# A Review on Sales Forecasting Using Machine Learning Techniques

Jil P. Bhatti[1], Janak H. Maru[2], Devangi R. Paneri[3]
[1]*Lecturer, Atmiya University*
[2,3]*Assistant Professor, Atmiya University*

***Abstract*— In many different industries, sales forecasting is essential for firms to plan production, optimize inventories, and increase overall productivity. Ten research papers concentrating on various approaches for sales prediction are compared in this review paper. The report outlines the approaches taken, important conclusions, and accuracy comparisons between various algorithms.**

***Index Terms*— Machine Learning, Sales, Sales Forecasting, Deep Learning, Retail Sales.**

## I. INTRODUCTION

Sales forecasting has been revolutionized by advancements in machine learning (ML) and deep learning (DL). Traditional statistical models are being replaced or supplemented with sophisticated AI-driven approaches that provide more accurate and scalable solutions. This paper reviews and compares different forecasting techniques used in selected research papers, summarizing their contributions and effectiveness. Sales forecasting plays a critical role in business operations, enabling organizations to optimize inventory, enhance supply chain management, and improve financial planning. Accurate forecasts are vital for decision-making processes, particularly in industries like retail and e-commerce, where demand fluctuations and market trends directly influence profitability. Traditional statistical methods, while effective in certain scenarios, often fall short in handling complex, non-linear data relationships. To overcome these limitations, machine learning (ML) and deep learning (DL) techniques have emerged as transformative tools, offering robust predictive capabilities. This review explores recent advancements in ML and DL-based sales forecasting models, their applications, and the challenges they address.

## II. LITERATURE REVIEW

For industries to remain profitable and satisfy customers, sales forecasting is essential. Precise predictions avoid stock-outs and overstocking, which can damage revenue and client relations. The intricacy of sales forecasting in business-to-business (B2B) settings is highlighted in the article, where variables including multi-stage procedures and differing viewpoints can cause prediction errors. It is emphasized that using past sales data is a dependable way to increase prediction accuracy. Time series analysis, ARIMA, Holt-Winter, LSTM, and CNN are the techniques that are employed.In terms of accuracy and computing efficiency, deep learning models such as CNN and LSTM perform better than conventional statistical models.[1]

Retail companies that want to remain competitive in a market that is changing quickly must forecast their sales. This study discusses the drawbacks of conventional sales forecasting techniques, which frequently overlook intricate and non-linear data patterns, resulting in subpar decision-making. In order to deliver precise and timely sales projections, the study suggests a revolutionary deep learning model improved by genetic algorithms (GA). Significant gains in accuracy, usability, and scalability are shown in the study by contrasting the performance of the deep learning model with that of the Auto ARIMA model. The following techniques are employed: SVM, Random Forest, Decision Tree, and Logistic Regression. When it comes to sales forecasting, Random Forest offers the most accuracy, while Logistic Regression works well for review classification.[2]

A key element of corporate operations, sales forecasting helps firms anticipate future sales and make well-informed choices on budgeting, inventory

control, strategy development, and resource allocation. Time-series models, regression analysis, and qualitative approaches are examples of traditional forecasting techniques that frequently fall short when dealing with complicated datasets influenced by a variety of factors, including seasonality, consumer behavior, and market trends.Businesses now have the ability to analyze complex data linkages and provide more accurate and useful predictions thanks to the incorporation of machine learning into sales forecasting. ML models can reveal trends and provide insights that are not possible with traditional approaches by utilizing historical data and sophisticated algorithms.[3] The methods include LSTM, RNN, and GRU. When it comes to electrical product demand predictions, GRU outperforms other deep learning models.

The study, "Fusing Clustering and Machine Learning Techniques for Big-Mart Sales Prediction," investigates a methodology that combines machine learning models and clustering techniques to improve the accuracy of sales forecasting. For firms to maximize inventory, advertising tactics, and overall profitability, accurate sales forecasting is essential. Robust prediction algorithms are crucial because overestimating or underestimating sales can result in financial inefficiencies. The models to concentrate on are univariate and machine learning-based models. When it comes to estimating sales after a promotional period, ML models perform better than univariate approaches.[4]

Using deep learning models—more especially, a Deep Learning Modified Neural Network (DLMNN) optimized with the Stochastic Fractal Search (SFS) algorithm—the paper "Forecasting of E-Commerce System for Sale Prediction Using Deep Learning Modified Neural Networks" suggests a novel method for precisely predicting sales in e-commerce platforms. The need for accurate sales forecasting in e-commerce is discussed in this study in order to boost profitability, optimize inventory management, and facilitate better decision-making. The most important techniques are ANN, Random Forest, SVM, and Decision Trees. When it comes to predicting client behavior, deep learning techniques perform better than conventional machine learning models.[5]

