A Project Report on Modern Portfolio Theory

Birla Institute Of Technology and Science Pilani
Hyderabad Campus

Security Analysis and Portfolio Management (ECON F412)
Experiential Learning Assignment - 1

Under the supervision of
Prof. Shreya Biswas

Submitted By: **Group 33**

Sr No.	Name	ID Number	Contribution
1	Aryan Madhur Mohan Sharma	2021B3A33037H	Yes
2	Abhinav Srivastava	2021B3AA1608H	Yes
3	Anusha Jain	2021B3A330891H	Yes
4	Om Sonkusare	2022A2PS1703H	Yes
5	Nikhil Gajare	2021A4PS2466H	No
6	Subal Tankwal	2021A7PS1407H	Yes
7	Bhavya Choudhary	2022A2PS1874H	Yes

ACKNOWLEDGEMENT

We would like to express our gratitude to Dr. Shreya Biswas for allowing us to work on this project and enabling us to apply our classroom learning in a practical context. Her timely guidance and support were crucial to successfully completing this project, and we deeply appreciate her assistance throughout the course and this assignment. Her encouragement has been invaluable, and we will always remain grateful for her mentorship.

We also sincerely thank the Economics Department at BITS Pilani, Hyderabad Campus, for fostering an environment that encourages students to engage in creative and practical projects. Their support has allowed us to gain hands-on experience in applying our knowledge to real-world data, greatly enhancing our skills and preparing us with essential tools for success in this field.

ABSTRACT

The primary goal of this assignment is to create an efficient portfolio, focusing on minimizing risk (minimum variance) and maximizing expected returns (tangency portfolio). To achieve this, we are applying the principles of Markowitz Portfolio Theory to both domestic and international portfolios of securities.

For every investor, the key objective is to grow the value of their portfolio and generate returns while managing the risks or uncertainties associated with it. Risk managers play a crucial role in determining the optimal investment allocation for each asset or security, aiming to minimize risk and uncertainty.

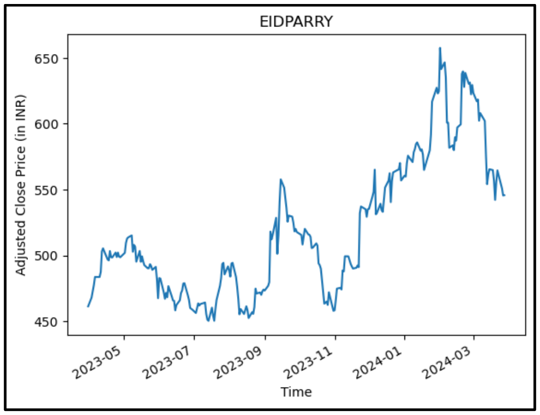
In our project, we first constructed a domestic portfolio of seven securities. We then calculated the annualized returns, variances, and daily excess returns, adjusted for Treasury Bill rates, for the financial year 2023-24. To enhance diversification and reduce overall risk, we expanded the portfolio to include Microsoft (International Security) and Bitcoin(Cryptocurrency). Afterwards, we derived the minimum variance and tangency portfolios and traced the efficient frontier for these portfolios.

Lastly, we evaluated the performance of these portfolios in comparison to a passive index portfolio, drawing conclusions based on our analysis.

TABLE OF CONTENTS

DOMESTIC PORTFOLIO OVERVIEW

1. EIDPARRY



❖ **Overview**

➢ EID Parry, a pioneer in the Indian sugar industry and part of the Murugappa Group, was founded in 1788.

➢ It operates across the sugar, ethanol, distilleries, and nutraceuticals sectors, emphasizing sustainability and innovation.

❖ **Q1 FY2024 Financial Performance**

➢ **Revenue:** ₹6,806.98 crore

➢ **Net Profit:** ₹91.33 crore, reflecting a decline from ₹108.86 crore in Q1 FY2023.

➢ **Net Profit Margin:** 1.34% (compared to 1.55% in Q1 FY2023)

❖ **Segment-wise Highlights**

➢ **Sugar Operations:** Continued losses but showed improvement, with reduced operating losses compared to the previous year.

➢ **Farm Inputs & Nutraceuticals:** Posted solid profits, providing stability to the company amidst challenges in sugar production.

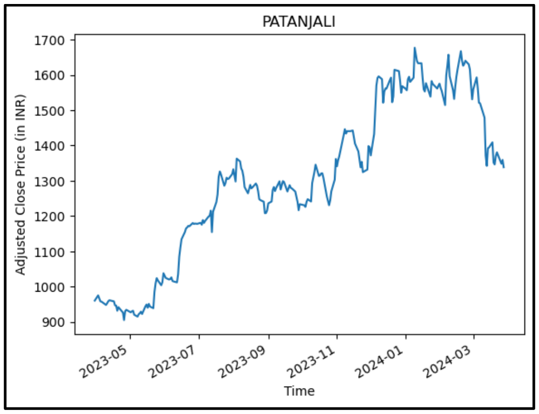
➢ **Consumer Products:** New product launches boosted the group's turnover, driving growth in an otherwise tough market environment.

❖ **Strategic Direction and Future Outlook**

➢ EID Parry is focusing on ethanol production and premium consumer products to diversify its revenue streams.

➢ The company aims to improve profitability by reducing dependency on sugar and capitalizing on value-added bio-products.

2. PATANJALI



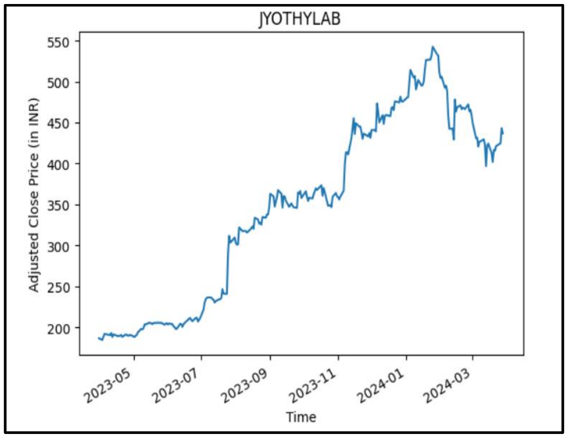
- **Overview**
  - Patanjali Foods Limited produces a wide variety of goods, including edible oils, soy-based products, food, and FMCG items, and it even generates electricity from wind power.
  - Formerly known as Ruchi Soya, the company rebranded to Patanjali Foods in 2022 and operates well-known brands like Nutrela, Mahakosh, and Sunrich, expanding rapidly in the FMCG sector.

- **Q1 FY2024 Financial Performance**
  - **Revenue:** ₹7,173 crore, dropped 8% from the last quarter.
  - **Net Profit:** ₹263 crore, nearly tripled from ₹88 crore in the last year quarter.
  - **Net Profit Margin:** 3.67% (compared to 1.13% in the last quarter)

- **Segment-wise Highlights**
  - **Food and FMCG:** The revenue from the Food and FMCG segment increased to ₹9,643.32 crores, contributing approximately 30% to total revenue, up from 20% the previous year (2022-2023.)
  - **Edible Oils:** The segment experienced a 13.16% increase in sales volume, with notable growth in palm oil plantations.
  - **Wind Turbine Power Generation:** Wind power projects generated ₹39.22 crores in revenue, with a total installed capacity of 84.6 MW across six states.

