

PORTFOLIO ANALYSIS

ECON F412 & FIN F313 : SECURITY ANALYSIS & PORTFOLIO MANAGEMENT

GROUP: 30



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
HYDERABAD CAMPUS

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ABSTRACT

The foremost upshot of this report is establishing the efficient frontier and the tangency portfolio, which was based on Modern Portfolio Theory (MPT) for several domestic and international securities. The assignment has two main aims. First, it aims to draw a domestic portfolio by focusing on specified Indian companies. Then, it moves on to constructing the efficient frontier out of the just-drawn domestic portfolio and, finally, the tangency portfolio containing a risk-free asset. These portfolios are then analyzed w.r.t. benchmark indices such as NIFTY50 and SENSEX30.

Third, the investigation goes beyond the domestic portfolio to include international securities and some coins, tracing the efficient frontier and building the tangency portfolio for this composite investment. A benchmarking exercise is carried out to measure the international portfolio against the domestic portfolio and the selected index. Relevant time series data for the securities was imported for the period suggested, along with the values of risk-free rates from credible sources. In the end, the report concludes by presenting some of the lessons learnt through the comparative performance of two portfolios under review.

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MARKOWITZ PORTFOLIO THEORY

Markowitz's portfolio theory explains how risk-averse investors can build a portfolio that reduces risk while maintaining a certain level of expected return. It asserts that an investment's risk and return characteristics should not be evaluated in isolation but rather about how the investment influences the entire risk and return of the portfolio. This theory provides the set of returns for a given hazardous asset that is most likely to be maximally efficient to invest in for establishing an **efficient frontier**. Expected returns, risk, and covariance are used to plot the Efficient frontier. By optimizing the **Sharpe ratio**, this theory adds the risk-free asset and generates the tangency portfolio. This **tangency portfolio** is held by all investors, regardless of their risk appetite, and risk aversion is only considered when allocating capital to risky assets.

Minimum Variance Portfolio:

A minimum variance portfolio is a position on the investment possibility frontier with the smallest portfolio variance. All points below this point are known as inefficient investment zones, and risk-averse investors will avoid them. Still, the region above is known as the efficient frontier, and risk-averse investors find it appealing to invest there.

$$\begin{aligned}\sigma^2 &= w' \Sigma w \\ w' \cdot 1 &= 1\end{aligned}$$

Where, w : Vector of Asset Weights

σ^2 : Variance of Portfolio

w' : Transpose of w

1 : Unit Vector

Σ : Variance - Covariance Matrix

Sharpe Ratio:

Sharpe Ratio is a metric that compares the return of an investment with its risk.

$$\text{Sharpe Ratio: } S(x) = (R_p - R_f) / \sigma.$$

Where, R_p : Return of Portfolio

R_f : Risk-free rate (T-bills)

σ : Standard Deviation (Risk) of portfolio

The higher the ratio, the better the returns for each unit of risk.

Tangency Portfolio:

A tangency portfolio is located where the capital market line (CML) is tangent to an efficient frontier in the risk-return plane. It stands for the highest risk-adjusted return attainable at any level of risk and integrates optimal diversification and asset allocation.

Investors can reap the maximum return achievable for a particular degree of risk appropriate to them by allocating assets optimally concerning the construction of the tangency portfolio. It has the optimal Sharpe ratio among all the points in the efficient frontier and touches the CML, which connects the risk-free rate and the tangency portfolio.

$$\begin{aligned} \text{Maximise: } & (w' \mu - R_f) / (w' \Sigma w) \\ \text{s.t. } & w' \mathbf{1} = 1. \end{aligned}$$

Efficient Frontier:

The efficient frontier represents that set of portfolios with the maximum rate of return for every given level of risk or the minimum risk for every level of return. The efficient frontier minimises risk subject to target returns.

Portfolios that lie below the efficient frontier are sub-optimal because they need to provide more return for the level of risk. Portfolios that cluster to the right of the efficient frontier are sub-optimal because they have a higher level of risk for the defined rate of return.

$$\begin{aligned} \text{Min } & \sigma^2 = w' \Sigma w \\ \text{Constraint: } & E(r) = w' \mu, \\ \text{s.t. } & w' \mathbf{1} = 1 \end{aligned}$$

Where μ is the vector of expected returns on assets.

$$\text{Efficient Frontier: } Z = \alpha M + (1 - \alpha)E,$$

Where M: minimum variance portfolio.

E: efficient portfolio.

1. Portfolio Overview :-

1.1 Trident Ltd. (TRIDENT)



Trident Limited (BSE: 521064, NSE: TRIDENT), the flagship company of the Trident Group with a score of achievement founded in 1990 and is based in Ludhiana, India. Trident Limited has developed into one of the largest integrated manufacturers of textiles and paper in India with a presence in Asia, Europe, the Americas and other global markets. The company's strengths are in the production of high-quality home textiles, yarns and paper and has carved a niche for itself in the FMCG and the textiles sector. Among its broad focus areas, the company is involved in the production of bath and bed linens and specializes in paper products made from wheat straw, as well as cotton yarn. The company has been serving various sectors like home textiles, stationery, and packaging materials and has consistently supplied to world major retail companies and brands.

On the other hand, with the direction of Chief Executive Officer Rajinder Gupta and Chief Financial Officer Deepak Nanda, Trident has been recognized as a growing business obsessed with sustainability and Corporate Social Looking at the company's activities: The company has made important progress in greening its operations in areas such as energy use (focusing on renewable sources) and water management. The company had a Market Cap valuation over Rs 250 billion and Rs 79 billion in revenue in FY 23.

