Jurnal Minfo Polgan
Volume 13, Nomor 2, Februari 2025 e-ISSN : 2797-3298
DOI : https://doi.org/10.33395/jmp.v13i2.14503 p-ISSN : 2089-9424

Analysis of the Influence of Machine Learning on Sales Prediction and Stock Management in Online Business

[1]Muhamad Malik Mutoffar, [2]Yudi Limbar Yasik, [3]Ridwan, [4]Narti Eka Putria
[1,2]Universitas Teknologi Bandung, [3]ARS University, [4]University Nagoya
[1]malik@utb-univ.ac.id, [2]yudiyasik@utb-univ.ac.id [3]ridwan@ars.ac.id
[4]nartiekaputria@gmail.com

***Received**: 22th January 2025; **Accepted**: 31th January 2025 **Published**: 05th February 2025*

ABSTRACK

Online businesses continue to experience rapid development along with digital transformation that drives efficiency and competitiveness. However, one of the main challenges faced is the uncertainty in predicting sales, which can cause an imbalance between demand and stock. The inaccuracy of this prediction often results in overstock or understock, thus increasing operational costs and decreasing customer satisfaction levels. This study aims to analyze the effect of implementing Machine Learning (ML) algorithms on the accuracy of sales predictions and the efficiency of stock management in online businesses. Historical sales data collected from e-commerce platforms were processed using Random Forest and Long Short-Term Memory (LSTM) algorithms. The results showed that the ML algorithm was able to increase the accuracy of sales predictions by up to 20% compared to traditional methods. In addition, the implementation of ML-based predictions allows for more efficient stock management with a decrease in the level of overstock by 15% and a reduction in the risk of understock by up to 25%. These findings not only strengthen the literature related to the role of intelligent technology in digital business management but also offer practical guidance for online business actors to improve their operations through Machine Learning technology. Thus, this study makes an important contribution to digital transformation strategies in a competitive online business ecosystem.

Keywords: *Machine Learning, sales prediction, stock management, online business, operational efficiency.*

INTRODUCTION

In the era of digital transformation, online businesses are growing rapidly, supported by technological advances that enable business actors to improve operational efficiency and competitiveness. One of the main challenges faced by online businesses is the uncertainty in predicting sales, which can cause an imbalance between demand and stock. Accurate sales predictions are an important factor in optimizing stock management, because excess stock can increase storage costs, while shortages can reduce customer satisfaction levels. In this context, Machine Learning (ML) technology has emerged as a promising solution to overcome these challenges by providing more accurate predictions based on historical data.

Several previous studies have explored the role of Machine Learning in sales prediction and stock management. For example, research conducted by (Win & Bo, 2020) shows that the Random Forest algorithm is able to provide better sales predictions than traditional statistical models. Another study by Nasseri utilized Long Short-Term Memory (LSTM) to predict sales in the retail business (Nasseri, Falatouri, Brandtner, & Darbanian, 2023), with results showing an accuracy increase of up to 15% compared to conventional methods. In addition, Zubair's study highlights the importance of integration between ML-based predictions and automated stock management systems, which can significantly reduce the risk of understocking and overstocking. (Zubair et al., 2024).

Jurnal Minfo Polgan
Volume 13, Nomor 2, Februari 2025 e-ISSN : 2797-3298
DOI : https://doi.org/10.33395/jmp.v13i2.14503 p-ISSN : 2089-9424

This study aims to analyze the effect of Machine Learning implementation on the accuracy of sales predictions and its impact on stock management efficiency in online businesses. By evaluating relevant algorithms and measuring their results in the context of stock management, this study is expected to make a significant contribution to academic literature and offer practical insights for online business actors to optimally utilize Machine Learning technology.

LITERATURE REVIEW

Sales Forecast in Online Business

Sales forecasting is an important aspect in managing an online business, especially to determine efficient marketing strategies and stock management. According to Win & Bo, the use of algorithms such as Random Forest can improve prediction accuracy compared to traditional statistical methods (Win & Bo, 2020). This study shows that Machine Learning (ML) based algorithms have the ability to exploit complex patterns in historical data, resulting in more accurate predictions. Sales forecasting is a way for business owners to estimate revenue in a certain period based on predictions of the number of products that will be sold, previous data, market trends, and business analysis (Maiyana, 2021).

Application of Machine Learning for Sales Prediction

Machine Learning has become a popular tool in processing data in addition to the health sector, it can also be used for sales (Setiyadi et al., 2025). Nasseri uses the Long Short-Term Memory (LSTM) algorithm to predict long-term sales trends in the retail industry. (Nasseri et al., 2023). Their research shows that LSTM is able to capture seasonal patterns and sales fluctuations with a high degree of accuracy. In addition, this algorithm is also effective for processing large volumes of data with various variables. This technology allows the analysis of historical data such as sales trends, seasonal patterns, promotions, and external factors such as economic conditions or weather (Husein, Lubis, & Harahap, 2021). In the process, the collected data is processed through a preprocessing step to address issues such as missing data, outliers, or scale differences between features. Once the data is ready, Machine Learning algorithms such as linear regression, decision trees, random forests, or deep learning methods such as LSTM are used to build predictive models. These models are then evaluated using metrics such as Mean Absolute Error (MAE) or Root Mean Squared Error (RMSE) to ensure their accuracy before being applied to new data (Novarida, Pasrun, & Sutoyo, 2024). With this approach, companies can optimize production planning, inventory management, and marketing strategies to improve operational efficiency and profitability.

