

AI-Driven Stock Market Forecasting Using Financial Statement Analysis

By

Marwa Othman Esaa

Midocean University

Advisor

Dr. Ashraf Elsayed

Abstract

The proposed approach aims to assist investors in making data-driven decisions by integrating financial analysis with AI-driven forecasting models. Machine learning and deep learning techniques are utilized to enhance the accuracy of stock price predictions, enabling investors to anticipate future trends and maximize returns. This paper studies advanced Long Short-Term Memory (LSTM) models, a type of Recurrent Neural Network (RNN) designed to capture long-term dependencies in sequential data. Additionally, Convolutional Neural Networks (CNN) and Full Convolutional Neural Networks (FULL CNN) are employed to improve feature extraction and forecasting performance. The predictive model incorporates financial statement analysis, leveraging key financial metrics such as earnings per share (EPS), price-to-earnings (P/E) ratio, book value per share (BVPS), price-to-book (P/B) ratio, revenue growth, and debt-to-equity ratio. By integrating these financial indicators with advanced deep learning techniques, the model aims to achieve higher forecasting accuracy compared to existing approaches, providing investors with actionable insights for informed decision-making.

Introduction

Background and Motivation

Traditional stock market forecasting approaches often fail to capture the complex dependencies in stock price movements. With the advancement of artificial intelligence, deep learning models have emerged as powerful tools for improving stock price predictions. These models can identify intricate patterns in stock market data and financial statements, leading to more precise predictions.

In this paper, we apply deep neural networks and leveraging financial statement analysis to enhance time-series forecasting. Specifically, we utilize Recurrent Neural Networks (RNNs), focusing on advanced Long Short-Term Memory (LSTM) networks such as the Extended Long Short-Term Memory (xLSTM) model and the Extended Long Short-Term Memory for Time Series (xLSTM-TS) model, to capture sequential dependencies in stock price data. Additionally, Convolutional Neural Networks (CNNs) are incorporated for feature extraction, where preprocessing techniques and Full CNN architectures are used to identify meaningful financial patterns. Furthermore, we integrate Extended Long Short-Term Memory (xLSTM) and Time-series Recurrent Neural Networks (TRNN) to enhance prediction accuracy and better handle market fluctuations.

Deep learning models have demonstrated remarkable success in detecting complex stock market dynamics. In this study, multiple deep learning architectures are evaluated to determine their effectiveness in stock price forecasting. The models are assessed based on key performance metrics, such as mean accuracy, to compare their efficiency against previous studies. This research aims to improve AI-driven financial forecasting by enhancing prediction reliability and aiding investors in making data-driven investment decisions.

Problem Statement

Stock market prediction has remained a complex and uncertain task due to the highly dynamic and volatile nature of financial markets. Traditional forecasting models, including statistical and econometric methods, often struggle to accurately predict stock price movements because they fail to capture non-linear relationships and deep patterns in financial data. Additionally, existing artificial intelligence-based approaches, while promising, still face challenges related to data preprocessing, feature selection, and interpretability, limiting their practical adoption in financial decision-making.

There is a need for an advanced and robust predictive model that can integrate financial statement analysis with deep learning techniques to enhance stock market forecasting accuracy. This study aims to bridge this gap by exploring the effectiveness of deep learning models, particularly Long Short-Term Memory (LSTM), Convolutional Neural Networks (CNNs), Extended Long Short-Term Memory (xLSTM), and Time-series Recurrent Neural Networks (TRNN), in analyzing financial data and predicting stock price trends. The research will assess the efficiency, reliability, and practical applicability of these models, addressing the limitations of traditional methods and improving AI-driven financial forecasting for investors and analysts.

Research Objectives

- Develop an AI-driven model to forecast stock prices using financial statement data.
- To assess the impact of financial statement data preprocessing on the accuracy and reliability of stock price predictions.
- To analyze the effectiveness of deep learning models such as LSTM, CNN, xLSTM, and TRNN in forecasting stock prices based on financial statement analysis.
- To identify challenges in AI-driven stock market forecasting, including data quality, feature selection, and model interpretability.

- To provide insights into the practical applicability of deep learning models for investors and financial analysts, enhancing decision-making strategies in the stock market.

Literature Review

Introduction

Financial statement analysis is essential for investors as it helps assess a company's financial stability, profitability, and potential growth. More importantly, it allows investors to determine whether a stock is priced, an attractive investment opportunity, or overvalued. This enables informed decision-making regarding stock valuation, risk management, and investment strategies. By analyzing financial statements, investors can distinguish between undervalued and overvalued stocks, anticipate financial distress, and understand market trends. Recent advancements in Artificial Intelligence have further enhanced the accuracy and efficiency of financial analysis. While technical analysis primarily benefits speculators, financial statement analysis remains crucial for long-term investors. This research explores the significance of financial analysis in predicting investment opportunities based on companies' financial statements.

