

# Analyze Stock Performance

A Data-Driven Approach to Market Risk Analysis

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## Executive Summary

This report analyzes the stock returns and volatility of 10 Indian stocks over a 6-year period, aiming to assess market risk and identify suitable investment opportunities. Based on the analysis, recommendations are provided to balance risk and return for long-term investors.

- **Top Performers:** Shree Cement and Infosys showed high returns with low volatility, ideal for long-term investments.
- **Moderate Performers:** Axis Bank and Indian Hotel offer balanced risk-return profiles for moderate-risk investors.
- **Underperforming Stocks:** Mahindra & Mahindra and Sun Pharma had negative returns with moderate risk, requiring cautious monitoring.
- **High-Risk Stocks:** Jet Airways, Idea Vodafone, and Jindal Steel had high volatility and negative returns, unsuitable for risk-averse investors.
- **Logarithmic Returns:** The logarithmic scale analysis provided accurate insights into compounded stock performance over time.
- **Business Recommendations:** Focus on stable, high-return stocks, avoid high-risk low-return stocks, and maintain diversification for risk mitigation.

## Problem Statement

The project aims to analyze the stock price movements of 10 Indian stocks over a 6-year period to calculate average returns and volatility, using logarithmic returns. The goal is to identify high-return, low-risk stocks while providing insights into overall market risk for informed investment decisions.

### Objectives:

- Calculate and analyze **average returns** and **volatility** for each stock.
- **Visualize** stock price trends and stock returns using scatter plots.
- Compare stock performance to identify **high-return and low-risk** stocks.
- Use **logarithmic returns** for accurate long-term stock performance analysis.
- Provide **business recommendations** for investors based on risk-return trade-offs.

## Solution Approach

The solution involves analyzing historical stock price data using statistical and financial techniques to calculate average returns and volatility. The analysis is performed on 10 Indian stocks over a 6-year period, using logarithmic returns to assess long-term stock performance. This approach helps identify high-return, low-risk stocks and provides actionable business recommendations.

## Approach Breakdown:

- **Data Preprocessing:** Stock price data was cleaned and converted to weekly logarithmic returns to ensure accurate long-term analysis.
- **Stock Returns Calculation:** Both percentage and logarithmic returns were calculated to compare performance over time.
- **Volatility Analysis:** Standard deviation of stock returns was computed to evaluate the risk (volatility) for each stock.
- **Scatter Plot Visualization:** A scatter plot of average returns vs. volatility was created to identify patterns and classify stocks based on their risk-return profile.
- **Segregation of Stocks:** Stocks were classified into high-return, moderate-return, and high-risk categories based on the calculated metrics.
- **Conclusions & Recommendations:** Based on the analysis, recommendations were provided for investors to focus on low-risk, high-return stocks while avoiding volatile, low-performing stocks.

## Data Overview

The dataset contains weekly stock prices for 10 Indian companies over a 6-year period. It includes key variables such as stock prices and dates, with the goal of calculating returns and assessing risk through volatility. Data preprocessing steps were essential for accurate analysis.

## Observations:

- **Data Shape:** The dataset contains 314 rows and 11 columns, 10 stock price column, 1 date column.
- **Date Column:** The date column was converted to datetime format.
- **Summary Statistics:** Mean, standard deviation, minimum, and maximum values were calculated for each stock to analyze trends and volatility.
- **Duplicate Checks:** No duplicate rows were found in the dataset, ensuring unique weekly stock prices.
- **Missing Value Checks:** No missing values were detected, confirming that the dataset is complete and ready for analysis.
- **Date Range:** The data spans from March 2014 to March 2020, providing sufficient historical context for long-term analysis.

