MARKETING INTELLIGENCE

PART B

AI, Trust, and Innovation in the Modern Business Landscape

EDITED BY

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Preface

Consumer behaviour in the age of digital transformation has undergone a significant revolution. With the help of digital technology adaptation like AI and ML, consumers can access a wealth of information and choices. This transformation has revolutionized the customer brand and service interaction. As the customer can access abundant information at their fingertips, they can easily search and research product information, review information, price, etc., to make a purchase decision. The digital era has significantly changed online shopping, and eCommerce platforms have engaged customers with more personalized experiences. Personalization goes beyond addressing the customer by name; it experiences product recommendations, identification of the right content and identification of products based on previous search history and purchase, which helps to enhance customer satisfaction and make loyal customers for an organization. Establishing a strong online presence is crucial for reaching and engaging digital consumers. This includes creating a user-friendly website, optimizing it for search engines (SEO) and utilizing social media platforms to connect with the target audience. With the rise of online shopping, businesses should consider integrating eCommerce into their operations. Setting up an online store enables customers to browse and purchase products at any time conveniently. Offering secure payment options and a seamless checkout process enhances the customer experience and encourages repeat purchases. Social media platforms provide an excellent opportunity for businesses to connect directly with their target audience. Developing a comprehensive social media strategy involves identifying the platforms most relevant to the business and its target market, creating engaging content and actively interacting with followers. Leveraging social media advertising and influencer collaborations can further amplify brand visibility and reach. Personalization is key to enhancing the customer experience in the digital age. Utilize data and customer profiles to deliver personalized recommendations, targeted offers and relevant content. Personalization extends beyond product recommendations, including personalized email marketing campaigns, customized landing pages and tailored customer support experiences. By analyzing data from website analytics, social media metrics and customer interactions, businesses can identify patterns, trends, and areas for improvement. This data-driven approach helps make informed decisions and tailor marketing strategies to meet consumer needs effectively. Nowadays, many B2B and B2C models largely utilize AI to personalize interaction with clients to get a much more impactful outcome than social platforms. In the retail industry, the application of AI and

ML is much more and provides the user with a tailored recommendation in the right way. Natural language processing (NLP), predictive analytics and algorithms are used to extract user context from brand data. Most consumers think AI will improve their lives by solving complex problems, while others think AI will make it more difficult for them to obtain employment. The book *Marketing Intelligence, Part B: AI, Trust, and Innovation in the Modern Business Landscape* aims to provide a comprehensive guide for marketing professionals and businesses to navigate the digital landscape and stay ahead of the competition. One of the book's key themes is gathering, analyzing, and using data to inform marketing decisions. The book has explained how to collect data, including using technology such as AI and machine learning, and how to make sense of the data to drive marketing strategies. This book has provided the best practices for building a marketing strategy centred on customers; needs and preferences. The book will also guide how to align the marketing strategy with overall business goals while addressing the ethical and privacy concerns surrounding the collection and use of customer data. In summary, the book has provided a practical and up-to-date guide for marketing professionals, business owners and students studying marketing. It will provide a comprehensive overview of the impact of digitalization on marketing and provide practical advice on how to harness the power of digitalization to create effective marketing strategies that deliver results. This book is distinctive in several ways, like written in the context of the latest developments in the field of digital marketing with a practical approach, with up-to-date information, which makes this book a unique one and a valuable resource for anyone interested in staying ahead in the rapidly changing digital landscape.

Chapter 1

Utilizing LSTM Forecasting and Intelligent Algorithmic Computing for a Dynamic Trading Approach

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Abstract

Predicting stock market movements is a daunting task for traders, primarily owing to the pronounced volatility and inherent fluctuations that characterize the Indian stock market. This market's behaviour is intricately influenced by many factors, encompassing governmental policies, corporate financial disclosures, investor sentiment, geopolitical developments, and various other determinants. The study involves creating a predictive model for stock prices using an LSTM (Long Short-Term Memory) enabled Algorithmic Computing System. It compares this system with the GANN (Genetic Algorithm Neural Network) methodology, specifically evaluating technical indicator-based resistance prices. The research extends across small-cap, mid-cap, and large-cap categories, aiming to identify patterns and trends in stock price prediction. Notably, the analysis focusses on forecasting stock prices for the next 30 days, providing a thorough evaluation of the model's predictive performance. Consequently, the system generates comprehensive analytical reports that enrich the decision-making process for traders adopting a dynamic trading approach. As computed within the report, the investment success score emerges as a valuable tool for traders seeking to refine their investment decisions. Advancements in predictive modelling techniques for stock markets offer traders and investors more reliable tools to circumnavigate the convolutions and uncertainties of the Indian stock market. Statistical measures such as the Root Mean Square Error and Theil Inequality coefficient were utilized to gauge the accuracy of

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the outcomes produced by the presented model. These measures revealed notably superior performance when compared to contemporary techniques.

