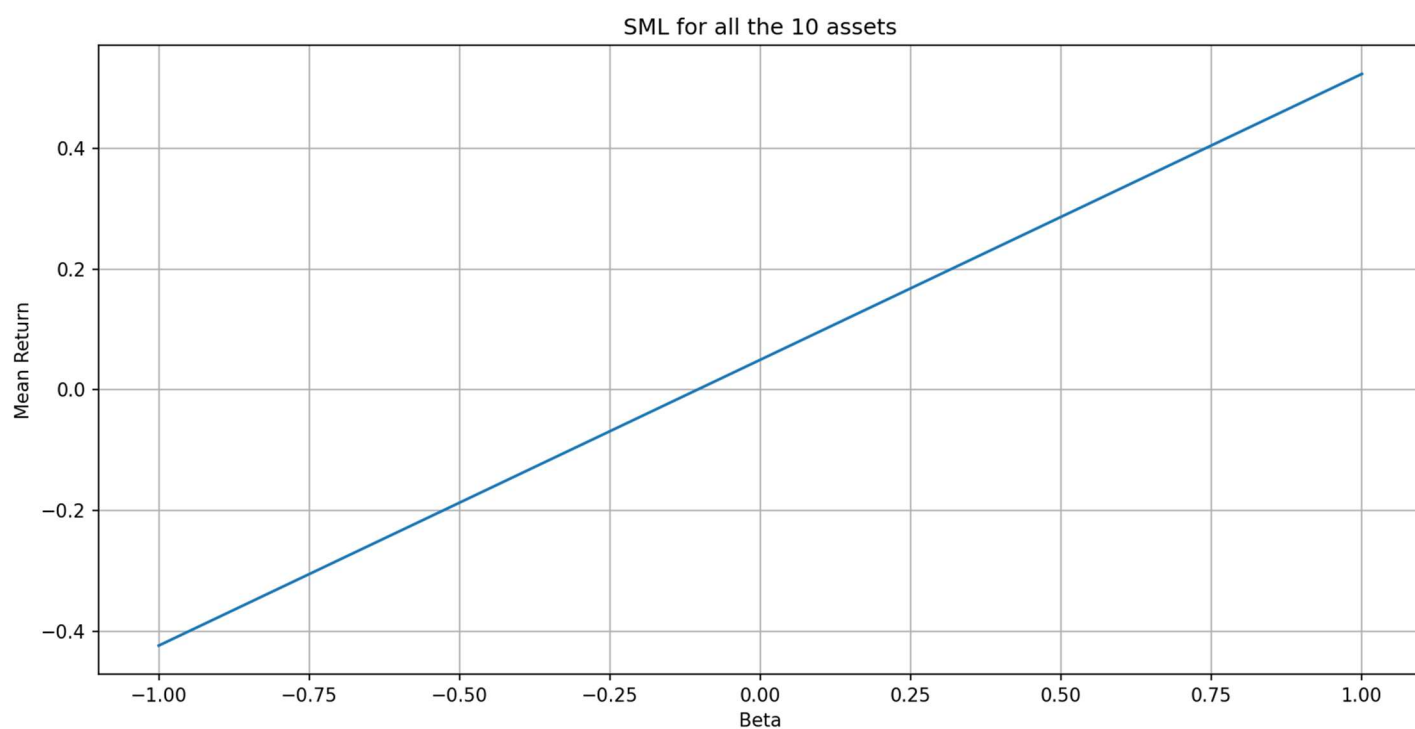
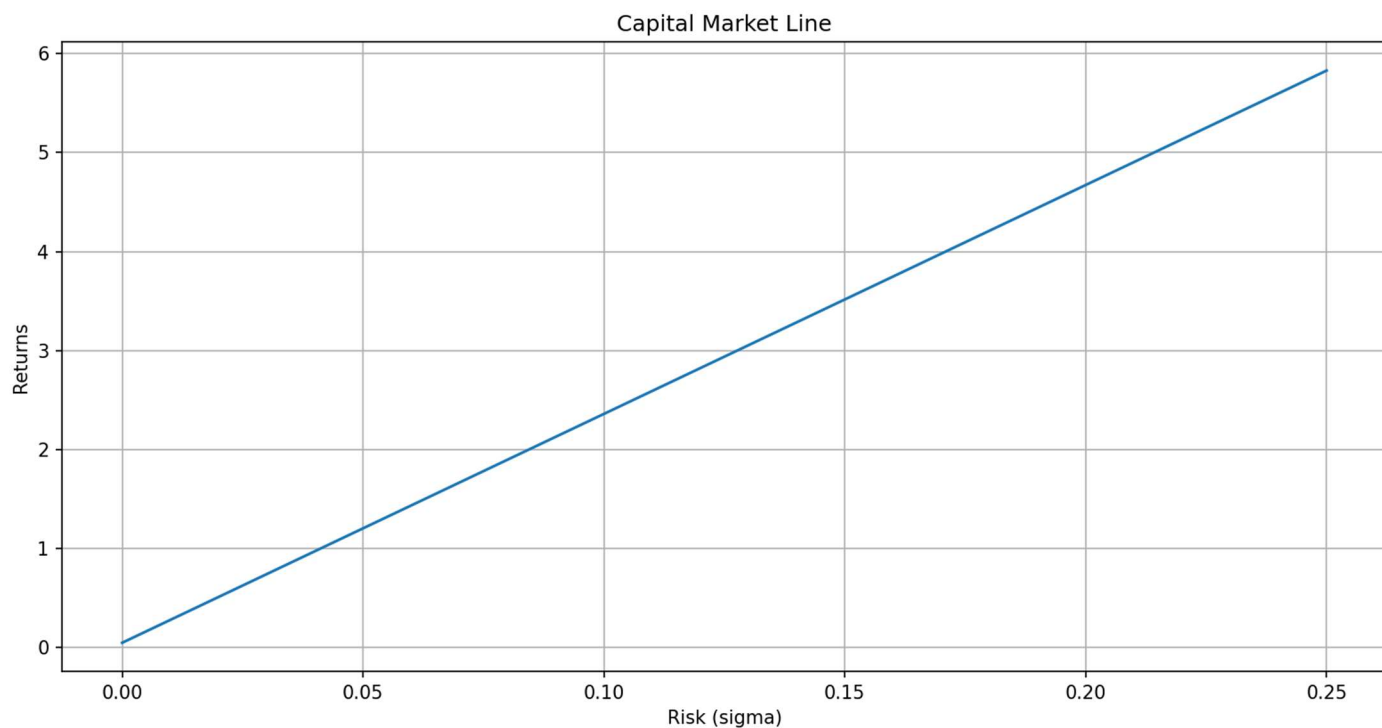


```
***** Inference about stocks not listed in BSE with index taken from BSE values*****
Market Portfolio Weights      = [ 0.19765412  0.23391236 -0.06674379  0.02968716  0.38826395 -0.13880
025
-0.17273922 -0.29072318  0.53256552  0.28692334]
Return                        = 0.5239676196823649
Risk                          = 2.0511368338575924 %
```

