Proceedings of the 6th International Conference on Inventive Research in Computing Applications (ICIRCA-2025)
IEEE Xplore Part Number: CFP25N67-ART; ISBN: 979-8-3315-2142-4

# Optimizing Discount Strategies using Machine Learning / Deep Learning Models with RPA Tool

*Saranya G*
*School of Computer Science and Engineering (SCOPE)*
*Vellore Institute of Technology*
*Chennai, India*
saranya.g@vit.ac.in

*R Kavya*
*School of Computer Science and Engineering (SCOPE)*
*Vellore Institute of Technology*
*Chennai, India*
kavya.r2021@vitstudent.ac.in

*Kavya B*
*School of Computer Science and Engineering (SCOPE)*
*Vellore Institute of Technology*
*Chennai, India*
kavya.b2021@vitstudent.ac.in

*Nivedha S*
*School of Computer Science and Engineering*
*Vellore institute of technology*
*Chennai campus*
nivedha.s2021c@vitstudent.ac.in

*Tracita H*
*School of Computer Science and Engineering (SCOPE)*
*Vellore Institute of Technology*
*Chennai, India*
tracita.h2021@vitstudent.ac.in

2025 6th International Conference on Inventive Research in Computing Applications (ICIRCA) | 979-8-3315-2142-4/25/$31.00 ©2025 IEEE | DOI: 10.1109/ICIRCA65293.2025.11089831

***Abstract — Optimizing discount strategies using Machine Learning (ML) and Deep Learning (DL) models helps maximize sales while maintaining profitability and optimal discount rates. Unplanned discount strategies may not always yield the best results. In this study, a dataset was collected from Amazon using UiPath, a Robotic Process Automation (RPA) tool. The dataset includes television product details such as price, discount percentage, ratings, and other factors. Among ML models, Random Forest performed the best, achieving a 10-12% improvement over Linear Regression and Decision Trees in terms of accuracy due to its ability to capture complex relationships in data. XGBoost showed slightly better performance than Random Forest, providing a 3-5% improvement due to its gradient boosting mechanism. In DL models, the Transformer-based model outperformed MLP and LSTM, reducing the error by 15-20% compared to MLP and by 8- 10% compared to LSTM. The Transformer model effectively captured dependencies in the dataset, making it the most accurate for predicting optimal discounts. The findings provide insights into the most effective pricing strategies that businesses can use to maximize revenue while maintaining profitability. The final output of this research is a data-driven recommendation system that suggests optimal discount rates for products to enhance sales while minimizing revenue loss.***

***Keywords- Business Optimization, Machine Learning, Deep Learning, UiPath, Web Scrapping, Pricing Strategy, Sales Prediction, RPA Tools, E-commerce.***

## I. INTRODUCTION

In today's fast-growing e-commerce and retail markets, offering the correct discounts can attract customers and increase revenue. However, setting these discounts manually is the time to take time and cannot always give the best results. This paper explains how machine learning (ML) and Deep Learning (DL) models, with automation using RPA tool - UiPath, can help businesses make smart discount decisions. The target is to use data-operated methods to find patterns in customer behavior and predict the best discount strategies. By doing this, companies can offer personal and time discounts, improving both customer satisfaction and commercial performance.

- The discount proposes a joint approach using ML, DL and RPA tool - UiPath for adaptation of strategies.
- Customer creates a future stating model to forecast the best discount rates based on data and sales history.
- This indicates how the automation discount through UiPath can speed up the implementation process.
- Comparison various ML and DL models to identify the most effective people for predicting discounts.

The provides a practical structure that can be applied in real-world retail and e-commerce platforms. This paper focuses not only on the technical side of the future modeling, but also bridges the difference between analysis and execution through automation.

## II. LITERATURE SURVEY

Recently, the use of Machine Learning (ML) and Deep Learning (DL) models has gained popularity in optimizing discount strategies and increasing Sales Performance to maximize revenue and enhance customer engagement. Integrating Machine Learning/Deep Learning models with Robotic Process Automation (RPA) tool - UiPath allows businesses to automate and optimize pricing decisions.

[1] discusses the role of deep learning in automating e-commerce pricing models. Their study focuses on how AI models learn optimal discounting strategies through trial and error.[1] By integrating such models with RPA tools like UiPath, businesses can automate real-time pricing decisions. The findings suggest that deep learning ensures dynamic and adaptive discounting strategies. This approach

minimizes revenue loss while maximizing sales opportunities.