Table 1: Top 5 Rows

	Date	Infosys	Indian Hotel	Mahindra & Mahindra	Axis Bank	SAIL	Shree Cement	Sun Pharma	Jindal Steel	Idea Vodafone	Jet Airways
0	31-03-2014	264	69	455	263	68	5543	555	298	83	278
1	07-04-2014	257	68	458	276	70	5728	610	279	84	303
2	14-04-2014	254	68	454	270	68	5649	607	279	83	280
3	21-04-2014	253	68	488	283	68	5692	604	274	83	282
4	28-04-2014	256	65	482	282	63	5582	611	238	79	243

**Table 2: Dataset Information**

```

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 314 entries, 0 to 313
Data columns (total 11 columns):
#   Column                Non-Null Count  Dtype
---  -
0   Date                  314 non-null   object
1   Infosys               314 non-null   int64
2   Indian_Hotel          314 non-null   int64
3   Mahindra_Mahindra     314 non-null   int64
4   Axis_Bank             314 non-null   int64
5   SAIL                  314 non-null   int64
6   Shree_Cement          314 non-null   int64
7   Sun_Pharma            314 non-null   int64
8   Jindal_Steel          314 non-null   int64
9   Idea_Vodafone         314 non-null   int64
10  Jet_Airways           314 non-null   int64
dtypes: int64(10), object(1)
memory usage: 27.1+ KB

```

## Data Statistics Numerical and DateTime

- **Stock Price Ranges:** **Shree Cement** has the highest price range (up to 24,806), while **SAIL** and **Indian Hotel** show lower volatility with smaller price ranges.
- **Volatility:** **Idea Vodafone** and **Jet Airways** are highly volatile, as seen from their high standard deviations, whereas **SAIL** and **Indian Hotel** are more stable.
- **Outlier:** **Shree Cement** stands out with a significantly higher mean price (14,806), indicating it's priced far above other stocks with notable fluctuations.
- **Periodicity:** The stock prices are recorded on a weekly basis.
- **Data Span:** The dataset covers stock prices from March 2014 to March 2020, providing a 6-year timeframe for analysis.