- **Strategic Direction and Future Outlook**
  - Patanjali is focusing on expanding its FMCG segment with premium and health products while enhancing its digital presence through e-commerce and D2C platforms to boost consumer engagement.
  - The company is growing its renewable energy projects for sustainability and increasing oil palm cultivation to reduce India's dependence on imported edible oils.

3. JYOTHYLAB



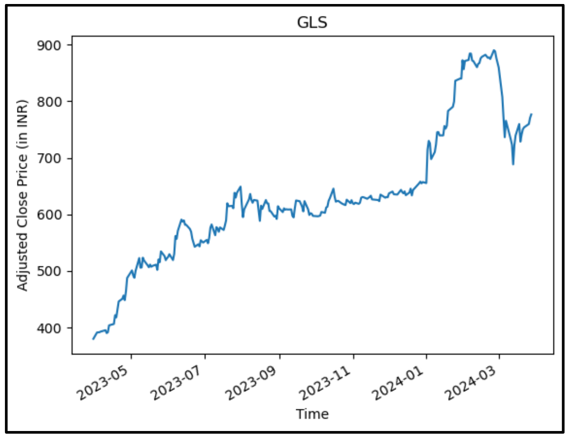
- **Overview**
  - Established in 1983, Jyothy Labs is a major player in India's **FMCG sector**
  - It has products in Fabric care, Home care, Personal care and Household insecticides.
  - Focus on **innovation**, **product quality**, and a deep understanding of consumer preferences.

- **Q1 FY2024 Financial Performance**
  - **Revenue:** 741.81 crore
  - **Net Profit:** 101.73 crore, which has increased from 96.29 crore in Q1 FY2023
  - **Net Profit Margin:** 13.7%

- **Segment-wise Highlights**
  - Fabric Care: A 7% increase in revenue bolstered by introducing new products and robust rural demand.
  - Dishwashing: Sales of the Exo brand increased by 10%. Volume growth and fresh marketing initiatives are the main drivers of growth.
  - Household Insecticides: Sales of the Maxo line increased by 6% strengthened by improved distribution and seasonal demand.
  - Personal Care: Revenue growth for brands such as Margo was 12% driven by the consumers' preference for natural and herbal products.

- **Strategic Direction and Future Outlook**
  - Focus on expanding market share through product innovation, digital transformation, and strengthening distribution.
  - Investment in sustainable methods throughout the business's operations.
  - Explore new product categories and strengthen your e-commerce presence.

4. GLS



❖ **Overview**

- Founded in 2011, **Glenmark Life Sciences** is a key supplier of Active Pharmaceutical Ingredients (APIs).
- It focuses on chronic therapeutic areas like cardiovascular, CNS, and oncology, along with anti-infectives.
- The company prioritizes **R&D**, process innovation, and compliance with global quality standards.

❖ **Q1 FY2024 Financial Performance**

- **Revenue:** ₹594.11 crore
- **Net Profit:** ₹111.48 crore, which decreased from ₹135.45 crore in Q1 FY2023
- **Net Profit Margin:** 18.76%, down from 23.34% in Q1 FY2023

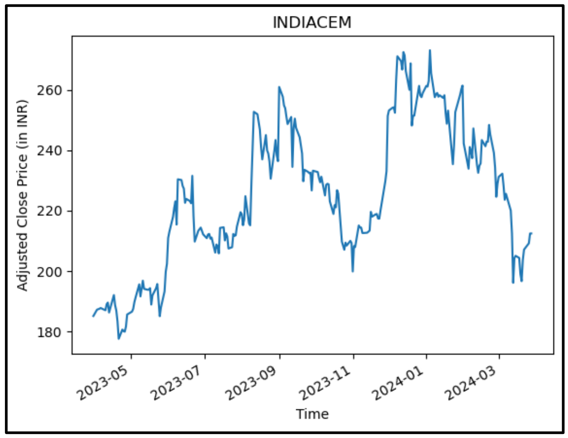
❖ **Segment-wise Highlights**

- **Generic API:** Revenue rose by 10.5% QoQ and 6.2% YoY to ₹5,354 million, driven by growth in regulated and emerging markets.
- **CDMO Business:** Increased revenue by 20.2% QoQ to ₹425 million, supported by demand recovery and global partnerships.
- **High Potency APIs (HP APIs):** Added five products, expanding the portfolio to 20 with a market potential of USD 40 billion.
- **DMF/CEP Filings:** Reached 532 cumulative filings across key markets, enhancing global presence and regulatory compliance.

❖ **Strategic Direction and Future Outlook**

- Focused on growing its high-potency API range, especially in oncology, to capture a larger market share.
- **Strengthening Global Partnerships:** Leveraging multi-year agreements with drug companies, aiming to commercialize these partnerships in the near term.
- **Investing in R&D and Innovation:** Committed to enhancing product innovation and manufacturing capabilities to maintain competitiveness in the API market.

5. INDIACEM



❖ **Overview**

➢ Established in 1946, The India Cements Limited (INDIACEM) is a cement manufacturing company based in Chennai.

➢ 9th largest listed cement company in India by revenue.

➢ Sankar Cement, Coromandel Cement and Raasi Gold are the brands owned by India Cements.

❖ **Q1 FY2024 Financial Performance**

➢ **Revenue:** ₹1,026.76 Cr in Q1 2024, up 14.4% from ₹898.14 Cr in Q1 2023.

➢ **Net Profit:** 58.47 crore, compared to a net loss of ₹60.55 crore in Q1 FY2023.

➢ **Net Profit Margin:** 5.69%

❖ **Segment-wise Highlights**

➢ **Cement:** The company's cement segment has witnessed a growth of 65.66% increase in the last 1 year. The majority of the company's revenue, approximately 95%, comes from the Cement Segment.

➢ A comparatively tiny portion of the company's total revenue comes from other sources, such as Power Generation and Others.

➢ Increased demand for cement and government programs to support infrastructure development all contributed to growth.

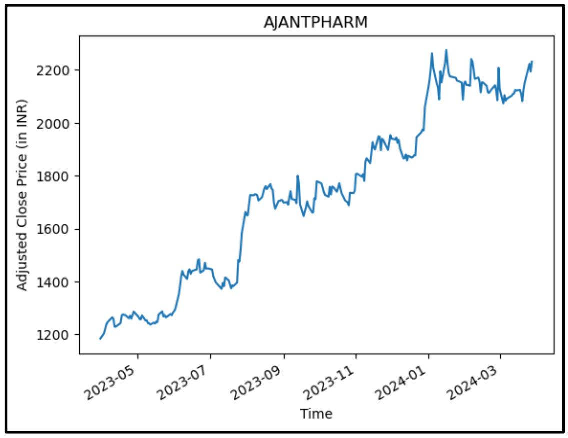
❖ **Strategic Direction and Future Outlook**

➢ Focus on solving its financial challenges, improving operational efficiency, and enhancing profitability.

➢ By increasing its production capacity, it can experience enhancement of its distribution network.

➢ Maximizing benefits from government initiatives to promote infrastructure development, growing urbanization

6. AJANTPHARM



❖ **Overview**

- ➢ Ajanta Pharma operates in 30+ countries, with key markets in India, the U.S., and Africa.
- ➢ It runs 7 facilities approved by the US FDA and WHO, aiming for 50% renewable energy by 2026.
- ➢ The company focuses on R&D to deliver first-to-market, niche healthcare solutions.

