Modern Portfolio Theory(MBT)

Modern Portfolio Theory is developed by harry markowitz, who he won a noble price for this theory.

MBT, is built on the foundation of diversification and risk management

It uses Expected returns and Expected Variance to weigh the assets

Why MBT?

There are many other alternatives to MBT, such behavioural finance

The reason we're not including it because, emotions can't be quantified, even if they were, the market movement is rarely dictated by emotions in the long run.

However, it's not to say MBT is the best option out there, they're are others
such as
Post-Modern Portfolio Theory (PMPT),
Risk Parity, etc
which when used in tandom may yeild a greater result than MBT.
But MBT is extremly easy to build

How MBT works?

Date	Price(Adan	Price(Reliance)	
2/2/2024	3157.45	2915.4	
2/5/2024	3173.45	2878.05	
2/6/2024	3203.75	2855.6	
2/7/2024	3229.85	2884.3	
2/8/2024	3168.6	2900.25	

Consider a very simple example of two assets, AdaniPower and Reliance

Calculate the returns

$$R_i = \frac{x_i - x_{i-1}}{x_{i-1}}$$

Assume $x_{i-1} = 0$ **For** $i = 1$

Date	Price(Adan	Price(Relia	R(A)	R(R)
2/2/2024	3157.45	2915.4	0	0
2/5/2024	3173.45	2878.05	0.51	-1.28
2/6/2024	3203.75	2855.6	0.95	-0.78
2/7/2024	3229.85	2884.3	0.81	1.01
2/8/2024	3168.6	2900.25	-1.9	0.55

These are the values we're going to end up with

Date	Price(Adan	Price(Relia	R(A)	R(R)
2/2/2024	3157.45	2915.4	0	0
2/5/2024	3173.45	2878.05	0.51	-1.28
2/6/2024	3203.75	2855.6	0.95	-0.78
2/7/2024	3229.85	2884.3	0.81	1.01
2/8/2024	3168.6	2900.25	-1.9	0.55

Calculate Expected returns for both assets

$$E(r) = \sum_{j=1}^{j=m} P_j R_j$$

P_j — **Probalility of jth outcome, since probalities of all outcomes isn't mentioned we'll assign equal probabilites**

R_j — **Return at the jth outcome**

Since we already found the returns of in the previous step, we'll plug those values into the formaula to find expected return of Reliance and Adani Power

$$E(r) = \frac{1}{m} \sum_{j=1}^{j=n} R_j$$

For Equal probabilites

Calculate Standard Deviation for Returns

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}}$$

For Equal probabilites

$$var(r) = \sum_{j=1}^{j=m} P_j(r_j - E(r))^2$$

$$\sigma = \sqrt{var(r)}$$

For UnEqual probabilites

Exp Return(A)	Standard Deviation(A)	Exp Return(B)	Standard Deviation(B)
0.074	1.162037005	-0.1	0.938003198

We'll End with these values

Since we now have two assets, pick the weight combination between assets1 and asset2 such that their weights add up to 100

