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Implementation of Web Based Motorcycle Sales Prediction System Using the Least Squares Method

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Abstract

The development of information technology has brought significant changes in business data management, including in the automotive industry. Dony Jaya Motor, as one of the motorcycle dealers, faces challenges in predicting sales, particularly in balancing stock availability with market demand. This study aims to develop a web-based motorcycle sales prediction system using the Least Squares method due to its ability to identify linear trend patterns from historical data, producing accurate and measurable sales projections. The data used cover motorcycle sales from May 2024 to April 2025. The implementation results show that the Least Squares method provides good predictive accuracy, with the average Mean Absolute Percentage Error (MAPE) value below 10%, indicating a very low prediction error rate. For example, for the Honda Beat 2015 type, the predicted sales for May 2025 were 5.67 units compared to the actual 6 units, resulting in a MAPE value of 4.67%. The developed system includes features for data input, graphical visualization, and real-time prediction reporting. The application of the Least Squares method in this web-based system has proven to assist management in stock planning, improve decision-making processes, and enhance overall operational efficiency and effectiveness within the company.

Keywords: *Prediction, Least Squares Method, Web-Based System, Mape.*

1. Introduction

The advancement of information technology over the past two decades has brought significant and transformative changes to nearly all industrial sectors, including the automotive industry. In the current digital era, companies are required not only to produce competitive and innovative products but also to leverage data as a strategic asset to support fast, accurate, and well-informed decision making processes. Data driven decision making has become a key factor in determining a company's ability to compete in highly dynamic markets. In the automotive sector, one of the most substantial and persistent challenges is aligning product availability with fluctuating market demand[1]. When demand forecasts are inaccurate, companies often experience overstock, resulting in increased storage and maintenance costs, or understock, which leads to customer dissatisfaction, lost sales, and declining loyalty. Both conditions significantly affect operational efficiency and financial performance.

Dony Jaya Motor, a motorcycle dealership operating in a competitive local market, faces similar challenges. Although the company has adopted a digital recording system for daily operational documentation, the data collected has not been fully utilized for analytical or predictive purposes. The stock planning process remains reactive, relying primarily on managerial intuition and past experiences [2]. This traditional approach often fails to accurately capture market fluctuations, especially when consumer purchasing behavior changes rapidly due to economic conditions, seasonal patterns, or promotional campaigns by competitors. As a result, the dealership frequently struggles to maintain optimal inventory levels. To overcome these issues, an integrated prediction system capable of estimating future demand based on historical data is urgently necessary [3]. Such a system would enable the company to move from reactive stock management to proactive, data-driven planning.

The primary problem faced by Dony Jaya Motor is the lack of an integrated sales forecasting system that can assist management in planning stock more accurately. Without such a system, decisions regarding inventory procurement still rely heavily on subjective judgment, which does not always reflect actual market behavior. This condition exposes the company to the risks of overstock leading to capital being tied up unproductively or understock, which limits sales potential and negatively affects customer trust [4]. Similar challenges are commonly encountered by many small and medium enterprises in Indonesia, where technology is used merely for data storage rather than analytical processing. The absence of predictive analytics limits the ability of companies to anticipate consumer demand and respond efficiently. Therefore, the development of a technology based forecasting solution is essential to make stock planning more measurable, objective, and

aligned with real-time market dynamics. With the implementation of an automated forecasting system, Dony Jaya Motor is expected to maintain a better balance between supply and demand, resulting in improved operational performance [5].

A number of previous studies have validated the effectiveness of statistical methods, especially regression based approaches, in improving the accuracy of sales forecasting. Mulyani (2021) demonstrated that the application of the Least Squares method in automotive companies generated more accurate sales estimates than qualitative or intuition-based approaches [6]. Another study by Ridwan (2020) successfully implemented the same method in a web-based prediction system for a sports equipment store, allowing managers to obtain real time forecasts that significantly increased operational efficiency [7]. Moreover, Herlambang (2021) emphasized that integrating predictive analytics into a web based platform enhances managerial responsiveness, giving companies the ability to adapt quickly to market shifts through timely and reliable information [8]. Collectively, these findings highlight the relevance and robustness of the Least Squares method for sales prediction, especially in sectors characterized by regular demand variations such as automotive and retail. The success of these studies provides a strong theoretical and practical foundation for developing a web-based prediction system tailored to the operational characteristics of Dony Jaya Motor.