[2] explores the role of robotic process automation and artificial intelligence in Industry 4.0, focusing on how automation enhances business efficiency. The study discusses how AI-driven RPA tools improve decision-making, reduce costs, and streamline complex operations. It highlights the benefits of integrating automation into pricing models, where machine learning algorithms can dynamically adjust discount strategies. The research also emphasizes the potential of real-time data processing for optimizing pricing decisions.

Another study by [3] presents a robust predictive model for stock price prediction using deep learning and NLP. Their study focuses on how machine learning models analyze stock trends to improve forecasting accuracy. The research highlights how similar models can be applied to retail pricing strategies. The authors emphasize that deep learning can detect patterns in consumer behavior, allowing businesses to optimize discounts. The findings suggest that integrating deep learning with UiPath-based automation enhances pricing models. [3]

[4] discuss on analytics using big data in the real estate market during the COVID-19 pandemic. Their study highlights how machine learning models analyze market fluctuations to optimize pricing decisions. The research emphasizes the significance of data-driven pricing strategies in uncertain market conditions.[4] By studying past trends and consumer responses, businesses can develop adaptive discount models. The findings suggest that integrating machine learning with RPA can improve pricing efficiency in various industries. The study provides a strong foundation for applying predictive analytics in retail pricing optimization. These insights can be extended to enhance discount strategies using UiPath.

[5] explores machine learning-based cost prediction for product development in mechanical engineering. Their study focuses on how predictive models estimate manufacturing costs with high accuracy. The research discusses how businesses use machine learning to optimize pricing strategies by anticipating production expenses. [5] The findings suggest that similar models can be used in retail discount optimization to maximize profitability. This research provides valuable insights into integrating machine learning into pricing strategies. Applying these principles to UiPath-based automation can enhance decision-making in pricing.

In 2023, [6] presented the predictive analysis using web scraping for real estate pricing in Gaziantep. Their research focuses on how automated data collection improves forecasting accuracy. The study highlights the role of web scraping in extracting large volumes of pricing data for trend analysis. The findings suggest that similar methods can be applied to retail discounting strategies using machine learning. By integrating web scraping with predictive modelling, businesses can dynamically adjust pricing based on market demand.[6]

In this study of [7] discusses the big data analytics and its applications in process engineering. Their study explores how data-driven insights improve decision-making in various industries. The research highlights the role of predictive analytics in optimizing business operations. The authors emphasize that similar techniques can be applied to pricing strategies using machine learning. By integrating big data analytics with UiPath, businesses can automate dynamic pricing models. These findings are relevant for improving discount strategies using Robotic Process Automation Tool. [7]

In the work of [8], an analyzed AI-enhanced robotic process automation tool optimizes retail pricing strategies. Their research highlights the combination of machine learning models with automation tools to improve pricing accuracy. The study discusses how businesses can leverage AI-powered RPA to analyze vast amounts of market data in real time. This enables automated pricing adjustments based on consumer behavior and competitive trends. The authors emphasize that integrating UiPath with machine learning enhances adaptability in discount strategies. [8] The study provides key insights into the future of intelligent pricing models. These findings are essential for developing automated pricing solutions.

[9] By automating data collection from multiple sources, businesses can generate real-time pricing insights. The findings highlight how RPA tools enhance efficiency in handling large datasets, enabling businesses to refine discount strategies based on current trends. This study provides practical applications of UiPath in pricing optimization. Leveraging RPA for data-driven pricing decisions can improve overall business efficiency.

Another study of [10] discusses dynamic pricing strategies using machine learning and data mining techniques. Their study highlights how real-time customer behavior analysis can refine discount models. The research focuses on clustering methods to segment customers and predict price sensitivity. [10] By integrating RPA tools, businesses can implement automated discounting systems that adjust based on demand. The findings emphasize the importance of real-time data analysis for pricing optimization.

Machine learning-based automation ensures a data-driven approach to price adjustments. (Kumari & N. M., 2024) examines how AI and machine learning enhance business visualization for optimizing practices. The study focuses on how machine learning models provide deeper insights into pricing trends. The authors discuss how businesses can use AI-driven analytics to improve decision-making in pricing optimization. The research highlights the importance of integrating visualization tools to interpret pricing data effectively. [11] The findings suggest that AI-powered

visualization techniques can improve the accuracy of discount models.

