CAPITAL ASSET PRICING MODEL

Project-3 Group 20

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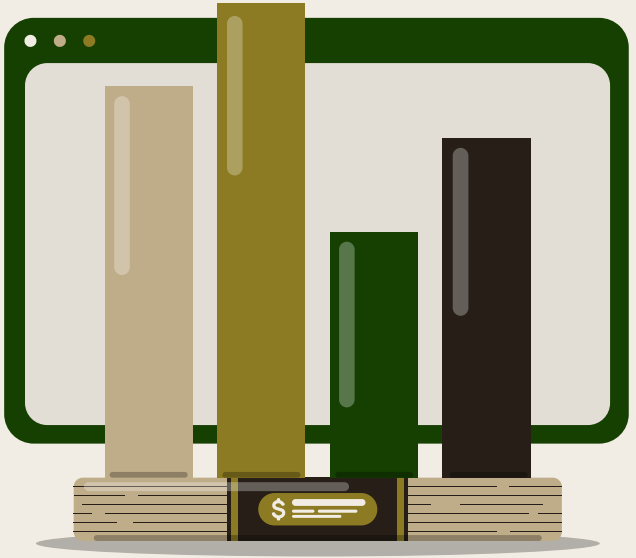
01

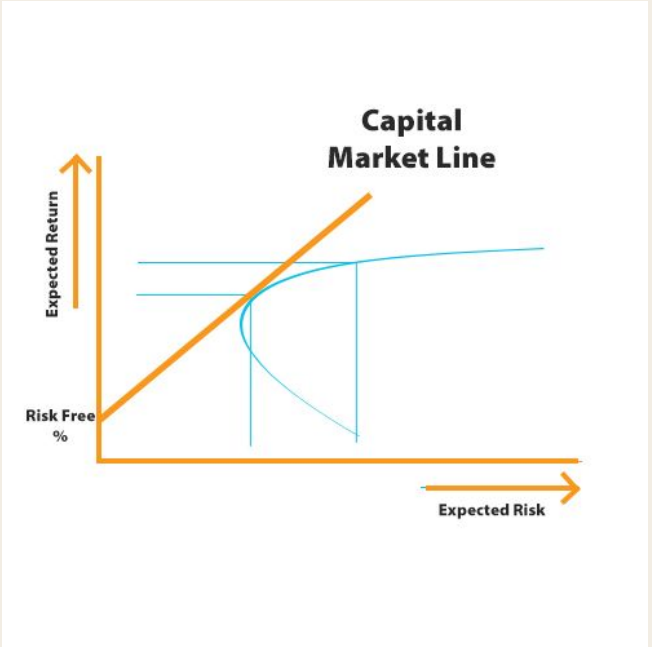
CAPITAL MARKET LINE AND EFFICIENT FRONTIER



CAPITAL ASSET PRICING MODEL

The Capital Asset Pricing Model (CAPM) is a financial model used to determine the expected return on an investment based on its risk.

The model suggests that the expected return of a security or portfolio is equal to the risk-free rate plus a risk premium, where the risk premium is proportional to the asset's beta (β) coefficient, which measures the asset's volatility relative to the overall market.



DATA INFORMATION

We picked the **T-bill as the risk free asset** whose return is **0.00074.**

Then we pick **10 risky assets from NSE**, namely: "RELIANCE.NS", "COALINDIA.NS", "KOTAKBANK.NS", "BAJAJ-AUTO.NS", "ITC.NS", "BAJAJFINSV.NS", "ADANIENT.NS", "INDUSINDBK.NS", "HEROMOTOCO.NS", "TATASTEEL.NS". This was done in order to have a **diverse portfolio** and to test how markowitz theory holds for Indian economy as a whole The data which we considered was from **30 October 2022 to 30th January 2024.**

METHODOLOGY

1. We already had found the efficient frontier for these 10 risky assets in the previous project so using the same we calculated the return and volatility for 10000 portfolios.

