MA374

LAB-5

VARUN BHARDWAJ

200123068

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:

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

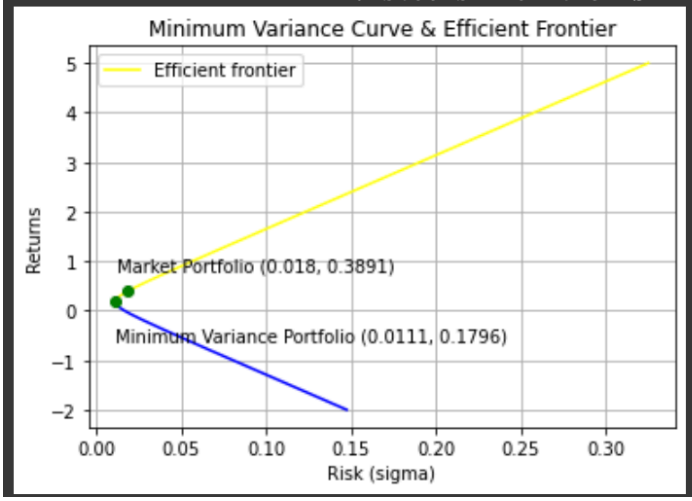
where, β_k = beta of the asset k

R_k = return of the asset k

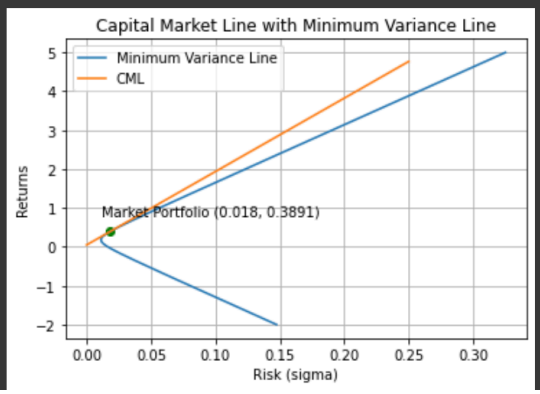
R_M = return of the entire market portfolio

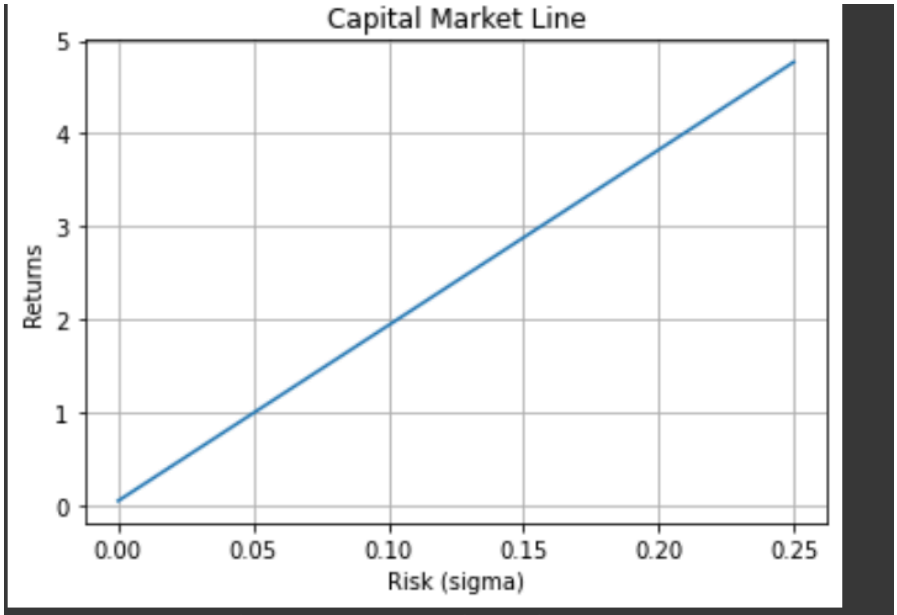
σ_M^2 = variance of the market portfolio

```
********************  Market portfolio for BSE using Index  ********************
Market return    = 0.18828521206023865
Market risk      = 0.9858488532026951 %


********************  Market portfolio for NSE using Index  ********************
Market return    = 0.2691388127952176
Market risk      = 1.021122580243631 %


********************  10 stocks from the BSE Index  ********************
```