❖ **Q1 FY2024 Financial Performance**

- ➢ **Revenue:** ₹1,171.39 crore, up 11.27% year-over-year and 7.51% from the previous quarter.
- ➢ **Net Profit:** ₹245.77 crore, up 18.09% year-over-year and 21.24% quarter-over-quarter.
- ➢ **Net Profit Margin:** 20.98%, up 6.13% from last year and 12.77% from the previous quarter.

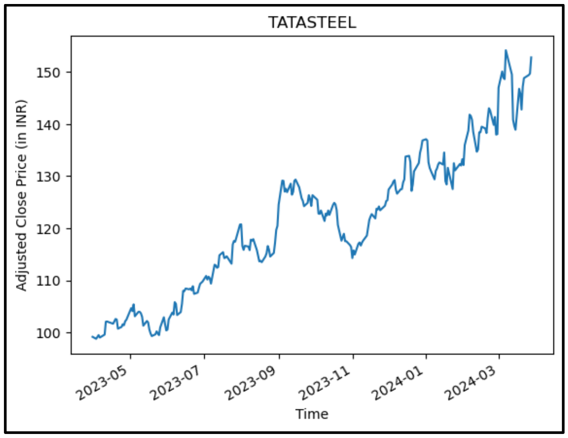
❖ **Segment-wise Highlights**

- ➢ **Branded Generic Business:** Sales grew 17% to ₹860 crore, driven by a 17% increase in dermatology compared to a 7% segment growth.
- ➢ **US Generic Business:** Revenue increased 7% to ₹228 crore, securing 3 ANDA approvals and filing 2 new applications.
- ➢ **Africa Institutional Business:** Sales declined 36% to ₹42 crore due to reduced orders from the previous year.

❖ **Strategic Direction and Future Outlook**

- ➢ Ajanta Pharma allocates about 5% of its revenue to developing speciality drugs.
- ➢ The company plans to grow its presence in domestic and emerging markets for branded generics.
- ➢ Recently, it reported significant revenue and profit growth, indicating a positive outlook for the future.

7. TATASTEEL



- ❖ **Overview**
  - ➢ Founded on 26 August 1907, Tata Steel Limited is an Indian multinational steel-making company based in Jamshedpur, Jharkhand and headquartered in Mumbai, Maharashtra..
  - ➢ One of the few entirely integrated global steel producers, it engages in all aspects of steel production, including the exploration and processing of raw materials, as well as the manufacture of finished steel products.
  - ➢ Tata Steel has a global presence with operations in 26 countries, including India, the Netherlands, the UK, and Thailand.

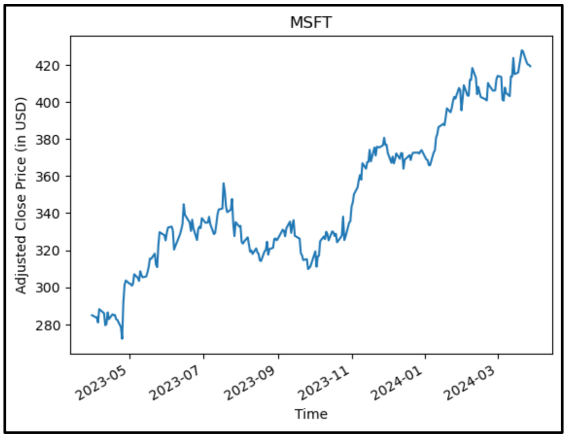
- ❖ **Q1 FY2024 Financial Performance**
  - ➢ **Revenue:** ₹54,771.39 crore
  - ➢ **Net Profit:** ₹959.61 crore, which has increased 51% from Q1 FY2023
  - ➢ **Net Profit Margin:** 1.74%, increased from 1.04% in Q1 FY2023

- ❖ **Segment-wise Highlights**
  - ➢ **India Operations:** Tata Steel produced 5.03 million tons in India operations, up by 4.8% year on year. Standalone realizations remained stagnant quarter on quarter.
  - ➢ **Europe Operations:** Tata Steel's Europe operations reported an EBITDA loss of $30/t, as losses in UK operations continued to offset the positive contribution from Netherlands operations.

- ❖ **Strategic Direction and Future Outlook**
  - ➢ **Leadership in India**: Scale up to meet the emergent demands for steel in India as well as to be the respected and preferred choice for customers.
  - ➢ **Leadership in sustainability:** Seek a leadership role in sustainability in the steel industry, where technology is a key enabler to address this growing challenge.
  - ➢ Tata Steel aims to become one of the most respected and valuable steel companies globally.
  - ➢ Tata Steel sustains a robust strategic focus on research and development by undertaking multiple initiatives that enhance the sustainability and efficiency of its operation.

INTERNATIONAL AND CRYPTO PORTFOLIO

1. MSFT

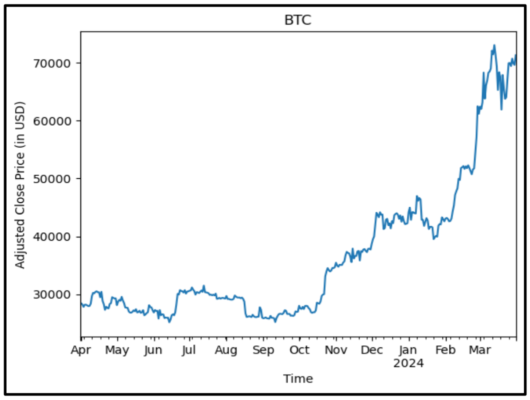


- **Overview**
  - Microsoft is a global leader in cloud computing, software, and hardware, with key products like Azure, Office 365, and Windows. It focuses on innovation and strategic acquisitions, including LinkedIn and Nuance, to drive growth and expand market presence.

- **Q1 FY2024 Financial Performance**
  - **Revenue:** Increased by $3.5 billion (+7%) due to cloud growth, despite weaker personal computing performance.
  - **Gross Margin:** Grew by $3.0 billion (+9%), reflecting the impact of cloud growth and a change in equipment depreciation estimates.
  - **Operating Expenses:** Increased by $996 million (+7%), driven by cloud engineering investments, LinkedIn, and acquisitions like Nuance and Xandr.

- **Segment-wise Highlights**
  - **Intelligent Cloud:** Grew, driven by Azure and other cloud services.
  - **Productivity & Business Processes:** Increased with strong Office 365 Commercial performance.
  - **More Personal Computing:** Declined due to lower Windows and device revenue.
- **Strategic Direction and Future Outlook**
  - Continued investments in cloud engineering and AI (LinkedIn, Azure).
  - Cloud services remain the primary growth driver, with plans to further integrate acquisitions like Nuance for healthcare innovations.
  - Efforts to offset challenges in personal computing with a focus on commercial and productivity solutions.