Stock Management in Online Business

Efficient stock management is a major challenge for online businesses. Rafisa emphasized the importance of integrating ML-based sales predictions with automated stock management systems. The study found that stock management supported by accurate predictions can reduce storage costs by up to 15% and increase product availability by up to 25%. Online businesses face unique challenges in stock management, such as demand fluctuations due to unexpected changes in consumer behavior, especially during promotions or holiday seasons (Rafisa, Veronika, & Aisyah, 2023). Some strategies that can be implemented to increase the efficiency of stock management in online businesses include the use of technology such as cloud-based inventory management systems for real-time stock monitoring. (Rafisa et al., 2023), demand prediction using data analysis and machine learning algorithms (Leung, Mo, Ho, Wu, & Huang, 2020), warehouse diversification by providing strategic locations to accelerate distribution (van Zantvoort, n.d.), and the implementation of dropshipping which relies on suppliers to send products directly to customers, thereby reducing the need for stock (Kamalapur & Lyth, 2020).

Jurnal Minfo Polgan
Volume 13, Nomor 2, Februari 2025 e-ISSN : 2797-3298
DOI : https://doi.org/10.33395/jmp.v13i2.14503 p-ISSN : 2089-9424

The Importance of Technology Integration in Digital Business

The use of intelligent technologies such as ML provides significant benefits for digital business management, including increasing operational efficiency and competitiveness. The integration of these technologies allows businesses to adapt more quickly to changing market demands and consumer trends.

RESEARCH METHODS

Research Design

This study uses a quantitative approach with an experimental method to analyze the effect of Machine Learning algorithms on the accuracy of sales predictions and stock management efficiency. Experiments are conducted using historical sales data from online businesses processed through Machine Learning algorithms to produce more accurate sales predictions.

Research Data

The data used in this study is secondary data in the form of daily sales data from online business platforms for the past two years. This data includes information such as sales volume, product category, price, and seasonal demand patterns. The data is cleaned to remove outliers and irrelevant data before further analysis.

Analysis Tools and Techniques

This study uses several Machine Learning algorithms, namely:

a. Random Forest: Used for sales prediction analysis by capturing complex patterns in historical data.
b. Long Short-Term Memory (LSTM): Used to predict long-term sales trends, especially for time series data.
c. Gradient Boosting: Used to compare prediction accuracy results with other algorithms.

The implementation of the algorithm is carried out using Python software with libraries such as Scikit-learn, TensorFlow, and Pandas. Evaluation of algorithm performance is carried out using the Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R-squared (R^2).

Research Procedures

The research stages include:

a. Data Collection: Data is taken from online business platforms and adjusted to the needs of the analysis.
b. Data Preprocessing: Data is cleaned, normalized, and converted into a format suitable for Machine Learning analysis.
c. Algorithm Application: Machine Learning algorithms are applied to predict sales based on the processed data.
d. Model Evaluation: Prediction results are analyzed using evaluation metrics to assess the accuracy and effectiveness of the algorithm.
e. Analysis and Interpretation: Evaluation results are used to conclude the effect of the algorithm on sales prediction and stock management efficiency.

Validation and Testing

The model used is validated using cross-validation techniques to ensure the reliability of predictions. In addition, testing is carried out on new data to measure the performance of the model in real situations. This method is expected to provide comprehensive and relevant results for online business actors in optimizing stock management using Machine Learning-based predictions.

Jurnal Minfo Polgan
Volume 13, Nomor 2, Februari 2025 e-ISSN : 2797-3298
DOI : https://doi.org/10.33395/jmp.v13i2.14503 p-ISSN : 2089-9424

RESULTS AND DISCUSSION

Results

1. Machine Learning Algorithm Performance

This study uses three main algorithms, namely Random Forest, Long Short-Term Memory (LSTM), and Gradient Boosting, to predict sales. Based on the evaluation using the Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R-squared (R^2), the results are as follows:

Table 1. Machine Learning performance results

Algoritma	MAE	RMSE	R^2
Random Forest	1.25	1.85	0.89
LSTM	0.95	1.60	0.93
Gradient Boosting	1.10	1.75	0.91

From the results, LSTM has the best performance in predicting sales, with an R^2 value of 0.93, indicating a very high level of prediction accuracy. This indicates that LSTM is more effective in capturing seasonal trends and sales fluctuations in time series data.

2. Stock Management Efficiency

Using prediction results based on Machine Learning algorithms, stock management simulations are carried out. Stock efficiency is measured based on reducing the level of excess stock and shortage of stock. The simulation results show that:

a. Excess stock can be reduced by 18% using LSTM-based prediction.
b. The risk of stock shortages decreases by 25% with the implementation of sales prediction.

This stock management efficiency has a direct impact on reducing storage costs and increasing customer satisfaction.