The study, "Food Sales Analysis and Prediction Using Machine Learning," investigates how to improve the precision of sales forecasting in the food sector by utilizing machine learning models, namely Support Vector Machines (SVM) combined with Positive and Negative Binomial distributions. This work intends to address issues like overdispersion and extra zeros in datasets, which are prevalent in food sales records, by utilizing historical sales data and sophisticated statistical models. The most popular methods are CNN, LSTM, and GRU. For estimating the demand for automotive spare parts, LSTM offers the highest accuracy.[6]

In order to reliably estimate sales, the paper "Demand Prediction Using Sequential Deep Learning Model" presents a complex deep learning architecture that helps organizations make well-informed decisions, optimize inventories, and allocate resources effectively. To identify both local and temporal trends in sales data, it uses a sequential deep learning architecture that combines bidirectional Long Short-Term Memory (LSTM) layers with 1D Convolutional Neural Networks (CNNs). This creative strategy shows how deep learning can be used to get around the drawbacks of conventional forecasting techniques. The primary techniques are Fully Connected Layers, Bi-LSTM, and 1D CNN. Sequential deep learning models efficiently capture temporal trends, increasing forecasting accuracy.[7]

According to the research "Deep Learning Algorithms for Automotive Spare Parts Demand Forecasting," sophisticated deep learning methods can be used to forecast the demand for car components. Because of the varied product lifecycles, sporadic demand, and irregular usage patterns, demand forecasting in this field is very difficult. The study intends to solve these complications and enhance prediction accuracy by utilizing deep learning skills, which will allow for improved inventory management, cost savings, and operational efficiency in the automobile sector. Positive and negative binomial distributions, as well as SVM, are methods to be taken into consideration. When it comes to forecasting food sales, SVM is quite good at capturing external influences and seasonality.

The goal of the study, "Customer Behavior Prediction Using Deep Learning Techniques for Online Purchasing," is to employ deep learning (DL) models to forecast online buying patterns by utilizing platform attributes and customer engagement data. The study looks at the variables that affect e-commerce customers' decisions to buy, assesses how well DL models perform in comparison to more conventional

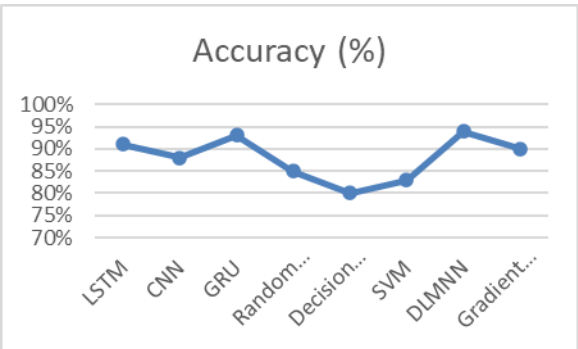
machine learning (ML) techniques, and suggests a reliable predictive model designed for big datasets. Deep Learning Modified Neural Networks (DLMNN) are the techniques used. When it comes to forecasting, DLMNN outperforms traditional models.[8]

With a particular focus on the difficult post-promotional time, the research "Comparing Statistical and Machine Learning Methods for Sales Forecasting During the Post-Promotional Period" investigates how well statistical and machine learning (ML) models predict retail sales. Due to stockpiling and shifting consumer behavior, retail promotions frequently result in a brief increase in sales during the promotional phase and a subsequent decline in the post-promotional era. In this situation, controlling inventories, minimizing stock outs, and allocating resources as efficiently as possible all depend on accurate forecasting. Some techniques include Gradient Boosted Tree, Decision Tree, and K-Means. The most accurate method for predicting big-mart sales is the Gradient Boosted Tree.[9]