2. Next, we found out the point on the efficient frontier for which the sharpe ratio is maximum using the formula:

Sharpe Ratio = (μ(m) – μ(rf)) / σ(m)

Where, μ(rf) = 0.00074

	Returns	Volatility
0	0.001734	0.008957
1	0.001270	0.007983
2	0.001460	0.008288
3	0.001519	0.008411
4	0.001799	0.009152

Returns and volatility of portfolios

Returns	0.003151
Volatility	0.014941

For maximum sharpe ratio point (tangent point)

CAPITAL MARKET LINE

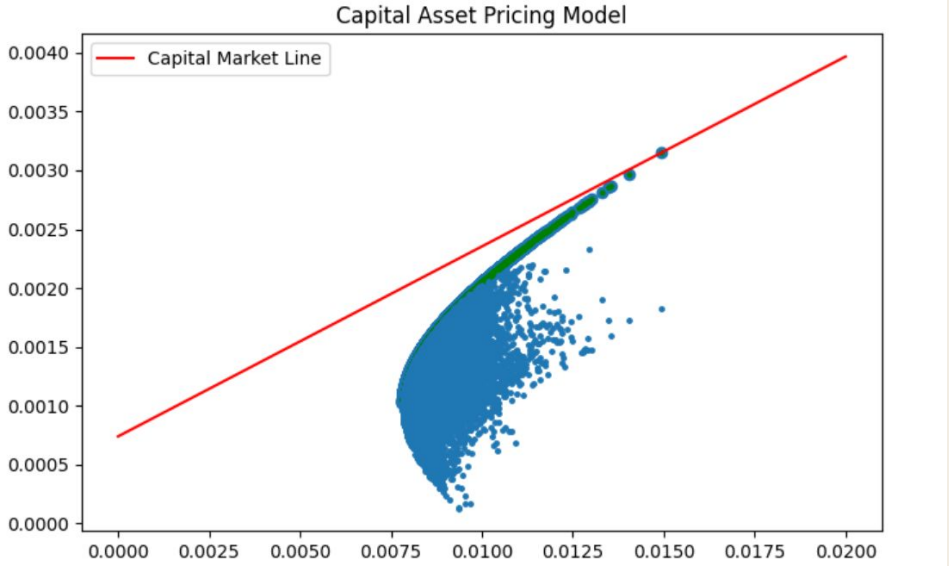
The Capital Market Line (CML) is a graphical representation which represents the combination of the risk-free asset and the market portfolio.

Calculated the CML using the formula:

μ = μ(rf) + (sharpe ratio)σ

The slope of CML = 0.16135121117445136

The CML to be positive rate of risk free return must be less than the return of the market which is indeed in the case here.