Discussion

1. Advantages of Machine Learning in Sales Prediction

The results of the study show that the Machine Learning algorithm is able to improve the accuracy of sales prediction compared to traditional methods. This finding is in line with research (Nasseri et al., 2023), which states that LSTM is effective in handling time series data with complex patterns.

2. Impact on Stock Management

The use of Machine Learning-based predictions has a significant impact on stock management efficiency. The reduction in overstock and understock levels reflects how accurate predictions can help businesses optimize resources. This finding is consistent with a study (Zubair et al., 2024), which shows that integration between sales prediction and stock management systems can reduce the risk of logistics inefficiencies.Implikasi bagi Bisnis Online

By integrating Machine Learning into business operations, business actors can increase their competitiveness in the digital market. This technology not only helps in planning stock, but also in making strategic decisions based on data. However, the adoption of this technology requires a large initial investment, including model development and workforce training.

This study proves that Machine Learning algorithms, especially LSTM, have great potential to improve sales prediction and stock management efficiency in online businesses. This provides a practical guide for businesses to leverage smart technologies to address operational challenges and improve customer satisfaction.

Jurnal Minfo Polgan
Volume 13, Nomor 2, Februari 2025 e-ISSN : 2797-3298
DOI : https://doi.org/10.33395/jmp.v13i2.14503 p-ISSN : 2089-9424

CONCLUSION

This study shows that the application of Machine Learning algorithms, especially Long Short-Term Memory (LSTM), can significantly improve the accuracy of sales predictions and stock management efficiency in online businesses. The experimental results show that LSTM produces more accurate predictions compared to other algorithms, such as Random Forest and Gradient Boosting, with an R^2 value reaching 0.93. The use of Machine Learning-based predictions also succeeded in reducing the level of excess stock by 18% and reducing the risk of stock shortages by 25%, which in turn can reduce operational costs and increase customer satisfaction. However, this study also has several limitations. First, the data used is limited to one e-commerce platform, so generalizing the results of this study to various platforms or other types of products may need to be done with further research. Second, the model applied only relies on historical sales data without considering external factors such as economic conditions, changes in consumer behavior, or promotions that can affect sales trends.

REFERENSI

Husein, A. M., Lubis, F. R., & Harahap, M. K. (2021). Analisis Prediktif untuk Keputusan Bisnis: Peramalan Penjualan. *Data Sciences Indonesia (DSI)*, *1*(1), 32–40.

Kamalapur, R., & Lyth, D. (2020). Impact of stockout compensation in e-commerce drop-shipping supply chain. *Operations and Supply Chain Management: An International Journal*, *13*(1), 82–93.

Leung, K. H., Mo, D. Y., Ho, G. T. S., Wu, C.-H., & Huang, G. Q. (2020). Modelling near-real-time order arrival demand in e-commerce context: a machine learning predictive methodology. *Industrial Management & Data Systems*, *120*(6), 1149–1174.

Maiyana, E. (2021). Pemanfaatan ann untuk prediksi penjualan online industri rumahan selama pandemi covid-19. *SAINS DAN INFORMATIKA: RESEARCH OF SCIENCE AND INFORMATIC*, *7*(1), 1–7.

Nasseri, M., Falatouri, T., Brandtner, P., & Darbanian, F. (2023). Applying Machine Learning in Retail Demand Prediction—A Comparison of Tree-Based Ensembles and Long Short-Term Memory-Based Deep Learning. *Applied Sciences*, *13*(19), 11112.

Novarida, E., Pasrun, Y. P., & Sutoyo, M. N. (2024). Implementasi Metode Time Series Simple Moving Average untuk Prediksi Penjualan Multi-Produk. *JISTech: Journal of Information Systems and Technology*, *1*(1), 1–6.

Rafisa, A. W., Veronika, R., & Aisyah, S. (2023). Implementation Of Supply Chain Management In Social Media–Based Online Shop Store (Case Study: Emstore). *Jurnal Akuntansi, Manajemen Dan Bisnis Digital*, *2*(1), 1–6.

Setiyadi, D., Henderi, H., Suryaningrat, A., Swastika, R., Saludin, S., Mutoffar, M. M., & Yunianto, I. (2025). Prediction of heart disease using random forest algorithm, support vector machine, and neural network. *TELKOMNIKA (Telecommunication Computing Electronics and Control)*, *23*(1), 129–137.

van Zantvoort, C. A. P. S. (n.d.). Optimizing Inventory Replenishment for Centralized and Decentralized 2-Location Supply Chains Using Genetic Algorithms in E-commerce.

Win, T. T., & Bo, K. S. (2020). *Predicting customer class using customer lifetime value with random forest algorithm*. In *2020 International Conference on Advanced Information Technologies (ICAIT)* (pp. 236–241). IEEE.

Zubair, M., Waleed, A., Rehman, A., Ahmad, F., Islam, M., & Javed, S. (2024). *Machine Learning Insights into Retail Sales Prediction: A Comparative Analysis of Algorithms*. In *2024 Horizons of Information Technology and Engineering (HITE)* (pp. 1–7). IEEE.