MA374 Financial Engineering Lab
Assignment - 5

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Information about the data used:-

bsedata1.csv

Stocks in Index

Stock Name	Stock Symbol
Infosys	INFY.BO
Reliance	RELIANCE.BO
HDFC Bank	HDFCBANK.BO
Axis Bank	AXISBANK.BO
Bharti Airtel	BHARTIAIRTL.BO
ICICI BANK	ICICIBANK.BO
Vedanta	VEDL.BO
Cipla	CIPLA.BO
Baja Auto	BAJAJ-AUTO.BO
Nestle India	NESTLEIND.BO

Stocks not in Index

Stock Name	Stock Symbol
Titan	TITAN.BO
Idbi	IDBI.BO
TVS Motor	TVSMOTOR.BO
Bosch	BOSCHLTD.BO
Gail	GAIL.BO
Yes Bank	YESBANK.BO
Voltas	VOLTAS.BO
Marico	MARICO.BO
Union Bank	UNIONBANK.BO
Berger Paint	BERGPAINT.BO

Note - In order to calculate the returns, I have calculated the daily returns at all posible data points and multiplied the data by length/5 to convert them into annual values

nsedata1.csv

Stocks in Index

Stock Name	Stock Symbol
UPL	UPL.NS
Wipro	WIPRO.NS
Asian Paints	ASIANPAINT.NS
Tech Mahindra	TECHM.NS
Eicher Motors	EICHERMOT.NS
ICICI BANK	ICICIBANK.NS
NTPC	NTPC.NS
Larsen & Tubro	LNT.NS
Coal India	COALINDIA.NS
Grasim	GRASIM.NS

Stocks not in Index

Stock Name	Stock Symbol
Bhel	BHEL.NS
Dabur	DABUR.NS
Colgate	COLPAL.NS
MRF	MRF.NS
Gail	GAIL.NS
Havells	HAVELLS.NS
Poonawalla	POONAWALLA.NS
Bosch	BOSCH.NS
Union Bank	UNIONBANK.NS
Godrej	GODERJ.NS

Constructing the Markowitz Efficient Frontier

In order to construct and plot the Markowitz efficient frontier using the given data, I first calculated the minimum variance portfolio that can be constructed using the given stocks. This was calculated as follows:-

$$w_{min}=\frac{uC^{-1}}{uC^{-1}u^{T}};\mu_{min}=w_{min}M^{T};\sigma^{2}_{min}=w_{min}C\,w^{T}_{min}$$

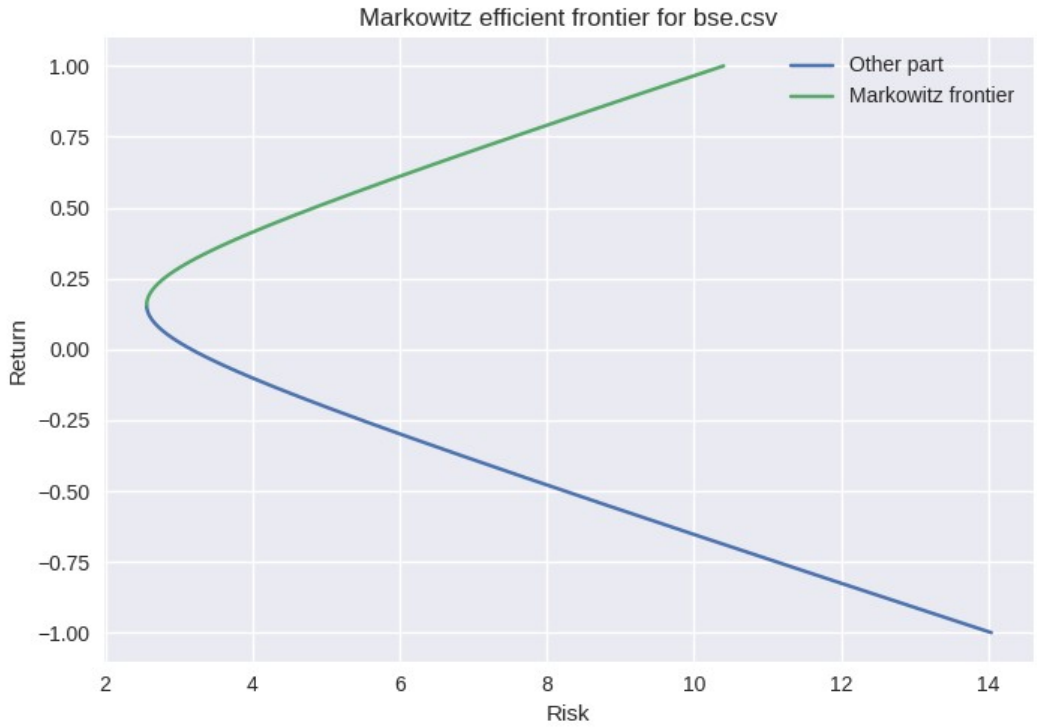
After this I calculated the different portfolios on the minimum variance line by varying the rate of return μ_V using the below formulae:-