1.2 Quess Corp Ltd. (QUESS)



Quess Corp Ltd.(NSE: QUESS) is a fully-owned subsidiary founded in 2007 and has since become one of the leading business services and staffing companies. The corporation is located in Bengaluru, India, and offers services in various parts of the world, including Southeast Asia, the Middle East, and North America. Quess is oriented around the four focus areas: workforce management, operating asset management, global technology solutions, and product-led. Each offering service includes but is not limited to recruitment, IT staffing, payroll processing, compliance management, etc. The range of their offerings serves industries like BFSI, healthcare, telecom, retail, manufacturing, and even IT.

The company is promoted by Fairfax Financial Holdings and its founder Ajit Isaac, who had the ambition of building a comprehensive coverage HR services company with solutions for human resource management and technology management. Quess caters to providing a combination of business services, including recruitment and human resource services, as well as outsourcing facilities management and the provision of technology.

Quess Corp leadership's core team consists of Guruprasad Srinivasan as CEO, D. Saravanan as CFO, and Srinath Gururaj as CTO. These leaders are responsible for driving the company's growth and diversification of its services. Publicly listed on BSE and NSE, Quess is also in an excellent financial position, with over Rs 108.88 billion in market capitalisation and revenue exceeding Rs 191 billion in FY23, a remarkable growth of 11.32% from the previous year.

1.3 JBM Auto Ltd. (JBMA)



JBM Auto Limited (NSE: JBMA) operates in diversified businesses and is among the strong contenders in the Indian auto sector. It includes sheet metal component manufacturing, tooling, dies, mould, and electric vehicles, and the company has positioned itself as one of the forerunners in India's increasingly growing e-mobility space through its electric bus offerings. JBM Auto operates in three main divisions: the Component Division, specialising in manufacturing components for commercial and passenger vehicles; the Tool Room Division, which undertakes die manufacturing for sheet metal components; and the OEM Division, where the design, assembly, and sale of electric buses and related parts and accessories are undertaken. Such a focus on sustainability and innovation has enabled the company to take considerable strides in this EV market, and recent electric luxury bus orders will prove to be a further boost. JBM Auto also had placed itself at the cutting edge while developing and maintaining infrastructure for electric vehicles, further consolidating its position as a comprehensive solutions provider in the mobility space.

Led by Nishant Arya (CEO) and Vivek Gupta (CFO), JBM Auto has solidified its position in the home and international markets. The company promoter, the Arya family, specifically S.K. Arya, had played an essential part in the growth and direction of the company. Listed on both NSE and BSE, the company has a market capitalisation of INR 206.91 billion. Last year, there was a solid growth in the company's share, with an appreciation of about 40.37%. JBM Auto has over 3,300 employees and is well-equipped to benefit from India's rising requirement for cleaner transport solutions and more efficient transportation, ensuring a change in India's automobile landscape.

1.4 TATA Communications Ltd. (TATACOMM)



Tata Communication(NSE: TATACOMM) is a digital ecosystem services provider that maximizes the potential of digital transformation for businesses across the globe. It serves 300 Fortune 500 corporations, providing cloud services, mobility, IoT, collaboration, security, and network solutions. Tata Communications is primarily connected globally with 80% of the clouds and four quasi-execution defense network section subscribers/mobiles because it has a Tier-1 IP network and the largest owned and managed flexible undersea fiber optical network. It also owns around 30% of the total ftp traffic and operates in more than 190 countries.

The company's business model centers on enabling customers with cyber structures that are secure, intelligent, and scalable while designing solutions for data services with products such as the Tata Communications IZO™ Multi-Cloud Connect and SD-WAN. It tends to verticals like media, telecom, manufacturing, and IT. It has collaborated with brands such as Singapore Airlines and Jaguar Land Rover to develop digital offerings.CEO Amur Lakshminarayanan and CFO Kabir Ahmed Shakir lead the company. The Indian multinational corporation Tata Communication continues to grow, projecting over Rs 20,000 crore of revenue in FY24, with the data segment increasing by 21.9 %.

As per market reports, Tata Communications is listed on BSE and NSE with a market cap of Rs 48,000 crores. Its booming demand for data services indicates its aspiration to expand and improve the global digital picture.

1.5 FDC Ltd. (FDC)



FDC Limited(NSE: FDC) is a pharmaceutical company based in India that manufactures and distributes various generics, formulations, and active pharmaceutical ingredients (APIs), among other products. The company provides services in many therapeutic areas, such as anti-infectives, gastrointestinal, eye care, cardio, and diabetes, among other areas of patients' health. FDC is also famous for manufacturing oral rehydration sales (ORS) and other products, such as functional food and electrolytes.

FDC has its roots in the Chandavarkar family and is currently led by the growth-focused Nandan Chandavarkar. The company's innovation cycle depends on the generic formulation business and APIs, which have been successful in domestic and overseas markets. The enterprise also emphasizes therapeutic formulations such as those of the ophthalmic and injectable.

FDC has a market capitalization of over ₹9,605 crores, maintaining a high growth rate of more than 31% within the last year. This has been favorable owing to its growth into different therapeutic segments and regulatory matters such as the passing of its Baddi facility by the US FDA audit. The shares of FDC are listed in both BSE and NSE. It has expanded through acquisition, such as upsizing its stake in South Africa-based Fair Deal Corporation, enhancing its international footprint.

