Stock Portfolio Project

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Libraries Used
- Pandas: A Python library designed for efficient data manipulation and analysis.
- Numpy: A Python library is used to perform numerical calculations.
- Matplotlib: A Python library for creating basic visualizations and graphs.
- Seaborn: A library built on top of Matplotlib, offering more advanced and customizable visualizations.
- Yfinance: A Python tool that facilitates the retrieval of financial data from Yahoo Finance.

Dataset
The dataset used is live and fetched in real-time using the yfinance module from Yahoo Finance. The data spans from 2008 to 2025 and includes the following portfolio stocks: NSE50, TCS, Tata Steel, and Tata Motors.

The dataset contains various columns, including Date, Symbol, Prev Close, Open, High, Low, Last Close, Turnover, Trades, and Volume. For the analysis, only the Date, Close, and Volume columns will be used.
- Dates: The date of each entry, formatted as YYYY-MM-DD.
- Close: The closing price of a stock on any given day, representing the last traded price during regular market hours.
- Volume: The total number of shares traded on that day, indicating the stock's liquidity and trading activity.

Objectives
- Analyze and compare the performance of Tata's key stocks (TCS, Tata Motors, Tata Steel) and NSE50 in the Indian stock market.
- Conduct a thorough Exploratory Data Analysis (EDA) to uncover patterns and insights.
- Assess each stock's long-term performance and the potential for Systematic Investment Plans (SIP).
- Compare the annual returns of the Tata Companies' stocks.
- Identify trends and performance patterns over time.

Data Import
The data is imported from Yahoo Finance using the tickers for each stock.

Exploratory Data Analysis (EDA)
EDA is a crucial initial step to understanding the structure of the data, recognizing patterns, and uncovering valuable insights. The following techniques will be applied during the EDA phase:
- Data Cleaning: To ensure the dataset is accurate and consistent.
- Statistical Analysis: For identifying trends and making data-driven conclusions.

● Visualization: To create charts and graphs that present the findings.

Data Cleaning

The data-cleaning process begins with importing the necessary data and preparing it for analysis. For this project, I directly imported the relevant columns: Close and Volume, as the Date column is unique and already indexed.

The following steps were performed during the cleaning process:

1. Reordering and Renaming: I reordered and renamed the columns to ensure the dataset was properly structured, bringing all the required columns into a single dataframe.
2. Shape Check: The shape of the dataframe was checked, revealing 4205 rows and 8 columns. This means the dataframe has 4205 entries and 8 attributes.
3. Data Summary: I used the info() method to obtain a quick summary of the dataframe, which provided information on the data types, non-null values, and memory usage. The analysis indicated that the nse_close and nse_volume columns contained fewer non-null values, suggesting missing data.
4. Missing Data Check: The isnull() method was used to detect missing values in the dataset, and the .sum() method was applied to count the missing values. It was found that nse_close and nse_volume had 23 missing values.
5. Duplicate Check: I verified the presence of duplicates using the duplicated() method, followed by .sum() to count any duplicated rows. No duplicates were found in the dataset.
6. Null Value Removal: The dropna() method was used to remove rows containing null values. Since the dataset contains over 4200 records, removing 23 missing values had little to no impact on the overall data integrity.

With these steps completed, the dataset is now ready for statistical analysis.

Statistical Analysis

Statistical analysis in Pandas involves applying various operations to understand relationships and trends in the dataset. For this project, the analysis focused on the correlation between different attributes.

Correlation Analysis

Using the .corr() method, I performed a correlation analysis to understand the relationships between variables in the dataset. This method calculates the correlation coefficients, which range from -1 to 1, and measures the strength and direction of linear relationships between attributes:

● Values close to 1 indicate a strong positive correlation (as one variable increases, so does the other).
● Values close to -1 indicate a strong negative correlation (as one variable increases, the other decreases).

● Values near 0 indicate no linear relationship between the variables.