Weight(Adani)	Weight(Reliance)
50	50
70	30
10	90
90	10
30	70
40	60

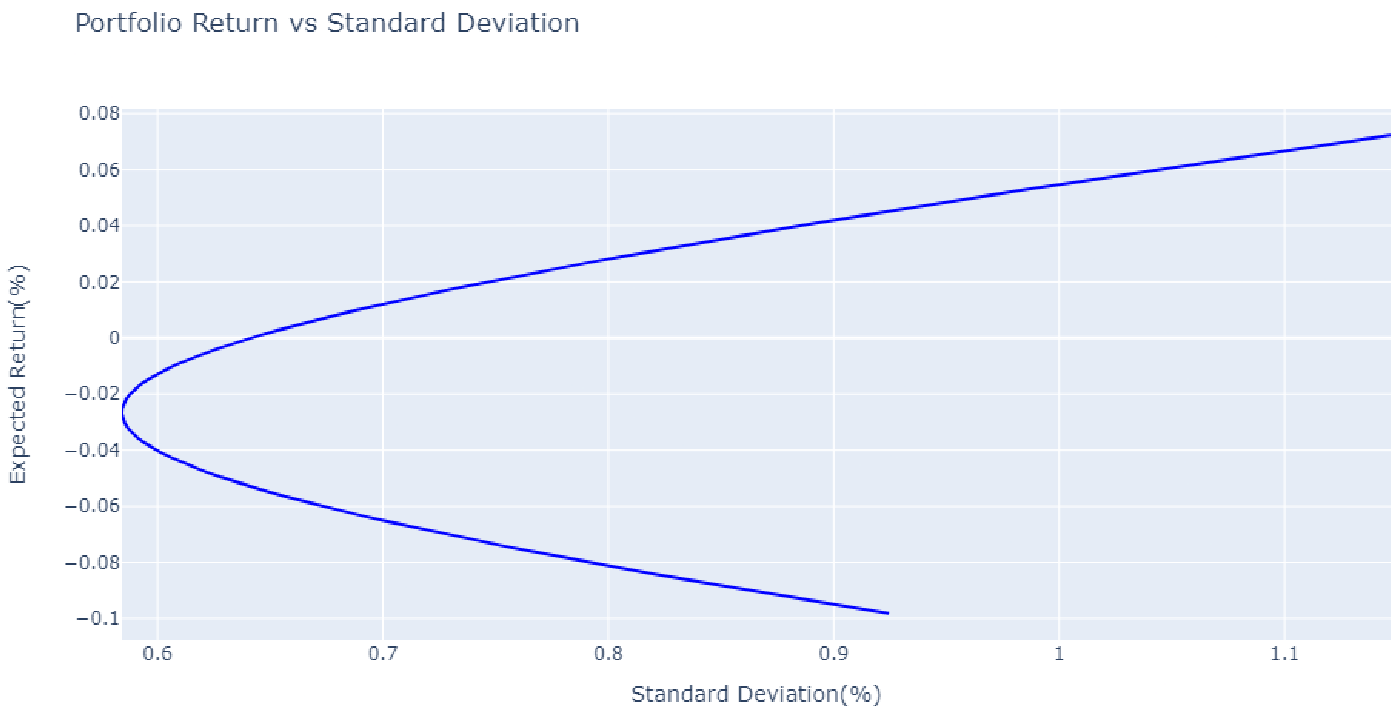
In this way pick all the combinations

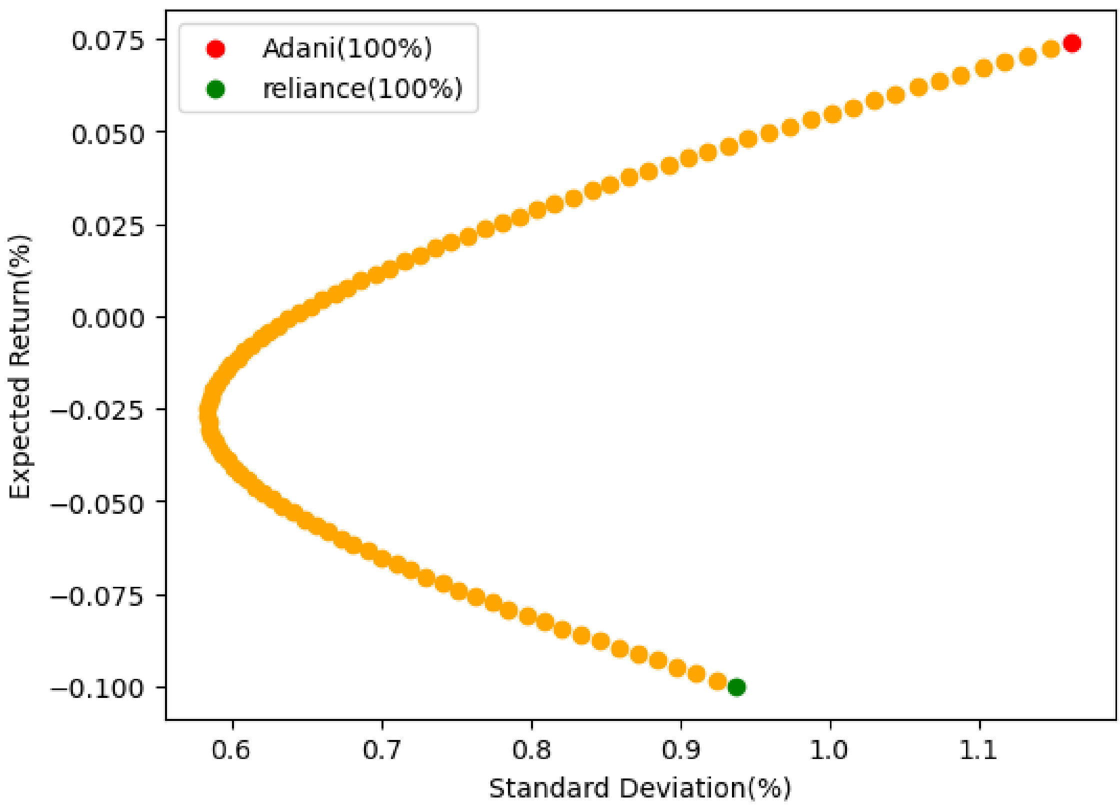
let w1 and w2 be weights of adani and reliance