1.6 Godrej Consumer Products Ltd. (GODREJCP)



Godrej Consumer Products Limited (NSE: GODREJCP) is one of the major companies in the fast-moving consumer goods(FMCG) industry, specifically in household and personal care products. It was incorporated in 2001 in Mumbai, India, and is a subsidiary of Godrej Group, boasting a 134-year history. The company has a wide range of products, including insect repellents, soaps, and air and hair grooming products, marketed under brands such as Good Knight, Godrej Aer, Cinthol, and HIT. It operates in markets across India, the southeast Asia region, and Africa, among other areas, with reach in over ninety countries.

GCPL's business model focuses on manufacturing and marketing affordable quality consumer goods. There have been innovative historical changes regarding hygienic and cosmetic products interest, especially during the onset of the disease. The company's strategic "Go to Market" plan is aimed at significantly increasing the company's distribution footprint and making use of technology to enhance market penetration.

Top management positions include Sudhir Sitapati as Managing Director & CEO and Sameer Shah as the CFO, among other key segments. The company has about INR 91,564 crores of market cap. In the last year, the stock value of GCPL went up by 19%, highlighting how the company's performance has remained relatively stable over time while its products have consistently been in demand.

1.7 Cyient Ltd. (CYIENT)

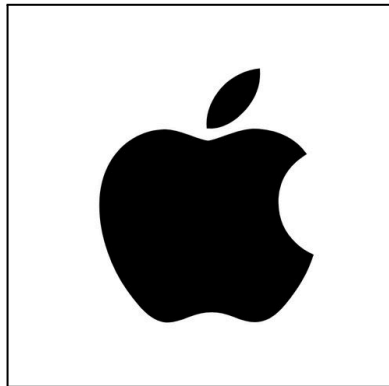


Cyient Limited(NSE: CYIENT) is a leading engineering and digital technology solutions provider. It was founded in 1991, with its headquarters in Hyderabad, India. The company is in several sectors, such as aerospace, automotive, communications, energy, healthcare, and transportation, and it provides product lifecycle management, engineering design, manufacturing, and geospatial data analytics services.

Cyient's business model comprises three business streams: Digital, Engineering & Technology, Design, and manufacturing, among others. This comprehensive strategy allows them to develop tailored solutions for various industries, from pure digital changes to core engineering works. Cyient has built a reputation in the industry for successfully performing complex tasks in multiple sectors, such as designing aerospace systems, embedded systems, and regional services such as LiDAR and underground mapping.

The people at the organisation's top are Karthikeyan Natarajan, the CEO; Prabhakar Atla, the CFO; and Rajaneesh Kini Ramananda, the CTO. Within a year, Cyient has convincingly grown due to the digital engineering services provided and the acquisition in most high-growth areas. The company's current market capitalization is approximately Cinderella of up to 17,500 crores as of 2024, owing to one year of steady growth.

1.8 Apple Inc. (AAPL)

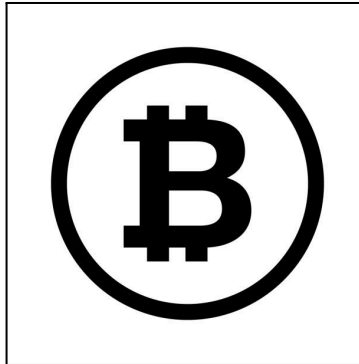


Apple Inc. (NASDAQ: AAPL) is one of the most recognized brands in the world and the leader in technology it was established in 1976 and is co-owned by Steve Jobs, Steve Wozniak, and Ronald Wayne. With its headquarters in Cupertino California, Apple is among the world's largest companies by market capitalization and arguably the most popular for its cutting-edge consumer electronics, software, and services with operations in North America, Europe, Greater China, and Asia Pacific.

Key world Apple product lines comprise the iPhone, the iPad, the Mac, the Apple Watch, the Apple TV, and software platforms such as iOS, MacOS, and Watch OS. Other value-added services offered by the company include the App Store, Apple Music, iCloud, and Apple Pay among others and these have great contributions in terms of revenue to the company. The company is an advocate for privacy, security, and sustainability as it continues to raise the bar on what its design and technology can achieve.

EC Tim Cook has been at the forefront of driving the vision for Apple and so far is focused on ensuring the company stays true to its primary goal of providing nothing short of excellence while growing its ecosystem of devices and services. The company's strategy going forward is to focus on research and development because that is where innovation is. Apple recently reported records of over \$383 billion in revenue which was registered in FY 23, a feat fabricated out of the higher demand for the company's devices and services.

1.9 Bitcoin. (BTC)



Bitcoin is a virtual currency that is decentralized and the largest in the world. Bitcoin (BTC) was created by an undisclosed person or group of them under the name of Satoshi Nakamoto in 2009. BTC is managed over a blockchain technological peer-to-peer network eliminating the need to utilize intermediaries such as banks or Governments for transactions that are considered secure, transparent, and unchangeable. Its inception was a true milestone that triggered the development of the crypto industry as a whole. Today, we can see thousands of altcoins, but Bitcoin remains the flagship of the decentralized economy. The main use of the Bitcoin currency on the Bitcoin network and among its users is considered to transfer value across borders. Bitcoin differs from traditional currencies in its volume, the number of coins generated is limited to 21 million. This makes such currencies attractive as a security against inflation and other economic uncertainties. Today, it is an integral part of the rapidly evolving decentralized finance (DeFi) system. The latter facilitates an extensive number of financial services without the aid of traditional institutions.

