



Project-3 (Capital Asset Pricing Model)

Group 29

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Overview

- Choosing the assets
- Exploratory Data Analysis (Correlation Matrix)
- Calculated Beta Values for risky assets
- Expected Return for risky assets using CAPM formula
- Calculating the CML equation using CAPM model and plotting the Efficient Frontier and CML
- Tangency Point obtained and its significance
- Security Market Line (SML) for 3 chosen assets
- Sharpe Ratio and Treynor Ratio (Relevant Performance Measures) for each optimized portfolios and comparing to individual assets
- (Bonus) Comparing the portfolios constructed using Markowitz and CAPM approaches



Chosen Assets

Risky Assets

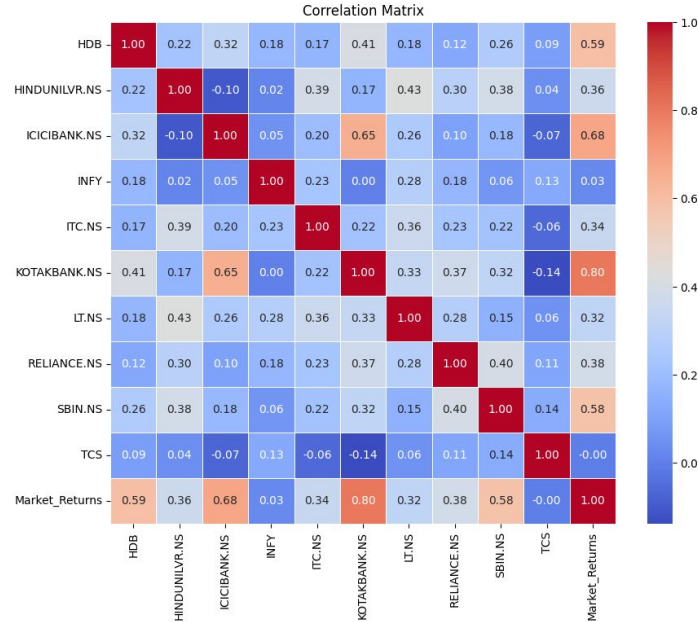
- RELIANCE.NS
- TCS
- INFY
- HDB
- HINDUNILVR.NS
- ICICIBANK.NS
- SBIN.NS
- ITC.NS
- KOTAKBANK.NS
- LT.NS

Risk-Free Assets

- Public Provident Fund
(risk-free rate = 7.1 %
p.a.)



Exploratory Data Analysis (Correlation Matrix)





Beta Values for Risky Assets

$$\beta = \frac{\text{Covariance of Asset Returns with Market Returns}}{\text{Variance of Market Returns}}$$

These beta values can be used to calculate the returns of the risky assets using the CAPM formula

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Beta for RELIANCE.NS: 1.14
Beta for TCS: 0.44
Beta for INFY: 0.83
Beta for HDB: 0.04
Beta for HINDUNILVR.NS: 0.39
Beta for ICICIBANK.NS: 0.91
Beta for SBIN.NS: 0.45
Beta for ITC.NS: 0.49
Beta for KOTAKBANK.NS: 0.89
Beta for LT.NS: -0.00
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Expected return for risky assets Using CAPM

$$E(R_i) = R_f + \beta_i \times (E(R_m) - R_f)$$

Where:

- $E(R_i)$ = Expected return of the asset or portfolio i
- R_f = Risk-free rate
- β_i = Beta of the asset or portfolio i
- $E(R_m)$ = Expected return of the market portfolio

Expected Returns using CAPM formula:

RELIANCE.NS: 0.42%
TCS: -0.14%
INFY: 0.21%
HDB: 0.01%
HINDUNILVR.NS: -0.02%
ICICIBANK.NS: 0.19%
SBIN.NS: 0.24%
ITC.NS: -0.04%
KOTAKBANK.NS: -0.00%
LT.NS: 0.02%