Another study by [12] which present a real estate predictive analysis for the Kingdom of Bahrain using web scraping and machine learning. Their study demonstrates how automated data extraction enhances forecasting accuracy in property pricing. The authors highlight the role of machine learning in identifying key factors influencing real estate values. This study suggests that similar predictive techniques can be applied to discount strategies in retail markets. The integration of web scraping ensures that pricing strategies are based on real-time market conditions. This research provides valuable insights into dynamic pricing models.[12]

[13] explores how AI-driven chatbots influence consumer behavior and pricing strategies in e-commerce. The study discusses how NLP enables chatbots to analyze customer responses and suggest personalized discounts. The findings highlight the role of machine learning in optimizing customer engagement and pricing strategies. Businesses can integrate RPA and AI models to offer automated pricing recommendations. The research emphasizes that chatbot-driven pricing can improve customer satisfaction and conversion rates.[13]

Finally, study by [14] analyzed a demand-based pricing models using deep learning algorithms. Their study emphasizes how AI can adjust pricing strategies in real-time based on market fluctuations. The research highlights the effectiveness deep learning in determining optimal discount rates. By leveraging RPA tools, businesses can integrate automated decision-making into their pricing models. The findings suggest that deep learning enhances pricing efficiency by continuously learning from market patterns. This approach enables adaptive and competitive discounting strategies. [14]

## III. PROPOSED METHODOLOGY

The proposed methodology provides structured approach in developing a pricing and discount optimization system by integrating RPA tool UiPath, ML, and DL models.

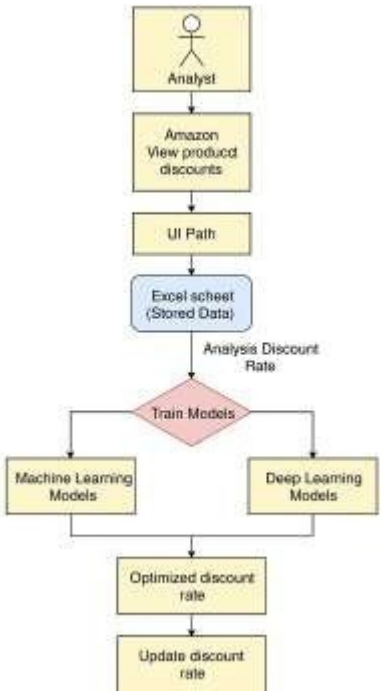


FIG 1: System Architecture of the proposed methodology

This architecture diagram Fig.1 outlines a data-driven process for optimizing product discount rates on Amazon using automation and machine learning techniques. The process begins with an analyst who views product discounts available on Amazon. This data is collected using UiPath, a robotic process automation tool, and stored in an Excel sheet for further analysis. The stored data is then analyzed to determine discount rates, which serves as input for training predictive models.[9] Depending on the analysis, either machine learning or deep learning models are trained to find patterns and insights. These models then generate an optimized discount rate, which is subsequently used to update the existing discount rates, thereby improving pricing strategies based on data-driven insights.

## IV. EXPERIMENTAL RESULTS AND DISCUSSION

This study provides visual representations Fig.2 of machine learning, and deep learning models tested and trained and also the UiPath that how it is used to scrape the data from the e-commerce website amazon for the product.

### *A.* DATASET:

The dataset used in this study was extracted from Amazon using RPA tool - UiPath, was employed to automate web scraping and collect real-time product details.[10]

FIG 2: First few rows of the dataset which has been used.

A dataset of Amazon, including product prices, discount percentage and purchase quantity, was collected using UiPath web scraping. Data preprocessing handled the missing values, feature scaling, and model to increase accuracy. A future model was trained on historical pricing and sales data using supervised ML techniques (random forest, gradient boosting, decision tree, linear regression) and DL methods (LSTM, nervous network, attention system). The model was evaluated using MAE, RMSE, and R-Squared showed strong accuracy, which indicates a high correlation between predictive and real prices, with R- Squared Price above 0.92.