Keywords: LSTM; intelligent algorithmic computing system; high-frequency trading; deep learning (DL) and machine learning (ML); root mean square error (RMSE); recurrent neural networks (RNNs)

1. Introduction

Proprietary traders, typically non-public market participants, frequently use delta-hedging strategies to manage their option positions (Ni et al., 2021). Proprietary trades comprise the maximum proportion of algorithmic trades, leaving the retail traders high and dry. A substantial portion of broker turnover is attributed to high-net-worth individuals and proprietary traders who use the algorithmic trading mechanism (Tripathi, 2014). Artificial Intelligence (AI) enhances algo trading through advanced data analysis, pattern recognition, and predictive analytics. Banks have used AI in risk management (T. Singh, 2022; T. Singh & Pathak, 2020).

Similarly, non-banking companies have also encashed emerging financial technologies. Paytm is a classic example which, despite reporting loss in the initial phase, turned into a profitable entity using Fintech (T. Singh, 2020). Machine learning enables algorithms to adapt to changing market conditions, optimizing risk management and portfolio strategies. AI, including natural language processing, incorporates news and social media sentiment analysis. In high-frequency trading, AI-driven algorithms execute rapid trades by analyzing market microstructure data. Overall, AI improves the effectiveness of algo trading by providing sophisticated tools for informed decision-making, risk mitigation, and portfolio optimization. Recent recognition of Artificial Intelligence (AI) as a vital tool for traders highlights its ability to analyze vast datasets swiftly and execute high-frequency trading (HFT) to exploit market anomalies. Cohen (2022) surveys recent research using advanced deep learning (DL) and machine learning (ML) techniques to forecast financial trends, emphasizing the success of these systems in trading complex markets. The reviewed studies leverage nonobvious correlations, employing linear or nonlinear models commonly used in conjunction with sentiment analysis from digital social platforms or pattern recognition, demonstrating the effectiveness of AI-driven systems in financial trading (Cohen, 2022).

The chapter embarks on a systematic journey, elucidating LSTM networks and their prowess in capturing intricate temporal patterns within financial data. It further delves into the nuanced aspects of intelligent algorithmic computing, showcasing how these algorithms can analyze vast datasets, discern market trends, and make informed trading decisions in real time.

The present research contributes to enhancing the effectiveness of LSTM-enabled Intelligent Algorithmic Computing Systems by combining it with GANN methodology using the mathematical application of geometric principles. In assessing the efficacy of an LSTM-enabled Intelligent Algorithmic Computing System coupled with GANN methodology for predicting stock price fluctuations, this study employs

two key statistical indicators: Root Mean Square Error (RMSE) and Theil Inequality Coefficient (TIC). RMSE measures the average deviation between forecasted and actual values, providing valuable insights into the model's accuracy.

Moreover, the chapter sheds light on case studies and empirical analyses, demonstrating the efficacy of this integrated approach in real-world trading scenarios. By presenting empirical evidence and exploring various use cases, it aims to validate the effectiveness and robustness of employing LSTM forecasting in tandem with intelligent algorithmic computing for achieving superior trading outcomes.

The novelty of the author's work lies in developing a predictive model using an LSTM-enabled Intelligent Algorithmic Computing System (a) while also encompassing the comparison of this novel system with GANN methodology concerning technical indicator-based resistance prices (b). Additionally, the evaluation and analysis of results across various market capitalization segments (small-cap, mid-cap, and large-cap) to discern unique patterns and trends in stock price prediction contribute to the innovative aspects of the research. Furthermore, a time series modelling approach was employed to predict daily stock prices accurately, emphasizing the use of LSTM for effective multistep prediction. The subsequent segments of this manuscript are structured as follows: The 'Literature Review' section amalgamates empirical studies about the variables under examination. The 'Research Methodology' section discusses the sources of data and research procedure applied in this study. Subsequently, the 'Results and Discussions' section elucidates the empirical findings, ultimately concluding the discourse.