Review of Key Studies

1. A study on stock forecasting using deep learning and statistical models

Gupta, H., & Jaiswal, A. (2024), find that the result of all the models is different and the best result is coming from the LSTM model and we have also seen how the Full CNN outweighs the pre-process CNN. This model helps the investors to know when to sell and buy the stock prices. As it is also known how the stock prices are affected by the climatic or geographical changes, company profit or loss, change in geographical seasons, loss in the region, inflation, competition in the market etc.

2. An evaluation of deep learning models for stock market trend prediction

López Gil, G., Duhamel-Seblin, P., & McCarren, A. (2024), the findings indicate that the proposed xLSTM-TS model consistently outperformed other state-of-the-art models, demonstrating superior predictive accuracy across multiple datasets. Specifically, the xLSTM-TS achieved the highest Test Accuracy and F1 Score, highlighting its robustness and ability to handle the complexities of financial time series. The use of wavelet denoising

significantly enhanced model performance by reducing noise, underscoring the importance of effective preprocessing.

3. TRNN: An efficient time-series recurrent neural network for stock price prediction. Information Sciences

Lu, C., & Xu, Y. (2023), The TRNN (Time-series Recurrent Neural Network) is an innovative and efficient model for stock price prediction, recently proposed in the field of financial forecasting. This model, published in Information Sciences, combines the power of recurrent neural networks with advanced time series processing techniques to enhance prediction accuracy and efficiency

4. Financial Statement Analysis and Earnings Forecasting

Financial statement analysis and earnings forecasting are critical components of investment decision-making. According to Monahan (2017), these analyses, particularly with an emphasis on accrual-based earnings over cash flows and dividends, play a pivotal role in predicting stock returns. Monahan introduced econometric models and panel-data approaches to enhance the accuracy of financial forecasts but highlighted the persistent dominance of the random-walk model. This raises concerns about the effectiveness of complex forecasting methods in real-world financial markets.

5. Estimating Stock Price Based on Financial Statements Using Machine Learning Approaches

Kunathananon (2022) explored stock price estimation using financial statement data and machine learning techniques, specifically Long Short-Term Memory (LSTM) networks. His study demonstrated that LSTM models effectively capture intricate financial patterns and dependencies, significantly improving predictive accuracy. However, he emphasized the necessity of proper data preprocessing and feature selection to optimize model performance.

6. Stock Price Prediction Based on Financial Statements Using SVM

Heo and Yang (2016) investigated the application of Support Vector Machines (SVM) for stock price prediction using financial statements. They analyzed key financial indicators such as Earnings Per Share (EPS), Book Value Per Share (BVPS), and Net Profit Growth Rate (NPGR). Their findings indicated that while SVM models provided reliable short-term stock predictions, their accuracy declined over time due to market efficiency constraints, aligning with the Efficient Market Hypothesis (EMH).

7. Using SVM with Financial Statement Analysis for Stock Prediction

Similarly, Han and Chen (2007) applied SVM to financial statement-based stock forecasting and found that integrating multiple financial ratios improved

predictive performance. However, they emphasized that careful parameter tuning is necessary to avoid overfitting, ensuring that models remain generalizable and effective across different market conditions.

References

- Gupta, H., & Jaiswal, A. (2024). A study on stock forecasting using deep learning and statistical models. arXiv. <https://arxiv.org/pdf/2402.06689v1>
- López Gil, G., Duhamel-Seblin, P., & McCarren, A. (2024). An evaluation of deep learning models for stock market trend prediction. Dublin City University
- Lu, C., & Xu, Y. (2023). *TRNN: An efficient time-series recurrent neural network for stock price prediction*. *Information Sciences*, 640, 119–134. <https://doi.org/10.1016/j.ins.2023.04.123>
- Kunathananon, T. (2022). *Estimating stock price based on information from financial statement using machine learning approach* (Master's thesis, Chulalongkorn University). Chula Digital Collections. Retrieved from <https://digital.car.chula.ac.th/chulaetd/5818>
- Monahan, S. J. (2017). Financial statement analysis and earnings forecasting. *Foundations and Trends® in Accounting*, 12(2), 105–215. <https://doi.org/10.1561/14000000036>
- Heo, J., & Yang, J. Y. (2016). Stock price prediction based on financial statements using SVM. *International Journal of Hybrid Information Technology*, 9(2), 57-66. <https://doi.org/10.14257/ijhit.2016.9.2.05>
- Han, S., & Chen, R.-C. (2007). Using SVM with financial statement analysis for prediction of stocks. *Communications of the IIMA*, 7(4), Article 8. <https://doi.org/10.58729/1941-6687.1059>