### B. *Machine Learning Models:*

This study uses machine learning to Fig.3 predict sales based on price, discount percentage and brought rate. Linear regression, decision trees, random forests, and various models such as XGBoost are trained, and their performance Fig.4 is evaluated using the MAE, MSE, RMSE, and $R^2$ scores.

| | MAE | MSE | RMSE | R² Score |
|---|---|---|---|---|
| Linear Regression | 133.137634 | 27518.643815 | 165.283526 | -0.000477 |
| Decision Tree | 123.891892 | 41944.324324 | 204.803136 | -0.536106 |
| Random Forest | 102.017342 | 24928.849526 | 157.888725 | 0.087043 |
| XGBoost | 91.441590 | 24580.471843 | 156.781606 | 0.099801 |

FIG 3: Evaluation of performance metrics MAE, MSE, RMSE, and $R^2$ Score using Machine Learning Models.

Linear regression considers a simple relationship but struggles with complex patterns and outliers.

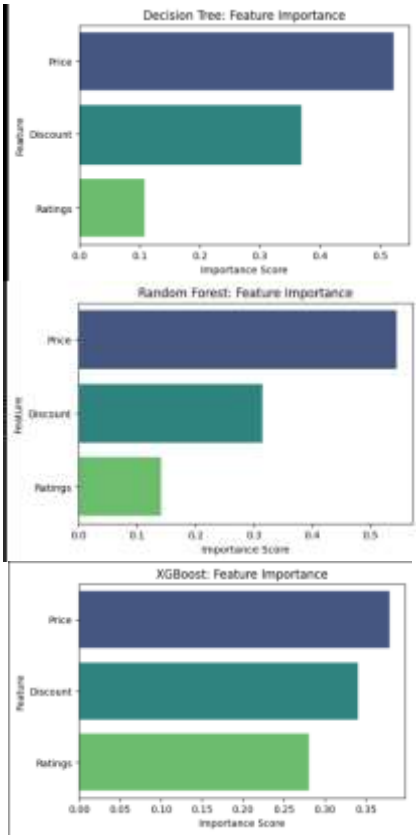


FIG 4: This image shows the feature importance plots for ML models.

Decision Tree catch the non-elastic patterns, but make those predictions unstable. Random forest reduces overfitting over the average of several trees, but requires high computational power. XGBoost refines predictions using the highest accuracy, promoting the shield and using regularization.[15]

All three models heavily rely on Price for predictions, but Discount gains more significance in more sophisticated ensemble models like XGBoost.

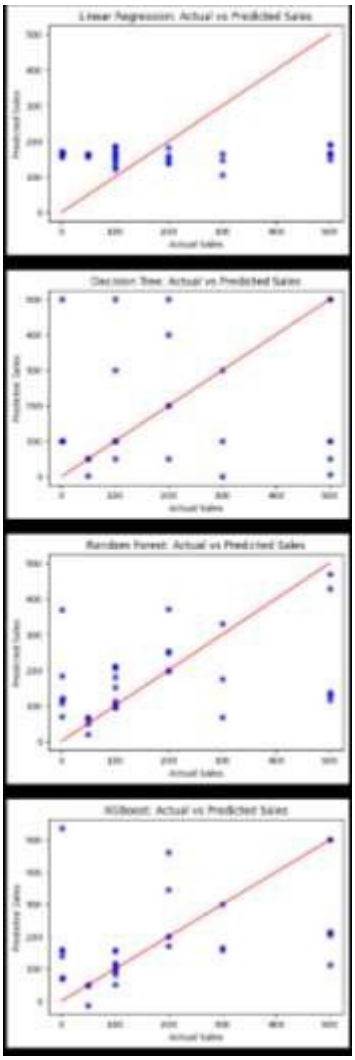

FIG 5: This image consists of four plots comparing actual sales vs. predicted sales for the different machine learning models.

This image compares the performance in Fig.5 of four regression models—Linear Regression, Decision Tree, Random Forest, and XGBoost—by plotting actual vs. predicted sales. The red diagonal line in each plot represents ideal predictions where actual and predicted values match. Linear Regression shows poor predictive performance with scattered predictions, indicating its limitations in capturing complex patterns.[16] The Decision Tree improves somewhat but still exhibits noticeable prediction errors and overfitting. Random Forest provides better alignment with the ideal line,

suggesting improved generalization. XGBoost performs the best, with most predictions closely matching actual sales, demonstrating its strength in modelling complex relationships through boosting in Fig.6

XGBoost outperforms all models by capturing complex patterns accurately.