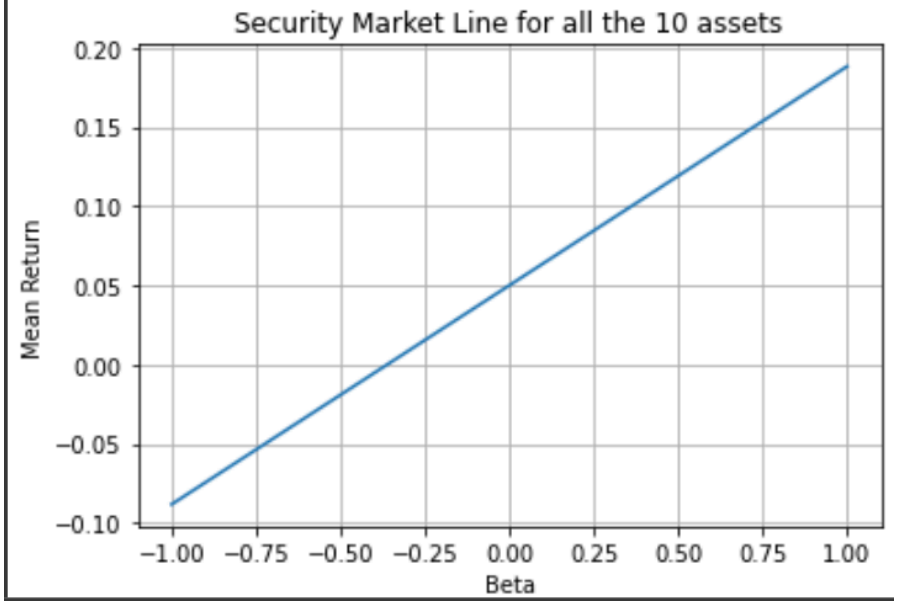



```
Market Portfolio Weights        =  [-0.13836107  0.00239926  0.13150299 -0.35485775  0.27998497  0.42669864
  0.54610275 -0.30735634  0.42348177 -0.00959522]
Return                          =  0.3891320730462697
Risk                            =  1.796729807687594  %

Equation of CML is:
y = 18.8750 x + 0.0500
```