**Table 3: Statistics for Numerical Values**

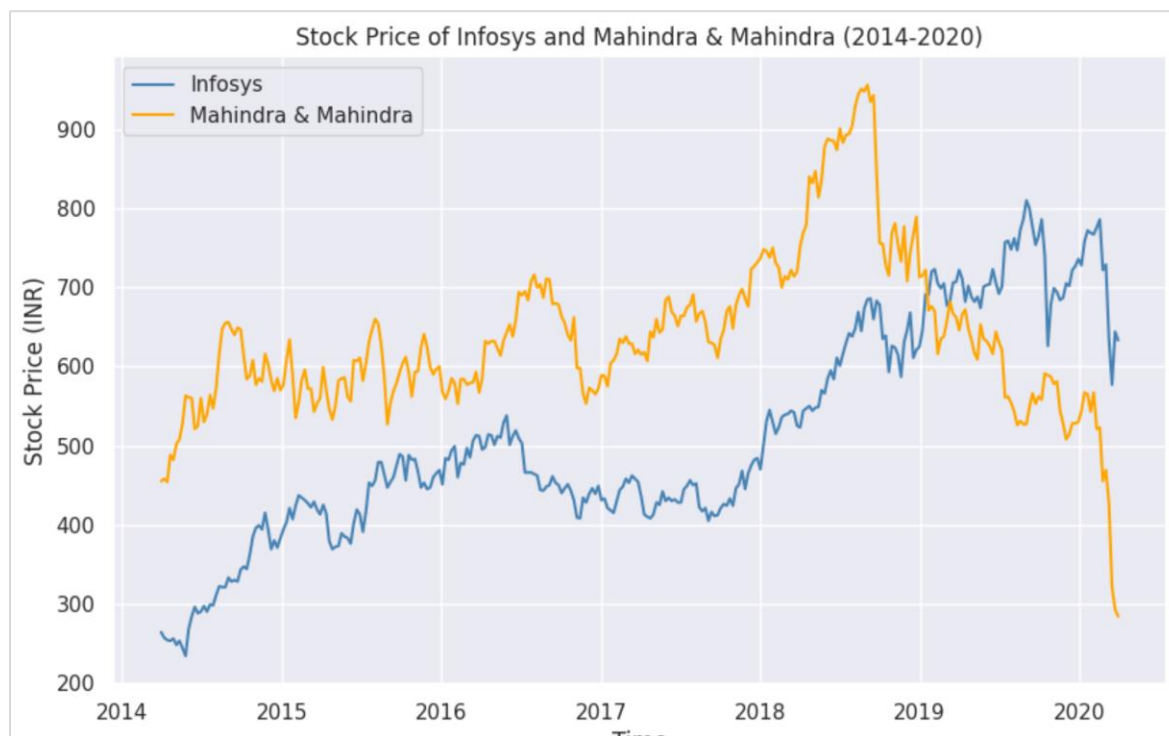
	count	mean	std	min	25%	50%	75%	max
<b>Infosys</b>	314.0	511.340764	135.952051	234.0	424.00	466.5	630.75	810.0
<b>Indian_Hotel</b>	314.0	114.560510	22.509732	64.0	96.00	115.0	134.00	157.0
<b>Mahindra_Mahindra</b>	314.0	636.678344	102.879975	284.0	572.00	625.0	678.00	956.0
<b>Axis_Bank</b>	314.0	540.742038	115.835569	263.0	470.50	528.0	605.25	808.0
<b>SAIL</b>	314.0	59.095541	15.810493	21.0	47.00	57.0	71.75	104.0
<b>Shree_Cement</b>	314.0	14806.410828	4288.275085	5543.0	10952.25	16018.5	17773.25	24806.0
<b>Sun_Pharma</b>	314.0	633.468153	171.855893	338.0	478.50	614.0	785.00	1089.0
<b>Jindal_Steel</b>	314.0	147.627389	65.879195	53.0	88.25	142.5	182.75	338.0
<b>Idea_Vodafone</b>	314.0	53.713376	31.248985	3.0	25.25	53.0	82.00	117.0
<b>Jet_Airways</b>	314.0	372.659236	202.262668	14.0	243.25	376.0	534.00	871.0

# Exploratory Data Analysis

Exploratory Data Analysis (EDA) included plotting stock price graphs for two companies, showcasing trends over time, and scatter plots for all stocks, illustrating stock movements over the 6-year period.

## Q1: Stock Price Graph

**Figure 1: Stock Price Graph comparison for Infosys and Mahindra & Mahindra**



### Observations and Inferences:

The graph above shows the stock prices of Infosys and Mahindra & Mahindra over the 6-year period from 2014 to 2020.

#### Infosys:

- **Steady Growth:** The stock shows a consistent upward trend over the years, indicating steady long-term growth.
- **Moderate Volatility:** While there are occasional sharp movements, the overall price trajectory remains upward, suggesting Infosys is a relatively stable stock.
- **Resilience:** The stock seems to recover well from any dips, indicating resilience to market fluctuations, particularly post pandemic market corrections.

#### Mahindra & Mahindra:

- **Cyclical Movements:** The stock shows distinct cycles of growth and correction, reflecting sensitivity to market or sector-specific factors.
- **Higher Volatility:** The stock experiences more pronounced price swings compared to Infosys, suggesting higher risk for short-term investors.