Correlation Heatmap
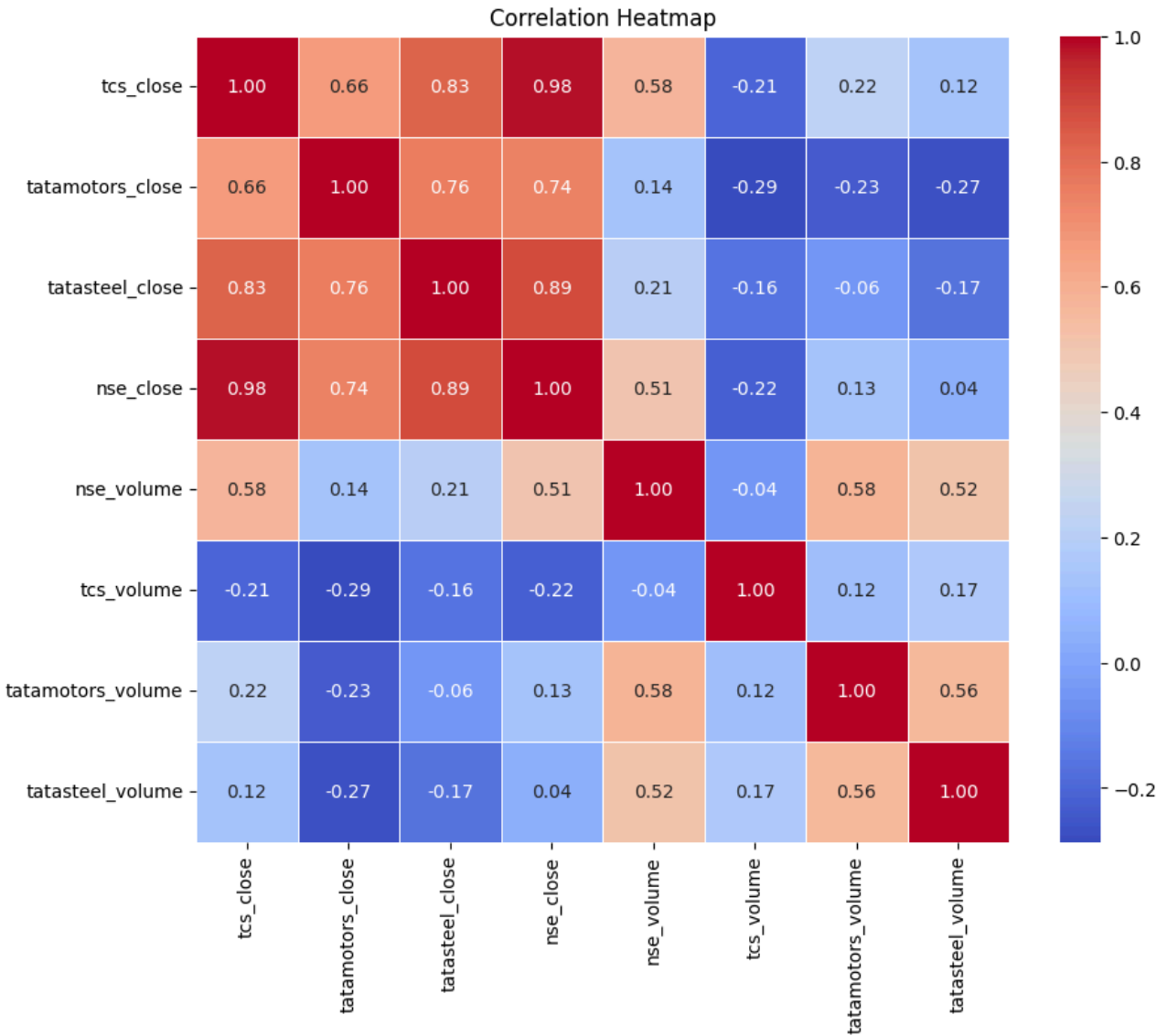
Key Observations

Attributes	Findings	Interpretations
TCS Stock Price	Strong positive correlation between the NSE stock price (0.98) and Tata Steel stock price (0.83). Weak positive correlation with Tata Motors stock price (0.66).	If NSE stock prices rise, TCS and Tata Steel stock prices increase significantly, while Tata Motors shows a smaller increase.
Tata Motors Stock Price	Moderately positive correlation with Tata Steel (0.76) and NSE stock price (0.74). Weak positive	Tata Motors' stock price is somewhat linked to the overall market but shows a

	correlation with TCS stock price (0.66).	weaker correlation compared to TCS and Tata Steel.
Tata Steel Stock Price	Strong positive correlation with the NSE stock price (0.89) and TCS stock price (0.83). Moderately positive correlation with Tata Motors stock price (0.76).	Tata Steel's stock price closely follows the performance of the NSE and TCS.
NSE Stock Price	Strong positive correlation between TCS stock price (0.98) and Tata Steel stock price (0.89). Weak positive correlation with Tata Motors stock price (0.74).	NSE stock prices strongly influence TCS and Tata Steel but have a weaker impact on Tata Motors.
NSE Volume	Weak positive correlation with Tata Steel volume (0.52), Tata Motors volume (0.58), and TCS stock price (0.58).	NSE trading volume has a weaker relationship with other stocks.
TCS Volume	Very weak positive correlations with other attributes.	TCS trading volume shows minimal influence on other stocks.
Tata Motors Volume	Weak positive correlation between NSE volume (0.58) and Tata Steel volume (0.56).	Tata Motors' volume is slightly influenced by NSE and Tata Steel's trading volumes.
Tata Steel Volume	Weak positive correlation between Tata Motors volume (0.56) and NSE volume (0.52).	Tata Steel's volume shows some relationship with the trading volumes of Tata Motors and NSE.

Key Insight

NSE stock prices strongly impact TCS and Tata Steel, making them highly correlated. Tata Motors exhibits weaker relationships with other stocks, indicating more independent price movement compared to the others. Volume correlations across all stocks are generally weak, highlighting less interdependence in trading activity.

Descriptive Statistics

Descriptive statistics summarize and highlight key characteristics of a dataset, such as measures of central tendency (mean, median, and mode) and variability (standard deviation and variance). These insights help to better understand the performance and behavior of stocks in a structured manner. To understand the characteristics of the stocks I used .describe() to get all descriptive statistics.

	tcs_close	tatamotors_close	tatasteel_close	nse_close	nse_volume	tcs_volume	tatamotors_volume	tatasteel_volume
count	4183.00	4183.00	4183.00	4183.00	4183.00	4183.00	4183.0	4.183000e+03
mean	1509.97	336.99	35.29	10243.63	208981.16	3109637.44	19070239.9	7.532418e+07
std	1205.46	217.03	41.06	5617.60	208111.43	2645450.43	24479637.8	5.752310e+07
min	83.73	22.91	4.37	2524.20	0.00	73380.00	62417.0	6.932760e+05
25%	475.39	170.32	13.21	5614.17	0.00	1761968.00	6917220.5	3.919896e+07
50%	1067.22	303.51	17.82	8543.55	183100.00	2450426.00	11276250.0	5.893959e+07
75%	2462.56	444.07	26.25	12277.00	288250.00	3669020.00	20302098.0	9.136298e+07
max	4471.39	1161.85	179.94	26216.05	1811000.00	88067154.00	390577839.0	6.428460e+08

Stock Insights

TCS
1. Price Behavior: TCS stock has a wide price range (₹83.89 to ₹4,531.87) with a high standard deviation of ₹1,222.63, reflecting significant growth and notable price fluctuations. This performance showcases strong investor confidence in the stock.
2. Trading Activity: The lower trading volumes and low variability indicate TCS might be favored by long-term investors, with fewer short-term speculative trades compared to Tata Motors and Tata Steel.