In light of the problems identified and the supporting evidence from previous research, the Least Squares method was chosen as the primary analytical technique for designing the sales prediction system at Dony Jaya Motor. This method is widely recognized for its effectiveness in capturing linear trends from time-series datasets and generating a regression model that represents the relationship between time and sales volume [3]. By minimizing the squared differences between predicted and actual values, the method provides stable and accurate forecasting outputs. Additionally, the use of Mean Absolute Percentage Error (MAPE) as an evaluation metric ensures that prediction accuracy can be measured quantitatively and interpreted easily by management. Compared to other forecasting techniques such as ARIMA or Exponential Smoothing, the Least Squares method offers simpler computation, ease of implementation, and suitability for datasets that exhibit linear trends without complex seasonal components. Therefore, it is considered the most appropriate approach for a dealership environment where data volume is manageable and trend patterns are relatively stable.

The implementation of the Least Squares method within a web-based system provides significant added value for Dony Jaya Motor. The designed system incorporates various functional features, including data input modules, automated prediction calculations, interactive trend visualizations, and real-time report generation [9]. Since the system is web-based, it can be accessed flexibly through various devices, enabling management to perform monitoring and analysis at any time and from any location. This accessibility improves the efficiency of business processes by reducing reliance on manual calculation methods, which are time-consuming and prone to human error. The forecasting results generated by the system serve multiple managerial purposes, such as stock procurement planning, identifying sales opportunities, preparing promotional strategies, and supporting medium- and long-term strategic decisions. Beyond addressing internal operational challenges at Dony Jaya Motor, the system developed in this study can also serve as a technological model for other automotive businesses in Indonesia that seek to adopt digital transformation and predictive analytics [1]. By empowering companies to anticipate market needs, the integration of predictive analytics into business systems contributes meaningfully to the advancement of data-driven management practices in the country.

2. Research Methods

A prediction system is an application of information technology designed to estimate future events or phenomena by analyzing patterns and trends found in historical data. In essence, prediction systems serve as analytical tools that convert raw datasets into meaningful insights, enabling organizations to plan future strategies more effectively. In the business world, particularly within the automotive industry where competition is intense and consumer demand fluctuates rapidly, prediction systems play a crucial role in supporting accurate, measurable, and evidence-based decision making. By utilizing this technology, companies can forecast market demand, determine optimal production quantities, and maintain a balance between available stock and consumer purchasing needs [10]. Such capabilities ensure that operational decisions are no longer based solely on intuition or experience but grounded in quantitative analysis.

This function is especially important because errors in forecasting can have significant impacts on business performance. Overestimation of demand may lead to excess stock, which increases storage and maintenance costs, ties up capital, and reduces overall efficiency. On the other hand, underestimation of demand can cause shortages, resulting in missed sales opportunities, dissatisfied customers, and reduced competitiveness. Both conditions pose financial and strategic risks for companies. Several studies have shown that data-driven prediction systems enable organizations to anticipate market fluctuations, optimize inventory levels, and design more efficient distribution and sales strategies [11]. In this way, prediction systems not only improve operational performance but also enhance a company's responsiveness to external market dynamics.

One of the major advantages of prediction systems is their ability to transform historical data such as sales records, customer behavior, and market trends into valuable information that can be used for managerial decision making [12]. Through statistical modeling, trend analysis, and predictive algorithms, these systems reveal hidden patterns that may not be easily identified through manual observation. Furthermore, modern prediction systems are increasingly integrated into web-based digital platforms, making them accessible across various devices and locations. The adoption of web-based prediction systems provides several benefits, including real-time monitoring, automated data processing, remote accessibility, and more user-friendly visualization of forecasting results.

With such a system in place, management can reduce decision-making uncertainty and respond more quickly to shifts in market behavior, promotional cycles, seasonal demand variations, or competitive actions. This agility is essential for maintaining business continuity and achieving long-term sustainability, especially in industries that rely heavily on accurate demand planning. As global competition intensifies and digital transformation becomes a necessity rather than an option, prediction systems have evolved into an essential component of data-oriented business strategies [13]. They not only support operational efficiency but also contribute to strategic planning, risk mitigation, and performance optimization across multiple business functions.

2.1. The Least Squares Method

The Least Squares method is one of the most widely used statistical approaches in regression analysis to predict future trends based on historical data. The main principle of this method is to minimize the sum of squared differences between actual values and predicted values. Thus, the resulting regression line is considered the best fit for the existing data pattern. In the context of sales forecasting, the Least Squares method is highly effective for identifying linear trend patterns in sales data over a specific period [3]. Its advantage lies in its simplicity while still providing accurate and measurable results. The basic formula of this method involves calculating the slope and intercept of the regression line, which are then used to project future values [14].