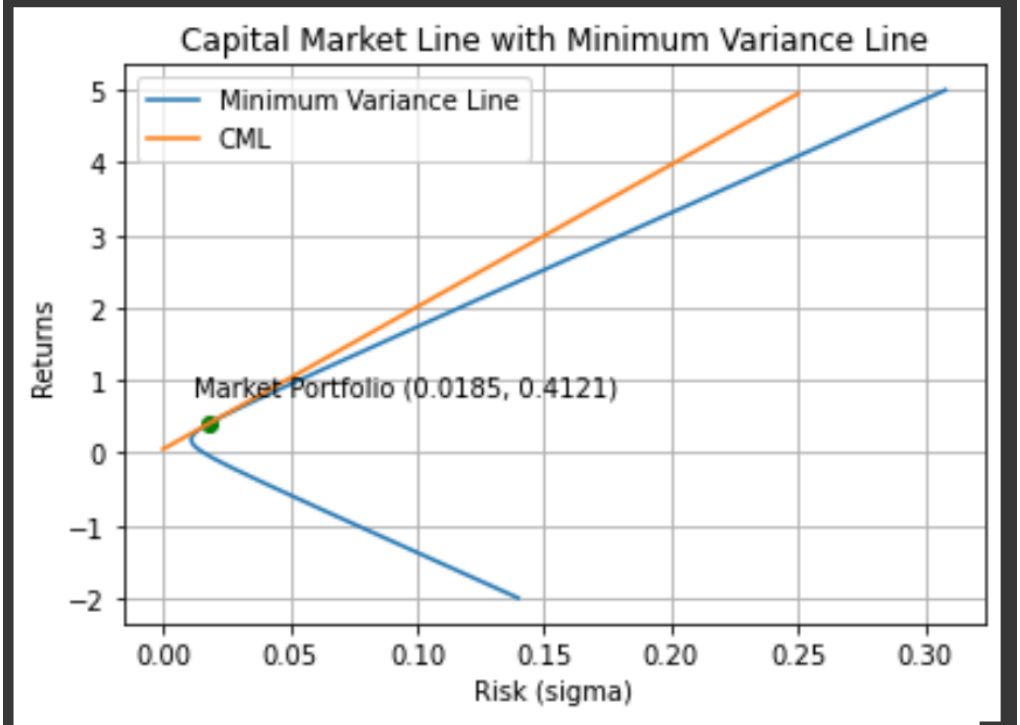


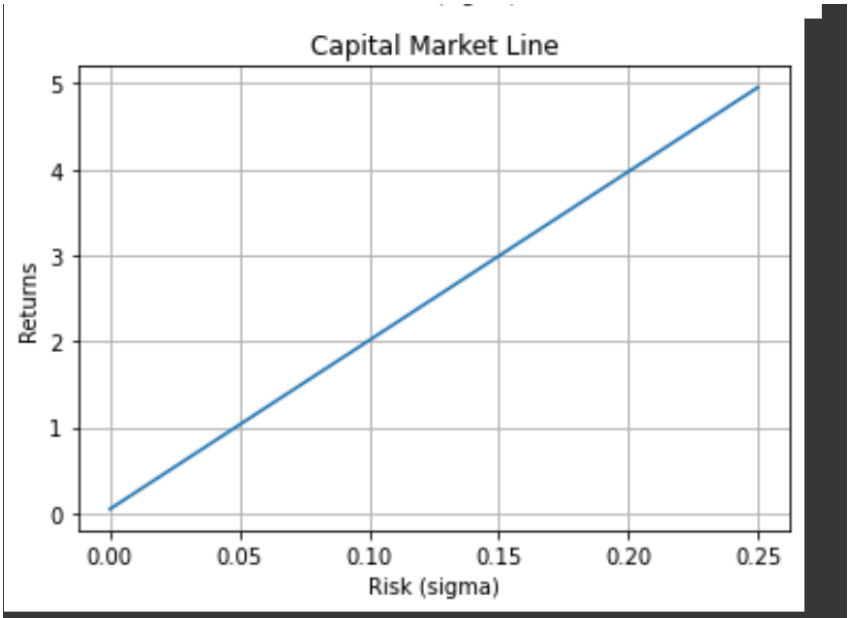



```
Eqn of Security Market Line is:
mu = 0.14 beta + 0.05
```

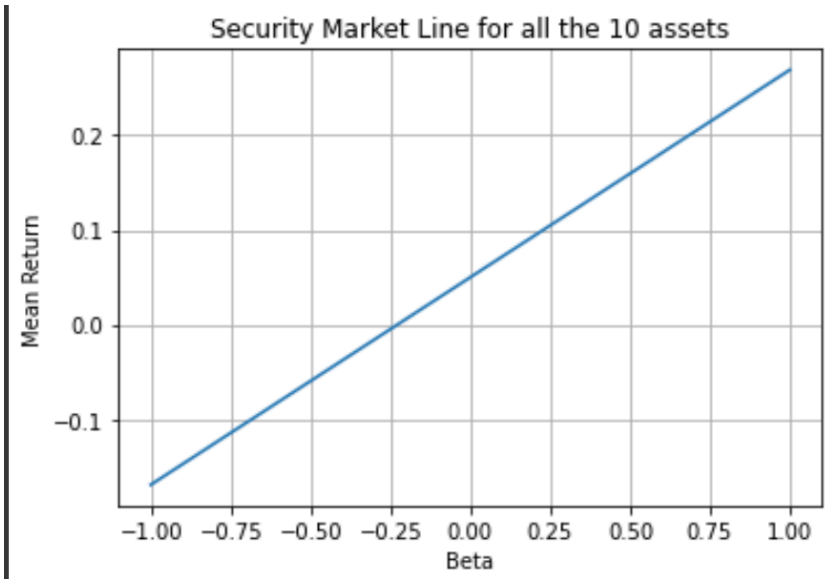



```
Equation of CML is:
y = 19.6189 x + 0.0500
```

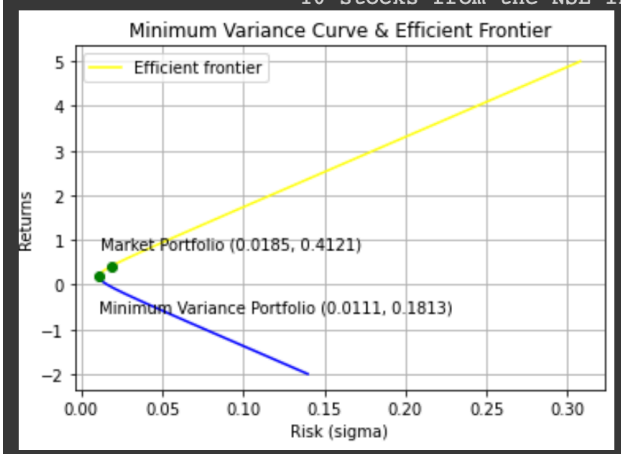





```
Eqn of Security Market Line is:
mu = 0.22 beta + 0.05
```