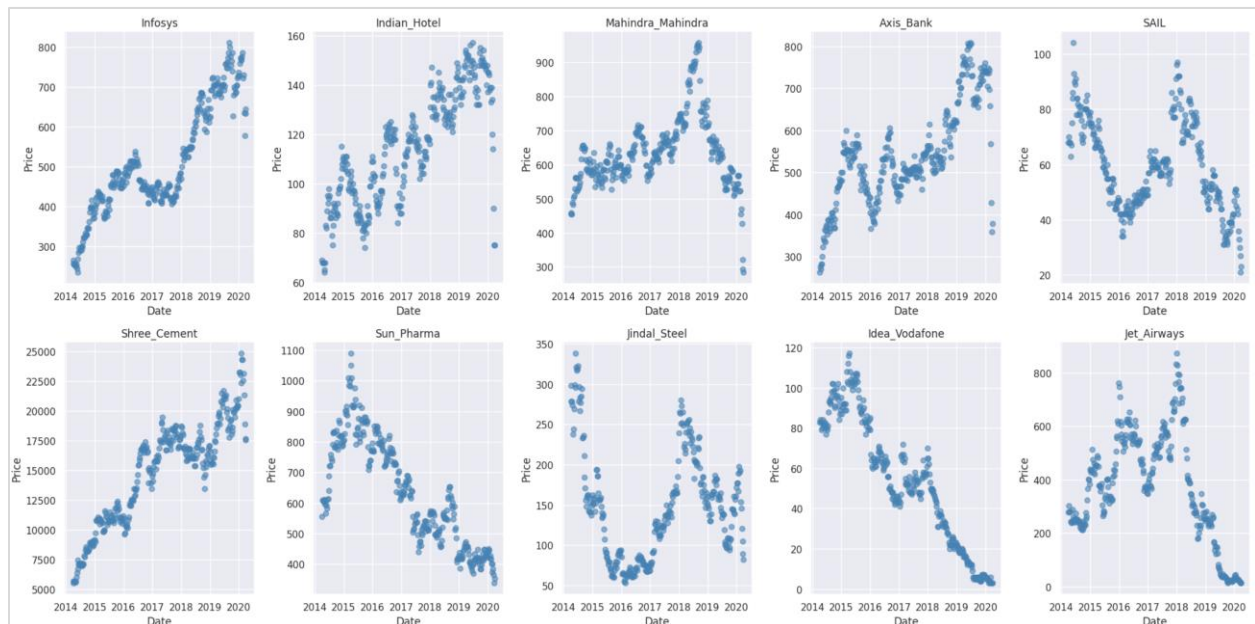
- **Long-term Stability:** Despite volatility, the overall price trend seems stable over the long term, making it a reasonable investment for those with a higher risk tolerance.

#### Final Takeaway:

- **Infosys** offers steady growth and moderate volatility, making it suitable for risk-averse, long-term investors.
- **Mahindra & Mahindra** is more volatile and cyclical, catering to investors willing to take on more risk for potentially higher returns.

## Stock Price Movement Over Time

Figure 2: Scatter Chart for Stock Price by Date



#### Observations:

The scatter plots above show the movement of stock prices for each stock over the time period from 2014 to 2020. Here are some quick observations:

- **Infosys:** There is a general upward trend with some periods of sharp fluctuations, indicating steady growth with some volatility.
- **Indian Hotel:** The stock shows more stability with smaller price fluctuations, reflecting gradual changes over time.
- **Mahindra & Mahindra:** The stock demonstrates periods of growth followed by corrections, suggesting cyclical performance with significant price shifts.
- **Axis Bank:** Similar to Mahindra, there are sharp upward and downward movements, reflecting volatility over time.
- **SAIL:** The stock price fluctuates within a narrow range, showing stability but with occasional large shifts towards the later periods.
- **Shree Cement:** The stock shows consistent growth, with a steep upward trend and higher volatility in the later years.



- **Sun Pharma:** The stock fluctuates significantly, with noticeable drops and recoveries, indicating high volatility.
- **Jindal Steel:** The stock shows large fluctuations, with sharp peaks and troughs, reflecting significant volatility.
- **Idea Vodafone:** The stock experiences a steady decline, especially in the later years, showing a downward trend.
- **Jet Airways:** The stock exhibits a sharp fall towards the later period, likely due to business troubles, indicating a dramatic decline.

These plots help in visualizing the volatility and trends for each stock over the period, giving insights into their performance patterns.