2. BTC



- **Overview:**
  - Bitcoin, introduced in 2009 by an anonymous entity known as Satoshi Nakamoto, is a decentralized digital currency without a central bank or single administrator.
  - It can be sent from user to user on the peer-to-peer Bitcoin network without the need for intermediaries.
  - Bitcoin is the world's largest cryptocurrency by market capitalization and has a significant influence on the global cryptocurrency market.
- **Q1 FY2024 Financial Performance:**
  - **Price**: Increased significantly, reaching **$70,000** as of the end of Q1 FY2024.
  - **Market Capitalization**: Currently exceeds **$1 trillion**, making it one of the most valuable assets globally.
  - **Growth Rate**: Demonstrated an approximate **45% increase** from the previous quarter, attributed to rising adoption and market optimism.
- **Market Highlights:**
  - **Global Adoption**: Bitcoin adoption has grown globally, with more institutions and individuals using it for investment and transaction purposes.
  - **Regulatory Developments**: Countries like El Salvador have adopted Bitcoin as legal tender, while others are exploring regulatory frameworks to integrate cryptocurrency into their economies.
  - **Network Upgrades**: The Bitcoin network continues to implement technical upgrades such as Taproot, enhancing privacy, scalability, and smart contract functionality.
- **Strategic Direction and Future Outlook:**
  - **Mainstream Adoption**: Bitcoin aims to further its adoption as a store of value and a medium of exchange, expanding into traditional financial markets and gaining acceptance as legal tender in more countries.
  - **Technological Advancements**: Ongoing developments in blockchain technology are expected to improve Bitcoin's scalability and security, supporting its role as a primary digital asset in the global economy.
  - **Regulatory Challenges**: The cryptocurrency faces regulatory scrutiny in various regions, and addressing these challenges is key to its continued growth and stability.

MODERN PORTFOLIO THEORY (MARKOWITZ PORTFOLIO)

A Portfolio Optimization (Investment Theory) allows an investor to make an asset portfolio that maximizes expected return for a given level of Risk.

Assumptions:

1. Investors are risk-averse, which means that for a given level of expected return, investors will always prefer the less risky portfolio.
2. Investors are Rational

Such Portfolios (Markowitz Portfolio) consist of two parts: the Risky fund and the Risk-free fund. The risky part may consist of multiple risky securities. Modern Portfolio Theory employs the core idea of diversification, which means owning a portfolio of assets from different classes is less risky than holding a portfolio of similar assets. Hence, to allocate some weight to the securities constituting the portfolio:

1. Identify the risk-return combinations available from the set of risky assets. (To get an Efficient Frontier).
2. Identify the optimal portfolio of risky assets by finding the portfolio weights that result in the steepest CAL by maximizing the Sharpe Ratio of our portfolio.
3. Finally, we choose an appropriate complete portfolio by mixing the risk-free asset with the optimal risky portfolio by maximizing the utility function based on the investor's risk aversion.

EFFICIENCY FRONTIER AND MINIMUM VARIANCE PORTFOLIO

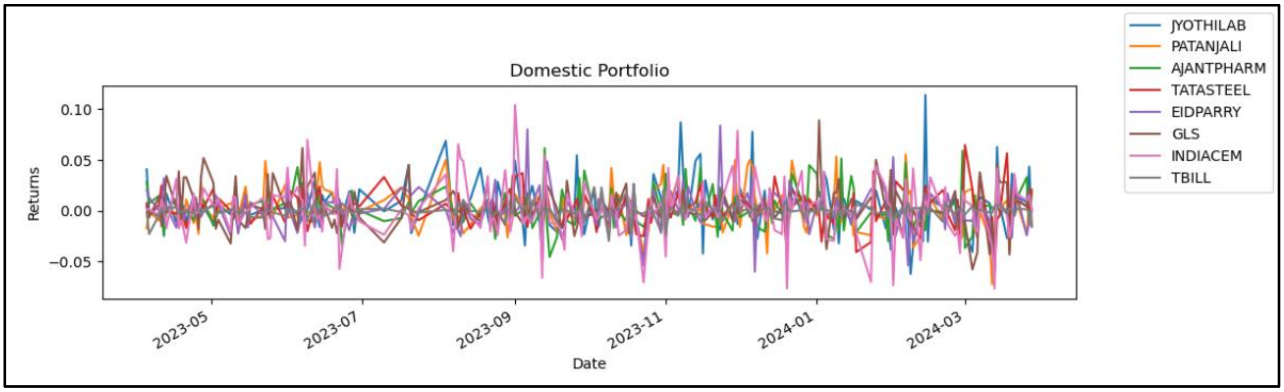
Minimum variance portfolio: This is a collection of securities that yields the lowest risk. The region below the Minimum Variance Portfolio is inefficient due to the availability of a combination of securities that yields higher returns for the same risk.

The Efficiency Frontier: This is the upward-sloping part of the investment opportunity set originating from the minimum variance portfolio. The efficient frontier represents that set of portfolios with the minimum risk for every level of return.

1. To get the Efficient Frontier, identify the Minimum Variance Portfolio by Minimizing Variance with the added constraints mentioned below.
2. When short selling is allowed:
    a. **Min σ_p^2 = w'Σw**
    b. **Constraint: w'1= 1**
        i. **w** - vector of asset weights
        ii. **Σ** - variance-covariance matrix
3. When short selling is **not** allowed:
    a. **Min $\boldsymbol{\sigma_p^2}$ = w'Σw**
    b. **Constraint: w'1= 1**
    c. **w** ≥ 0
        i. **w** - vector of asset weights
        ii. **Σ** - variance-covariance matrix

For our report, we have only considered the case where **Short-Selling is not Allowed.**
The risk-free rate (R_f) is presumed to be **6.5%.**

RESULTS (DOMESTIC PORTFOLIO)



1. VARIANCE & COVARIANCE MATRIX

	JYOTHILAB	AJANTPHARM	PATANJALI	TATASTEEL	EIDPARRY	GLS	INDIACEM	TBILL
JYOTHILAB	0.000525	0.000040	0.000109	0.000039	0.000087	0.000075	0.000128	0.000017
AJANTPHARM	0.000040	0.000291	0.000030	0.000024	0.000003	0.000031	0.000074	-0.000018
PATANJALI	0.000109	0.000030	0.000373	0.000088	0.000076	0.000061	0.000151	0.000003
TATASTEEL	0.000039	0.000024	0.000088	0.000230	0.000056	0.000040	0.000145	-0.000004
EIDPARRY	0.000087	0.000003	0.000076	0.000056	0.000354	0.000064	0.000087	-0.000005
GLS	0.000075	0.000031	0.000061	0.000040	0.000064	0.000372	0.000115	0.000005
INDIACEM	0.000128	0.000074	0.000151	0.000145	0.000087	0.000115	0.000678	0.000021
TBILL	0.000017	-0.000018	0.000003	-0.000004	-0.000005	0.000005	0.000021	0.000046

2. MINIMUM VARIANCE PORTFOLIO

Security	Weight	Portfolio Risk	Portfolio Return
JYOTHYLAB	0.0000	**8.39%**	**11.67%**
AJANTPHARM	0.1232		
PATANJALI	0.0204		
TATASTEEL	0.0911		
EIDPARRY	0.0637		
GLS	0.0315		
INDIACEM	0.0000		
TBILL	0.6701		

Analysis of the Table:

- **Portfolio Risk:** 8.39%, representing the lowest risk achievable.
- **Portfolio Return:** 11.67%, which is the expected return corresponding to this minimized risk level.
- **Asset Allocation:**
  - A large portion (67.01%) is invested in **T-Bills** to maintain low risk.
  - Smaller investments are made in other assets like **AJANTPHARM** (12.32%), **TATASTEEL** (9.11%), **EIDPARRY** (6.37%), **GLS** (3.15%), and **PATANJALI** (2.04%) to boost returns without significantly increasing risk.
  - Assets such as **JYOTHYLAB** and **INDIACEM** are excluded, as they would raise the portfolio's risk profile.

Summary:

In order to minimize variation, this portfolio allocates the majority of its weight to low-risk assets, such as T-Bills (67.01%). It also diversifies by making moderate investments in a few chosen securities, such as **TATASTEEL** and **AJANTPHARM**. Excluding higher-risk assets like **JYOTHYLAB** and **INDIACEM** maintains a well-balanced portfolio that generates an optimal return while retaining a low-risk profile. The portfolio strikes a strategic balance between return and safety, making it largely conservative.