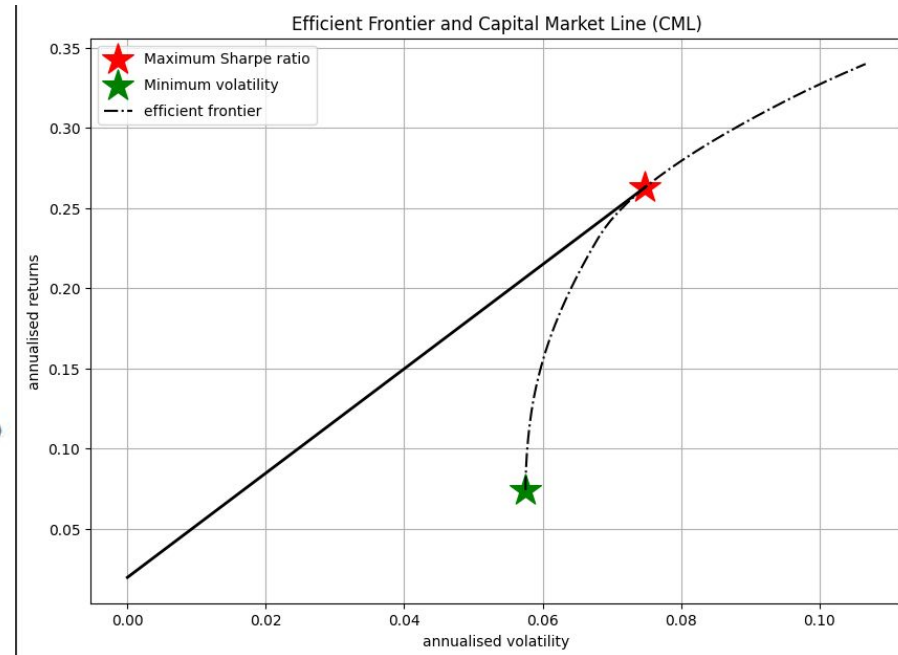
Efficient frontier and CML

CML Equation:

$$E(R_p) = R_f + \frac{E(R_m) - R_f}{\sigma_m} \times \sigma_p$$

Where:

- $E(R_p)$ = Expected return of the portfolio
- R_f = Risk-free rate
- $E(R_m)$ = Expected return of the market portfolio
- σ_m = Standard deviation (volatility) of the market portfolio
- σ_p = Standard deviation (volatility) of the portfolio





Tangency Point

- Tangency point on efficient frontier where CML touches it is (0.26, 0.07)
- The tangency point on the efficient frontier indicates the portfolio with the highest Sharpe ratio, maximizing return per unit of risk.
- It represents the optimal allocation of assets, providing investors with the best risk-adjusted return achievable within the given set of investment options.



Significance of Tangency Point

Optimal Portfolio Composition: The tangency point signifies the best portfolio for maximizing risk-adjusted return.

Efficiency: It indicates the most efficient mix of risk-free asset with a risky portfolio.

Portfolio Allocation: Helps investors choose their ideal asset allocation based on risk tolerance and return goals.

The CML's tangency point determines the optimal combination of risky assets and risk-free asset in a portfolio.

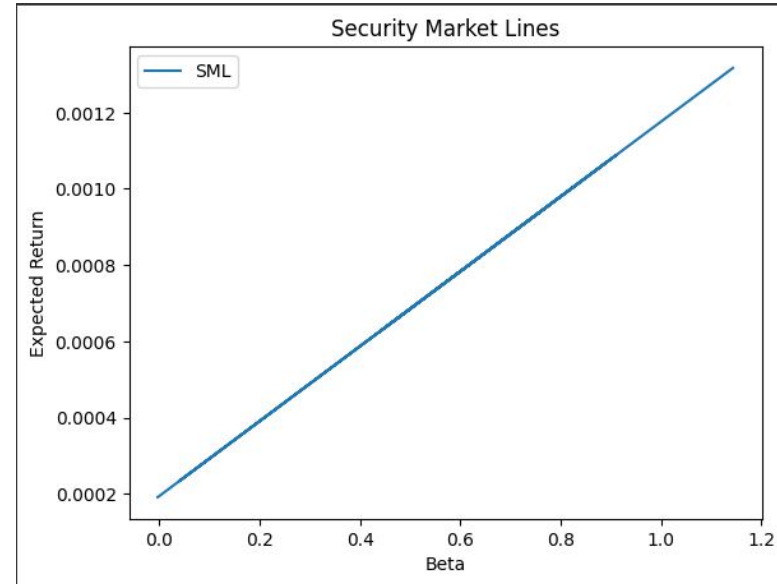
Security Market Lines

Chosen three assets → RELIANCE.NS, TCS, INFY

$$E(R_i) = R_f + \beta_i \times (E(R_m) - R_f)$$

Where:

- $E(R_i)$ is the expected return of the asset or portfolio i .
- R_f is the risk-free rate.
- β_i is the beta of the asset or portfolio i .
- $E(R_m)$ is the expected return of the market portfolio.





Sharpe Ratio and Treynor Ratio

Sharpe Ratio Formula:

$$S = \frac{R_p - R_f}{\sigma_p}$$

where:

- S represents the Sharpe Ratio,
- R_p is the portfolio return,
- R_f is the risk-free rate,
- σ_p is the standard deviation of the portfolio's returns.