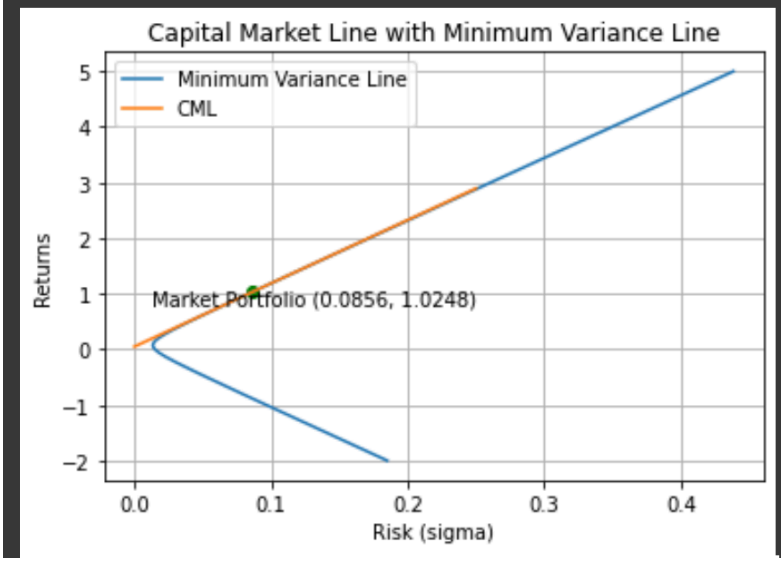



```
********************  10 stocks from the NSE Index  ********************
```

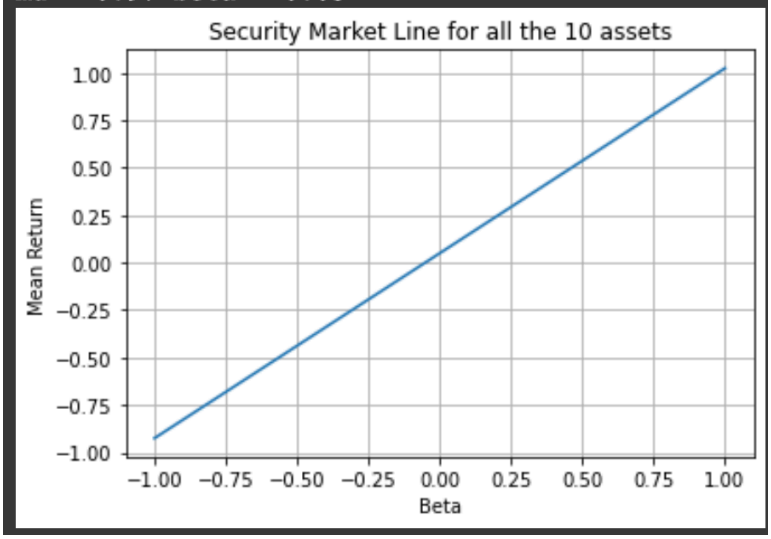


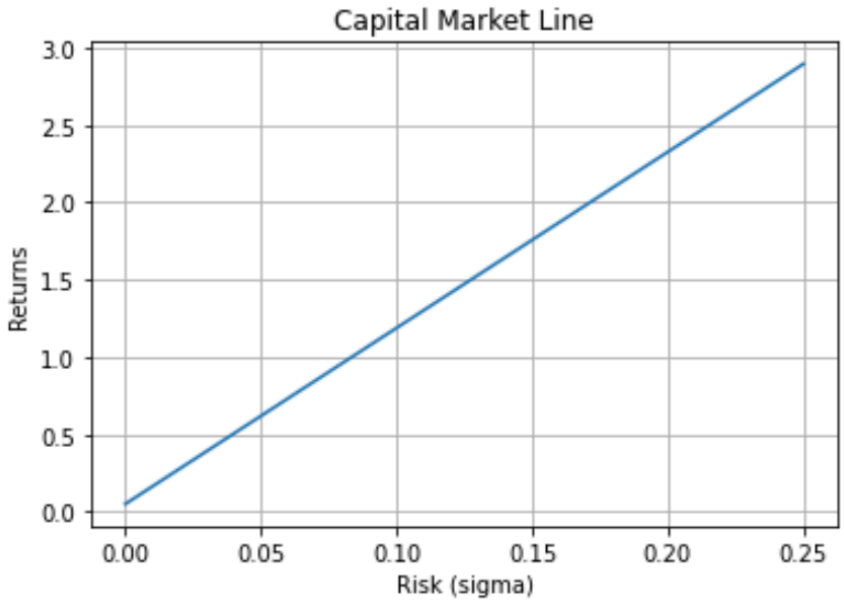

```
arket Portfolio Weights        =  [-0.13578158  0.03292941  0.15339818 -0.48609186  0.25141976  0.45845427
 0.60139794 -0.28036715  0.42195312 -0.0173121 ]
eturn                          =  0.41208616987508273
isk                            =  1.8455963327783234  %
```

```
Equation of CML is:
y = 11.3849 x + 0.0500
```