3. TANGENCY PORTFOLIO

Security	Weight	Portfolio Risk	Portfolio Return	Sharpe Ratio
JYOTHYLAB	0.1166	**16.52%**	**55.45%**	**2.96**
AJANTPHARM	0.2916			
PATANJALI	0.0000			
TATASTEEL	0.3428			
EIDPARRY	0.0000			
GLS	0.2490			
INDIACEM	0.0000			
TBILL	0.0000			

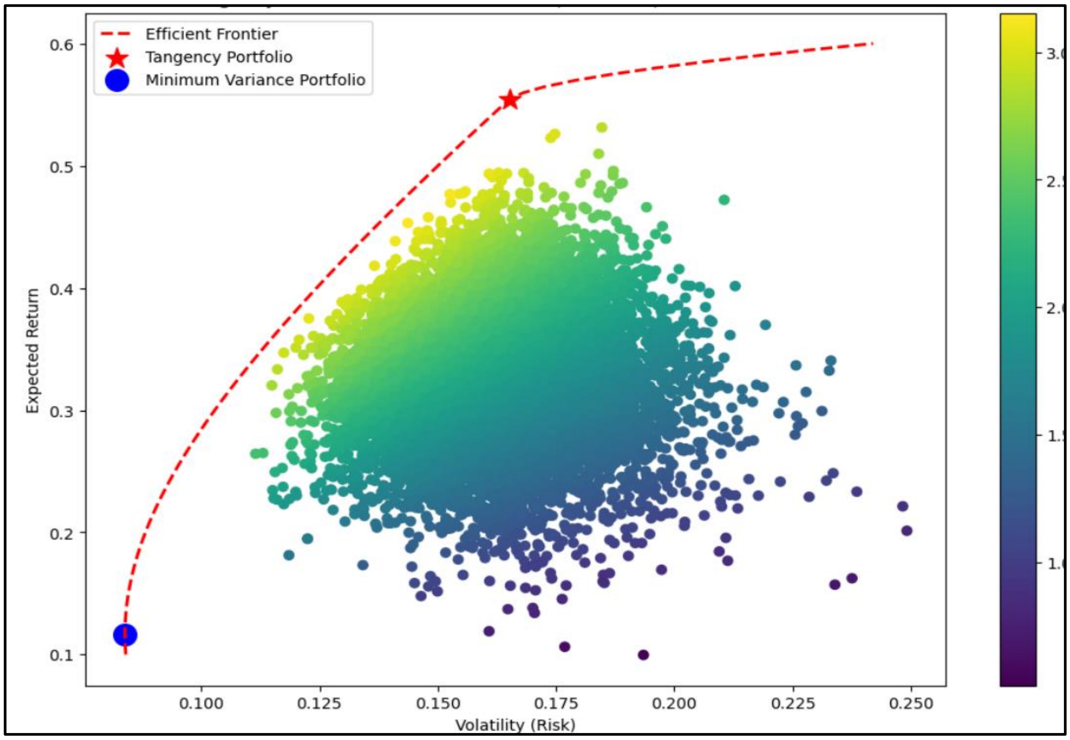
Analysis of the Table:

- **Portfolio Risk:** 16.52%, indicating the risk level associated with this portfolio.
- **Portfolio Return:** 55.45%, representing the expected return.
- **Sharpe Ratio:** 2.96, calculated with a risk-free rate of 6.5%, showing the portfolio's efficiency in maximizing return per unit of risk.
- **Asset Allocation:**
  - The highest allocation to **TATASTEEL** (34.28%), emphasizing its importance in maximizing the portfolio's returns.
  - Significant investments are also made in **AJANTPHARM (29.16%)** and **GLS (24.90%)**, both contributing to the portfolio's performance while maintaining a balanced risk.
  - **JYOTHYLAB** (11.66%) is given a lower weight, which increases returns even more without significantly increasing the risk of the portfolio.
  - Zero allocation to **PATANJALI**, **EIDPARRY**, **INDIACEM**, and **TBILL** to avoid unnecessary risk or lower return contributions.

Summary:

This tangency portfolio, which has the largest exposure to **TATASTEEL** (34.28%), aims to maximize returns while retaining a manageable level of risk. Assets such as **PATANJALI**, **EIDPARRY**, **INDIACEM**, and **TBILL** are not included in the portfolio since they either raise risk or don't increase returns. The Sharpe ratio of 2.96 indicates that the portfolio strikes a balance between high returns and moderate risk, making it an effective and well-diversified investment option for investors looking for higher returns.

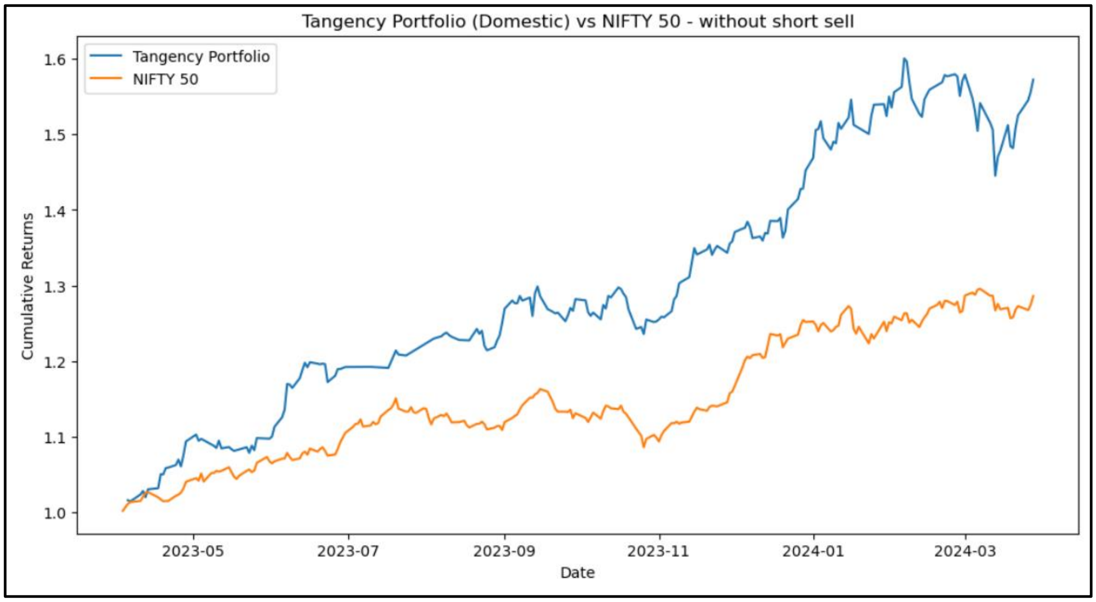
4. EFFICIENT FRONTIER



Key Elements:

- **Efficient Frontier (Red Curve):** This curve represents the optimal portfolios, offering the best possible expected return for each level of risk. Portfolios below the curve are suboptimal as they provide lower returns for the same risk, while those above are unattainable.
- **Minimum Variance Portfolio (Blue Dot):** Positioned at the lowest point on the curve, it indicates the least risk achievable (8.39% risk and 11.67% return, as shown in the MVP Table). It serves as the starting point of the Efficient Frontier. It shows how the MVP is an efficient choice for risk-averse investors.
- **Tangency Portfolio (Red Star):** This portfolio maximizes the Sharpe Ratio (2.96, with a return of 55.45% and risk of 16.52%, as shown in the Tangency Portfolio Table). The optimal portfolio lies where the Capital Allocation Line (CAL) touches the Efficient Frontier, demonstrating the most efficient risk-reward tradeoff. This portfolio includes more risk than the MVP but offers a significantly higher return, making it suitable for investors willing to take on additional risk for higher returns.