1.1 Gann Square Model

Gann Square, a tool developed by W.D. Gann, is used in technical analysis to forecast price movements in financial markets. Combined with algorithmic trading, it can enhance accuracy and potentially improve trading outcomes. This synergy between Gann Square and algorithmic trading relies on several strategies and principles contributing to its effectiveness. Gann Square is based on geometric principles and consists of a grid of lines and angles, predicting future price movements based on historical patterns. Integrating this concept into algorithmic trading involves leveraging these geometric relationships to create predictive models. Algorithmic trading relies heavily on data analysis. Integrating Gann Square involves preprocessing historical data to identify cyclical patterns and significant price levels. This process enables the algorithm to recognize key Gann Square levels for trade execution. Developing algorithmic trading strategies based on Gann Square principles involves using Gann angles, squares, or other geometric patterns to determine entry and exit points for trades and incorporating machine learning algorithms to identify and adapt to changing market conditions, incorporating Gann Square principles into predictive models to improve accuracy. GANN methodology helps implement adjust position sizes and risk

exposure based on Gann Square-derived signals to optimize trade outcomes. Gann Square's accuracy in Algorithmic Trading involves the following steps:

1.1.1 Backtesting and Optimization

Carry out widespread backtesting to evaluate the presentation of Gann Square-based strategies in different market conditions. Optimize parameters and rules to enhance accuracy.

1.1.2 Real-Time Market Adaptability

Develop algorithms that can adapt in real time to market fluctuations using Gann Square principles. Continuous monitoring and adaptation are crucial for accuracy.

1.1.3 Integration of Multiple Indicators

Combine Gann Square with other technical indicators or fundamental analysis within the algorithm. This synergy may further improve accuracy by validating signals from different perspectives.

1.1.4 Adherence to Market Conditions

Create algorithms that switch between Gann Square strategies based on market conditions (trending, ranging, volatile, etc.). This adaptability ensures better accuracy in diverse scenarios.

1.1.5 Continuous Improvement and Testing

Algorithms should be continuously refined and tested to adapt to changing market dynamics. This iterative process aims to enhance accuracy over time.

Integrating Gann Square principles into algorithmic trading strategies offers potential benefits in enhancing accuracy. However, achieving higher accuracy requires a comprehensive approach that involves data processing, rule-based strategy, machine learning, risk management, and continuous optimization. By leveraging the strengths of both Gann Square and algorithmic trading, traders can aim to develop more robust and accurate trading systems capable of navigating various market conditions. It is important to note that the success of any trading strategy, including those involving Gann Square, depends on market conditions and the effectiveness of the implemented algorithm. Additionally, historical performance does not guarantee future results, and risk management remains paramount in trading activities (Jangir et al., 2022)

1.2 Theoretical Model of Long Short-Term Memory Approach

Recognizing the restrictions of traditional recurrent neural networks (RNNs) in catching long-range dependencies in chronological data, Hochreiter and Schmidhuber proposed the LSTM model as a solution (Graves, 2012). Fig. 1.1 explains the theoretical model of long short-term memory approach. The innovative design of LSTM includes specialized memory cells and gating mechanisms, enabling it to store and retrieve information over extended sequences selectively. This breakthrough has significantly enhanced the capacity of neural networks to model complex temporal patterns, making LSTM a foundational architecture in deep learning. In essence, the LSTM's theoretical model allows it to capture intricate patterns, dependencies, and temporal relationships within sequential data, making it a powerful tool for time-series forecasting, natural language processing, and various other applications requiring the comprehension of sequential information.

The theoretical model of the LSTM approach forms the foundation for its practical implementation in various domains, contributing significantly to the expansion of more accurate and robust predictive replicas in financial forecasting, language generation, and other fields reliant on sequential data analysis.

Fig. 1.2 represents the steps involved in executing trades in the automated mode once the formulated strategy is developed through a model and backtested. Through a comprehensive analysis and practical application, this chapter aims to elucidate the nuanced intricacies of LSTM forecasting and intelligent algorithmic computing, offering insights into their combined potential to redefine the landscape of dynamic trading strategies. Long Short-Term Memory (LSTM) networks, a type of recurrent