A distributed network of miners and nodes supports Bitcoin which secures and verifies transactions on the blockchain. Through the years, alongside becoming a currency, Bitcoin has also developed a substantial following as an investment asset class, and many institutions and corporations have included it within their portfolios as well. Bitcoin became the first cryptocurrency to cross the \$1 trillion market cap, and as of 2023, it is the most-valued cryptocurrency with a capitalization of over \$500 billion.

1.10 Stock Performance Metrics

Ticker	Mean Daily Return	Daily Variance	Annualized Return	Annualized Variance
AAPL	0.00138	0.000102	0.3364	0.24826
BTC-USD	0.02822	0.00567	0.688461	1.38324
CYIENT.NS	0.00215	0.000455	0.524646	0.111047
FDC.NS	0.001467	0.000251	0.358069	0.061264
GODREJCP.NS	0.000785	0.000131	0.191659	0.031987
JBMA.NS	0.002973	0.000767	0.725491	0.187128
QUESS.NS	0.001016	0.000204	0.24802	0.049855
TATACOMM.NS	0.001432	0.000229	0.349438	0.055829
TRIDENT.NS	0.009951	0.000474	0.232051	0.115764

BTC-USD exhibits the highest annualized return and variance, indicating significant volatility and potential for high returns compared to more stable assets like AAPL and the domestic stocks.

1.11 Covariance matrix

Ticker	AAPL	BTC	CYIENT	FDC	GODREJCP	JBMA	QUESS	TATACOMM	TRIDENT
AAPL	0.0248	0.0023	0.0025	-0.0018	-0.0041	0.0081	0.0025	0.0010	0.0018
BTC	0.0023	0.1383	-0.0108	0.0092	-0.0057	-0.0163	-0.0158	-0.0148	-0.0071
CYIENT	0.0025	-0.0108	0.1110	0.0141	0.0063	0.0094	0.0068	0.0133	0.0193
FDC	-0.0018	0.0092	0.0141	0.0613	0.0053	0.0064	0.0031	0.0072	0.0144
GODREJCP	-0.0041	-0.0057	0.0063	0.0053	0.0320	0.0128	0.0042	0.0052	0.0066
JBMA	0.0081	-0.0163	0.0094	0.0064	0.0128	0.1871	0.0220	0.0066	0.0355
QUESS	0.0025	-0.0158	0.0068	0.0031	0.0042	0.0220	0.0499	0.0133	0.0082
TATACOMM	0.0010	-0.0148	0.0133	0.0072	0.0052	0.0066	0.0133	0.0558	0.0129
TRIDENT	0.0018	-0.0071	0.0193	0.0144	0.0066	0.0355	0.0082	0.0129	0.1158

This matrix details the relationships between the returns of various securities, showing how pairs of investments move in relation to each other. Higher positive values indicate securities that move similarly, while negative values suggest inverse movements. For instance, BTC-USD generally shows negative covariance with other stocks, suggesting it can offer diversification benefits in a portfolio.

1.12 Beta and Alpha for Each Stock (Single Index Model)

Ticker	Beta	Alpha
TRIDENT.NS	1.098886	0.002042
FDC.NS	0.458008	0.001146
GODREJCP.NS	0.716158	-0.000282
CYIENT.NS	1.267694	0.001126
QUESS.NS	0.642356	-0.000565
JBMA.NS	0.785686	0.002421
TATACOMM.NS	1.115453	0.000649
AAPL	0.054481	-0.000099
BTC-USD	-0.110786	-0.002899

Overall Portfolio Beta and Alpha (Based on Optimum Sharpe Ratio Weights)

Metric	Value
Beta	0.616045
Alpha	0.001445

The beta values range from negative (BTC-USD) to relatively high (over 1 for TRIDENT.NS, CYIENT.NS, and TATACOMM.NS), indicating varying levels of market risk. Alpha values provide insight into the stocks' performance relative to a benchmark after adjusting for risk, with most stocks showing small positive alpha, suggesting they slightly outperform the market on a risk-adjusted basis. The overall portfolio has a moderate beta of 0.616045 and a small positive alpha of 0.001445, highlighting a risk-averse strategy with slight outperformance.

2. Generating a Domestic Portfolio:-

This analysis focuses on constructing and evaluating a domestic portfolio based on Modern Portfolio Theory over the financial year from April 1, 2023, to March 31, 2024. The evaluation period consists of 244 trading days. We incorporated a daily risk-free rate based on an annual rate of 6%, resulting in a daily rate of approximately 0.06/244. Our analysis aimed to construct two main portfolio types:

1. **Minimum Variance Portfolio (MVP)** - Focused on minimizing risk.
2. **Tangency Portfolio** - Aimed at maximizing the Sharpe ratio.