$$w=\frac{\begin{vmatrix}1 & uC^{-1}m^{T}\\ \mu_V & mC^{-1}m^{T}\end{vmatrix}uC^{-1}+\begin{vmatrix}uC^{-1}u^{T} & 1\\ mC^{-1}u^{T} & \mu_V\end{vmatrix}mC^{-1}}{\begin{vmatrix}uC^{-1}u^{T} & uC^{-1}m^{T}\\ mC^{-1}u^{T} & mC^{-1}m^{T}\end{vmatrix}},$$

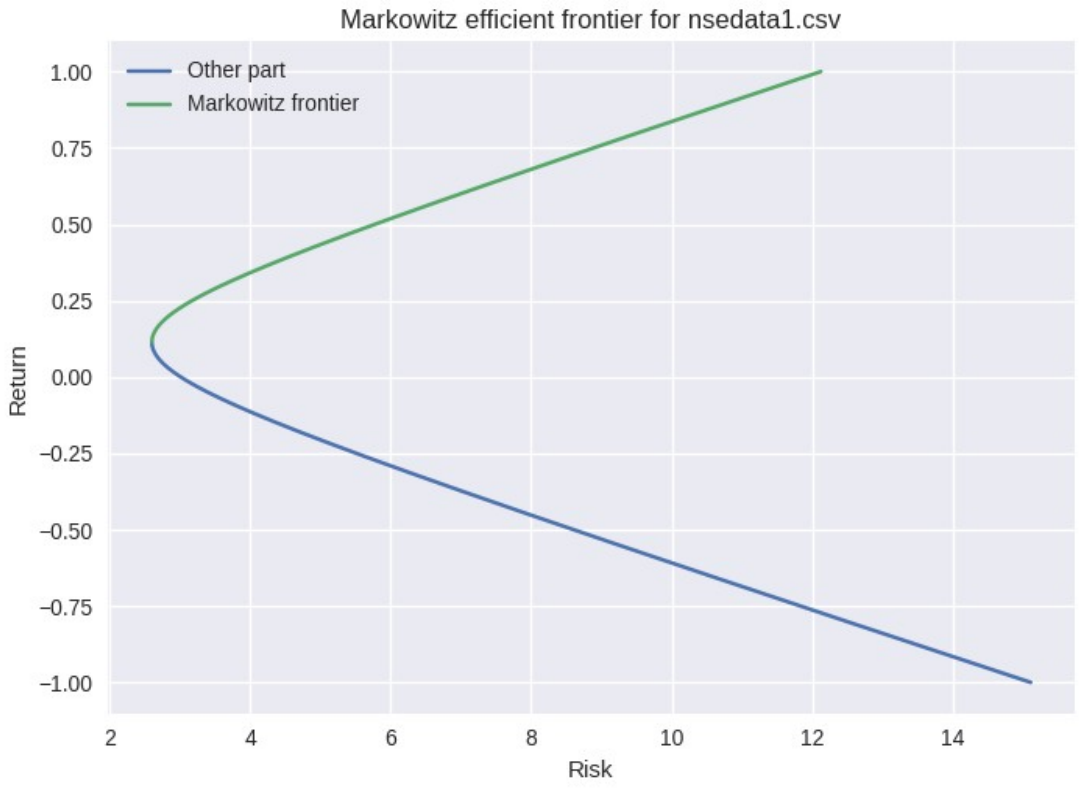
After this, I calculated the risk involved with the corresponding portfolio using $\sigma^2=wCw^T$. Now I plotted the tuples of the form (σ,μ_V) on the XY plane . Note that the values of $\mu_v\geq\mu_{min}$ are plotted