## Q2: Analyzing Return on Stocks

The analysis of stock returns using logarithmic scale highlights continuous compounding effects, offering accurate long-term performance insights. **Shree Cement** and **Infosys** demonstrated strong growth, while **Jet Airways** and **Idea Vodafone** exhibited poor performance and high volatility, indicating greater investment risk.

**Table 4: Top 5 Rows Stocks Returns Dataset**

	Infosys	Indian_Hotel	Mahindra_Mahindra	Axis_Bank	SAIL	Shree_Cement	Sun_Pharma	Jindal_Steel	Idea_Vodafone	Jet_Airways
0	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1	-0.026873	-0.014599	0.006572	0.048247	0.028988	0.032831	0.094491	-0.065882	0.011976	0.086112
2	-0.011742	0.000000	-0.008772	-0.021979	-0.028988	-0.013888	-0.004930	0.000000	-0.011976	-0.078943
3	-0.003945	0.000000	0.072218	0.047025	0.000000	0.007583	-0.004955	-0.018084	0.000000	0.007117
4	0.011788	-0.045120	-0.012371	-0.003540	-0.076373	-0.019515	0.011523	-0.140857	-0.049393	-0.148846

### Observations:

- **Logarithmic Returns Stability:** Logarithmic returns provide a clearer representation of continuous compounding, offering a more accurate measure of return over time, particularly useful for long-term stock analysis.
- **Infosys and Shree Cement:** These stocks show **positive average log returns**, indicating consistent growth. Infosys has moderate but steady growth, while Shree Cement shows higher growth, consistent with its significant price increase.
- **Volatile Stocks:** Stocks like **Jet Airways** and **Idea Vodafone** show relatively lower or negative average log returns, reflecting poor long-term performance and significant volatility. This is in line with their observed price declines over the time period.
- **Riskier Stocks:** Stocks with higher volatility, such as **Jindal Steel** and **SAIL**, demonstrate fluctuating returns, indicating that these stocks are riskier investments over time, with periods of both high gains and losses.

- **Axis Bank and Sun Pharma:** Both stocks show moderate average log returns, indicating balanced growth with some volatility. This suggests they may provide reasonable long-term returns for investors with a moderate risk tolerance.
- **Compounding Effects:** The log return method effectively captures the compounding effects, making it useful in comparing returns over extended periods. Stocks with more frequent fluctuations (like Idea Vodafone) show lower compounded returns.

#### Final Takeaway:

Logarithmic returns indicate that **Shree Cement** and **Infosys** are strong performers over the long term, while stocks like **Jet Airways** and **Idea Vodafone** exhibit negative returns, signaling poor performance and higher risk.

## Q3: Means and Standard Deviations of Stocks Returns

The means and standard deviation of stock returns were calculated to evaluate each stock's average performance and volatility. This helps assess risk and identify stocks with stable returns versus those with higher fluctuations, guiding informed investment decisions.