5. COMPARISON OF DOMESTIC PORTFOLIO WITH NIFTY 50 INDEX



Analysis of the Graph:

This graph compares the cumulative returns of the Tangency Portfolio and the NIFTY 50 Index for FY 2023-24.

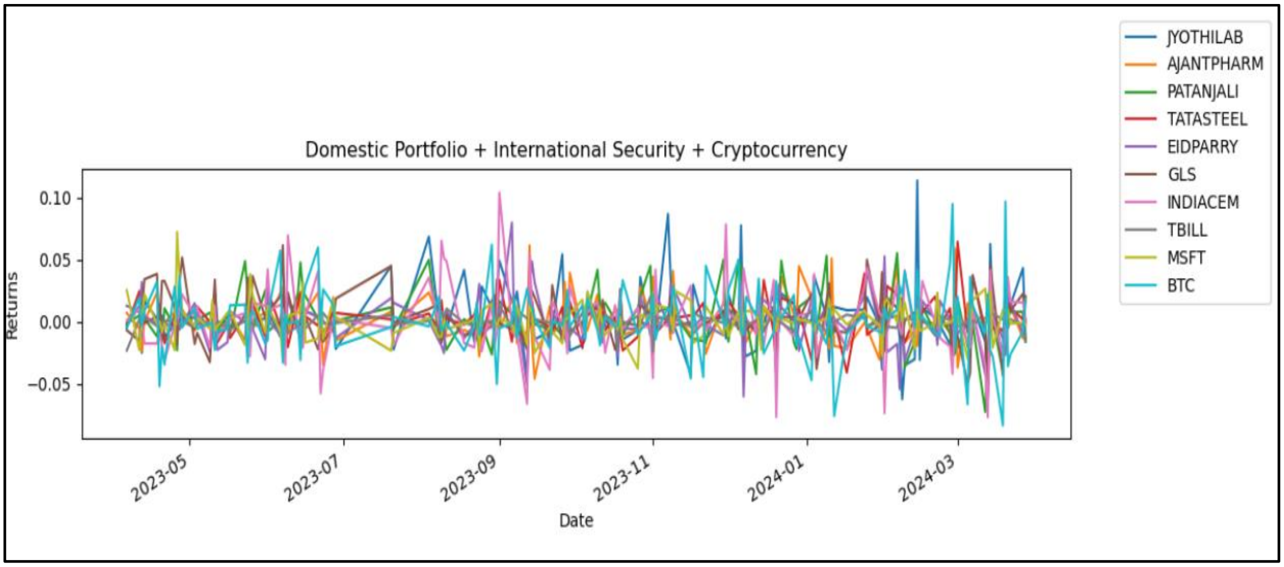
Key observations:

- The Tangency Portfolio's (Blue Line) performance is continuously higher than the NIFTY 50. It increased substantially from mid-2023 to early 2024, hitting 1.6 cumulative returns, although with greater volatility.
- The NIFTY 50 Index's (Orange Line) performance shows a slower development as it rises slowly while exhibiting less volatility, gaining a cumulative return of 1.2 by early 2024.

Comparing volatility, the NIFTY 50 offers smoother, lower-risk growth, while the Tangency Portfolio is more volatile but yields larger returns.

In conclusion, the NIFTY 50 delivers more stable but lower returns, making it suited to risk-averse investors, while the Tangency Portfolio gives better returns with more risk, making it appropriate for investors ready to accept more volatility.

RESULTS (INTERNATIONAL PORTFOLIO)



1. VARIANCE & COVARIANCE MATRIX

	JYOTHILAB	AJANTPHARM	PATANJALI	TATASTEEL	EIDPARRY	GLS	INDIACEM	TBILL	MSFT	BTC
JYOTHILAB	0.000584	2.507568e-05	0.000144	0.000058	1.155014e-04	8.903338e-05	0.000143	0.000022	5.765200e-06	0.000018
AJANTPHARM	0.000025	3.000578e-04	0.000053	0.000030	2.051192e-06	3.450402e-05	0.000068	-0.000021	5.918371e-07	-0.000028
PATANJALI	0.000144	5.315484e-05	0.000399	0.000089	8.052785e-05	9.886966e-05	0.000152	0.000005	-1.098258e-05	-0.000038
TATASTEEL	0.000058	3.037653e-05	0.000089	0.000225	5.483710e-05	4.929798e-05	0.000143	-0.000011	1.254582e-05	-0.000035
EIDPARRY	0.000116	2.051192e-06	0.000081	0.000055	3.631314e-04	8.204707e-05	0.000094	-0.000012	8.889237e-07	-0.000077
GLS	0.000089	3.450402e-05	0.000099	0.000049	8.204707e-05	3.550246e-04	0.000152	0.000003	-2.996093e-07	-0.000027
INDIACEM	0.000143	6.802416e-05	0.000152	0.000143	9.355550e-05	1.519607e-04	0.000722	0.000028	1.082932e-05	-0.000053
TBILL	0.000022	-2.064455e-05	0.000005	-0.000011	-1.193371e-05	3.318707e-06	0.000028	0.000042	-5.780141e-06	0.000004
MSFT	0.000006	5.918371e-07	-0.000011	0.000013	8.889237e-07	-2.996093e-07	0.000011	-0.000006	2.102998e-04	0.000028
BTC	0.000018	-2.808483e-05	-0.000038	-0.000035	-7.664808e-05	-2.722099e-05	-0.000053	0.000004	2.840332e-05	0.000680

2. MINIMUM VARIANCE PORTFOLIO

Security	Weight	Portfolio Risk	Portfolio Return
JYOTHYLAB	0.0000	**7.2%**	**19.42%**
AJANTPHARM	0.1012		
PATANJALI	0.0000		
TATASTEEL	0.0858		
EIDPARRY	0.0662		
GLS	0.0186		
INDIACEM	0.0000		
TBILL	0.5863		
MSFT	0.1030		
BTC	0.0390		

Analysis of the Table:

- **Portfolio Risk**: 7.2%, representing the lowest risk achievable.
- **Portfolio Return**: 19.42%, which is the expected return corresponding to this minimized risk level.
- **Asset Allocation**:
  - A large portion (58.63%) is invested in **T-Bills** to maintain low risk.
  - Smaller investments are made in other assets like **AJANTPHARM** (10.12%), **MSFT** (10.3%), and **BTC** (3.9%) to boost returns without significantly increasing risk.
  - Assets such as **JYOTHYLAB**, **PATANJALI**, and **INDIACEM** are excluded, as they would raise the portfolio's risk profile.