with different color in order to differentiate the Markowitz Effiicient Frontier from the other part of the curve .

Plot for bsedata1



Plot for nsedata1



Market Portfolio

The market return and risk values were simply calculating by finding the mean and the standard deviation of the data otained pertaining to the required index value. The values obtained are given below.

Bse return = 13.1371% ***Nse return = 13.11176%***
Bse risk = 3.101106722 ***Nse risk - 3.1028759***

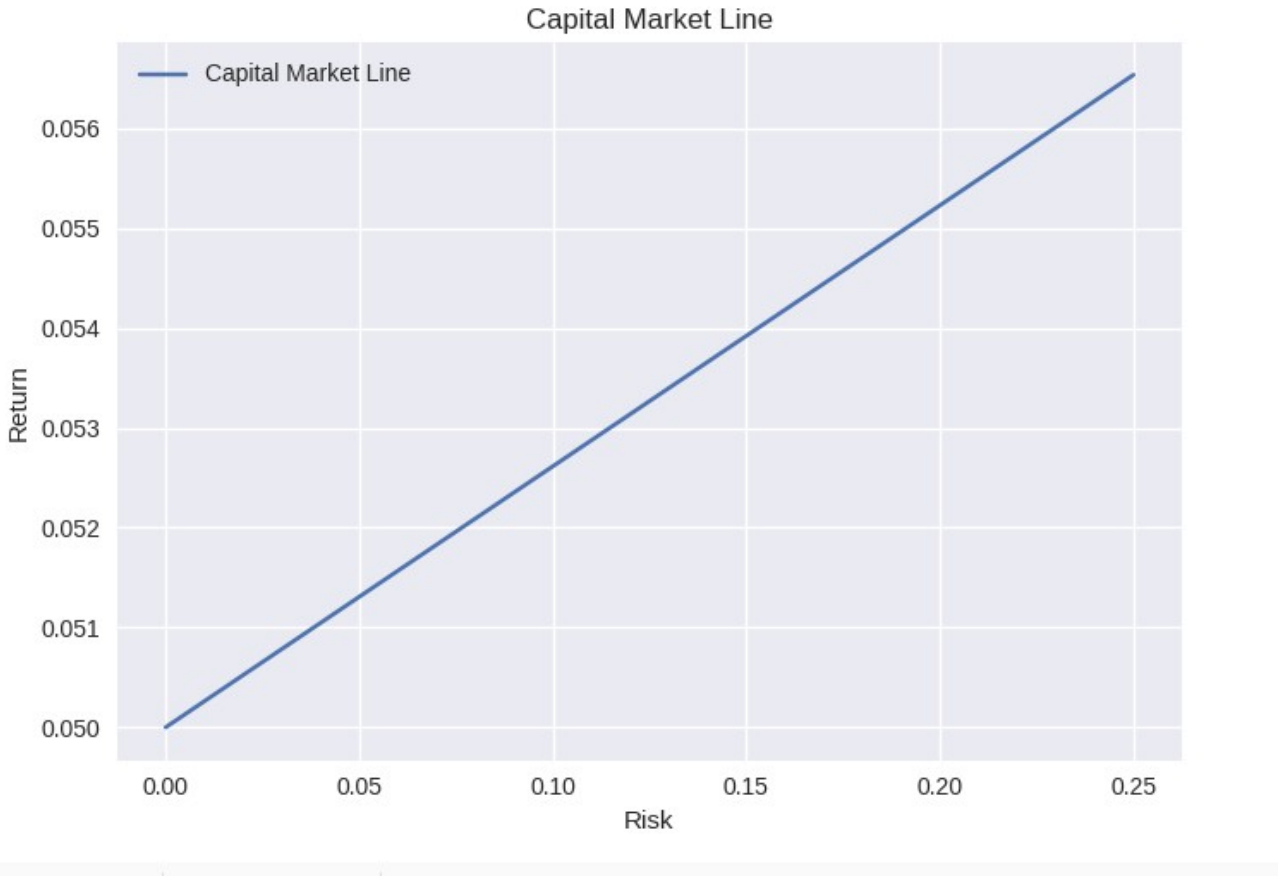
Capital Market Line (CML)