Tata Motors
1. Price Stability: With a mean price of ₹336.89, close to the median of ₹303.34, and a standard deviation of ₹216.96, Tata Motors has demonstrated consistent performance over time, despite moderate fluctuations.
2. Liquidity: Its high trading volumes suggest strong liquidity, making it easier to trade without causing major price impacts. This accessibility appeals to a wide range of investors but also exposes the stock to market-driven fluctuations.

Tata Steel
1. Price and Variability: Tata Steel has a lower mean price of ₹35.27 and a standard deviation of ₹41.03, indicating a relatively stable stock with less price variability. Investors likely view this as a steady, low-risk investment rather than a growth opportunity.

2. Trading Activity: Like Tata Motors, Tata Steel's high trading volumes indicate strong liquidity and make it an accessible choice for investors. However, its stability and affordability might make it more prone to market influences.

NSE

3. Market Representation: The NSE's price range (₹2,524.20 to ₹26,216.05) reflects both the overall growth and volatility of the Indian stock market. This performance mirrors positive economic trends and favorable policy impacts.

What does all these insights "mean"?

Portfolio Diversity: The Tata stocks analyzed offer varying levels of risk and reward, providing investors with opportunities to build a well-diversified portfolio.

1. Stability Seekers: Investors who prefer stable returns with less risk may gravitate toward Tata Steel and Tata Motors due to their lower volatility and high liquidity.
2. Growth-Oriented Investors: Those seeking higher returns and are willing to accept more risk might lean towards TCS, which has shown significant growth over time.

Market Dependency: The strong correlation of these stocks with NSE highlights their dependence on overall market conditions. In case of market downturns, these stocks are likely to experience declines, emphasizing the importance of risk management in investment strategies.

Visualization
Stock price graphs analysis

NSE price

TCS price

Tata Motors price

Tata Steel price
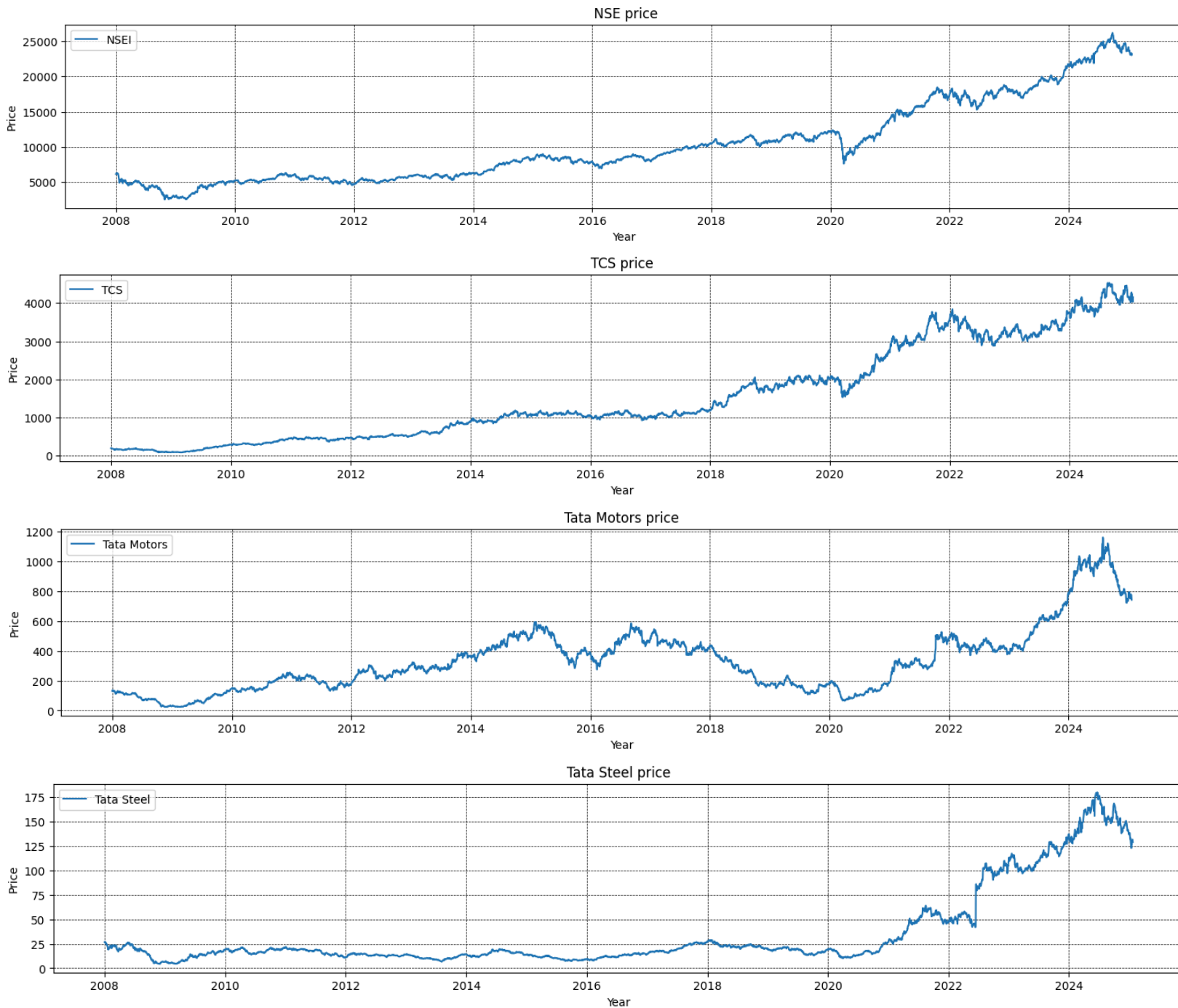
Past Records Highlights

2008–2010: Global Financial Crisis

The global financial crisis of 2008 significantly impacted the Indian stock market, with investors selling stocks to liquidate cash.

Key Observations:

1. NSE, Tata Motors, and Tata Steel stocks experienced notable price declines during this period.
2. TCS stock displayed relative stability, with fewer fluctuations, demonstrating its resilience during the crisis.