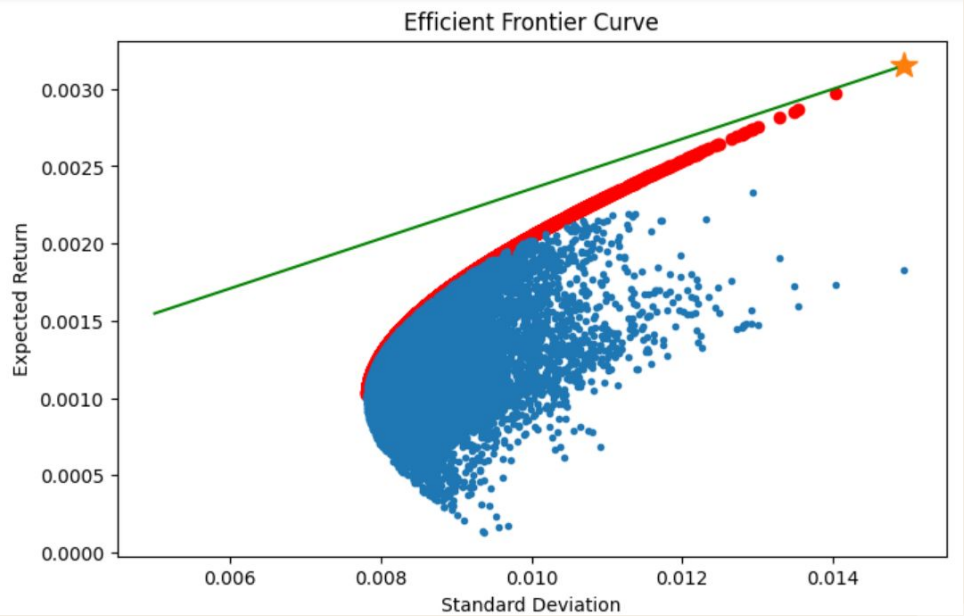


EFFICIENT FRONTIER AND TANGENCY POINT

We see that the CML is a tangent to the Markowitz efficient frontier curve. So, now we calculate this tangency point which plays a very important role.

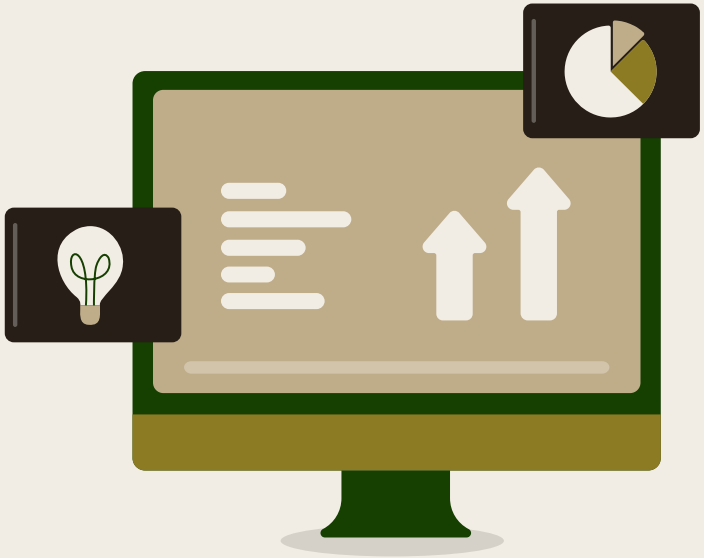
The tangent point has the coordinates:
(σ(m), μ(m))

Here the coordinates are:
(0.014941, 0.003151)



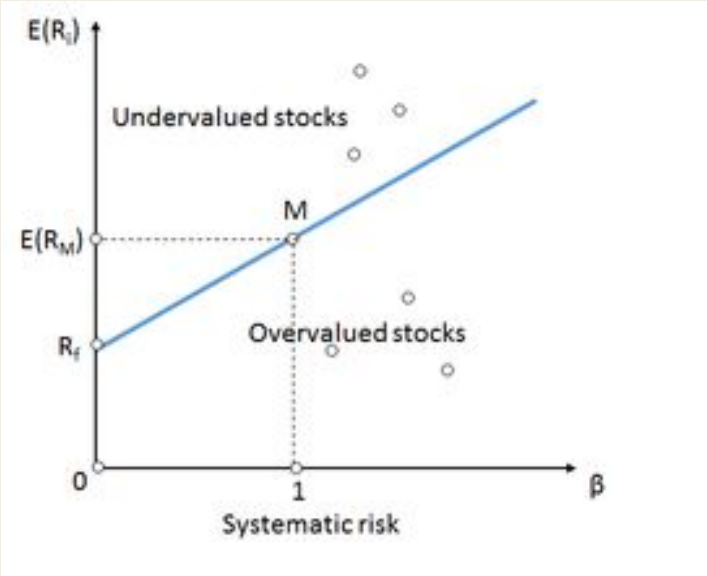
SIGNIFICANCE OF THE TANGENT POINT

- The tangent point on the CML which touches the efficient curve plays a very important role.
- This point on the Capital Market Line (CML) represents the optimal portfolio for investors . This portfolio provides the best risk-return trade-off available in the market.
- The tangency point also coincides with the market portfolio, which comprises all available investments in the market, weighted by their market capitalizations.
- Portfolios lying below the CML are inefficient because they offer lower expected returns for the same level of risk, while portfolios lying above the CML are also inefficient because they have higher risk for the same expected return.
- Its main significance lies in the part that it guides investors in constructing their portfolios and investing to achieve the maximum return.