The equation of the capital market line is given by:-

$$\mu = \mu_{rf} + \left(\frac{\mu_M - \mu_{rf}}{\sigma_M}\right)\sigma \quad where\, \mu_{rf} = 0.05$$

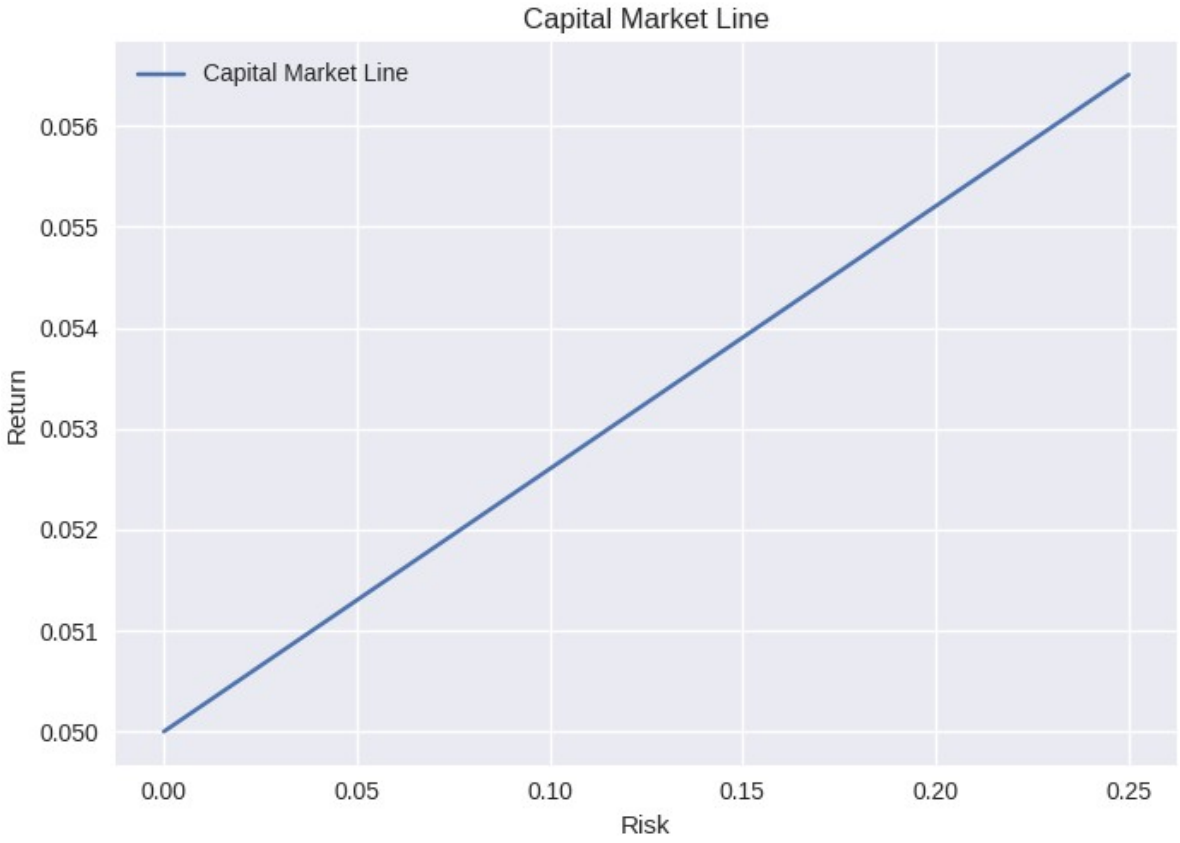
Where μ_M, σ_M are the risk and return of the market portfolio respectively calculated in the last part.The plot and equation of the CML using the market portfolio as each index is shown below:-