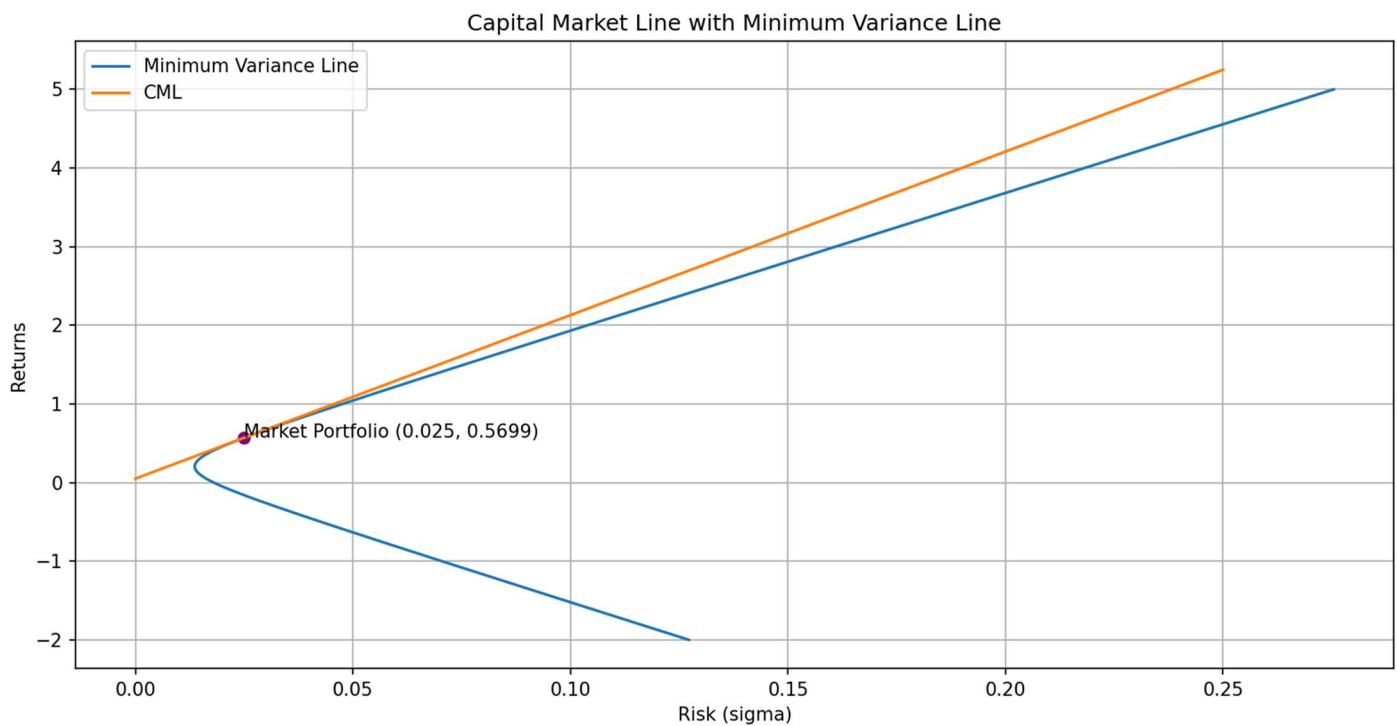
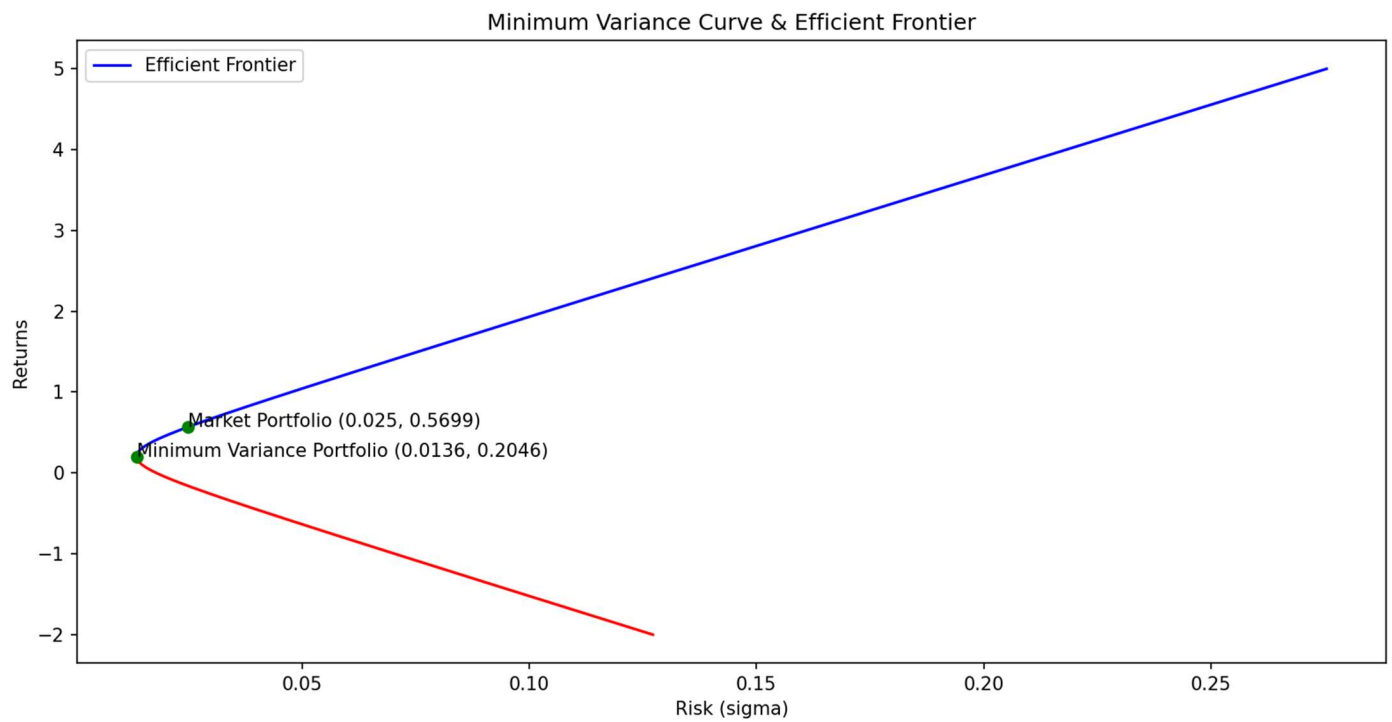