**Table 5: Average Returns (Means) and Volatility (Standard Deviation) of Stocks**

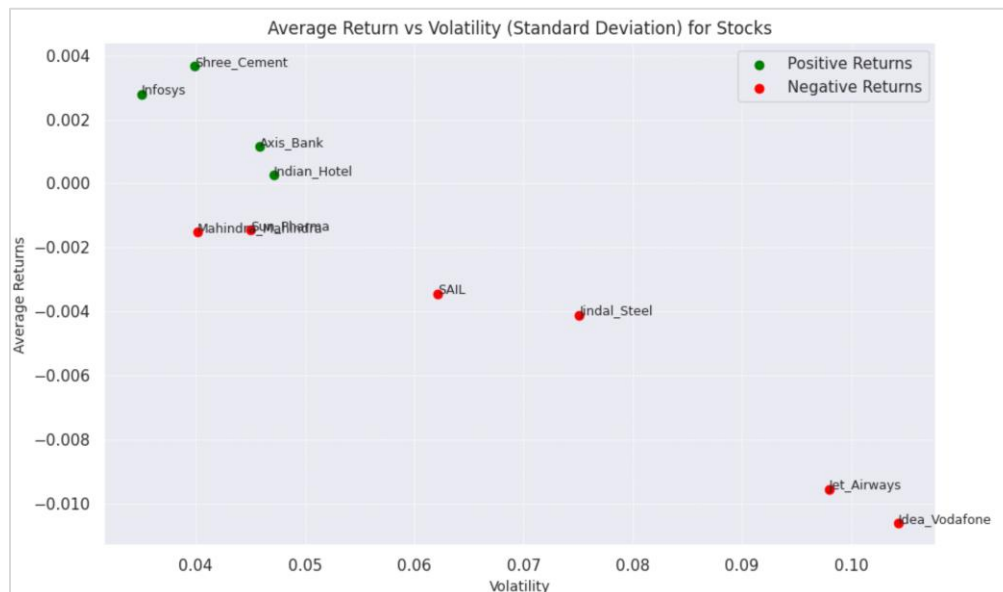
	Average_Returns	Volatility
Infosys	0.002794	0.035070
Shree_Cement	0.003681	0.039917
Mahindra_Mahindra	-0.001506	0.040169
Sun_Pharma	-0.001455	0.045033
Axis_Bank	0.001167	0.045828
Indian_Hotel	0.000266	0.047131
SAIL	-0.003463	0.062188
Jindal_Steel	-0.004123	0.075108
Jet_Airways	-0.009548	0.097972
Idea_Vodafone	-0.010608	0.104315

#### Observations:

- **Shree Cement** and **Infosys** have positive means and relatively low standard deviations, indicating consistent growth with lower volatility.
- **Mahindra & Mahindra** and **Sun Pharma** show negative means with moderate standard deviations, suggesting underperformance with moderate risk.
- **Jet Airways** and **Idea Vodafone** have negative means and high standard deviations, reflecting poor performance and high volatility, making them riskier investments.
- **SAIL** and **Jindal Steel** have negative returns but high standard deviations, signaling high-risk stocks with uncertain returns.
- **Axis Bank** and **Indian Hotel** show balanced means and moderate standard deviations, suggesting stable, moderate-risk investments with potential for reasonable returns.

## Q4: Plot for Stock Means vs Standard Deviation

Figure 3: Average Returns vs Volatility



### Observations:

- Stocks with higher **volatility** (e.g., **Idea Vodafone**, **Jet Airways**) tend to have lower or negative returns, highlighting their risky nature.
- **Shree Cement** and **Infosys** are positioned with higher means and lower volatility, making them attractive for long-term, risk-averse investors.
- The plot shows a clear distinction between low-risk, stable stocks (e.g., **Infosys**) and high-risk, volatile stocks (e.g., **Jindal Steel**).
- Moderate-risk stocks like **Axis Bank** occupy middle ground, offering a balanced risk-return profile suitable for investors with moderate risk tolerance.

### Final Takeaway:

- **Low-risk, high-return** investments are **Shree Cement** and **Infosys**, while **Jet Airways** and **Idea Vodafone** exhibit **high-risk, poor returns**.
- The **risk-return trade-off** is clearly demonstrated, where higher volatility typically correlates with lower or negative returns in this dataset, suggesting investors should carefully consider both factors before making decisions.

## Q5: Conclusion and Recommendations:

The conclusion highlights that **Shree Cement** and **Infosys** are top-performing, low-volatility stocks, ideal for long-term investments. Stocks like **Jet Airways** and **Idea Vodafone** exhibit high risk and poor returns. Recommendations focus on investing in stable, growth-oriented stocks while avoiding high-risk, underperforming ones.