For bsedata1



Equation of CML : $\mu = 0.0281\,\sigma + 0.05$

For nsedata1



Equation of CML : $\mu = 0.026142\sigma + 0.05$

Security Market Line (SML)

The equation of the security market line is given by:- $\mu = \mu_{rf} + (\mu_M - \mu_{rf})\beta$. In this part apart from plotting and finding the SML, I have also plotted the β value of index and non index stocks in the same plot alongside there corrseponding returns. This is because we have to draw inference about these stocks from the SML . The equations and plots are given in the **next page.** Note that to calculate the β value of a stock, I have used the formulae:-

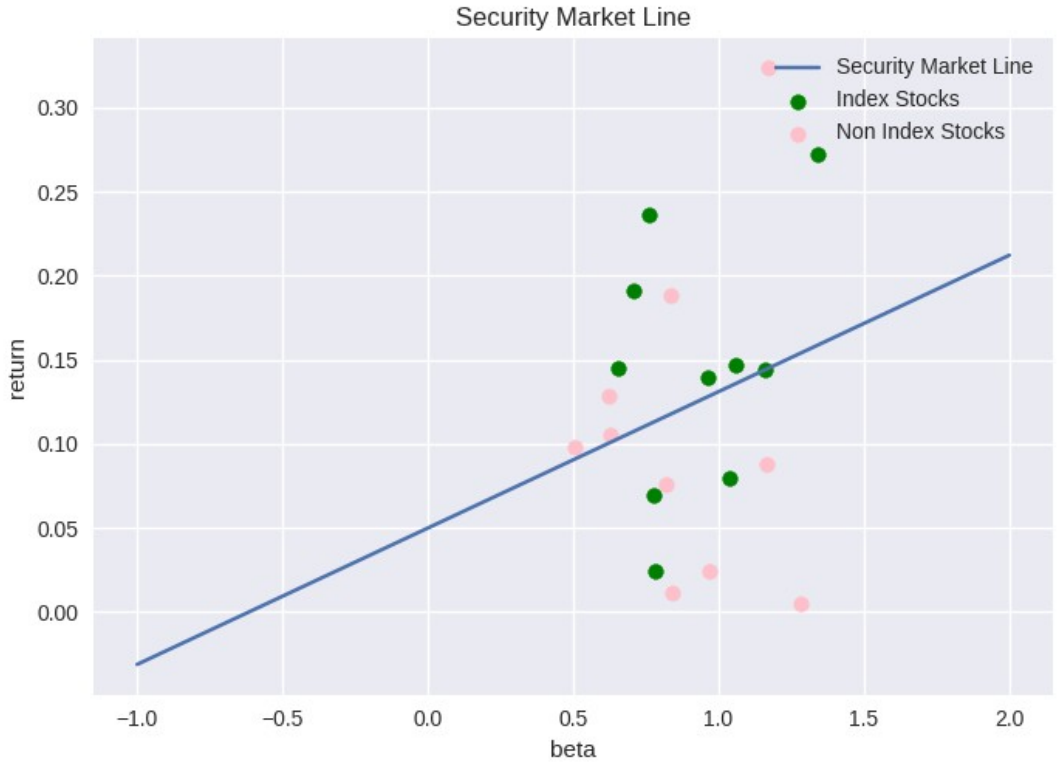
$$\beta = \frac{Cov(K, K_M)}{\sigma_M^2}$$