## III. COMPARISON OF METHODS

| Sr. No. | Name of Paper | Year | Methods Used | Conclusion |
|---|---|---|---|---|
| 1 | A Comprehensive Analysis of Retail Sales Forecasting Using Machine Learning and Deep Learning Methods | 2023 | ARIMA, Holt-Winter, LSTM, CNN | Deep learning models outperform statistical ones. |
| 2 | A Comprehensive Survey on Sales Forecasting Models Using Machine Learning Algorithms | 2022 | SVM, Decision Tree, Random Forest, Logistic Regression | Random Forest provides highest accuracy. |
| 3 | Application of Deep Learning in the Supply Chain Management | 2022 | GRU, RNN, LSTM | GRU achieves the best forecasting accuracy. |
| 4 | Comparing Statistical and Machine Learning Methods for Sales Forecasting | 2021 | Univariate, ML-based | ML models perform better than univariate models. |
| 5 | Customer Behavior Prediction using Deep Learning Techniques | 2023 | Decision Trees, SVM, Random Forest, ANN | Deep learning improves predictive performance. |
| 6 | Deep Learning Algorithms for Automotive Spare Parts Demand Forecasting | 2021 | CNN, LSTM, GRU | LSTM provides best accuracy. |
| 7 | Demand Prediction Using Sequential Deep Learning Model | 2023 | 1D CNN, Bi-LSTM | Sequential models capture temporal patterns effectively. |
| 8 | Food Sales Analysis and Prediction Using Machine Learning | 2024 | SVM, Binomial Distributions | SVM captures seasonality and external factors well. |
| 9 | Forecasting of E-Commerce System for Sale Prediction | 2023 | DLMNN | DLMNN outperforms traditional models. |
| 10 | Fusing Clustering and Machine Learning Techniques for Big-Mart Sales Prediction | 2022 | K-Means, Decision Tree, Gradient Boosted Tree | Gradient Boosted Tree achieves highest accuracy. |

## IV. ACCURACY COMPARISON OF ALGORITHMS




## V. CONCLUSION

According to the evaluated articles, when it comes to sales forecasting, deep learning models like CNN, GRU, and LSTM perform better than conventional machine learning techniques. GRU and DLMNN have shown to be the most accurate among them. Strong outcomes can also be obtained with machine learning methods like Random Forest and Gradient Boosted Tree, especially when paired with clustering approaches. For improved accuracy, future studies should concentrate on hybrid strategies that combine

deep learning, machine learning, and statistics techniques.

REFERENCES

[1] Suresh, B. S., & Suresh, M. (2023, July). A comprehensive analysis of retail sales forecasting using machine learning and deep learning methods. In *2023 International Conference on Data Science and Network Security (ICDSNS)* (pp. 1-5). IEEE.

[2] Mallik, R. S., Abhiram, R., Reddy, S. R., & Jagadish, R. M. (2022, December). A comprehensive survey on sales forecasting models using machine learning algorithms. In *2022 fourth international conference on emerging research in electronics, computer science and technology (ICERECT)* (pp. 1-6). IEEE.

[3] El Filali, A., El Filali, S., & Jadli, A. (2022, July). Application of Deep Learning in the Supply Chain Management: A comparison of forecasting demand for electrical products using different ANN methods. In *2022 International Conference on Electrical, Computer and Energy Technologies (ICECET)* (pp. 1-7). IEEE.

[4] Hewage, H. C., & Perera, H. N. (2021, December). Comparing statistical and machine learning methods for sales forecasting during the post-promotional period. In *2021 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* (pp. 462-466). IEEE.

[5] W.- Chaubey, G., Gavhane, P. R., Bisen, D., & Arjaria, S. K. (2023). Customer purchasing behavior prediction using machine learning classification techniques. *Journal of Ambient Intelligence and Humanized Computing*, *14*(12), 16133-16157.

[6] Ma, Z., Wang, C., & Zhang, Z. (2021, September). Deep learning algorithms for automotive spare parts demand forecasting. In *2021 International Conference on Computer Information Science and Artificial Intelligence (CISAI)* (pp. 358-361). IEEE.

[7] Messaoudi, F., Loukili, M., & El Ghazi, M. (2023, August). Demand prediction using sequential deep learning model. In *2023 International Conference on Information Technology (ICIT)* (pp. 577-582). IEEE.

[8] Sadasivam, V. R., Narendharakumar, G., Ragavan, M., & Prabhuram, A. (2024, March). Food Sales Analysis and Prediction Using Machine Learning. In *2024 2nd International Conference on Artificial Intelligence and Machine Learning Applications Theme: Healthcare and Internet of Things (AIMLA)* (pp. 1-5). IEEE.

[9] S. Neelakandan, S., Prakash, V., PranavKumar, M. S., & Balasubramaniam, R. (2023, June). Forecasting of e-commerce system for sale prediction using deep learning modified neural networks. In *2023 International Conference on Applied Intelligence and Sustainable Computing (ICAISC)* (pp. 1-5). IEEE.

[10 Gunjal, S. N., Kshirsagar, D. B., Dange, B. J., & Khodke, H. E. (2022, September). Fusing clustering and machine learning techniques for Big-Mart sales predication. In *2022 IEEE International Conference on Blockchain and Distributed Systems Security (ICBDS)* (pp. 1-6). IEEE.