2010–2020: Recovery and Volatility

1. NSE & TCS: Both showed a steady upward trend, indicating strong performance and correlation during this decade.
2. Tata Steel: Prices remained relatively unchanged, reflecting stability without significant growth.
3. Tata Motors: This stock experienced significant volatility, with frequent price fluctuations. Possible reasons for volatility might be due to the weak financial performance of Jaguar Land Rover, stricter emission regulations in Europe, increased competition in the global automotive industry, or combinations of all factors. Both internal and external factors contributed to the instability of Tata Motors' stock during this period.

2020–Post-COVID Era

COVID-19 Impact (Early 2020): A sharp dip in stock prices was observed across all stocks due to the pandemic-induced lockdowns. The global market shutdown, along with disrupted manufacturing and production chains, caused widespread selling by investors.

Recovery (Mid-2020): By Q2 2020, stock prices began to recover. Possible Contributing Factors may be due to:

1. Government and RBI measures, including fiscal stimulus packages.
2. Economic reopening, fostering hope for recovery in business activity.
3. Investor confidence remained optimistic, driving an upward trend.

2024: Sectoral Volatility

In Q3 2024, the Indian stock market experienced sector-specific volatility. The IT sector, in particular, delivered mixed performance and fell short of expectations.

Volume graph analysis
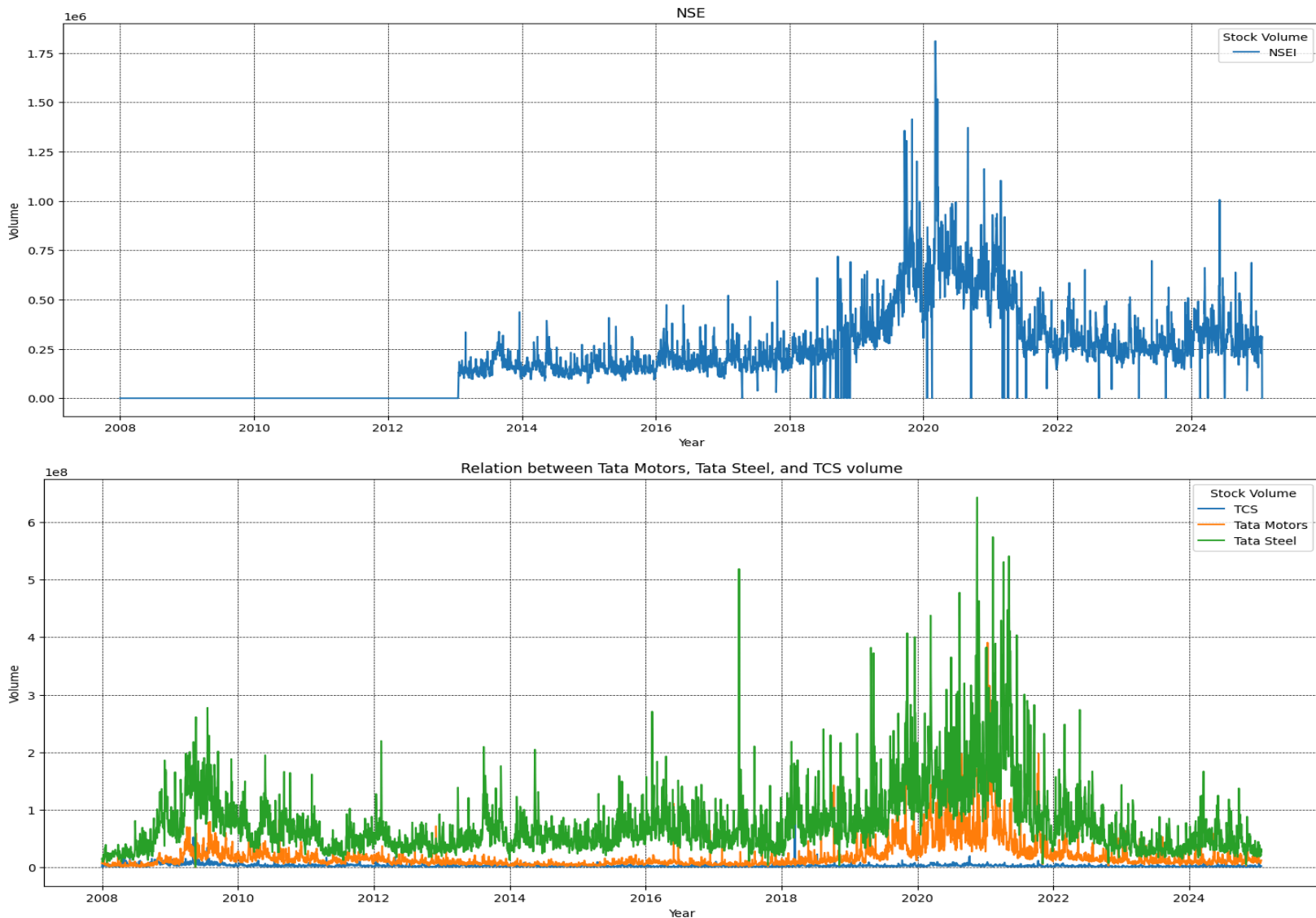
NSE and Tata Portfolio Stocks

2008–2010: High Share Volume Transactions

Tata Motors and Tata Steel experienced a significant increase in share volume transactions during this period.

Trend Analysis:

1. The upward trend in share volume between 2008 and 2009 coincided with a reduction in stock prices, indicating a mass selling of shares.
2. This behavior aligns with the 2008 financial crisis, where investors sold off stocks to secure liquidity amidst market uncertainty.

2020–2021: Lockdown-Induced Selling:

A similar trend was observed during the COVID-19 pandemic.

Key Observations:

1. The share volume increased sharply as stock prices fell, highlighting panic-driven selling.
2. Comparison with 2008: Selling volumes in 2020 were higher than those in 2008, possibly due to the uncertainty and fear surrounding the extended lockdown and its economic impact.