This method is often chosen in academic research and business applications because it captures long term trends effectively. Compared with more complex forecasting methods such as ARIMA or Exponential Smoothing, the Least Squares method is easier to implement and suitable for datasets with stable linear trends. Therefore, it is considered appropriate for use in the web-based motorcycle sales prediction system at Dony Jaya Motor [15]. The prediction formula using the Least Squares method forms a simple linear regression equation that describes the relationship between the time variable (X) and the number of sales (Y):

$$y' = a + bx \tag{1}$$

With this equation, researchers can project sales quantities for upcoming periods more systematically based on historical data. The slope of the regression line is calculated to determine the average change in sales for every one unit increase in time.

$$b = \frac{\sum XY}{\sum X^2} \tag{2}$$

The slope value obtained becomes an important component of the regression equation because it determines the direction and magnitude of the sales trend. The intercept represents the point at which the regression line intersects the Y axis when the X variable is zero, thus illustrating the estimated initial sales before any changes in time occur.

$$a = \frac{\sum y}{N} b \left(\frac{\sum x}{N}\right) \tag{3}$$

By calculating the intercept, researchers obtain the initial baseline value of the regression equation, which is then combined with the slope to produce sales projections.

The automotive industry is one of the sectors that requires high precision in stock planning and product distribution. Errors in projecting market demand can significantly affect operational costs and customer satisfaction [8]. Therefore, the application of the Least Squares method in the automotive field becomes an effective solution to support decision-making. Several previous studies have shown that this method can provide highly accurate vehicle sales estimates. For instance, Gaum (2023) demonstrated that the Least Squares method consistently follows vehicle sales trends over time [16].

In its implementation, this method is used to process historical vehicle sales data and generate projections of the number of units required in the next period. With measurable prediction results, companies can adjust their production, promotion, and distribution strategies more effectively. Another advantage of this method is its compatibility with web-based technologies, enabling forecasting processes to be carried out automatically and in real time [6].

This capability has proven to be highly beneficial for automotive dealers such as Dony Jaya Motor in anticipating fluctuations in market demand. Therefore, the application of the Least Squares method in the automotive industry not only enhances operational efficiency but also provides significant value in supporting strategic company planning.

2.2. Mean Absolute Percentage Error (MAPE)

In studies involving prediction, forecast accuracy is a crucial aspect that must be considered. One of the most widely used metrics for measuring accuracy is the Mean Absolute Percentage Error (MAPE). MAPE calculates the average percentage of absolute error between actual values and predicted values [17]. The calculation is relatively simple: the absolute difference between the actual and predicted values is divided by the actual value and then multiplied by 100 percent. A low MAPE value indicates that the prediction results are close to the actual values, meaning the prediction system is accurate and reliable. One advantage of MAPE compared to other error metrics is that it expresses results in percentage form, making it easier to understand for management and non-technical users.

In research involving motorcycle sales prediction, MAPE is used to evaluate the performance of the Least Squares method in projecting sales trends [18]. The evaluation results then serve as the basis for assessing the reliability of the developed web-based system. Thus, MAPE functions not only as an accuracy indicator but also as a validation tool to ensure that the prediction system provides relevant information to support business decision-making. To evaluate the accuracy of forecasting results, this study uses the Mean Absolute Percentage Error (MAPE) as the prediction error measurement.

$$MAPE = \frac{1}{n} \sum_{t=1}^{n} \left| \frac{A_t - F_t}{\hat{t}} \right| x\, 100\% \tag{4}$$

A smaller Mean Absolute Percentage Error (MAPE) value indicates a higher level of predictive accuracy, which means the forecasting results are more reliable and can be effectively used to support managerial decision-making. In the context of this research, MAPE serves as a crucial indicator for evaluating the performance of the predictive model developed through the Least Squares method. The lower the MAPE score, the closer the predicted values are to the actual sales data, ultimately increasing confidence in the model's ability to represent real-world conditions accurately.

This study adopts a quantitative descriptive approach, focusing on the analysis of numerical data derived from the historical sales records of motorcycles at Dony Jaya Motor. Such an approach is highly suitable because the primary objective of the research is to transform raw numerical data into meaningful statistical information that can guide future business strategies. The dataset utilized in this study consists of motorcycle sales records collected over a continuous twelve-month period, specifically from May 2024 to April 2025. This one-year span provides a sufficient timeframe to observe fluctuations, identify seasonal patterns, and detect long-term sales trends [19].

By applying this approach, the study aims to generate an objective and comprehensive overview of existing sales tendencies. These findings are expected to help management understand market behavior more accurately and support them in preparing optimal stock allocations. The dataset includes several popular motorcycle categories, such as Honda Beat, Honda Vario, Honda Scoopy, and Yamaha Mio, each of which exhibits distinct sales characteristics. For instance, certain models may experience higher demand during particular months due to seasonal influences, promotional strategies, or consumer preferences. Considering these differences, the data-processing stage is carried out with careful attention to the unique attributes of each motorcycle type.