Here K is the return of the stock K_M, σ_M ***are the return and risk of the market portfolio already calculated and Cov represents the covariance.***

For bsedata1

Equation of SML : $\mu = 0.87189\beta + 0.05$

For nsedata1



Equation of SML : $\mu = 0.81117\beta + 0.05$

Tabulation of β values

For bse1data

Index Stocks(Upto 3 decimal places)

Stock Name	**Stock Symbol**	**Beta Value (β)**
Infosys	INFY.BO	0.745
Reliance	RELIANCE.BO	1.056
HDFC Bank	HDFCBANK.BO	1.128
Axis Bank	AXISBANK.BO	1.352
Bharti Airtel	BHARTIAIRTL.BO	0.893
ICICI BANK	ICICIBANK.BO	1.326
Vedanta	VEDL.BO	1.174
Cipla	CIPLA.BO	0.505
Baja Auto	BAJAJ-AUTO.BO	0.797
Nestle India	NESTLEIND.BO	0.531

Non Index Stocks(Upto 3 decimal places)

Stock Name	**Stock Symbol**	**Beta Value (β)**
Titan	TITAN.BO	0.883
Idbi	IDBI.BO	1.001
TVS Motor	TVSMOTOR.BO	1.028
Bosch	BOSCHLTD.BO	0.870
Gail	GAIL.BO	0.787
Yes Bank	YESBANK.BO	0.668
Voltas	VOLTAS.BO	0.835
Marico	MARICO.BO	0.569
Union Bank	UNIONBANK.BO	1.253
Berger Paint	BERGPAINT.BO	0.744

For nse1data

Index Stocks(Upto 3 decimal places)

Stock Name	**Stock Symbol**	**Beta Value (β)**
UPL	UPL.NS	0.961
Wipro	WIPRO.NS	0.652
Asian Paints	ASIANPAINT.NS	0.759
Tech Mahindra	TECHM.NS	0.709
Eicher Motors	EICHERMOT.NS	1.038
ICICI BANK	ICICIBANK.NS	1.340
NTPC	NTPC.NS	0.7745
Larsen & Tubro	LNT.NS	1.05
Coal India	COALINDIA.NS	0.7808
Grasim	GRASIM.NS	1.576

Non Index Stocks(Upto 3 decimal places)

Stock Name	**Stock Symbol**	**Beta Value (β)**
Bhel	BHEL.NS	1.1677
Dabur	DABUR.NS	0.623
Colgate	COLPAL.NS	0.507
MRF	MRF.NS	0.8201
Gail	GAIL.NS	0.838
Havells	HAVELLS.NS	0.835
Poonawalla	POONAWALLA.NS	1.168
Bosch	BOSCH.NS	0.966
Union Bank	UNIONBANK.NS	1.284
Godrej	GODERJ.NS	0.630

Observations

- ***We can clearly observe that in case of the BSE data the stocks that were included in the index had a value closer to the security market line whereas for the non index stocks it is spread out in a random manner***
- ***Below table shows the comparison of the calculated beta values to actual values obtained online . We can clearly see that the values are close to each other:-***

Stock Name	Calculated Beta	Actual Beta
Infosys	**0.745**	**0.683**
Cipla	**0.505**	**0.500**
Bharti Airtel	**0.893**	**0.938**
HDFC BANK	**1.128**	**0.844**
Asian Paints	**0.759**	**0.769**
NTPC	**0.774**	**0.856**
UPL	**0.961**	**1.06**