Equation of Capital Market Line is:
 $y = 23.1076 x + 0.0500$

Equation SML:
 $\mu = 0.47 \text{ beta} + 0.05$

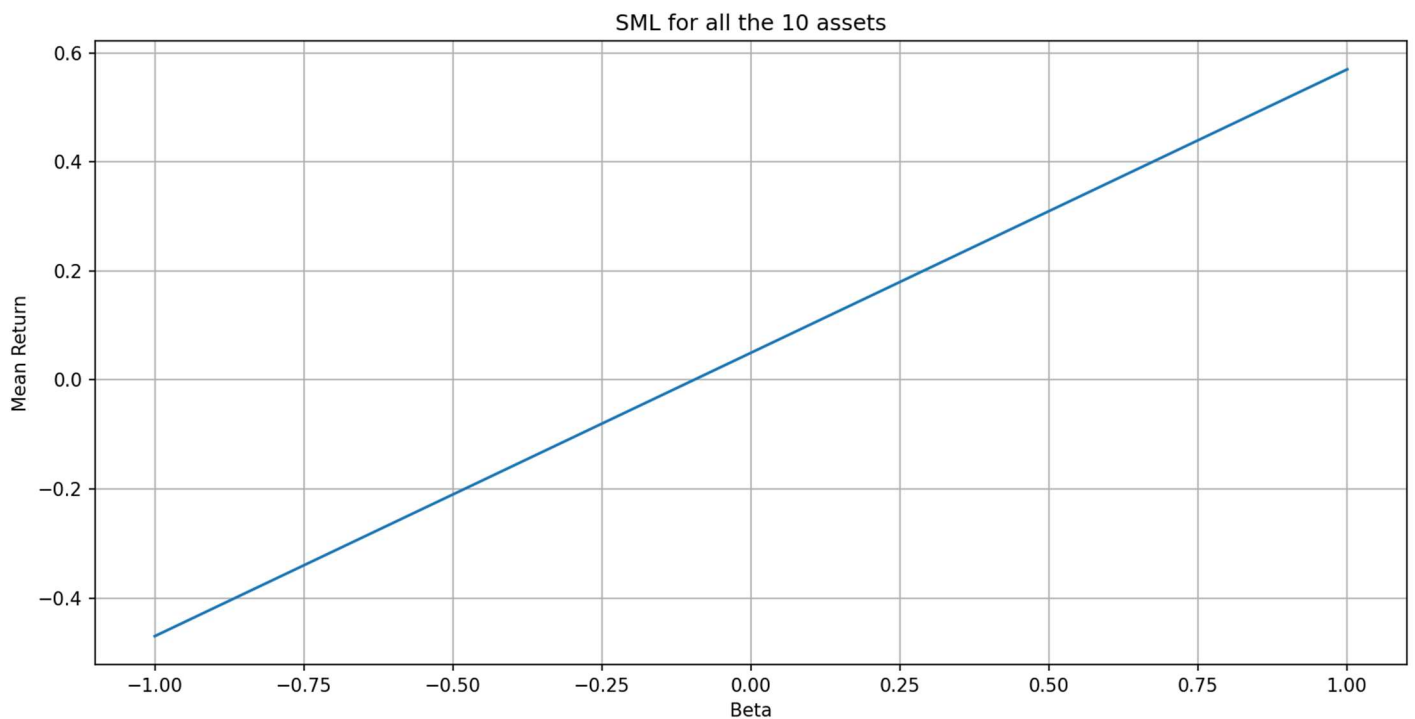
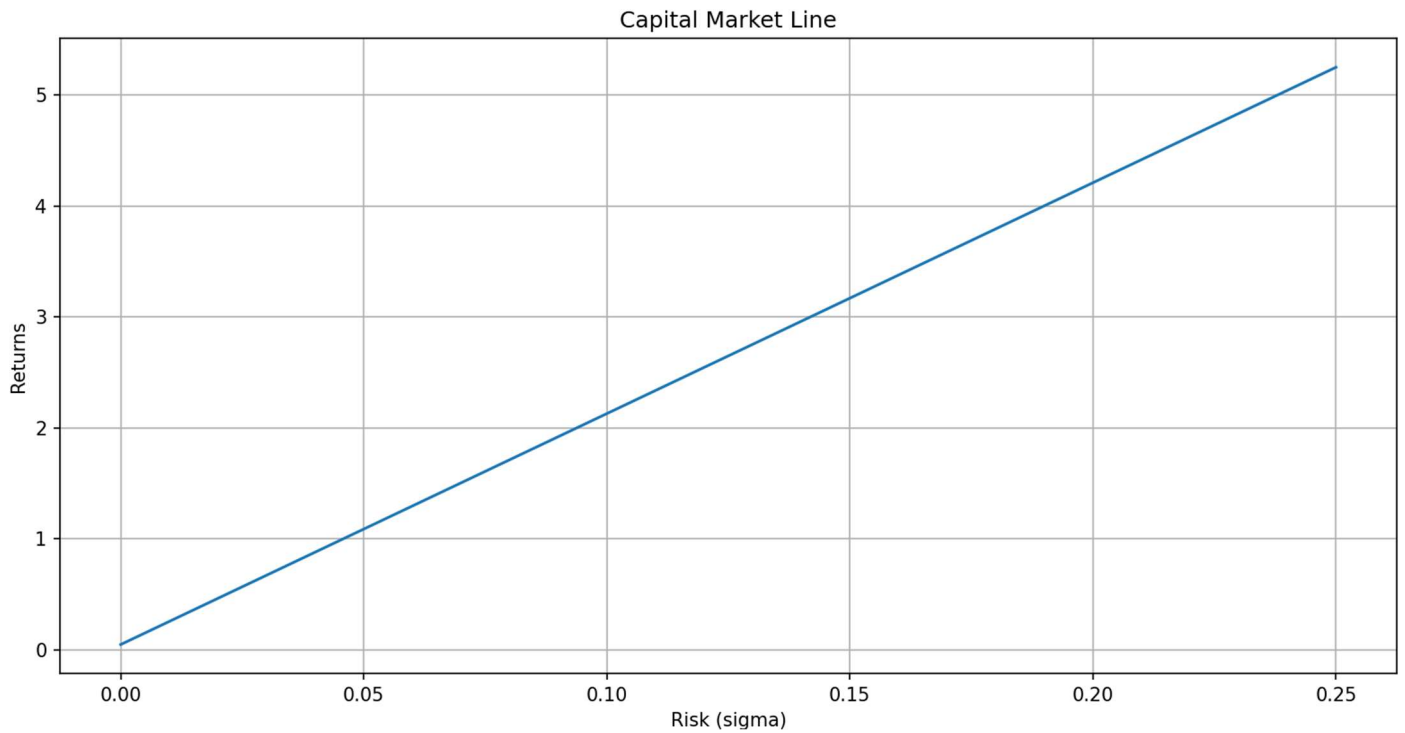


```
***** Inference about stocks not taken from any index with index taken from NSE values*****
Market Portfolio Weights      = [ 0.01441793  0.70670392 -0.05430286 -0.10610037  0.03366853 -0.40454
559
  0.38184923  0.154576    0.34841406 -0.07468085]
Return                        = 0.5699295818818378
Risk                          = 2.500105334676229 %
```