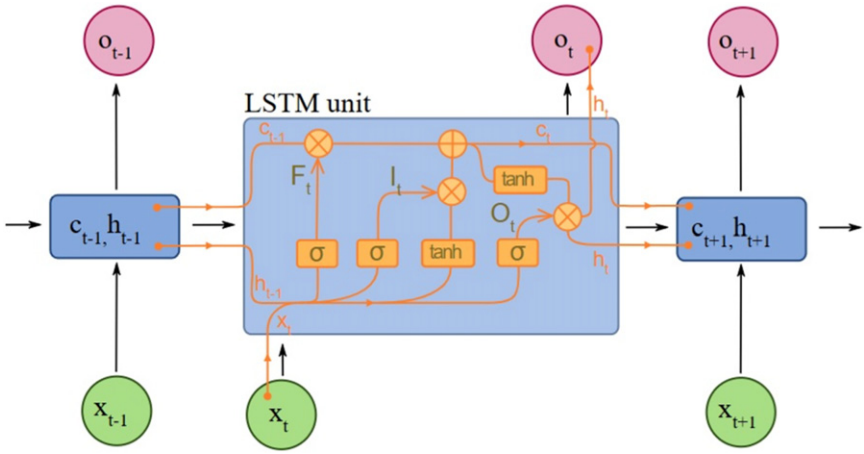

Fig. 1.1. Theoretical Model of Long Short-Term Memory Approach. *Source:* Author compilation (https://images.app.goo.gl/hh4NmSQprAWXccWy6).

Fig. 1.2. Algo Model. *Source:* Author compilation.

neural network (RNN), have gained prominence due to their capacity to record long-range dependencies and memory retention in sequential data. When applied to algorithmic trading, understanding the concepts of LSTM memory cells, input/output gates, and forget gates becomes crucial for enhancing trading strategies. LSTM networks utilize memory cells to store and regulate information flow across sequences. These cells maintain information over long periods, allowing the network to remember past events and patterns relevant to trading signals. The input gate controls the stream of new information into the memory cell, enabling the network to decide which information is essential to retain. The output gate regulates the flow of information from the cell to the network's output. The forget gate determines which material in the memory cell should be discarded or forgotten. It plays a pivotal role in managing the relevance of past information, preventing the accumulation of irrelevant historical data. Financial markets produce sequential data. LSTM's ability to retain and analyze historical patterns, influenced by memory cells, assists in recognizing market trends, cyclical behaviour, and repetitive price movements. LSTM networks process vast amounts of financial data. The input/output gates enable the identification of significant features and extracting trading signals, contributing to informed decision-making in algorithmic trading. The forget gate's function in discarding irrelevant information helps the algorithm focus on recent market behaviour, reducing the impact of outdated data. This ability to handle long-term dependencies aids in adapting to changing market dynamics. LSTM's memory cells aid in recognizing patterns associated with market volatility and risks. This knowledge assists in formulating risk management strategies and making more informed trading decisions. LSTM networks, through their gates and memory cells, facilitate adaptability to diverse market conditions. This adaptability helps algorithms adjust strategies based on varying trends, enhancing performance and accuracy.

Proper preprocessing of financial data and feature engineering are critical for LSTM's effectiveness in trading. Handling missing data, scaling features, and selecting relevant input variables are essential. Optimizing LSTM models involves tuning hyperparameters and managing model complexity. Balancing model depth, cell units, and training duration is crucial to avoid overfitting or underfitting. Rigorous backtesting and evaluation of LSTM-based trading strategies are necessary to assess their effectiveness. Robust evaluation methods help validate the strategy's performance under various market conditions. LSTM's memory cells, input/output gates, and forget gates offer a promising framework for enhancing

algorithmic trading strategies. Leveraging these components facilitates the extraction of meaningful patterns from sequential financial data, aiding in informed decision-making, risk management, and adaptability to evolving market conditions. However, challenges related to data preprocessing, model optimization, and rigorous evaluation persist and require careful attention for successful implementation in algorithmic trading systems (Sharma et al., 2023). Integrating LSTM concepts intelligently into trading algorithms holds the potential to improve trading outcomes and decision-making processes. It is important to note that while LSTM-based strategies offer potential advantages, the complexities of financial markets and the inherent uncertainties demand prudent risk management practices, continual refinement of strategies, and adherence to sound trading principles.

2. Literature Review

Although technical indicators (TIs) have limited efficacy in predicting returns, specific indicators like adaptive moving averages and turnover rates show significant effects. Ultimately, TIs in China's stock market are more valuable for enhancing risk management during downturns than for generating excess profits (Yao et al., 2022).