Overall Insights

1. High Volume Transactions: Serve as indicators of market uncertainty, reflecting a lack of investor confidence during crises.
2. Investor Behavior: Both periods highlight the tendency to sell stocks rapidly during economic downturns, further amplifying market volatility.

Return on Investment (ROI) and Systematic Investment Plan Analysis

In this section, we will evaluate the return on investment (ROI) for NSE, TCS, Tata Motors, and Tata Steel. Assuming a strategy of purchasing one share of each stock every 30 days from 2008 to 2025, we will analyze key metrics such as the total investment made, the number of shares owned, the average cost per share, the net profit or loss, and the final ROI for each stock.

NSE SIP

Total Invested in NSE	Rs. 1308508.05
Shares Owned of NSE	129
Average Investment per Share	Rs. 10143.47
Net Unrealized Profit	Rs. 1685504.55
NSE ROI from 2008-01-01 to 2025-01-23	128.81%

TCS SIP

|	
Total Invested in TCS	Rs. 192742.89
Shares Owned of TCS	129
Average Investment per Share	Rs. 1494.13
Net Unrealized Profit	Rs. 344535.66
TCS ROI from 2008-01-01 to 2025-01-23	178.75%

Tata Steel SIP

Total Invested in Tata Steel	Rs. 4443.25
Shares Owned by Tata Steel	129
Average Investment per Share	Rs. 34.44
Net Unrealized Profit	Rs. 12366.74
Tata Steel ROI from 2008-01-01 to 2025-01-23	278.33%

Tata Motors SIP

Total Invested in Tata Motors	Rs. 43223.38
Shares Owned of Tata Motors	129

Average Investment per Share	Rs. 335.06
Net Unrealized Profit	Rs. 53694.32
Tata Motors ROI from 2008-01-01 to 2025-01-23	124.23%

ROI comparision

Gain comparision
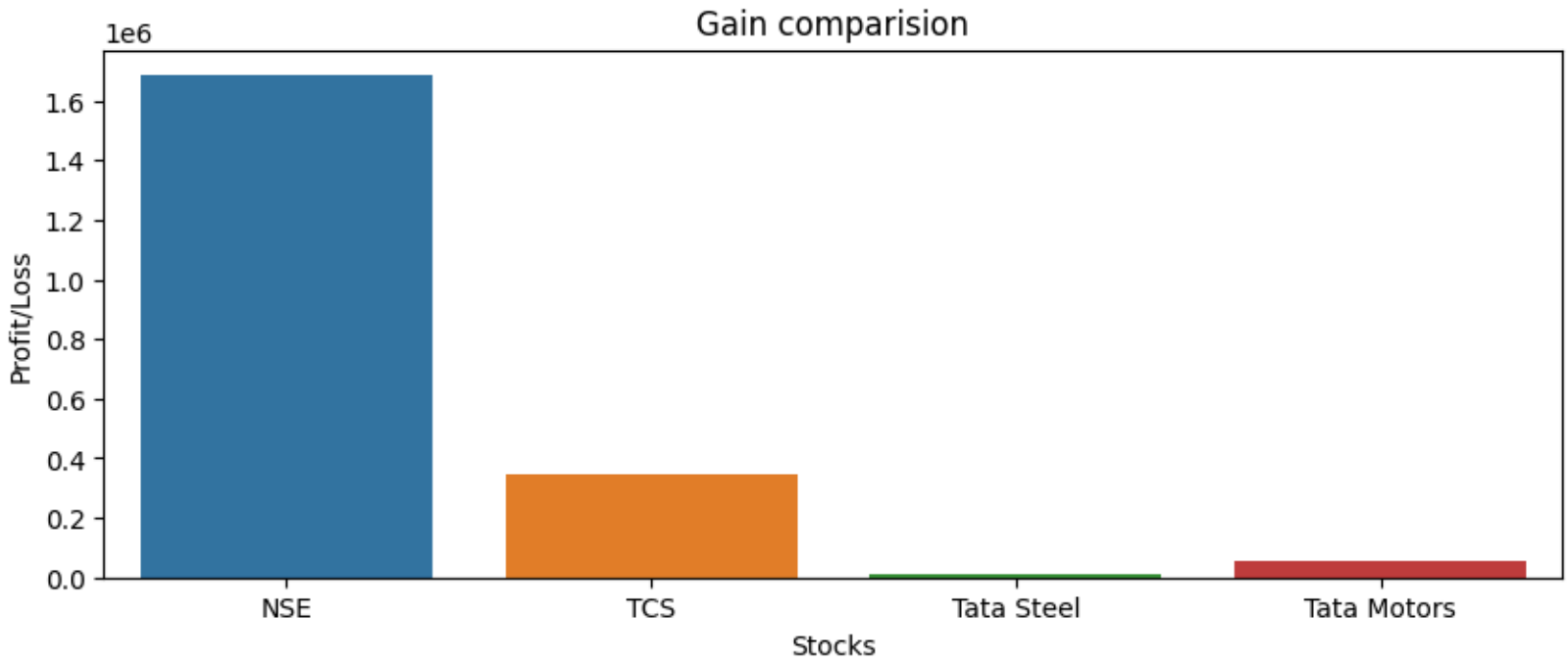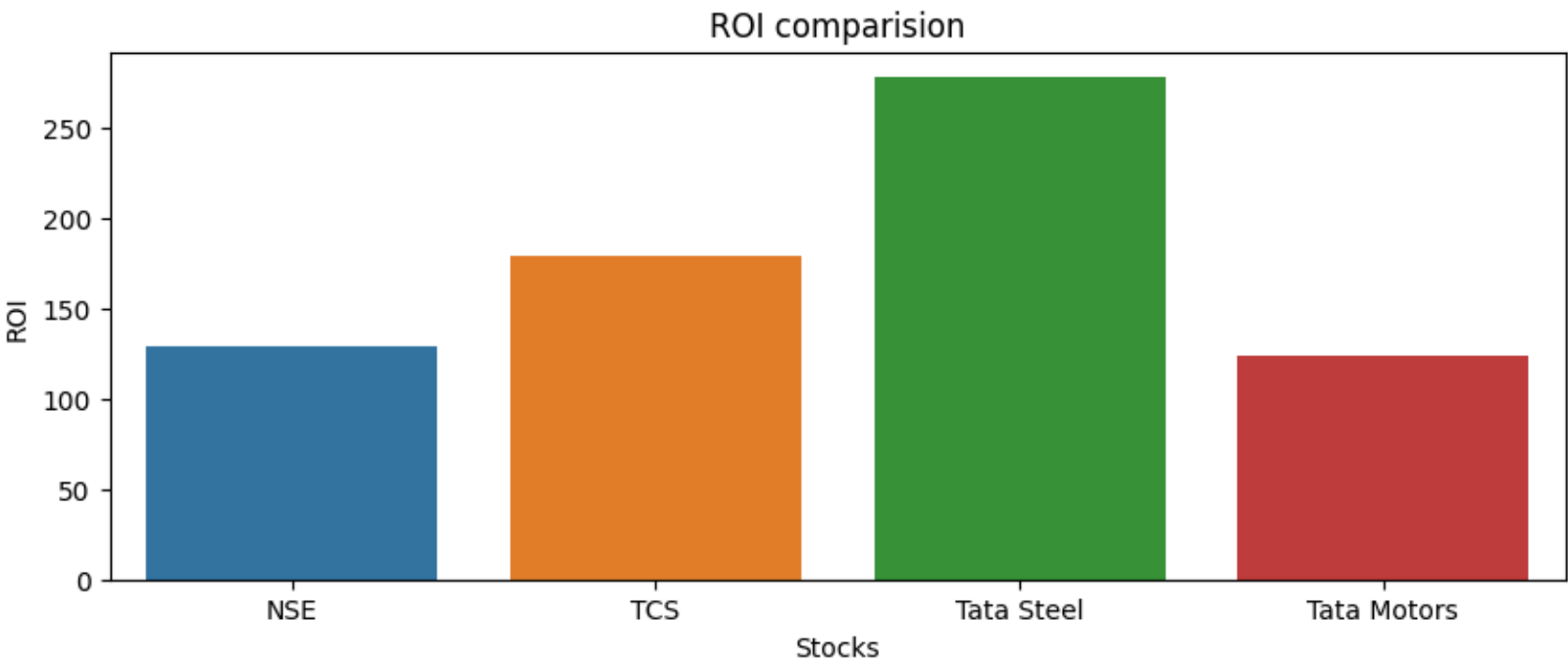
Overall Insights

