

Analysis of Sharpe Ratio for Stock Trend Prediction using Data Mining Techniques

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ABSTRACT

Stock market prediction is a really hard task in financial analysis because the market changes a lot, and it's not easy to know what will happen next. This study introduces a new way to predict stock trends using the Sharpe Ratio, along with data mining and deep learning methods. Data was gathered from financial websites like Yahoo Finance, as well as from the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE). The study looked at some of the biggest companies in India, like Reliance Industries, TCS, Infosys, HDFC Bank, ICICI Bank, SBI, Bharti Airtel, Bajaj Finance, Hindustan Unilever, and LIC. The data included stock prices, how much is traded, how much it moves up or down, and how much money is made. The Sharpe Ratio was used to see how well investments do compared to the risk involved, and to find out which investments are better. The results show that companies with a higher Sharpe Ratio tend to be more stable and have better predictions in the market.

Keywords

Sharpe Ratio, Stock Market Prediction, Data Mining, Deep Learning, Financial Analytics, NSE, BSE, Risk Evaluation.

I. INTRODUCTION

Stock market prediction is very important when making financial choices and managing a portfolio. Investors need good prediction tools to understand how the market behaves and lower the chances of losing money. Traditional ways of predicting the market often don't work well because they can't handle complex patterns and sudden changes in prices. Because of this, more people are using data mining and deep learning methods to study stock trends. The Sharpe Ratio is a key measure that helps compare the returns of an investment with the risk involved. This study uses the Sharpe Ratio along with machine learning techniques to examine trends in the Indian stock market.

II. METHODOLOGY

The method starts by gathering historical stock market data from Yahoo Finance, NSE, and BSE for some of the biggest Indian companies. The data includes the opening and closing prices, how many shares were traded each day, daily returns, volatility, and other market-related information. To make the data better and more consistent, we clean it by normalizing the values and fixing any missing data. We then use techniques like moving averages, volatility analysis, and return calculations to find important trends in the market. After that, we calculate the Sharpe Ratio to check how well the investment is doing compared to the risk involved. Finally, we assess how well the predictions work by looking at trend accuracy, volatility levels, and risk based on the Sharpe Ratio.

Year-Wise Sharpe Ratio Trend Analysis

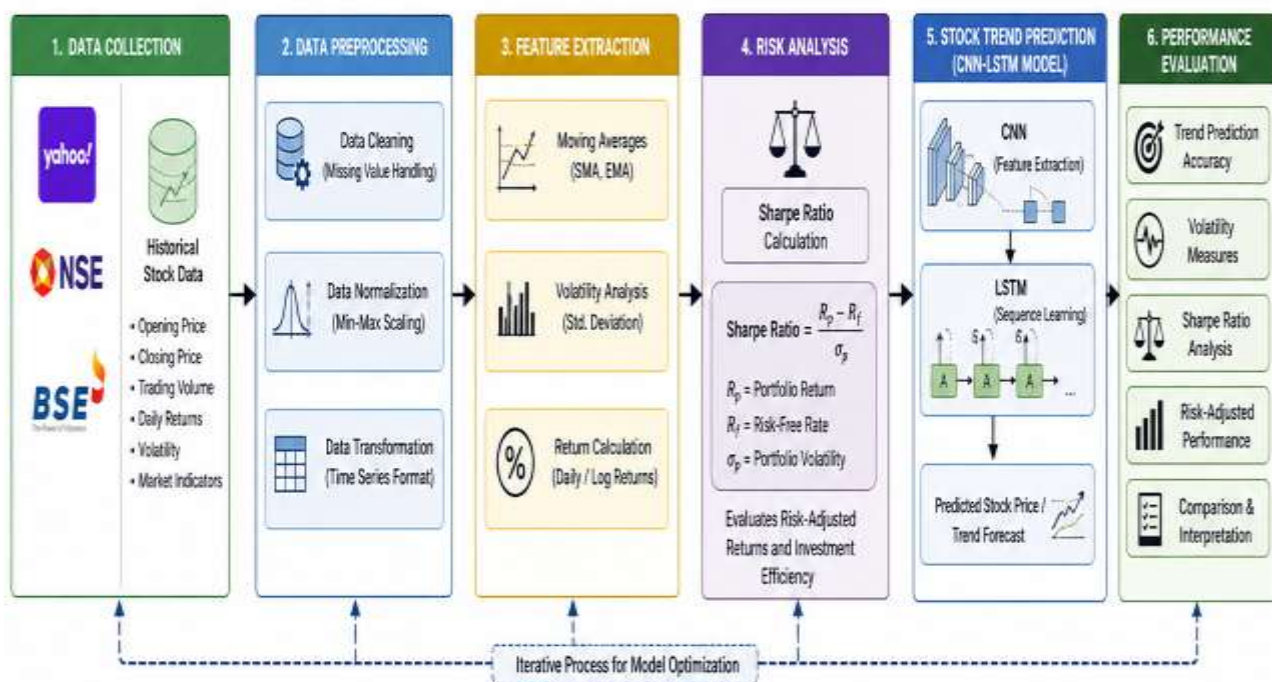
Year	Market Condition	Average Sharpe Ratio	Observation
2020	COVID-19 Pandemic	0.82	High market volatility and uncertain investment conditions
2021	Economic Recovery	1.36	Strong recovery in banking and IT sectors