Summary:

The MVP minimizes variance by focusing heavily on low-risk assets (T-Bills) and carefully balancing other securities for optimal return while excluding high-risk ones. The portfolio suggests investing the highest (or taking a long position) in **TBILLs** with 58.63% of the total investable sum and avoiding entirely investing in **JYOTHYLAB, PATANJALI and INDIACEM.**

3. TANGENCY PORTFOLIO

Security	Weight	Portfolio Risk	Portfolio Return	Sharpe Ratio
JYOTHYLAB	0.0731	**13.18%**	**52.93%**	**3.5219**
AJANTPHARM	0.1463			
PATANJALI	0.0757			
TATASTEEL	0.1202			
EIDPARRY	0.0000			
GLS	0.1935			
INDIACEM	0.0000			
TBILL	0.0000			
MSFT	0.2898			
BTC	0.1014			

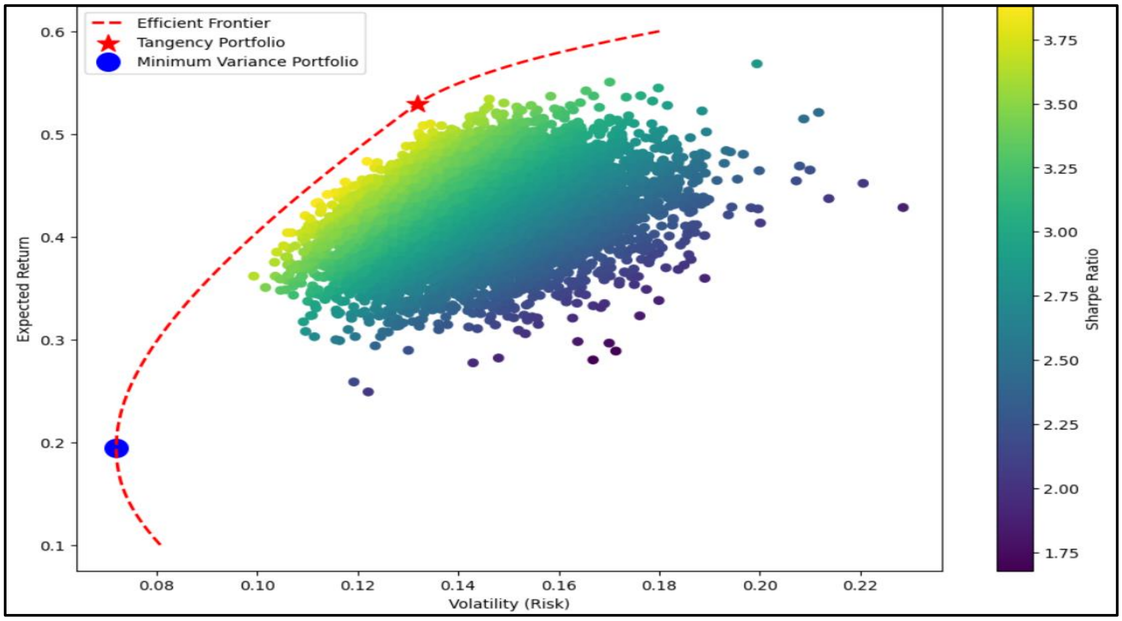
Analysis of the Table:

- **Portfolio Risk:** 13.18%, indicating the risk level associated with this portfolio.
- **Portfolio Return:** 52.93%, representing the expected return.
- **Sharpe Ratio:** 3.5219, calculated with a risk-free rate of 6.5%, showing the portfolio's efficiency in maximizing return per unit of risk.
- **Asset Allocation:**
    - Highest allocation to **MSFT** (28.98%), emphasizing its importance in maximizing returns.
    - Moderate weights are given to other assets like **GLS** (19.35%), **AJANTPHARM** (14.63%), and **BTC** (10.14%) to enhance the portfolio's performance.
    - Zero allocation to **EIDPARRY**, **INDIACEM**, and **TBILL** to avoid unnecessary risk or lower return contributions.

Summary:

The portfolio suggests investing the highest in Microsoft (**MSFT**), which is 28.98% of the total investable sum, and avoiding **EIDPARRY**, **INDIACEM** and **TBILLs**.

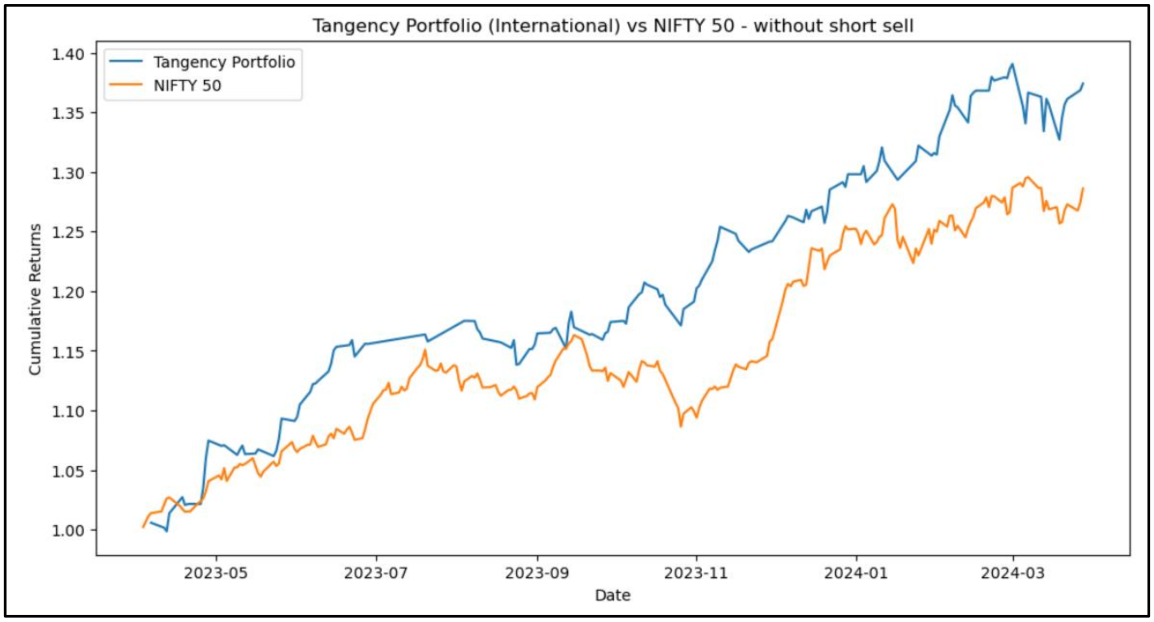
4. EFFICIENT FRONTIER



Key Elements:

- **Efficient Frontier (Red Curve):** This curve represents the optimal portfolios, offering the best possible expected return for each level of risk. Portfolios below the curve are suboptimal as they provide lower returns for the same risk, while those above are unattainable.
- **Minimum Variance Portfolio (Blue Dot):** Positioned at the lowest point on the curve, it indicates the least risk achievable (7.2% risk and 19.42% return, as shown in the MVP Table on page 21). It serves as the starting point of the Efficient Frontier. It shows how the MVP is an efficient choice for risk-averse investors.
- **Tangency Portfolio (Red Star):** This portfolio maximizes the Sharpe Ratio (3.5219, with a return of 52.93% and risk of 13.18%, as shown in the Tangency Portfolio Table on page 22). The optimal portfolio lies where the Capital Allocation Line (CAL) touches the Efficient Frontier, demonstrating the most efficient risk-reward tradeoff. This portfolio includes more risk (13.18%) than the MVP but offers a significantly higher return (52.93%), making it suitable for investors willing to take on additional risk for higher returns.

5. COMPARISON OF INTERNATIONAL PORTFOLIO WITH NIFTY 50 INDEX



Analysis of the Graph:

This graph provides a visual comparison of the cumulative returns between the Tangency Portfolio (International) and the NIFTY 50 Index for the financial year 2023-24.