1. ROI of 128.81%, NSE has exhibited consistent growth, mirroring the overall upward trajectory of the Indian stock market. Although it demands a high initial investment, it offers strong potential for long-term stability and gains.
2. TCS: TCS has delivered substantial growth, achieving a high ROI of 178.75%. Its significant unrealized profits highlight strong investor confidence, positioning it as a reliable growth stock.
3. Tata Steel: Despite boasting the highest ROI of 278.33% among the stocks, Tata Steel struggles to generate sufficient net income to justify its investment. This could be due to underperformance or unfavorable market conditions impacting its returns.
4. Tata Motors: With an ROI of 124.23%, Tata Motors has provided steady profitability over the years, offering reliable returns to investors.

TCS stands out as a top-performing growth stock, delivering substantial returns and unrealized profits, making it particularly attractive to investors. Tata Motors and Tata Steel, while profitable, provide more modest and steady returns. NSE, on the other hand, offers consistent growth and significant profitability, reflecting broader economic trends.

Golden and Death Cross Analysis

The golden cross and death cross are technical indicators used to predict future market trends based on moving averages.

- A golden cross occurs when a stock's short-term moving average, typically the 50-day moving average, crosses above its long-term moving average, usually, the 200-day moving average. It indicates that short-term price action is favorable and potential long-term uptrend.
- A death cross is the opposite scenario, where the 50-day moving average crosses below the 200-day moving average. It indicates that the short-term price action is weakening and potentially signaling the start of a long-term downtrend.

Rolling Average NSE 50 vs 200

Rolling Average TCS 50 vs 200

Rolling Average Tata Motors 50 vs 100

Rolling Average Tata Steel 50 vs 100

Key Takeaways

1. Tata Steel and Tata Motors: The 50-day moving average consistently remains below the 200-day moving average, indicating a "death cross." This pattern typically signals a potential downtrend in the stock's performance.
2. NSE: The stock also exhibits signs of a "death cross," reflecting a possible downward momentum in the broader market.
3. TCS: Unlike the other stocks, TCS displays an upward trend, with its 50-day moving average consistently staying above the 200-day moving average. This pattern, known as a "golden cross," suggests strong bullish momentum and potential long-term growth.

TCS demonstrates significant resilience and growth potential compared to the other stocks, while Tata Steel, Tata Motors, and NSE signal caution with potential downtrends.

Annualized Return Analysis

Annualized return, often referred to as annual return or annualized total return, represents the yearly rate of return on an investment over a specific period. This measure provides a clear picture of how an investment has performed annually, taking into account the total return from 2008 to 2025. By calculating annualized returns, investors can better understand and compare the performance of their investments over time, enabling more informed decision-making.

	nse_return	tcs_return	tm_return	ts_return
count	4181.000000	4181.000000	4181.000000	4181.000000
mean	0.000403	0.000907	0.000805	0.000802
std	0.013150	0.018531	0.028267	0.030650
min	-0.129805	-0.106906	-0.175827	-0.151194
25%	-0.005320	-0.008195	-0.013369	-0.013199
50%	0.000660	0.000521	0.000000	0.000393
75%	0.006579	0.009617	0.014210	0.013899
max	0.177441	0.154957	0.359480	1.005783

Descriptive Statistics of Returns

Mean Return Analysis

The NSE has the lowest average return, indicating steady but slower growth compared to the individual stocks. TCS stands out with the highest average return, reaffirming its position as a growth stock. Tata Motors and Tata Steel exhibit similar average returns, slightly below TCS.