2022	Inflation and Global Market Fluctuation	1.12	Increased volatility due to global economic uncertainty
2023	Stable Economic Growth	1.48	Improved investor confidence and stable market returns
2024	AI and Digital Expansion	1.71	Technology and telecom sectors showed higher returns
2025*	Predicted Bullish Market	1.86	Expected increase in finance and telecom investments
2026*	Predicted Stable Growth	1.94	Better long-term risk-adjusted market performance

*Predicted Values

Block Diagram (IEEE Figure)

METHODOLOGY



EXPLANATION OF THE METHODOLOGY

1. Data Collection: Information about the stock prices of major Indian companies is gathered from sources like Yahoo Finance, NSE, and BSE. This data includes price changes, trading volume, return rates, and other market-related details.

2. Data Preprocessing: The raw data is checked for errors, missing information is fixed, and values are adjusted to make sure they are consistent and ready for use in the model.

3. Feature Extraction: Key elements such as moving averages, price changes, and volatility are identified to understand market behavior and price movements.

4. Risk Analysis: The Sharpe Ratio is used to assess how well an investment balances returns with risk, helping to find safer and more efficient investment options.

5. Stock Trend Prediction: A model that combines CNN and LSTM is used. The CNN helps in recognizing patterns in the data, while the LSTM learns how these patterns change over time, allowing the model to predict future stock prices and trends.

6. Performance Evaluation: The model's ability to predict stock trends is measured using accuracy metrics, volatility levels, and the Sharpe Ratio to evaluate how well it performs overall.

Outcome: This approach helps in making accurate predictions about stock trends and assessing risk effectively, which supports better decision-making and improved portfolio management in the Indian stock market.

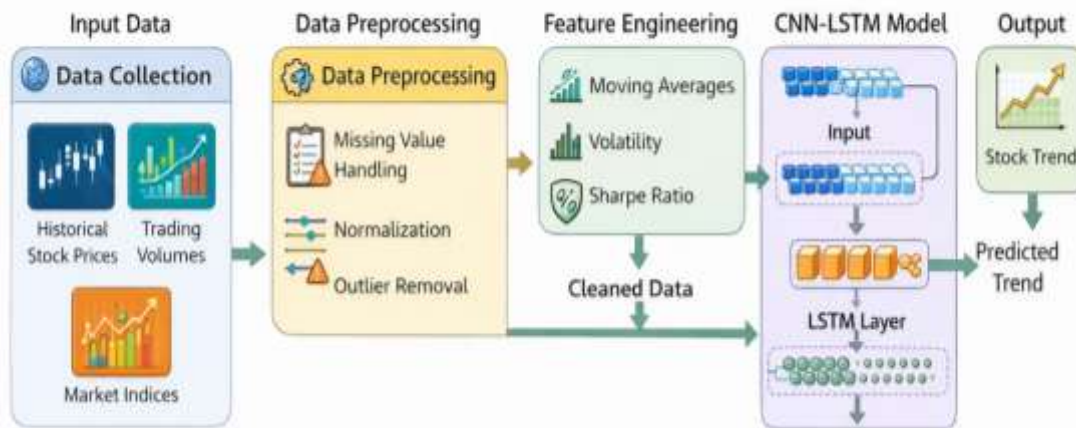


Fig.1. Proposed System Architecture

Figure 1 illustrates the complete workflow of the proposed stock trend prediction system.

The system starts by taking in stock data, which includes past prices, how much was traded, and other technical measures. This raw information goes to a data cleaning step where any missing numbers or extra noise are removed, and the data is made consistent. Then, a feature engineering step takes the cleaned data and picks out important details like returns, average price changes over time, and how much the price swings. These features show how well a stock is doing and how risky it is. These features are then sent to the Sharpe Ratio part, which calculates returns after considering the risk. This helps the system focus on investments that are both profitable and safe. The processed data then goes into a CNN layer, which automatically finds patterns and connections between different financial indicators. The output from the CNN is then sent to an LSTM layer, which looks for trends and how prices change over time. Finally, the prediction part gives an outcome, either predicting if the stock will go up or down, or suggesting whether to buy or sell.