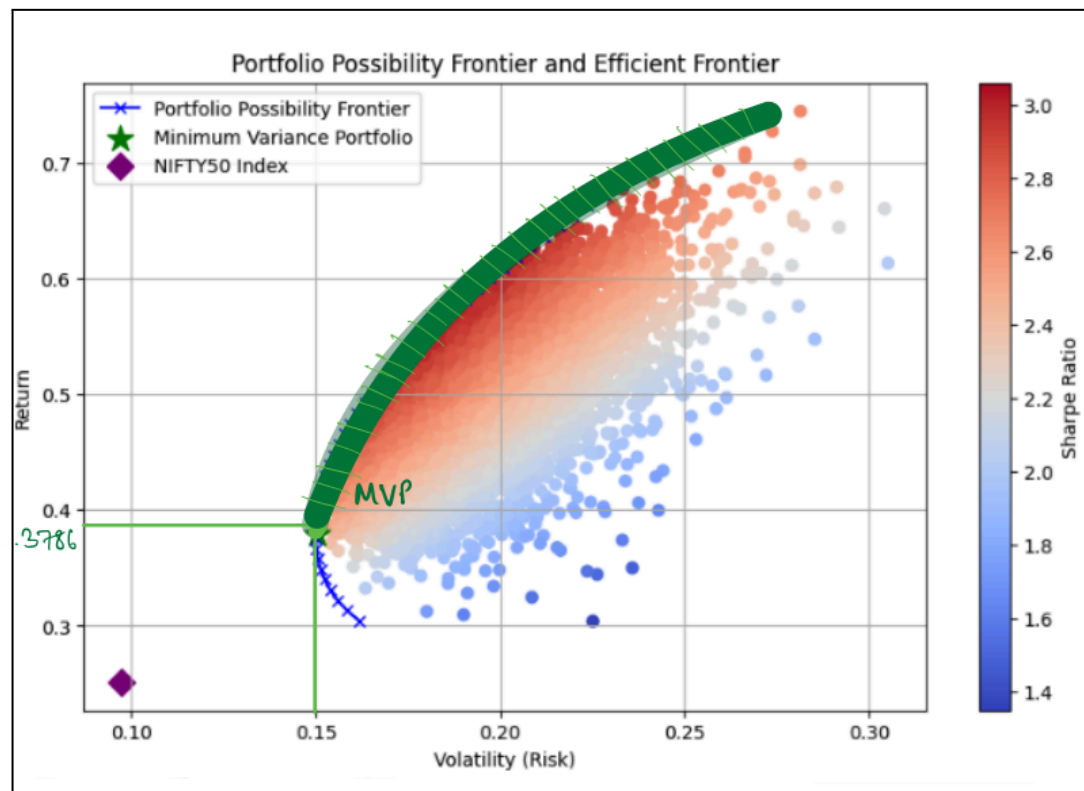
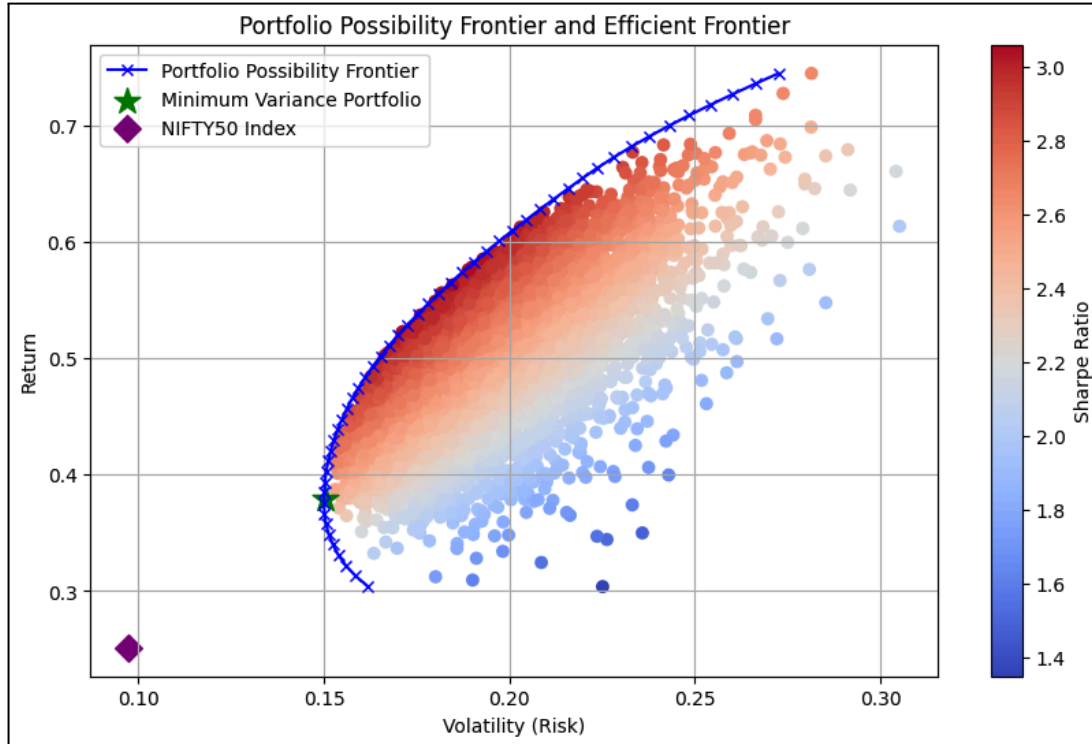
2.1 Minimum Variance Portfolio (MVP):-

The Minimum Variance Portfolio (MVP) was constructed to minimize volatility while considering the returns. The weight distribution and the corresponding financial metrics for the MVP are as follows:

Stock	Weight
TRIDENT	5.80%
FDC	16.60%
GODREJCP	37.30%
CYIENT	1%
QUESS	20.70%
JBMA	14%
TATACOMM	4.60%

Performance Metrics:

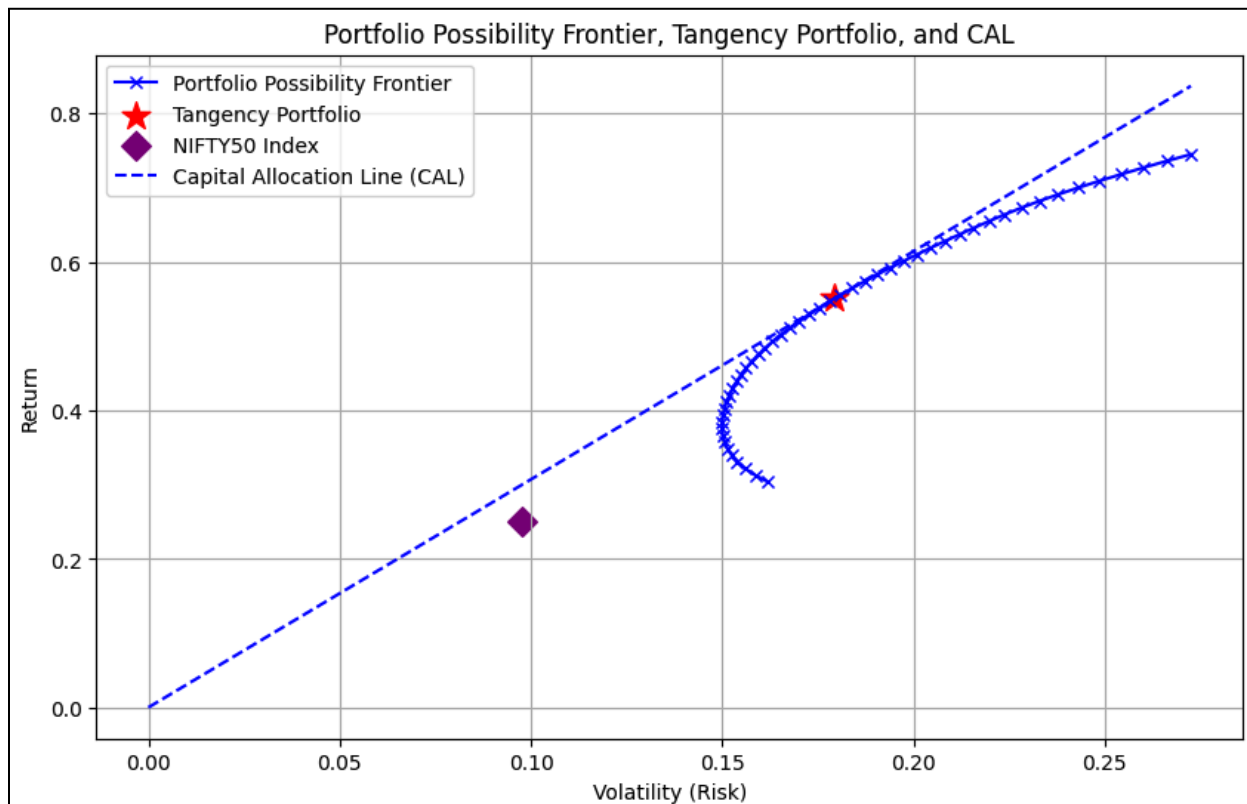
Metric	Value
Expected Return	37.86%
Volatility	0.1502
Sharpe Ratio	2.5192



2.2 Tangency (Sharpe Optimal) Portfolio:-

The Tangency Portfolio, designed to maximize the Sharpe ratio, optimizes both returns and volatility. The portfolio weights and performance metrics are:-

Stock	Weight
TRIDENT	17.30%
FDC	22%
GODREJCP	14.60%
CYIENT	16%
QUESS	9.30%
JBMA	20.80%
TATACOMM	0%



Performance Metrics:

Metric	Value
Expected Return	55.07%
Volatility	0.1793
Sharpe Ratio	3.069

2.3 Benchmark Comparison

For comparative analysis, the performance of the NIFTY50 Index during the same period was considered:

Metric	Value
Expected Return	25.15%
Volatility	0.0975
Sharpe Ratio	2.5771

2.4 Conclusion

→ Conclusion for Minimum Variance Portfolio (MVP):-

- ◆ ***Risk and Return Trade-off:*** Achieving an expected return of 37.86%, the MVP markedly surpasses the NIFTY50's return of 25.15%. This significant outperformance showcases a thoughtfully selected asset allocation that effectively balances risk and return.
- ◆ ***Volatility:*** While the MVP exhibits higher volatility at 0.1502 compared to the NIFTY50's 0.0975, it maintains a commendable balance between risk and reward. The increased volatility is offset by substantially higher returns, exemplifying the typical trade-off encountered in portfolio management.

-
- ◆ Sharpe Ratio: The MVP has a Sharpe ratio of 2.5192. Although this is slightly lower than that of the Tangency Portfolio, it still reflects an efficient risk-adjusted return. When compared to the NIFTY50's Sharpe ratio of 2.5771, the MVP remains competitive, particularly in light of its higher returns.

→ Conclusion for Tangency (Sharpe Optimal) Portfolio:-

- ◆ Maximizing the Sharpe Ratio: The Tangency Portfolio is designed to achieve the maximum Sharpe ratio, representing the excess return per unit of risk. With a Sharpe ratio of 3.0690—the highest among the portfolios discussed, including the NIFTY50—it indicates that the portfolio not only delivers higher returns but does so with greater efficiency concerning the risk undertaken.
- ◆ High Returns with Managed Risk: Boasting an expected return of 55.07%, the Tangency Portfolio offers the highest return among all portfolios considered. Its increased volatility of 0.1793, relative to both the MVP and the NIFTY50, is justified by these superior returns. This highlights the portfolio's capacity to leverage risk effectively for enhanced rewards.
- ◆ Comparison with NIFTY50: In comparison to the NIFTY50, the Tangency Portfolio provides not only higher returns but also a significantly better Sharpe ratio. This underscores the success of the portfolio manager's strategy to optimize for the Sharpe ratio, resulting in a more attractive risk-return profile than the benchmark.