## Conclusion

- **Top Performers:**
  - **Shree Cement** and **Infosys** show strong positive average returns (0.00368 and 0.00279, respectively) with relatively low volatility (0.0399 and 0.0350). These stocks have been consistent performers with moderate risk, aligning with the objective of finding stable, high-return investments.
- **Moderate Performers:**
  - **Axis Bank** and **Indian Hotel** show modest but positive average returns (0.00117 and 0.00027, respectively), with slightly higher volatility. These stocks offer a reasonable balance between risk and return, making them suitable for moderate-risk investors seeking steady growth.
- **Negative Returns, Moderate Risk:**
  - **Mahindra & Mahindra**, **Sun Pharma**, and **SAIL** have negative returns (-0.0015, -0.0014, -0.0035) despite having moderate volatility. This suggests these stocks have underperformed over the period, but the risk is relatively low compared to more volatile stocks.
- **High-Risk, Low-Performing Stocks:**
  - **Jindal Steel**, **Jet Airways**, and **Idea Vodafone** show significantly negative returns, with very high volatility, indicating these stocks are high-risk with poor performance. **Idea Vodafone** (-0.0106) and **Jet Airways** (-0.0095) have the highest volatility (0.1043 and 0.0979), and their negative returns make them unattractive for risk-averse investors.
- **Volatility and Risk:**
  - Stocks with the highest volatility, like **Idea Vodafone** and **Jet Airways**, experienced both the highest price swings and the worst performance in terms of average returns. High volatility has not translated into higher returns, emphasizing the importance of balancing risk with expected rewards.
- **Logarithmic Returns Insight:**
  - The use of logarithmic returns provides a clearer view of the compounded growth and volatility over time. This method is particularly helpful in understanding the performance of long-term investments, reinforcing that **Infosys** and **Shree Cement** have been the most stable growth-oriented stocks in the long run.
- **Low Volatility, Positive Returns:**
  - The stocks with the lowest volatility, such as **Infosys** and **Shree Cement**, have also generated the highest positive returns, highlighting the attractiveness of these stocks for long-term, risk-averse investors.
- **Impact of Market Conditions:**
  - Negative returns for **Mahindra & Mahindra**, **Sun Pharma**, and **SAIL** suggest that market conditions during the analysis period may have affected certain sectors negatively. These stocks could still offer potential upside in future periods depending on sector recovery.

## Business Recommendations

- **Focus on Stable, High-Performing Stocks:**
  - **Shree Cement** and **Infosys** are the top recommendations due to their strong average returns and relatively low volatility. These stocks are well-suited for long-term investors seeking stability with moderate growth potential.
- **Avoid High-Risk, Low-Return Stocks:**
  - Stocks like **Idea Vodafone**, **Jet Airways**, and **Jindal Steel** should be avoided by risk-averse investors. Their high volatility coupled with negative returns indicates poor performance and increased risk, which may not align with the objective of reducing market risk exposure.
- **Monitor Moderate Performers:**
  - **Axis Bank** and **Indian Hotel** present a balanced risk-return profile and may offer reasonable investment opportunities for those seeking moderate growth. While their returns are lower than **Shree Cement** and **Infosys**, they provide a stable growth trajectory.
- **Sector Diversification:**
  - The underperformance of stocks like **Sun Pharma** and **Mahindra & Mahindra** suggests that some sectors may face short-term challenges. However, diversification across different sectors can help mitigate such risks in the future.
- **Periodic Risk Reassessment:**
  - Regular reassessment of stock performance and market conditions is essential to ensure that selected stocks align with the risk-return profile of the investor. The use of logarithmic returns can help capture the compounding effects of both gains and losses over time.
- **Risk Mitigation:**
  - For conservative investors, focus on low-volatility stocks that still offer positive returns. Avoid high-volatility, negative-return stocks unless there is a specific turnaround strategy in play.
- **Strategic Exit Points:**
  - For stocks with negative returns but moderate volatility, such as **Mahindra & Mahindra** and **Sun Pharma**, investors should evaluate potential exit points unless these companies show clear signs of recovery.
- **Continuous Monitoring for Recovery:**
  - Keep a close watch on stocks like **Mahindra & Mahindra** and **Sun Pharma** for signs of recovery, as they have moderate volatility and may present buying opportunities if the market conditions improve.