Volatility (Standard Deviation)

Tata Steel has shown the highest volatility over the years, indicating significant price fluctuations and a higher risk profile. Tata Motors follows, with slightly less volatility than Tata Steel. In contrast, TCS and NSE display lower volatility, making them relatively stable investment options.

Minimum and Maximum Returns

NSE and TCS exhibit smaller negative extremes and modest maximum returns, suggesting greater resilience during adverse market conditions and a lower risk profile. Conversely, Tata Motors and Tata Steel display steep lows and highs, reflecting the unpredictable nature of these stocks.
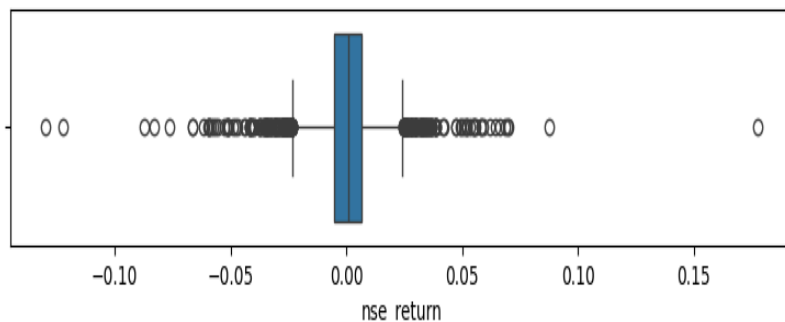
Quartile Analysis

The 25th percentile across all stocks indicates slight negative returns, showing that in a quarter of instances, returns were negative. The 50th percentile (median) is positive for NSE and TCS, demonstrating better performance overall compared to Tata Motors and Tata Steel, where the medians are close to zero. The 75th percentile reveals solid positive returns for all stocks, with TCS leading slightly among them.
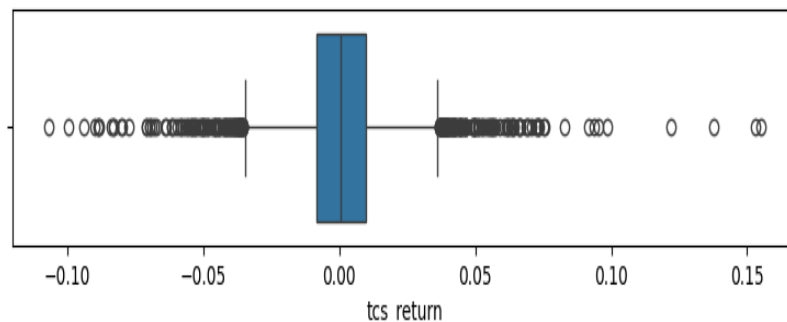
Overall Insights