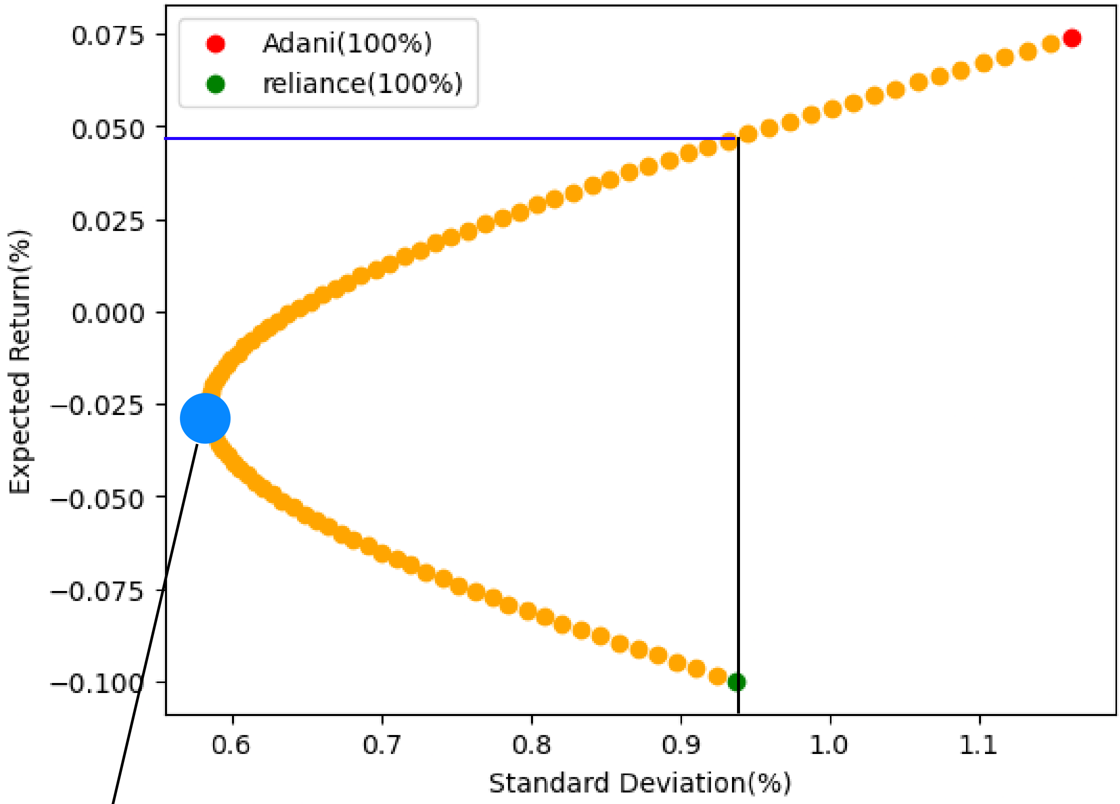
Calculate Portfolio Return and Portfolio Variance

