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TIMES SERIES TECHNIQUES TO PREDICT STOCK PRICES IN INDIA: WITH REFERENCE TO LSTM

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ABSTRACT

A dominant area of study in natural language processing analysing and machine learning is stock market prediction (SMP), where sentiment analysis techniques are utilized for predicting trends using models such as long short-term memory (LSTM). In this work, a modified LSTM model exceeds conventional to address the issue, recurrent neural networks (RNNs) of the vanishing gradient. One third was utilized to evaluate and seventy percent was applied for training using historical information on stock prices.

KEYWORDS: Stock Market Prediction(SMP), Long Short-Term Memory (LSTM), Recurrent Neural Networks (RNN), Sentiment analysis, Financial Forecasting

JEL CLLASIFICATION: G29, G1, G17, G11, G19

1. INTRODUCTION

Our everyday lives now revolve around the internet, which has an impact on a number of industries, including news outlets, social media, and e-commerce. It is difficult to organize and analyse this massive amount of data, though. At this point, Stock Market Prediction (SMP) becomes extremely useful since it provides information on investor sentiment and market trends, both of which are essential for making wise financial decisions **[1]**.Since a number of factors, such as news and investor sentiment, affect the financial market; SMP seeks to develop predictive models that will help investors make better choices **[2]**. Long Short-Term Memory (LSTM), a more sophisticated form of Recurrent Neural Networks (RNNs), is a well-liked deep learning method for SMP. Learning long-term dependencies in sequential data is a challenge for traditional RNNs due to the vanishing gradient problem. In order to solve this problem, LSTM employs a more intricate architecture that has a long retention time, which makes it ideal for time-series analysis and forecasting **[3]**. Sentiment analysis, stock price forecasting, and financial market prediction are just a few of the domains in which LSTM has demonstrated notable success.
Given that LSTM can analyse sequential data, it is especially useful for predicting stock market trends because it can identify both long-term patterns and short-term fluctuations. LSTM models can provide more precise forecasts by combining sentiment-driven features from news sources with historical stock data **[4]**. Through the analysis of sentiment-driven features and historical stock data, this study seeks to apply LSTM for stock market forecasting **[5]**..BEL is a leading Indian state-owned aerospace and defence company, known for its significant role in India's defence sector **[6]**. Understanding the dynamics of BEL's stock price requires consideration of both company-specific factors and the broader economic and political landscape affecting the Indian defence industry **[7]**.

2. REVIEW OF LITERATURE

Numerous examines experience endured performed on predicting the stock market with various neural network architectures, especially concentrating on LSTM because to its performance in handling sequential data. Several essential works are gathered as follows:

Duc Anh Nguyen and Xuan Vinh Tran(2022, ref-24) attempting to forecast stocks trends according to previous stock data and also on public opinion about news and social media, these researchers focused on integrating LSTM with sentiment analysis. Their research demonstrated that incorporating sentiment inputs to price data improved predictive performance and specified a deeper awareness of market movements. The usage of LSTM models with attention mechanisms over stock market prediction has been studied by Yanming Zhang and Ling Bai (2021, ref 25). They found that the model could focus on particular significant events in the time series by including attention that enhanced prediction accuracy, particularly for extremely volatile markets.

Zhe Zhang and YuehuiChen (2023, ref26)for

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financial forecasting, Chen and Zhang's research compared LSTM with a substitute RNN modifications, involving Gated Recurrent Units (GRUs). Given its greater ability to handle complicated stock data patterns with no lacking important data, their results demonstrated that LSTM succeeded more effectively across various kinds of stock datasets.A.Ghosh (2022, ref 27): Well-known for his research on LSTM's application in forecasting Indian stock markets of stock prices, Ghosh and his associates investigated the efficacy of Bi-LSTM and discovered that it frequently outperforms standard LSTM because it can process information both forward and backward, enhancing setting accumulation for price forecasting. Focused on prediction of stock price changes of Indian Market using LSTM — R. Comparing LSTM to other machine learning algorithms, it was demonstrated it due with the ability of long short-term memory networks (LSTMs) to discover time-dependent relationships in data automatically, LSTMs outperformed these models. M. R. Chatterjee and B. Choudhury (2019, ref-20): The renowned authors who become popular to use deep learning in forecasting financial news events also acknowledged the fact that LSTM can be useful for complex time-series data to producing precise predictions from stock market data in developing nation markets like Indian Country as well (Chatterjee & Choudhury, 2020).

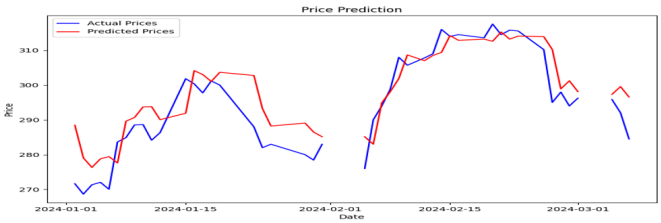
RESEARCH METHODOLOGY

Date	Predicted Price	Actual Price	Error
1/11/2024	293.72202	288.65	5.072015381
2/12/2024	307.0109	307.8	-0.789105225
3/12/2024	308.52887	309	-0.471130371
4/11/2024	293.8041	284.15	9.654107666
4/12/2024	309.38562	316	-6.614379883
5/11/2024	290.0569	286.35	3.706884766
5/12/2024	314.22906	314	0.229064941
6/11/2024	291.90247	301.85	-9.94753418
6/12/2024	312.87204	314.5	-1.627960205
7/11/2024	304.16605	300.35	3.816046143
8/11/2024	303.03598	297.75	5.285980225
9/12/2024	313.2133	313.6	-0.386712646
10/12/2024	312.59808	317.55	-4.951916504
11/11/2024	301.04837	301.2	-0.151629639
11/12/2024	315.26602	314.5	0.766021729

MAE= 5.59 and, MAE Percentage = 2.06%

The current study uses a Descriptive analytical model and the data utilized is secondary, to analyse stock price forecasting of Bharat Electronics Limited (BEL), one of the leading stock companies in India. The reason for descriptive analysis being selected is nice in historical stock price patterns and trends can be examined, revealing fundamental truths about the attitude of the market over time. It employs secondary data from public information like historical prices, financials and stock market performance.