02

SECURITY
MARKET LINE



SECURITY MARKET LINE

It is a line drawn on a chart that serves as a graphical representation of the capital asset pricing model.

While the CML focuses on the relationship between risk and return for efficient portfolios, the SML specifically applies to individual securities.

Fig 4: Explaining markowitz theory

METHODOLOGY

- We took the 3 risky assets : **(RELIANCE.NS , COALINDIA.NS, KOTAKBANK.NS)**
- Calculated the betas for these three securities using the below mentioned formulas which come out to be:
  Formula: **β = Covariance (Rs, Rm) / Variance(Rm)**

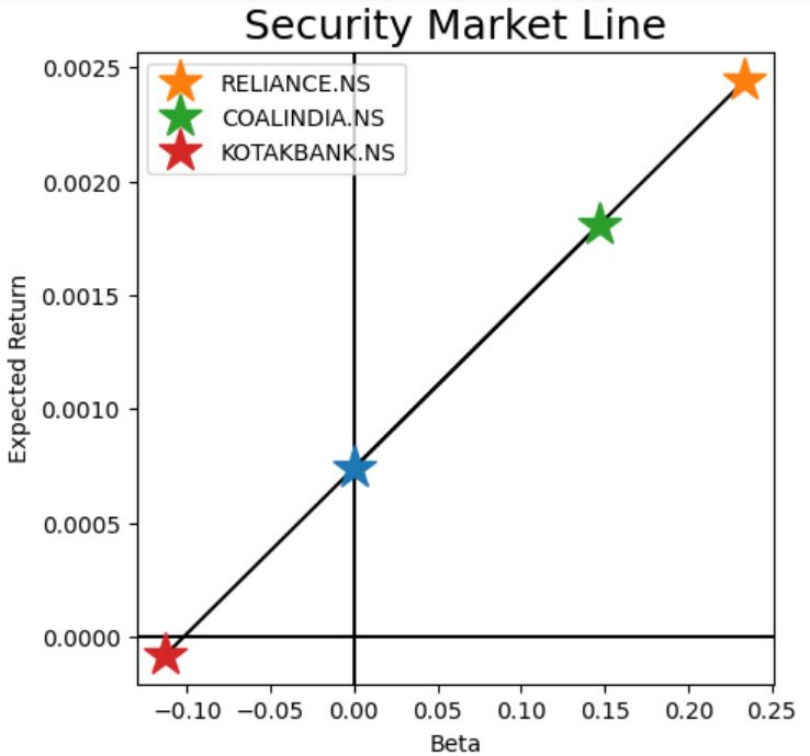
```
[0.23394406090169262, 0.14729306333999276, -0.11289321459092025]
```

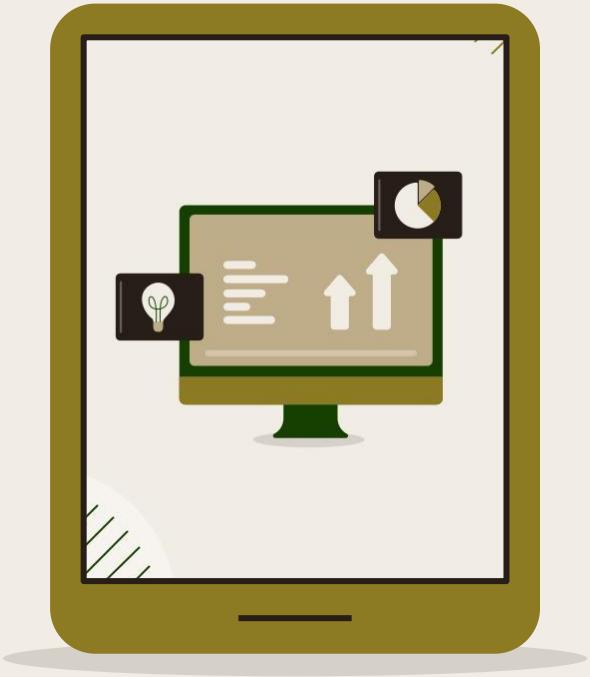
- Next, we calculate the slope of the security market line which come out to be **0.0072798928485194375 .**

$$E(R_i) = r_f + RP = r_f + \beta_i \times (RP_M) = r_f + \beta_i \times [E(R_M) - r_f]$$

REPRESENTATION

- The horizontal and vertical lines are the axes (x=0, y=0)
- The slanting line represents the security market line
- The different color stars denotes the (beta, return) of that particular asset.