3. Generating an International Portfolio :-

The expansion of our portfolio analysis to include international exposure involves the addition of **AAPL (Apple Inc.)** as an international security and **BTC-USD (Bitcoin)** as a cryptocurrency. This analysis spans from April 1, 2023, to March 31, 2024, including the following securities:

- Domestic Stocks: TRIDENT, FDC, GODREJCP, CYIENT, QUESS, JBMA, TATACOMM
- International Security: AAPL
- Cryptocurrency: BTC

The study period remains consistent with 244 trading days, and the risk-free rate used is the same as in the domestic portfolio analysis, allowing direct comparability.

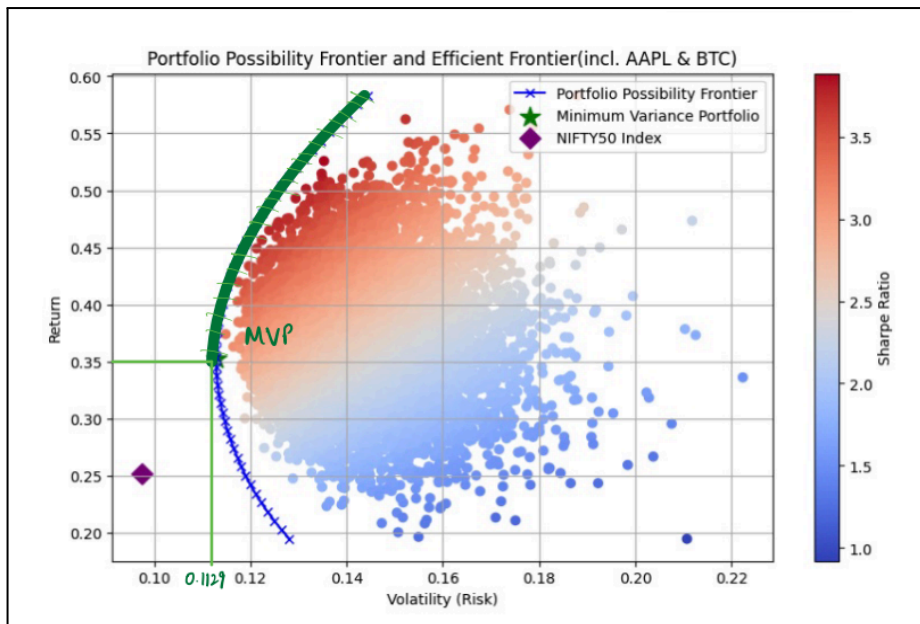
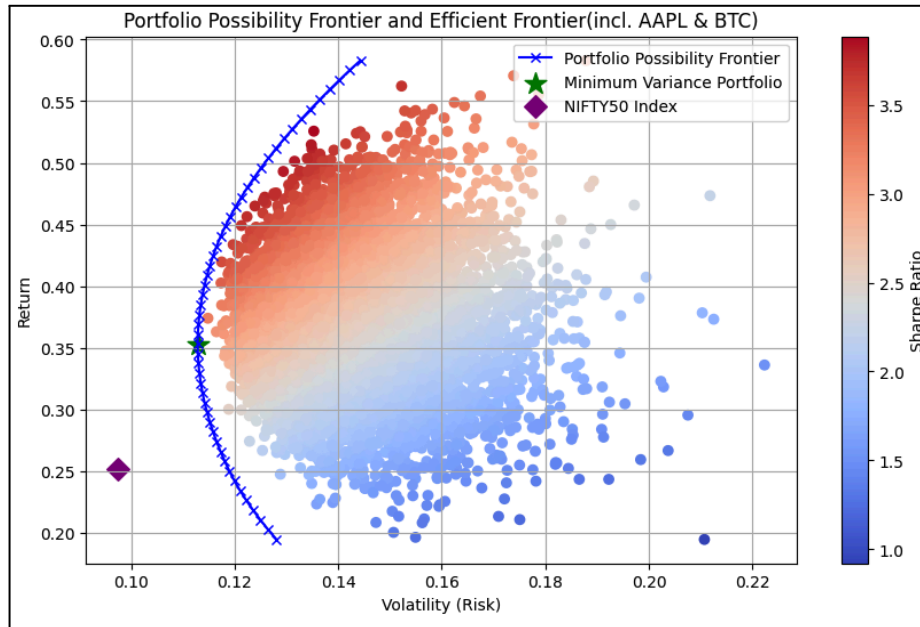
3.1 Minimum Variance Portfolio (MVP) - International

The International Minimum Variance Portfolio aimed to minimize volatility while incorporating global assets:

Stock	Weight
TRIDENT	26.70%
FDC	11.10%
GODREJCP	4.90%
CYIENT	11.90%
QUESS	18.50%
JBMA	0.40%
TATACOMM	14.30%
AAPL	8.30%
BTC-USD	3.90%

Performance Metrics:

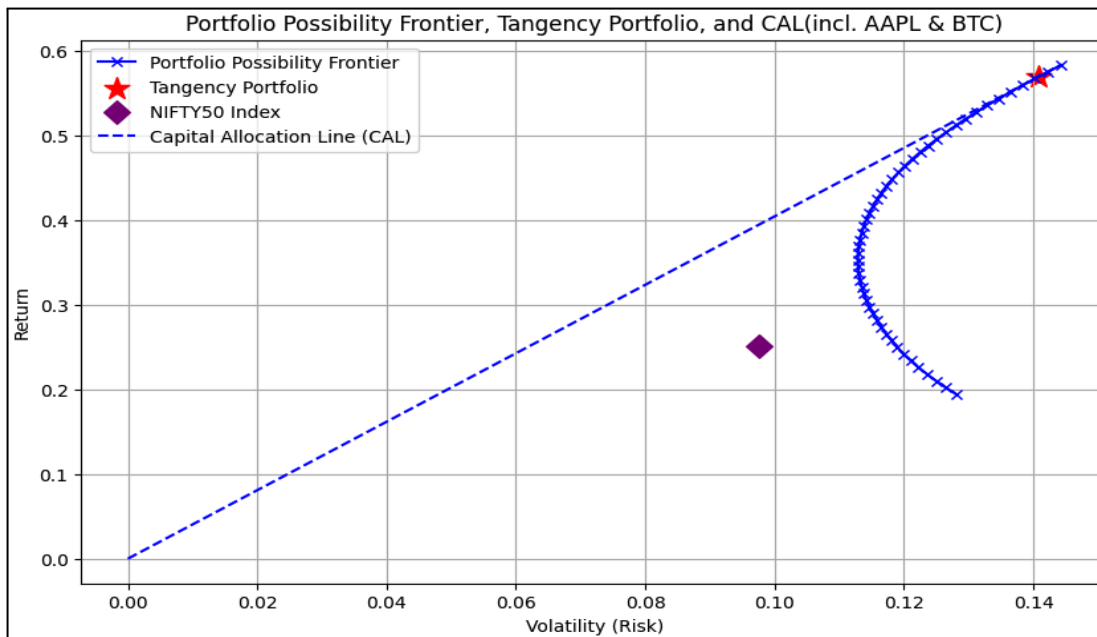
Metric	Value
Expected Return	35.22%
Volatility	0.1129
Sharpe Ratio	3.1183



3.2 Tangency (Sharpe Optimal) Portfolio - International

The International Tangency Portfolio was optimized to maximize the Sharpe ratio, highlighting an effective risk-return trade-off with the inclusion of international assets:

Stock	Weight
TRIDENT	0.80%
FDC	12.50%
GODREJCP	6.20%
CYIENT	25.50%
QUESS	15%
JBMA	0%
TATACOMM	12.30%
AAPL	27.70%
BTC-USD	0%



Performance Metrics:

Metric	Value
Expected Return	56.97%
Volatility	0.1409
Sharpe Ratio	4.0425

3.3 Benchmark Comparison

The NIFTY50 index serves as a benchmark for comparison:

Metric	Value
Expected Return	25.15%
Volatility	0.0975
Sharpe Ratio	2.5771

3.4 Performance Comparison

→ ***3.4.1 Expected Returns Comparison***

Portfolio	Expected Return
Domestic Minimum Variance	37.86%
International Minimum Variance	35.22%
Domestic Tangency	55.07%
International Tangency	56.97%
NIFTY50 Index	25.15%

- The international MVP has an expected return of 35.22%, which is slightly less than the domestic MVP's 37.86%. This suggests that while expanding investments internationally typically offers broader market exposure, it doesn't always result in higher returns. Factors such as differing market conditions and asset selection play a significant role in this outcome.

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- The international Tangency Portfolio outperforms its domestic counterpart by achieving an expected return of 56.97% compared to 55.07%. This indicates that the strategies used in selecting and weighing international assets—such as including AAPL (Apple Inc.) and BTC-USD (Bitcoin in USD)—were particularly effective.
 - Both international portfolios have significantly exceeded the performance of the NIFTY50 index, which has an expected return of 25.15%. This highlights the added value that comes from diversifying a portfolio beyond domestic equities, demonstrating enhanced returns through international investment.

→ 3.4.2 Volatility Comparison

Portfolio	Expected Return
Domestic Minimum Variance	0.1502
International Minimum Variance	0.1129
Domestic Tangency	0.1793
International Tangency	0.1409
NIFTY50 Index	0.0975

- The international Minimum Variance Portfolio (MVP) demonstrates lower volatility at 0.1129 compared to the domestic MVP's 0.1502. This suggests that risk management is more effective in the international setting.
- Likewise, the international Tangency Portfolio exhibits reduced volatility of 0.1409 versus 0.1793 for the domestic version. This further indicates that incorporating international assets and cryptocurrencies may contribute to more stable performance.
- While both international portfolios show higher volatility than the NIFTY50 index, their significantly higher returns compensate for this. This points to a successful trade-off between risk and return.

→ 3.4.3 Sharpe Ratio Comparison

Portfolio	Expected Return
Domestic Minimum Variance	2.5192
International Minimum Variance	3.1183
Domestic Tangency	3.069
International Tangency	4.0425
NIFTY50 Index	2.5771

- Both international portfolios have higher Sharpe ratios than their domestic counterparts, demonstrating superior risk-adjusted returns. The international MVP exhibits a Sharpe ratio of 3.1183, and the international Tangency Portfolio boasts a ratio of 4.0425. These figures indicate a more efficient use of risk in the international context.
- When compared to the NIFTY50 index, the international portfolios again show significantly better Sharpe ratios. This underscores the advantages of diversified and strategically managed portfolios over typical market performance. Overall, it is evident that actively managed portfolios can provide much better returns than passive ones like those considered here.

CODE

- <https://colab.research.google.com/drive/1YwwhIQ8bJUqmHZd3uWL0AqYUjwP6sCxh?usp=sharing>

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