RESULTS AND FINDINGS



STOCK MARKET AND STOCK PREDICTION

The prediction of stocks involves estimating the eventual value of the stock of a business. A stock is a share of ownership within a business. Holding more shares results in a greater percentage of ownership in the company. The stock exchange acts as a venue for buyers and sellers to trade stocks, in the National Stock Exchange and Bombay Stock Exchange getting popular exchanges in India.

Holt-Winters

Seasonality was added to Holt's methodology by winters (1960) and Holt (1957). The Holt-Winters seasonal model comprises three smoothing equations with smoothing coefficients α(alpha), β(beta), and γ(gamma), one for the seasonal component represented by s, one for the level ℓ, and one for the overall trend(t) the variable(m) indicates the seasonal period, the total number of seasons in a year.

Level 1: $st=\alpha xt+(1-\alpha)\, st-1$ ..... **Eq. 1**
Level 2: $st=\alpha xt+(1-\alpha)\,(st-1+bt-1)$ ..... **Eq. 2**
Level 3: $bt=\beta(st-st-1)+(1-\beta)\, bt-1$ ..... **Eq. 3**

- Formula h + m = L (h − 1) mod m + 1 is used to make sure that the seasonal effects (like the effect of specific months or periods) come from the data's latest year for prediction.

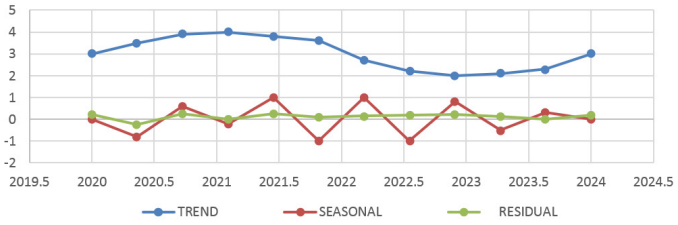


Figure 1: Graph presenting "Decomposed Time Series Analysis "Primary source: Self design

Long Short-Term Memory (LSTM) Models

The LSTM (Long Short-Term Memory) model, a type of recurrent neural network (RNN), is commonly utilized for forecasting and time series analysis since it can retain information about long-term dependencies. Long Short-Term Memory (LSTM) networks work directly with the time sequenced data and raw vector values that conventional RNNs can accept; however, they are designed to explicitly address problems encountered by standard RNNs when learning from longer sequences such as the vanishing gradient problem

This diagram describes the structure of a Long Short-Term Memory (LSTM) cell and illustrates flow of information

through its various components over a time step.

Linear Model

Numerical representation of linear trend is: Linear pattern calculation is a form of statistical analysis for understanding and analysing data.

Yt=a+bt…….....eq(1)

Where:

- *Yt* The measurement for a time series at time t,
- *a*is the interceptor. (the value of Y when t = 0)
- *b*is the line's slope(representing the rate of change or trend per unit of time),
- *t* is the time period.

The intercept b symbolizes to indicate at that the line of trend exceeds the y-axis, pointing to the genuine results of the predicted throughout the commencing of the time frame. The incline b symbolizes the extent to that the structure increases or breaks over time. if b is advantageous, the trend is up, suggesting a rise across time, whereas minus b implies a downward trend.

The LSTM Model's Nonlinear Analysis Component

Long Short-Term Memory (LSTM) networks are ideal for predicting stock prices because they are excellent at identifying temporal patterns and intricate, nonlinear dependencies in data but LSTM model can learn complex patterns, seasonality, and abrupt fluctuations by being trained on the pre-processed stock price data.

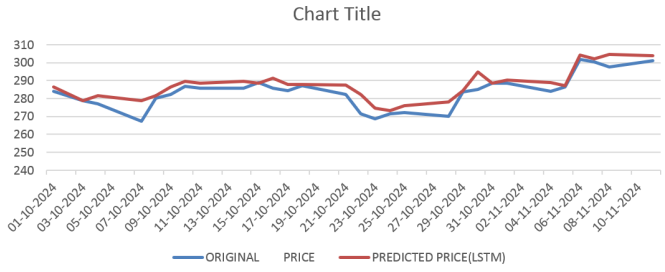


Figure 2: Graph presenting "Price Forecasting for BEL: 1/10/2024 to 10/11/2024

CONCLUSION

The accuracy of Holt-Winters and LSTM models for predicting stock prices, with an emphasis on Bharat Electronics Limited (BEL) in the Indian stock market Seasonality and trends were revealed by the Holt-Winters method, while LSTM's deep learning capabilities assisted in identifying intricate patterns in historical data. When combined, these models produced predictions with a high degree of accuracy, which makes them useful for financial forecasting. The hybrid method demonstrated how combining traditional models with machine learning can enhance predicted insights and facilitate better decision-making.

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