Treynor Ratio Formula:

$$T = \frac{R_p - R_f}{\beta_p}$$

$$\beta_p = \sum_{i=1}^n w_i \times \beta_i$$

Where:

- β_p is the portfolio beta,
- w_i is the weight of asset i in the portfolio,
- β_i is the beta of asset i ,
- n is the number of assets in the portfolio.



Sharpe Ratio, Treynor Ratio

Portfolio Sharpe Ratios:

max_sharpe_ratio portfolio: 0.3473005740751381

min_volatility portfolio: 0.1052317697407258

Portfolio Treynor Ratios:

max_sharpe_ratio portfolio: 0.005734574920040447

min_volatility portfolio: 0.001619179304703188

Optimized portfolios Ratios

Sharpe Ratio indicates how well a portfolio's return compensates for its risk, while Treynor Ratio measures how efficiently a portfolio utilizes systematic risk to generate returns.

Asset Sharpe Ratios:

RELIANCE.NS: 0.2827510927660742

TCS: -0.020409732934092328

INFY: 0.12492269095801321

HDB: -0.002991574844438204

HINDUNILVR.NS: -0.027946683370393178

ICICIBANK.NS: 0.1252238206958829

SBIN.NS: 0.13202290494671146

ITC.NS: -0.04880078205972612

KOTAKBANK.NS: -0.01902775313967368

LT.NS: 9.435364629122385e-05

Asset Treynor Ratios:

RELIANCE.NS: 0.003531580410074106

TCS: -0.0038295159785722904

INFY: 0.0022379200047535964

HDB: -0.001568170689197713

HINDUNILVR.NS: -0.000949596548292983

ICICIBANK.NS: 0.001868109082702987

SBIN.NS: 0.004981331371494623

ITC.NS: -0.0012532768200315088

KOTAKBANK.NS: -0.00026905454929599434

LT.NS: 0.001984283849199401

Each Asset Ratios



(BONUS) Comparing the portfolios constructed using Markowitz and CAPM approaches.

Markowitz Approach (MPT):

Diversification: Emphasizes spreading investments across assets to reduce risk.

Efficient Frontier: Identifies portfolios offering optimal risk-return tradeoffs.

Risk-Return Tradeoff: Highlights the balance between risk and return in portfolio construction.

CAPM Approach:

Systematic Risk Assessment: Evaluates assets based on their sensitivity to market movements (beta).

Expected Return Estimation: Estimates expected returns using the risk-free rate, market risk premium, and beta.

Pricing Implications: Suggests assets are priced according to systematic risk, with higher returns demanded for higher beta assets.

Difference between Markowitz and CAPM Approaches

Maximum Sharpe Ratio Portfolio Allocation

Annualised Return: 0.33

Annualised Volatility: 0.09

Ticker	HDB	HINDUNILVR.NS	ICICIBANK.NS	INFY	ITC.NS	KOTAKBANK.NS	\
allocation	0.0	0.0	18.59	19.41	0.0	0.0	

Ticker	LT.NS	RELIANCE.NS	SBIN.NS	TCS
allocation	0.0	21.51	40.49	0.0

Minimum Volatility Portfolio Allocation

Annualised Return: 0.09

Annualised Volatility: 0.07

Ticker	HDB	HINDUNILVR.NS	ICICIBANK.NS	INFY	ITC.NS	KOTAKBANK.NS	\
allocation	0.0	24.17	23.66	21.46	12.7	7.69	

Ticker	LT.NS	RELIANCE.NS	SBIN.NS	TCS
allocation	0.0	9.77	0.0	0.55

Markowitz Results

Maximum Sharpe Ratio Portfolio Allocation

Annualised Return: 0.26

Annualised Volatility: 0.07

	HDB	HINDUNILVR.NS	ICICIBANK.NS	INFY	ITC.NS	KOTAKBANK.NS	\
allocation	0.0	0.0	13.65	16.56	0.0	0.0	

	LT.NS	RELIANCE.NS	SBIN.NS	TCS
allocation	1.21	20.76	27.83	0.0

Minimum Volatility Portfolio Allocation

Annualised Return: 0.07

Annualised Volatility: 0.06

allocation	HDB	HINDUNILVR.NS	ICICIBANK.NS	INFY	ITC.NS	KOTAKBANK.NS	\
	0.0	20.99	19.84	16.24	8.06	6.56	

allocation	LT.NS	RELIANCE.NS	SBIN.NS	TCS
	0.0	7.87	0.0	0.44

CAPM Results



Key Insights

- Markowitz focuses on **diversification** and **risk optimization**.
- CAPM provides a **systematic framework** for **assessing risk** and **estimating expected returns**.
- Integrating both approaches enhances portfolio management and investment decisions.

Thank You