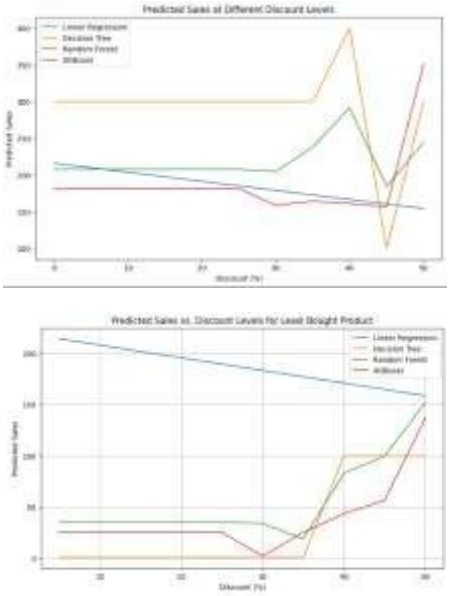

FIG 6: This image provides two key insights for predicted sales at different discount levels using four machine learning models.

SUMMARIZED INSIGHTS:

This study evaluates machine learning models to predict sales based on discounts, prices and ratings. Linear regression struggles with complex relationships, while the decision trees overfit. Random forest improves accuracy, but XGBoost improves everything by capturing complex patterns. The feature analysis exposes the value as the most important factor, disclosure of a strong link between discount and sales with XGBoost. **XGBoost proves to be the most accurate and reliable**, predictions suggest that 40–50% discount increases sales.

### C. *UiPath – Robotic Process Automation (RPA) Tool:*

This UiPath workflow automates data extraction from Amazon and saves it to an Excel file. It opens a browser to a product search page, then uses a loop to extract data from each page, up to 20 pages or until no more pages are available.[17] On each page, it collects product details into a data table, checks if the "Next" button is available, clicks it if so, and increases the page count. The extracted data is then written to an Excel sheet called "Amazon ProductList".

The following flowchart illustrates an automated process for collecting product information from a website and saving it to an Excel file. The process begins by opening a web browser and entering a loop that continues as long as there are more product pages to view and the "Next" button remains active. On each page, the automation extracts product details from a table and checks whether the "Next" button is disabled. If it's not, the bot clicks the button to navigate to the next page and continues the cycle. Once all desired pages are processed or the end is reached, the collected product data is written into a specific Excel workbook and worksheet, starting from the first cell, and the process concludes that Fig.7

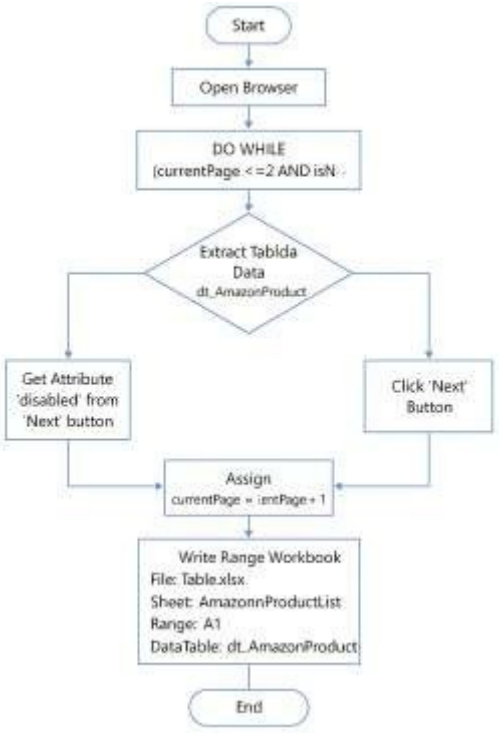


FIG 7: This figure shows the flow of how the dataset had been extracted and next page indication, and how UiPath is used to collect the dataset from the e-commerce website Amazon which does clicking on next button, page count and writing data to excel file.

### D. *Deep Learning Models:*

In this study, deep learning data begins with preprocessing, where the data collected is cleaned, structured and generalized. The model applies an input layer, several hidden layers and an output layer, weight, biases and activation functions.[14] During training, backpropagation adjusts weight by transmitting errors up to backward to improve accuracy. This recurrence process increases the performance of the model over time. Once trained, it captures complex relations between discount rates, prices and sales to enable data-operated pricing decisions in Fig.8

| | MAE | RMSE |
|---|---|---|
| MLP | 8.0079 | 10.0403 |
| LSTM | 7.5361 | 9.9391 |
| Transformer | 9.5526 | 12.1698 |

FIG 8: Evaluation of performance metrics MAE, and RMSE using Deep Learning Models.