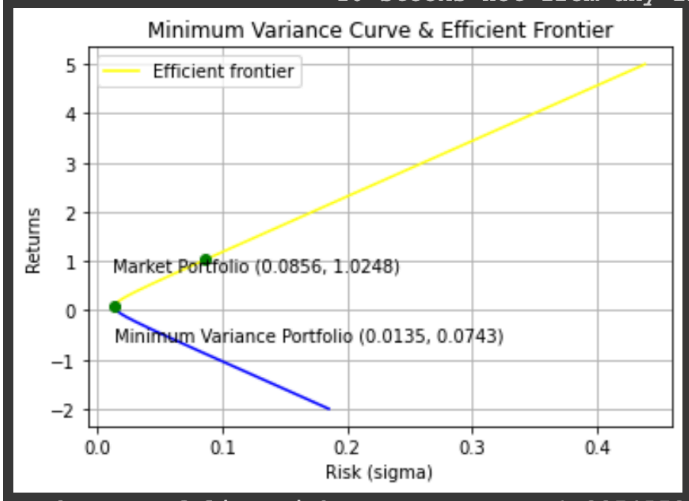



```
Eqn of Security Market Line is:
mu = 0.97 beta + 0.05
```





```
********************  10 stocks not from any Index  ********************
```




```
Market Portfolio Weights        =  [ 1.33745784 -0.02814459 -0.34046223 -1.75049733  1.694612   -1.0670993
  0.97811283 -2.83885276  1.83141123  1.18346232]
Return                          =  1.0247702927424194
Risk                            =  8.561925477329027  %
```

```
**********  Inference about stocks not taken from any index  with index taken from BSE values**********
```

Stocks Name	Actual Return	Expected Return
ACC.NS	0.11605967774155172	0.18041187794116192
HINDZINC.NS	0.07864009623765908	0.13642357888323298
IDEA.NS	-0.021600118970564745	0.26885757954598266
GODREJIND.NS	-0.004632973090229623	0.1444798362941803
IGL.NS	0.10678405208864272	0.1762164602079337
LUPIN.NS	0.02078363161245805	0.12299521968822105
MAHABANK.NS	0.20732344246569498	0.16707893340025665
MGL.NS	0.00483767281289127	0.17545572512930713
PAGEIND.NS	0.17033200879993451	0.15235475830125864
TATACHEM.NS	0.16605096469586234	0.1849753516970613

```
**********  Inference about stocks taken from NSE  **********
```