- TCS: Offers the best balance of high average returns and low volatility, making it a favorable choice for long-term investors seeking growth with stability.
- Tata Steel and Tata Motors: Provide higher potential gains but come with increased risk due to higher volatility and occasional significant losses.
- NSE: Reflects stable, moderate growth with the lowest volatility, ideal for conservative investors looking for steady market-linked returns.
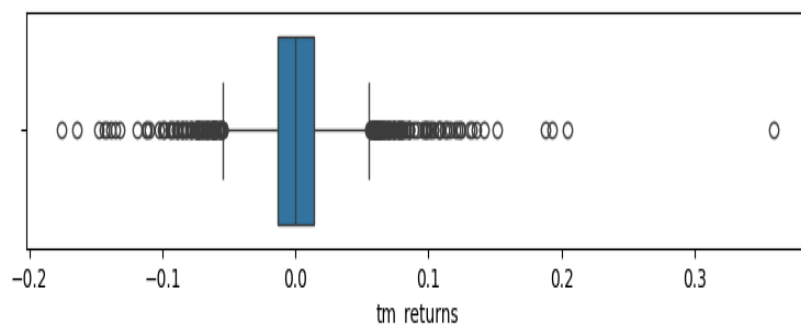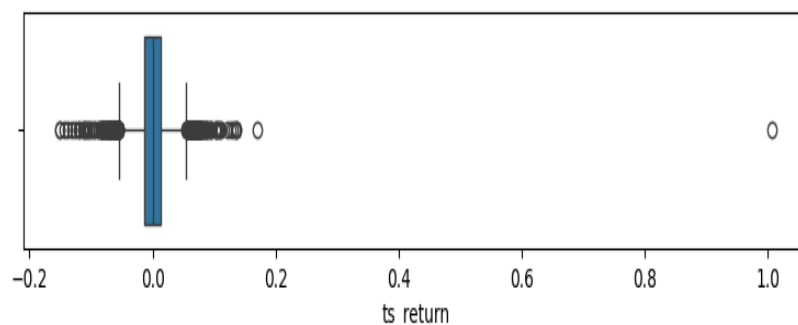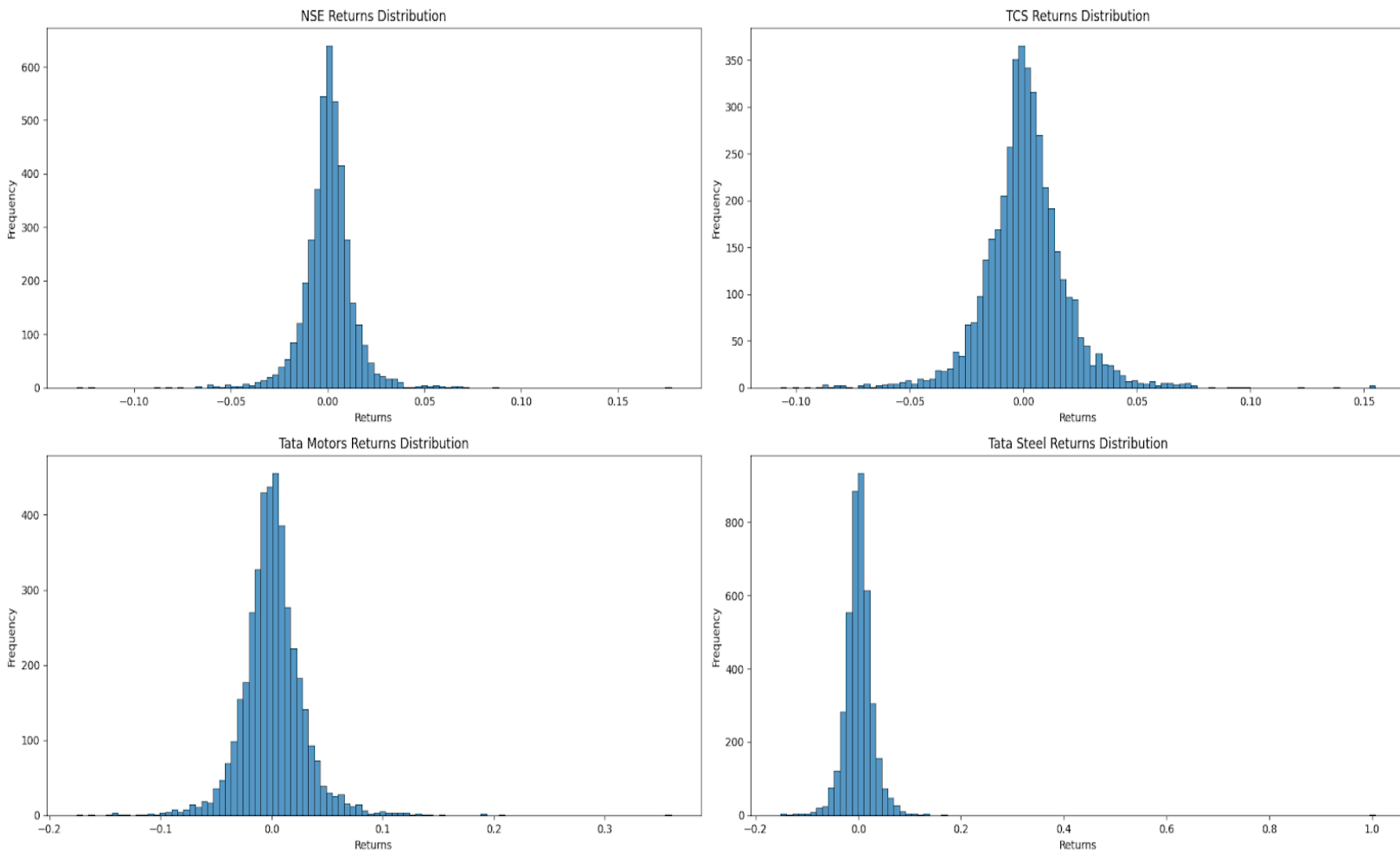
Box Plot Visualization

Return Distribution Visualization (bins = 100)

Beta Analysis

Beta is a statistical measure used to evaluate a stock's volatility relative to the broader market. It provides insights into how a stock's price is expected to react to market fluctuations. A beta of 1.0 signifies that the stock moves in tandem with the market, reflecting average volatility. Stocks with a beta greater than 1.0 exhibit higher volatility, implying greater potential for returns or losses compared to the market. Conversely, a beta below 1.0 indicates lower volatility, suggesting reduced sensitivity to market movements and generally more stable performance.

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Beta analysis: TCS vs Market
Beta: 0.76 [Green: Stock is less volatile than the market]
Beta analysis: Tata Motors vs Market
Beta: 1.29 [Red: Stock is more volatile than the market]
Beta analysis: Tata Steel vs Market
Beta: 1.32 [Red: Stock is more volatile than the market]
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Insights

1. TCS vs Market: With a beta of 0.76, TCS demonstrates lower volatility than the market, making it a relatively stable stock. Its price movements are less dramatic, providing steady returns and lower risk for investors.
2. Tata Motors vs Market: A beta of 1.29 indicates that Tata Motors is more volatile than the market. Its significant price fluctuations suggest higher potential returns but come with increased risk.
3. Tata Steel vs Market: With a beta of 1.32, Tata Steel exhibits even higher volatility. This elevated beta reflects substantial price swings, highlighting its riskier nature as an investment.

TCS stands out as a safer option for investors seeking stability and consistent returns. Conversely, Tata Motors and Tata Steel attract investors willing to embrace greater risks in pursuit of higher rewards.

Final Conclusion

The analysis of NSE, TCS, Tata Motors, and Tata Steel stocks over the years reveals a comprehensive understanding of their performance, volatility, and investment potential:

1. **NSE**: Representing the broader market, NSE shows steady growth with moderate returns and low volatility. It offers a reliable investment option for those seeking long-term stability aligned with economic trends.
2. **TCS**: Emerging as the strongest growth stock, TCS delivers the highest returns with relatively low volatility. Its stability and consistent performance make it an attractive choice for investors seeking lower-risk, high-growth opportunities.
3. **Tata Motors**: Exhibiting high volatility and substantial price fluctuations, Tata Motors carries a higher risk profile. It appeals to investors who are prepared to handle greater risk in exchange for the potential of higher returns.
4. **Tata Steel**: The most volatile among the analyzed stocks, Tata Steel has shown significant price fluctuations, indicating higher risk. Despite delivering the highest ROI, its unstable performance and unpredictability make it suitable for risk-tolerant investors.

TCS stands out as a reliable and consistent growth stock, ideal for investors seeking steady returns with minimal risk. NSE provides stable, market-aligned growth, while Tata Motors and Tata Steel offer high-risk, high-reward opportunities, suitable for those with a greater appetite for risk. Investors should align their choices with their risk tolerance and investment goals.

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