03

PORTFOLIO
PERFORMANCE

PERFORMANCE MEASURES

We used three performance measures:

1. **Sharpe ratio :** It measures the risk-adjusted return of an investment relative to its volatility or standard deviation. It's calculated as the excess return of the investment (return above the risk-free rate) divided by its standard deviation.

2. **Sortino ratio :** It is similar to the Sharpe Ratio but focuses only on the downside risk, considering the standard deviation of negative returns (downside deviation) instead of total volatility. It's especially useful for evaluating investments where minimizing downside risk is a priority, such as in risk-averse portfolios.

3. **Treynor ratio :** It evaluates the risk-adjusted return of an investment relative to its systematic risk or beta. It's calculated as the excess return of the investment (return above the risk-free rate) divided by its beta.

```
Sharpe Ratio: 2.21
Sortino Ratio: 2.1
Treynor Ratio: 0.73
```

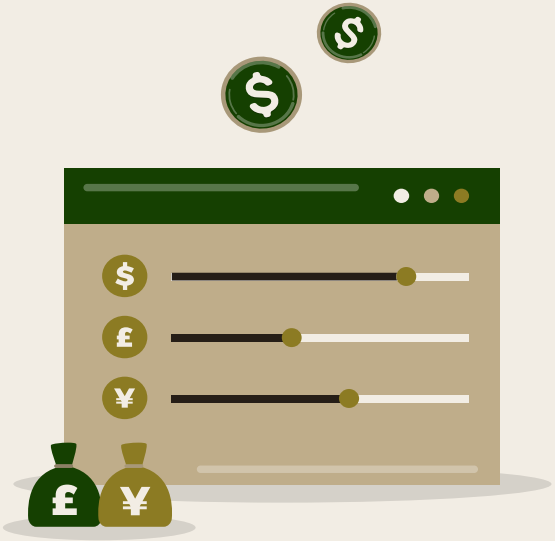
Calculated values

IMPLICATIONS OF THESE MEASURES

1. The Sharpe Ratio helps investors compare the performance of different portfolios while considering their risk levels. However, it assumes that risk is captured entirely by volatility. Investors typically **prefer portfolios with higher Sharpe Ratios** because they offer better risk-adjusted returns.

2. The Sortino Ratio provides a more nuanced view of risk by focusing on downside volatility, which may be more relevant for certain investors.**Portfolios with higher Sortino Ratios are preferred** because they indicate better risk-adjusted performance, specifically in terms of downside protection.

3. The Treynor Ratio helps investors assess whether the returns generated by a portfolio adequately compensate for the level of systematic risk taken. However, it does not account for unsystematic risk. A **higher Treynor Ratio suggests better risk-adjusted performance** relative to the systematic risk of the market.



04

COMPARISON OF MARKOWITZ AND CAPM

Comparison

Comparing the values of the expected return and volatility of the portfolios of these two different approaches we observe that the expected return is more in case of CAPM however the volatility is also more in this case.

	Markowitz	**CAPM**
Return	0.0015	0.0031
Volatility	0.0078	0.0149

MARKOWITZ VS CAPM

MARKOWITZ	CAPM
Maximize portfolio returns while minimizing risk.	Determine required rate of return based on systematic risk.
Requires estimates of expected returns, variances, and covariances.	Relies mainly on market data.
Results in diversified portfolios along the efficient frontier.	Suggests holding the market portfolio combined with the risk-free asset.
More data-intensive and subjective due to input requirements.	Simplified approach to portfolio construction.
Emphasizes diversification and risk-return trade-off.	Focuses on the relationship between systematic risk and expected returns.

THANK YOU