Key Observations:

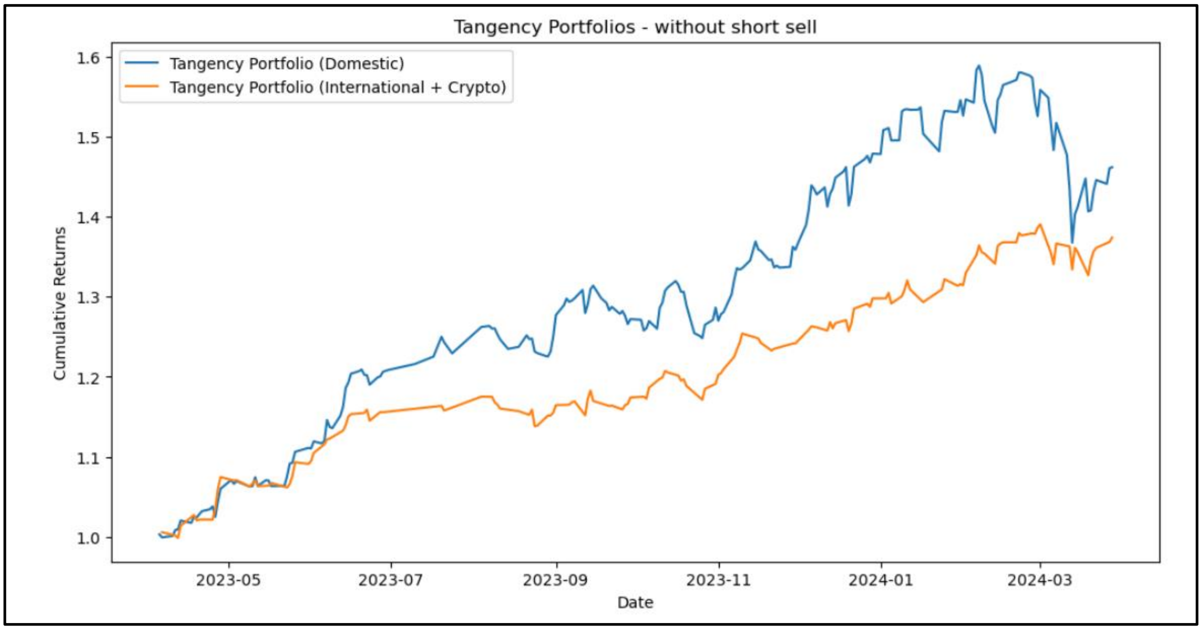
- **The Tangency Portfolio (Blue Line)** performs consistently higher than the NIFTY 50. It trends upwards from mid-2023, reaching a cumulative return of approximately 1.35 by early 2024. However, this higher performance comes with moderate fluctuations, showing that the portfolio experiences some volatility during this period.
- **NIFTY 50 Index (Orange Line)** follows a more gradual upward path. It reaches around 1.2 in cumulative returns by early 2024, showcasing a steadier and less volatile growth pattern compared to the Tangency Portfolio.

Volatility Comparison:

The NIFTY 50 presents a more stable growth trajectory, appealing to investors who prefer lower risk. In contrast, the Tangency Portfolio offers higher potential returns but also comes with increased volatility, which is suitable for investors who are open to taking on more risk for the possibility of greater rewards.

In Conclusion, The Tangency Portfolio demonstrates the potential for higher gains with some moderate volatility, making it a viable choice for investors willing to accept some market fluctuations. Conversely, the NIFTY 50 serves as a safer option, delivering stable returns with minimal risk, making it an attractive choice for risk-averse investors seeking consistent growth**.**

6. COMPARISON BETWEEN DOMESTIC AND INTERNATIONAL PORTFOLIOS



Graph Analysis:

1. **Performance Summary:** The graph illustrates that the domestic portfolio (blue line) consistently shows higher cumulative returns than the international portfolio (orange line) throughout the observed period. This is supported by the data, where the domestic portfolio yields a higher return (55.45%) compared to the international portfolio (52.93%).
2. **Volatility Analysis:** The domestic portfolio experiences greater fluctuations, which is in line with its higher risk value (16.52%). This reflects the potential for higher returns but also higher volatility. In contrast, the international portfolio's lower risk (13.18%) corresponds to its steadier growth pattern, making it less volatile.
3. **Risk-Adjusted Returns:** The international portfolio's Sharpe Ratio (3.5219) indicates that it provides better risk-adjusted returns than the domestic portfolio (2.96). The graph visually supports this, where the international portfolio (orange line) shows a smoother and more stable growth trend. The diversification from including global assets like MSFT and cryptocurrency helps manage and reduce risk effectively.

Summary:

- **Domestic Portfolio:** Offers higher returns but comes with more risk and volatility. This makes it suitable for investors looking for high gains who are also willing to accept a higher level of risk.
- **International Portfolio:** Provides a more balanced approach, with moderated returns and lower risk. Its steady growth curve and higher Sharpe Ratio highlight its efficiency in risk management, making it ideal for those seeking more consistent growth with less volatility.

CONCLUSION

This project demonstrated the practical application of Modern Portfolio Theory (MPT) in building and analyzing both domestic and international investment portfolios. By strategically selecting assets (Microsoft and Bitcoin) and leveraging diversification, we aimed to balance risk and return, offering solutions for investors in accordance with their risk appetites.

Our analysis showed that the domestic portfolio delivered higher returns but came with increased volatility—making it a suitable choice for growth-oriented investors willing to take on more risk. On the other hand, the international portfolio, which included global assets like Microsoft and Bitcoin, provided a more stable and consistent growth pattern, appealing to those who prefer a balanced approach with lower risk.

Exploring the Efficient Frontier, Minimum Variance Portfolio and Tangency Portfolio highlighted the power of diversification in enhancing portfolio efficiency. Incorporating international assets proved beneficial, particularly in improving risk-adjusted returns and reducing overall portfolio volatility.

Comparing these portfolios with the NIFTY 50 Index illustrated how thoughtful asset allocation can outperform traditional, passive investment strategies. The findings reaffirm the value of diversification, risk management, and optimal asset allocation in creating efficient and effective portfolios tailored to different investor preferences.

In conclusion, our study validates the impact of Modern Portfolio Theory in building robust investment portfolios and emphasizes the importance of global diversification for achieving optimal results in both domestic and international markets.

REFERENCES

1. *INDmoney: Track, Plan & Invest in Stocks, SIP in Mutual Funds to Grow Money. (n.d.). INDMoney: Track, plan & invest in stocks, SIP in mutual funds to grow money. INDmoney.* *https://www.indmoney.com/stocks/eid-parry-india-ltd-share-price/results*
2. *Devdiscourse News Desk. (2024, August 14). EID Parry reports mixed financial performance in Q1 2024 | Business. Devdiscourse.* *https://www.devdiscourse.com/article/business/3051933-eid-parry-reports-mixed-financial-performance-in-q1-2024*
3. *Yahoo is part of the Yahoo family of brands. (n.d.).* *https://finance.yahoo.com/quote/JYOTHYLAB.NS/financials/*
4. *Podishetti, A. (2024, July 19). Patanjali Foods Q1 Results: Net profit nearly triples YoY to Rs 263 cr; revenue drops 8%. The Economic Times.* *https://economictimes.indiatimes.com/markets/stocks/earnings/patanjali-foods-q1-results-net-profit-nearly-triples-yoy-to-rs-263-cr-revenue-down-8/articleshow/111865804.cms?from=mdr*