$$E(R_p) = \ w1.E(A) + w2.E(B)$$

Calculate Portfolio return for all weight combination







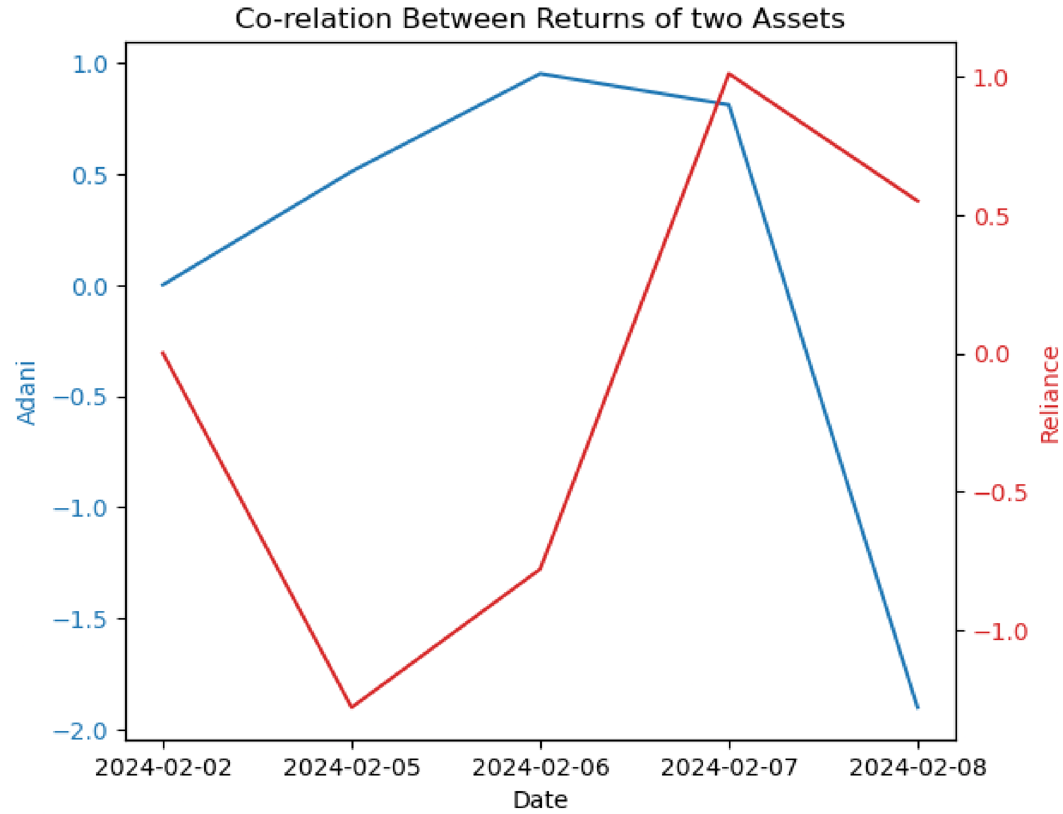
Interpretation

Global Minimum Variance

Rather than investing 100% in reliance, we can achieve muchhigher return for same amount of risk we get by investing in 100% in reliance Look at the blue line

Now this is an small demo, imagine how much return, by diversification can you achieve by investing in more negatively correlated or weakly corelated assets

we already achieved much higher return just by investing in proper way



Now the corelation between reliance and adani in terms of their return is extremly choppy in this case, as our dataset is very small, but if we were to increase the size of it the results, will vary, as the lines will be much more smooth.

Global Minimum Variance

The Minimum amount of risk that can't be mitigated throught diversification