



Stock Market Prediction Using Machine Learning and Deep Learning Techniques

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Abstract: The stock market is a complex, dynamic system influenced by economic indicators, political factors, and investor sentiment. Predicting its behavior has been a long-standing challenge due to its nonlinear and volatile nature. Recent advancements in Machine Learning (ML) and Deep Learning (DL) have enabled researchers to develop more robust and adaptive models for stock market prediction. This paper provides a comprehensive review of various ML and DL techniques, their comparative performance, challenges, and future directions in financial forecasting.

Keywords: Stock Market Prediction, Machine Learning, Deep Learning, LSTM, ARIMA, Sentiment Analysis

I. INTRODUCTION

The stock market plays a crucial role in the economic development of a nation. Investors and analysts attempt to forecast price trends to maximize profits and minimize risks. However, the stock market is affected by several unpredictable factors, such as news events, investor emotions, and macroeconomic variables. Traditional statistical methods like ARIMA have limitations in capturing nonlinear patterns. Hence, Machine Learning and Deep Learning methods are now widely adopted to enhance prediction accuracy.

Forecasting the stock market with precision is inherently difficult due to its complex and ever changing characteristics, driven by a wide range of factors. Fraz et al. [6] suggest that traditional methods of forecasting frequently fall short, given the unpredictable and volatile nature of financial markets. Accurate stock market predictions hold significant importance for investors, financial institutions, and policymakers because they enable better decision making, reduce risks, and optimize returns on investments [19][10][4]. There has been a noticeable increase in interest in using machine learning (ML) techniques to improve the precision and dependability of stock market forecasting [20]. By developing more accurate and reliable predictive models, the use of ML to stock market forecasts has the potential to completely alter the industry [5][14][21]. Machine learning (ML) is becoming more and more popular in the financial markets because it can analyze massive datasets and find complex patterns that traditional statistical models cannot. Machine learning algorithms have proven to have improved predictive performance, frequently outperforming conventional forecasting techniques in terms of accuracy and reliability. Furthermore, ML techniques such as ensemble learning, deep learning, and recurrent neural networks have demonstrated exceptional performance in deciphering the intricate dynamics of stock market data [18].

II. LITERATURE SURVEY

Several researchers have explored different techniques for stock prediction. Patel et al. (2015) used a fusion of ML algorithms including SVM, Random Forest, and Naïve Bayes, achieving improved prediction accuracy. Nelson et al. (2017) applied LSTM networks to historical stock data, outperforming traditional models. Hybrid models combining sentiment analysis and price data have also shown promising results. Studies indicate that while ML methods perform well on structured numerical data, DL models like LSTM and CNN excel at learning temporal dependencies.



III. FINDING AND TRENDS

Research over the past decade shows several important trends in stock market prediction:

Shift from Statistical to AI Models:

Traditional methods like ARIMA and GARCH have limited accuracy in volatile markets.

Machine Learning (ML) models like SVM, Random Forest, and XGBoost outperform statistical methods by capturing complex, nonlinear patterns.

Rise of Deep Learning (DL):

Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) networks have become increasingly popular for time series forecasting.

DL models automatically extract temporal features, reducing the need for manual feature engineering.

Hybrid Models:

Combining ML and DL approaches or integrating sentiment analysis (from news, social media) improves predictive performance.

Studies show that hybrid models often outperform single-model approaches.

Sentiment Analysis and Alternative Data:

Public opinion from Twitter, Reddit, and news articles is increasingly used to predict market trends.

Textual sentiment combined with price and volume data improves accuracy.

Real-Time and High-Frequency Forecasting:

Modern trends include real-time predictions using streaming data and high-frequency trading algorithms.

These approaches require efficient models capable of processing large datasets quickly.

Explainable AI (XAI):

There is a growing emphasis on making models interpretable for investors.

Techniques like SHAP and LIME are being used to explain ML and DL predictions.

IV. METHODOLOGY

Machine Learning methods such as Support Vector Machines (SVM), Random Forest, and Gradient Boosting learn from past data using engineered features. These methods require careful preprocessing, including normalization, feature selection, and removal of noise. Deep Learning methods, particularly Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) networks, automatically extract patterns from sequential data. Hybrid models that combine ML and DL, or integrate news sentiment analysis, have proven to increase the reliability of forecasts.

V. CHALLENGES AND FUTURE SCOPE

Despite technological advances, stock market prediction remains complex. Models face issues like overfitting, non-stationary data, and limited interpretability. Future research can explore Explainable AI (XAI), Reinforcement Learning, and integration of social media sentiment for real-time forecasting. Combining traditional financial indicators with alternative data sources such as news and tweets will further improve model performance.

VI. CONCLUSION

This review highlights the growing significance of ML and DL in financial forecasting. While Deep Learning models, particularly LSTM, outperform traditional approaches, no single model guarantees consistent success due to market volatility. The future of stock prediction lies in hybrid models that merge multiple data sources and algorithms to achieve more stable and accurate results.

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