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

Equation SML:
 $\mu = 0.52 \text{ beta} + 0.05$



IMPORTANT POINTS:-

1. The market portfolio return is taken as the corresponding value calculated using the index values.
2. The dependence between actual return and expected return depends on the value of beta. (which is discussed in detail in the next question)
3. If the value of beta is close to 1, the expected return is very close to the market portfolio return, otherwise if it is close to 0, then the expected return is around the risk-free return.

```

***** Beta for securities in BSE *****
WIPRO.BO           =           0.6715346942700791
BAJAJ-AUTO.BO      =           0.828684126967256
HDFCBANK.BO        =           1.141106183752262
HEROMOTOCO.BO      =           0.8986503419569092
TCS.BO             =           0.6590940810096556
INFY.BO            =           0.7329271570632576
BAJFINANCE.BO      =           1.5399992640876927
MARUTI.BO          =           1.071050846781488
RELIANCE.BO        =           1.1163600852053512
TATAMOTORS.BO      =           1.2119527441636075

```

```

***** Beta for securities in NSE *****
ACC.NS             =           0.9660141318193035
GODREJIND.NS       =           0.6155881580858165
HINDZINC.NS        =           0.6026777812817589
IDEA.NS            =           1.6419084680619533
IGL.NS             =           0.8994127238025518
LUPIN.NS           =           0.506002184611287
MAHABANK.NS        =           0.8831450227416593
MGL.NS             =           0.9060256238961149
PAGEIND.NS         =           0.6877117268056341
TATACHEM.NS        =           0.9873390812780302

```

```

***** Beta for securities in non-index using BSE Index *****
HAVELLS.NS         =           0.7263492815198991
HAL.NS              =           0.6394977384928774
ICICIGI.NS         =           0.6507210528932827
ICICIPRULI.NS      =           0.41945194593075935
AMBUJACEM.NS       =           0.8658444539912992
IOC.NS              =           1.05363934216652
NAUKRI.NS          =           0.8564233843156941
INDIGO.NS           =           0.8149497783723564
JINDALSTEL.NS      =           1.0044866839897817
BANKBARODA.NS      =           1.0475076223516449

```

```

***** Beta for securities in non-index using NSE Index *****
HAVELLS.NS         =           0.7807762730775936
HAL.NS              =           0.6527099497340919
ICICIGI.NS         =           0.8189933546899765
ICICIPRULI.NS      =           1.0942945244806597
AMBUJACEM.NS       =           1.08356591960823
IOC.NS              =           0.8541974228259217
NAUKRI.NS          =           0.9219123717083387
INDIGO.NS           =           0.8519156341205811
JINDALSTEL.NS      =           1.5735275153056445
BANKBARODA.NS      =           1.426029239657855

```

SOME IMPORTANT POINTS:

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

- Beta less than 1 can also occur when the asset price goes opposite to the market.
- We can see many companies from all 4 groups having $\text{Beta} > 1$ like, BankOf Baroda, Idea, Bajaj Finance, Maruti.