This following image compares the performance of three deep learning models—MLP, LSTM, and Transformer—for

predicting discount rates. The bar chart at the top shows that the MLP model achieves the lowest MAE and RMSE, indicating better accuracy, while the Transformer performs the worst. The middle line graph displays actual vs. predicted discount rates across test samples, where MLP and LSTM closely follow the actual values, but the Transformer shows larger deviations. The bottom scatter plot further confirms this, as MLP and LSTM predictions are more aligned with the actual discount rates, while Transformer predictions are more dispersed in Fig.9 Overall, MLP outperforms the others in accuracy and consistency.[14]

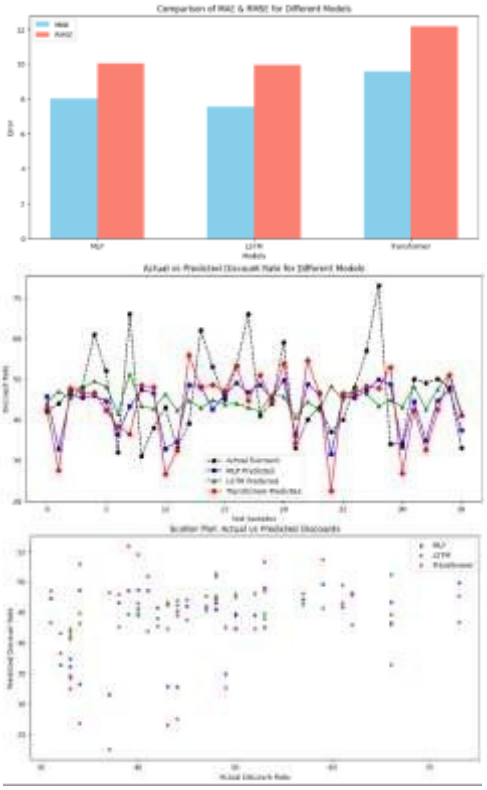

Fig 9: This image consists of three visualizations evaluating the performance of different models - MLP, LSTM, and transformer in predicting the discount rates.

SUMMARIZED INSIGHTS:

The deep learning models used in this study include MLP, LSTM, and a transformer-based model, all evaluated for predicting optimal discount rates. Among them, the **LSTM model performed the best**, achieving the lowest MAE and RMSE, and effectively capturing complex dependencies for accurate predictions. Although the transformer model showed some improvements, **LSTM remained the most accurate and reliable model** for optimizing strategies in this study.

## V. CONCLUSION AND FUTURE WORK

This study used machine learning and deep learning models to customize discount strategies and improve sales on Amazon. The transformer model performed the best, captured the complex pattern and ensured accurate predictions. Optimal rebate rates were found to maximize sales while maintaining profitability. Depending on the analysis of evaluation matrix from both Machine Learning and Deep Learning models, LSTM (longterm short -term memory) model displays the highest accuracy in predicting discount rates. It attains the lowest average absolute error (MAE) and root medium class error among all models, indicating its strong future performance. In contrast, traditional machine learning models such as linear regression, decision trees, random forests, and XGBoost show significantly more error values, making them less effective for this task. Therefore, LSTM model is the most suitable and reliable option to predict discount rates to customize sales strategies and increase product performance. Future work may include factors like customer demographics and seasonal trends for better accuracy. Integrating RPA tools such as UiPath can enable real time value adjustment. Advanced deep learning techniques can further refine exemption for better sales strategies.

## REFERENCES

[1] S. Shetty and S. Shetty, “Big Mart Sales Prediction using Machine Learning”.

[2] J. Ribeiro, R. Lima, T. Eckhardt, and S. Paiva, “Robotic Process Automation and Artificial Intelligence in Industry 4.0 – A Literature review,” Procedia Computer Science, vol. 181, pp. 51–58, 2021, doi: 10.1016/j.procs.2021.01.104.

[3] J. Sen and S. Mehtab, “A Robust Predictive Model for Stock Price Prediction Using Deep Learning and Natural Language Processing,” Jul. 26, 2021. doi:10.36227/techrxiv.15023361.

[4] A. Grybauskas, V. Pilinkienė, and A. Stundžienė, “Predictive analytics using Big Data for the real estate market during the COVID-19 pandemic,” J Big Data, vol. 8, no. 1, p. 105, Dec. 2021, doi: 10.1186/s40537-021-00476-0.