Stocks Name	Actual Return	Expected Return
WIPRO.NS	0.14561282593090663	0.16760880081547355
BAJAJ-AUTO.NS	0.053251531277694775	0.21833838226642505
HDFCBANK.NS	0.15205114058348362	0.27837820311444206
HEROMOTOCO.NS	-0.01668257790040928	0.2501677007994812
TCS.NS	0.21206234017379993	0.17763581303880494
INFY.NS	0.25756730115328247	0.1906331502709137
NESTLEIND.NS	0.2143027279051978	0.16639222976623202
MARUTI.NS	0.02489493229545939	0.2818535840020543
RELIANCE.NS	0.25362217824131594	0.28615178733065827
TATAMOTORS.NS	0.0951430626835397	0.31426584796478074

```
**********  Inference about stocks taken from BSE  **********


Stocks Name                      Actual Return                    Expected Return

WIPRO.BO                         0.14690917165334177              0.14174041427614487
BAJAJ-AUTO.BO                    0.05640396954621738              0.16859764927315574
HDFCBANK.BO                      0.15163208082492788              0.1982431486872513
HEROMOTOCO.BO                    -0.014028398008634854            0.18237001769852712
TCS.BO                  0.21145427987740212              0.13490920818243773
INFY.BO                 0.255941030134476                0.14689738782949563
NESTLEIND.BO                     0.2152940582388096               0.12670859435723175
MARUTI.BO                        0.025070595465348906             0.2067014494847189
RELIANCE.BO                      0.2528174168277474               0.20578765361176182
TATAMOTORS.BO                    0.09788723783323228              0.23038589407743348
```

```
**********  Inference about stocks not taken from any index  with index taken from NSE values**********

Stocks Name                      Actual Return                    Expected Return

ACC.NS                  0.11605967774155172              0.256662040580102
HINDZINC.NS                      0.07864009623765908              0.1869543437929977
IDEA.NS                 -0.021600118970564745            0.3968208164734891
GODREJIND.NS                     -0.004632973090229623            0.1997209922169711
IGL.NS                  0.10678405208864272              0.2500136155783083
LUPIN.NS                         0.02078363161245805              0.16567459415136
MAHABANK.NS                      0.20732344246569498              0.23553349332455237
MGL.NS                  0.00483767281289127              0.24880808839649166
PAGEIND.NS                       0.17033200879993451              0.21220028073796166
TATACHEM.NS                      0.16605096469586234              0.26389371926931937
```

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, them the expected return is around the risk-free return.

4. Also, since the market portfolio mean is calculated from the index values, and not from the combined asset of 10 chosen stocks, there can be some deviations in the observed values.

5. For the non-index stocks, the comparison was made twice, first by considering the market portfolio constructed using BSE index and then using NSE index

```
**********  Beta for securities in non-index using BSE Index  **********
ACC.NS          =               0.9430645258319666
HINDZINC.NS             =               0.624966166632379
IDEA.NS         =               1.5826535338474643
GODREJIND.NS            =               0.6832244380044323
IGL.NS          =               0.912725651047578
LUPIN.NS                =               0.5278599106925728
MAHABANK.NS             =               0.8466482544008807
MGL.NS          =               0.9072244476485105
PAGEIND.NS              =               0.7401713948753372
TATACHEM.NS             =               0.9760649724300564


**********  Beta for securities in non-index using NSE Index  **********
ACC.NS          =               0.8619340446378595
HINDZINC.NS             =               0.5401511994921713
IDEA.NS         =               1.3949038440991302
GODREJIND.NS            =               0.6236729587737769
IGL.NS          =               0.818300564724484
LUPIN.NS                =               0.45616346437756916
MAHABANK.NS             =               0.7786896026463915
MGL.NS          =               0.8258255117923045
PAGEIND.NS              =               0.6904098775826951
TATACHEM.NS             =               0.8972617338341531
```

```
**********  Beta for securities in BSE  **********
WIPRO.BO                =               0.6634144960936363
BAJAJ-AUTO.BO           =               0.8576307437811442
HDFCBANK.BO             =               1.0720101338288788
HEROMOTOCO.BO           =               0.9572246788099453
TCS.BO          =               0.6140150990653309
INFY.BO         =               0.7007067956571235
NESTLEIND.BO            =               0.5547129242121465
MARUTI.BO               =               1.1331757542987166
RELIANCE.BO             =               1.1265677022927
TATAMOTORS.BO           =               1.3044481863964985


**********  Beta for securities in NSE  **********
WIPRO.NS                =               0.5366863099937365
BAJAJ-AUTO.NS           =               0.7681815015751459
HDFCBANK.NS             =               1.042162272403376
HEROMOTOCO.NS           =               0.9134287908483619
TCS.NS          =               0.5824427512896995
INFY.NS         =               0.6417537289587013
NESTLEIND.NS            =               0.5311347099201411
MARUTI.NS               =               1.0580215391543553
RELIANCE.NS             =               1.0776356060272128
TATAMOTORS.NS           =               1.2059289935632431
```

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. From the above tables, is clear that for the stocks from MARUTI, RELIANCE, HDFCBANK and, TATAMOTORS, the value of beta is greater than 1 for both the indices, while for the stocks of the rest of the companies, the value of beta is less than 1.
4. Beta less than 1 can also occur when the asset price goes opposite to the market.