One of the studies aligns with the principles of fundamental analysis, revealing that at the macro level, economic factors like inflation and GDP growth, along with non-economic factors such as social contribution and human capital, are taken into account in influencing natural resource commodity prices in China (Chien et al., 2022). Addressing the enduring challenge of stock market forecast, a study integrates the analysis based on technical and fundamental factors using data science and machine learning. Through a classification task on time series data, it leverages technical indicators and news sentiment as inputs, resulting in a robust predictive model. The model demonstrates practical efficacy, achieving over 80% annualized return in a high-frequency trading simulation, marking a significant advancement in the amalgamation of technical and fundamental analysis for developing innovative trading strategies (Picasso et al., 2019). Behavioural Finance uses psychologically accurate models like extrapolation-based and overconfident belief models to explain asset prices and trading volume (Sharma et al., 2023). Based on simple assumptions about investor psychology, these models provide effective insights and hint at the potential for a unified psychology-based model for understanding investor behaviour in financial markets (Barberis, 2018). In a study predicting stock movement in the Shanghai Stock Exchange over 13 years, both Machine Learning and the Multiple Linear Regression Model were utilized. Results indicate both methods as accurate predictors (1.50–1.65% Absolute Percent Error), with the t-test highlighting Neural Network superiority in the finance sector, particularly during high volatility (Prime, 2020). Elliott's wave principle suggests the stock market moves in cyclic patterns with five upward and three downward waves in a complete cycle. Applied in technical analysis, this concept aids stock price prediction by recognizing repetitive wave patterns for forecasting future trends (Lo & Hasanhodzic, 2010). Sentiment analysis from social media platforms involves amalgamating emotional and opinion data

with technical indicators to formulate a stock price prediction model. A comparative analysis of several algorithms, including Support Vector Machine (SVM), Back-propagation, and LSTM, reveals that in contrast to basic technical indicators, LSTM demonstrated augmented performance in the prediction model (Stock Market Prediction Based on Technical-Deviation-ROC Indicators Using Stock and Feeds Data | Bentham Science, n.d.). Incorporating human sentiment significantly fortified accuracy, and significantly, the reduced standard deviation in LSTM's outcomes implies the potential for consistently precise predictions. The utilization of technical analysis within deep neural networks demonstrates both feasibility and effectiveness in predicting stock prices (Lee et al., 2021). There are substantial advantages to using LSTM modelling with technical indicators for traders. The LSTM model reveals better outcome, outperforming comparable models with minimal error tolerance. Technical indicators like MACD, MFI, RSI, support-resistance curves, and Fibonacci retracement levels offer traders valuable insights, clear buy/sell signals, and a deeper understanding of stock behaviour. This combined approach equips traders with the tools to make well-informed decisions, manage risk, and optimize returns for short-term trading or long-term investments (Banik et al., 2022). An effort was made to improve stock market trend prediction by developing an Evolutionary Deep Learning Model that utilizes the Correlation-Tensor concept. Traditional Stock Technical Indicators (STIs) often provide inaccurate predictions. The correlation tensor captures complex relationships and interactions between multiple variables, allowing the EDLM to make more nuanced and accurate stock price trend predictions, surpassing the limitations of traditional methods (Agrawal et al., 2021). Three machine learning techniques, Random Forest (RF), Gradient Boosted Trees (GBT), and Support Vector Machine (SVM), are applied to predict very short-term variations in the Moroccan stock market. Technical indicators serve as input variables, and feature and sample selection steps enhance prediction accuracy and training efficiency. RF and GBT outperform SVM for the dataset, with advantages in computational complexity and training time, making them suitable for short-term stock market forecasting (Labiad et al., 2016). While predicting financial time series by constructing an automated trading system employing an AI-driven LSTM model, the algorithm utilizes historical data, technical indicators, and risk management to autonomously execute trades, outperforming other methods (Silva et al., 2020). To enhance stock market forecasting via deep learning, the study integrated textual data from financial news sources and numerical data comprising historical prices and technical indicators. The prediction models employed Convolutional Neural Network (CNN) and LSTM architectures. The results showcased substantial improvements in prediction accuracy and annualized return, validated across diverse datasets from Reuters, Reddit, and Intrinio. This underscores the promise of refining stock market forecasting through a holistic fusion of textual and numerical data within a deep learning framework (Oncharoen & Vateekul, 2018). A survey categorizes data sources, neural network structures, and evaluation metrics for deep learning models in stock market prediction. With a focus on implementation and reproducibility, it aids researchers in staying current and reproducing past studies while pointing to future research directions (Jiang, 2021). Fabbri and Moro (2018) introduces a deep recurrent neural network solution for stock market trading,