[5] C. Hennebold, K. Klöpfer, P. Lettenbauer, and M. Huber, “Machine Learning based Cost Prediction for Product Development in Mechanical Engineering,” Procedia CIRP, vol. 107, pp. 264–269, 2022, doi: 10.1016/j.procir.2022.04.043.

[6] A. C. Üzümcü and N. EliGüzel, “Predictive Analysis Using Web Scraping for the Real Estate Market in Gaziantep,” Bitlis Eren Üniversitesi Fen Bilimleri Dergisi, vol. 12, no. 1, pp. 17–24, Mar. 2023, doi:10.17798/bitlisfen.1155725.

[7] M. Sadat Lavasani, N. Raeisi Ardali, R. Sotudeh-Gharebagh, R. Zarghami, J. Abonyi, and N. Mostoufi, “Big data analytics opportunities for applications in process engineering,” Reviews in Chemical Engineering, vol. 39, no. 3, pp. 479–511, Apr. 2023, doi: 10.1515/revce-2020-0054.

[8] K. Venigandla, N. Vemuri, N. Thaneeru, and V. M. Tatikonda, “Leveraging AI-Enhanced Robotic Process Automation for Retail Pricing Optimization: A Comprehensive Analysis,” JKLST, vol. 2, no. 2, pp.361–370, Jun. 2023, doi: 10.60087/jklst.vol2.n2.p370.

[9] B. S. Thakur, K. Saini, A. Prakash, K. Hrishikesh, and A.Reddy, "Research Paper on Data Migration and Web Scraping with UiPath and Integration with Excel," SSRN Journal, 2024, doi: 10.2139/ssrn.4490179.

[10] A. Klein, S. Falkner, S. Bartels, P. Hennig, and F. Hutter, "Fast Bayesian Optimization of Machine Learning Hyperparameters on Large Datasets".

[11] P. S. Kumari and P. N. M., "Exploring AI and Machine Learning in Visualization for Optimizing Business Practices:," in Advances in Business Information Systems and Analytics, M. A. Muniasamy, A. Naim, and A. Kumar, Eds., IGI Global, 2024, pp. 67–84. doi: 10.4018/979-8-3693-6537-3.ch004.

[12] E. A. Alburshaid and R. Ksantini, "Real Estate Predictive Analysis for the Kingdom of Bahrain Using Web Scraping and Machine Learning," in 2024 Arab ICT Conference (AICTC), Manama, Bahrain: IEEE, Feb. 2024, pp. 101–107. doi: 10.1109/AICTC58357.2024.10735042.

[13] M. Barua, T. Kumar, K. Raj, and A. M. Roy,"Comparative Analysis of Deep Learning Models for Stock Price Prediction in the Indian Market," FinTech, vol. 3, no. 4, pp. 551–568, Nov. 2024, doi: 10.3390/fintech3040029.

[14] Kiran Babu Macha, "Integrating AI, ML, and RPA for end-to-end digital transformation in healthcare," World J. Adv. Res. Rev., vol. 25, no. 1, pp. 2116–2129, Jan. 2025, doi: 10.30574/wjarr.2025.25.1.0264.

[15] S. P. S. Appalabatla, A. S. Kumar, A. P. Sai, A. Sanjana, and D. R. Poornima, "Automobile Resale Price Prediction Using ML Algorithm," vol. 10, no.12, 2023.

[16] D. Andrade, "Challenges of Automated Software Testing with Robotic Process Automation RPA - A Comparative Analysis of UiPath and Automation Anywhere," IJICR, vol. 11, no. 1, pp. 1066–1072, Dec. 2020, doi: 10.20533/ijicr.2042.4655.2020.0129.

[17] D. Jerab, "The Growth of E-Commerce and Its Effect on Brick-and-Mortar Stores," SSRN Journal, 2025, doi: 10.2139/ssrn.5092297.

[18] I. Dawar, A. Srivastava, M. Singal, N. Dhyani, and S. Rastogi, "A systematic literature review on municipal solid waste management using machine learning and deep learning," Artif Intell Rev, vol. 58, no. 6, p. 183, Mar. 2025, doi: 10.1007/s10462-025-11196-9.

[19] Rama Krishna Debbadi and Obed Boateng, "Enhancing cognitive automation capabilities with reinforcement learning techniques in robotic process automation using UiPath and automation anywhere," Int. J. Sci. Res. Arch., vol. 14, no. 2, pp. 733–752, Feb. 2025, doi: 10.30574/ijsra.2025.14.2.0450.