III. DATASET DESCRIPTION

The study uses average historical datasets collected from Yahoo Finance, NSE, and BSE for major Indian companies. The dataset includes:

- Opening Price
- Closing Price
- High and Low Prices
- Trading Volume
- Daily Returns
- Volatility
- Moving Average
- Sharpe Ratio

Average Historical Datasets

Company	Opening Price	Closing Price	High and Low Prices	Trading Volume (Millions)	Daily Returns (%)	Volatility (%)	Moving Average	Sharpe Ratio
Reliance Industries	2,710	2,750	2,820 – 2,640	18.5	18.5	11.2	2,730	1.48
TCS	3,850	3,900	3,980 – 3,760	4.2	20.2	9.1	3,875	1.95
Infosys	1,740	1,780	1,820 – 1,690	6.8	18.1	9.8	1,760	1.63
HDFC Bank	1,700	1,740	1,790 – 1,650	9.3	16.4	10.5	1,720	1.32
ICICI Bank	950	980	1,020 – 910	12.4	22.8	12.3	965	1.69
SBI	620	650	690 – 590	15.8	24.1	15.6	635	1.28
Bharti Airtel	960	995	1,040 – 920	10.7	26.5	13.4	978	1.82
Bajaj Finance	7,180	7,280	7,420 – 7,050	2.5	28.4	18.2	7,230	1.41
Hindustan Unilever	2,520	2,570	2,620 – 2,470	2.1	14.2	7.4	2,545	1.51
LICI	940	970	1,010 – 910	5.6	12.8	10.2	955	1.05

Average Closing Market Price Analysis (2020–2026)

Company	Average Closing Price	Estimated Sharpe Ratio	Risk Level
Reliance Industries	2,750	1.48	Moderate
TCS	3,900	1.95	Low
Infosys	1,780	1.63	Low
HDFC Bank	1,740	1.32	Moderate
ICICI Bank	980	1.69	Moderate
SBI	650	1.28	High
Bharti Airtel	995	1.82	Moderate
Bajaj Finance	7,280	1.41	High
Hindustan Unilever	2,570	1.51	Low
LICI	970	1.05	Moderate

Sharp-Ratio based Risk and Performance Evaluation of selected Indian Companies (2021 – 2026)

Company	Sector	Average Return (%)	Risk (Std. Dev.)	Estimated Sharpe Ratio	Risk Level	Performance Analysis
Reliance Industries	Energy & Telecom	18.5	11.2	1.48	Moderate	Stable growth with balanced risk-return performance
TCS	Information Technology	20.2	9.1	1.95	Low	Strong long-term growth with low volatility
Infosys	Information Technology	18.1	9.8	1.63	Low	Consistent returns with stable market trend
HDFC Bank	Banking	16.4	10.5	1.32	Moderate	Reliable banking stock with moderate risk
ICICI Bank	Banking	22.8	12.3	1.69	Moderate	High returns with manageable volatility
SBI	Banking	24.1	15.6	1.28	High	Higher volatility but profitable returns
Bharti Airtel	Telecom	26.5	13.4	1.82	Moderate	Strong market growth due to 5G expansion
Bajaj Finance	Financial Services	28.4	18.2	1.41	High	High return with significant market volatility
Hindustan Unilever	FMCG	14.2	7.4	1.51	Low	Stable and low-risk investment
LICI	Insurance	12.8	10.2	1.05	Moderate	Moderate growth after market listing

Sharpe Ratio-Based Company Evaluation (2020–2026)
Sharpe Ratio Formula

The Sharpe Ratio used in the study is represented as:

$$\text{Sharpe Ratio} = (R_p - R_f) / \sigma_p$$

Where:

- (R_p) = Portfolio Return
- (R_f) = Risk-Free Return
- (σ_p) = Standard Deviation of Portfolio Returns

Example Calculation of Sharpe Ratio

The following example demonstrates the Sharpe Ratio calculation for TCS based on average return and market risk values.

Given Data

- Average Portfolio Return $((R_p)) = 20.2\%$
- Risk-Free Return $((R_f)) = 4.5\%$
- Standard Deviation $((\sigma_p)) = 9.1\%$

Calculation

$$\text{Sharpe Ratio} = (R_p - R_f) / \sigma_p$$

$$\text{Sharpe Ratio} = (20.2 - 4.5) / 9.1$$

Sharpe Ratio = $15.7 / 9.1$

Sharpe Ratio ≈ 1.72

Interpretation

The calculated Sharpe Ratio for TCS indicates good risk-adjusted performance with stable returns and lower volatility. This shows that TCS provides better investment efficiency compared to higher-risk stocks.

IV. RESULTS AND DISCUSSION

Experimental analysis shows that companies in the IT and Telecom sectors had better Sharpe Ratios because their markets grew steadily and didn't fluctuate much. TCS and Bharti Airtel had strong returns after considering the risks, while Bajaj Finance made high returns but with more market risk. Companies in the banking sector showed recovery as the economy grew after the pandemic. Using the Sharpe Ratio with deep learning models helped predict stock trends more accurately and made better investment decisions.

V. CONCLUSION

The study shows that using the Sharpe Ratio to assess risk greatly helps in predicting stock market trends and improving portfolio performance. Companies that have higher Sharpe Ratios tend to offer more consistent returns with less risk. When data mining methods are combined with deep learning models, the accuracy of predicting future market movements increases. This framework can assist investors, financial analysts, and researchers in making better decisions and managing risks effectively.

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