All sales data are systematically input into the web-based forecasting system designed for this research. The system integrates PHP, HTML, JavaScript, and a MySQL database to automate data processing and prediction generation. Once entered, the system analyzes the data using the Least Squares method one of the most widely used linear regression techniques due to its straightforward computation process and strong ability to represent linear patterns in historical datasets. Through this method, the model calculates the slope and intercept of the regression line, producing a mathematical representation of the relationship between time (as the independent variable) and sales volume (as the dependent variable).

After the forecasting results are obtained, they are evaluated by comparing the predicted values with the actual sales data using MAPE as the key accuracy metric. This validation step is essential not only to determine the reliability of the model but also to measure how effectively the system can support real-time forecasting when implemented in a business environment. The use of MAPE ensures that accuracy is assessed in percentage form, making it easier for managers to interpret and compare prediction performance across different product categories and time periods. Therefore, the sales data in this research serve not only as computational input but also as an essential element for validating the model’s accuracy and proving the overall effectiveness of the forecasting technique.

The research framework is designed systematically to provide a complete, end to end representation of the entire process. The study begins with problem identification, particularly the challenge faced by the company in predicting future sales manually, which often leads to inaccurate forecasting and inefficient stock management. The next stage involves collecting one year of historical motorcycle sales data, which becomes the main basis for the forecasting process. This data is then processed using the Least Squares method to produce a linear regression model capable of illustrating the overall trend. Following this, the evaluation phase using MAPE is conducted to analyze the performance of the forecasting model.

The final phase of the research consists of interpreting the results, discussing the implications, and drawing conclusions regarding the effectiveness of the system. Through this multi-stage process, the study not only generates numerical forecasting outputs but also contributes valuable insights into improving operational efficiency, optimizing inventory planning, and enhancing decision-making accuracy within the company. Ultimately, the findings demonstrate how a structured forecasting system supported by statistical techniques can provide meaningful benefits for business operations, particularly in environments where accurate demand prediction is critical.

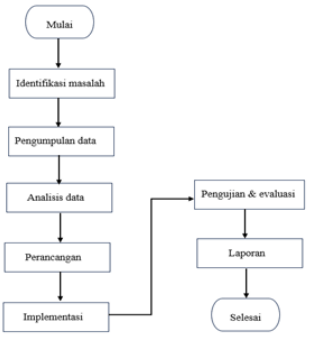

Fig. 1: Research Stage Scheme

In the next stage, the web-based system is developed with key features including data input, prediction processing, graphical visualization, and the generation of forecasting reports. After the system is fully built, an accuracy evaluation using MAPE is conducted to assess how closely the predictions align with actual data. The final stage involves discussing the implementation results and drawing conclusions regarding the system’s effectiveness in supporting decision-making. With this clear research framework, the forecasting process not only produces numerical outputs but also provides tangible contributions to improving the company’s operational efficiency.

The method used in this study is the Least Squares method, which is one of the linear regression techniques. This method was selected due to its advantages in capturing linear trend patterns and the simplicity of its calculations. The analytical process consists of collecting sales data, calculating the regression line parameters namely the slope and intercept and then projecting sales values for upcoming periods. After the calculations are completed, the prediction results are evaluated using the Mean Absolute Percentage Error (MAPE) to determine the accuracy level of the model in representing actual data. In addition to the mathematical analysis, this study also designs a web based system that automates the prediction process. The system is built using PHP, HTML, and JavaScript as the programming languages, with MySQL as the database. Through this design, the prediction system can be accessed in real time, display trend visualization graphs, and generate reports that support effective decision making.

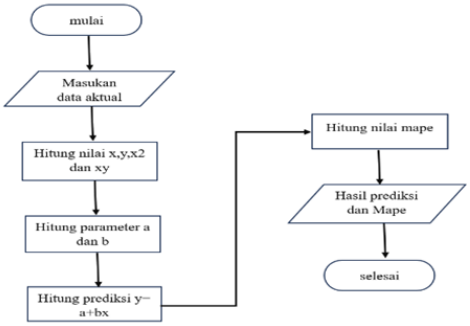

Fig. 2: DFD Flowchart Least Square Method

The flowchart of the Least Square method in this study illustrates the process of calculating a simple linear regression to predict motorcycle sales. The flow begins with the input stage of sales data taken from the company's historical records. The data is then processed through the calculation stage of regression parameter values, namely slope (b) and intercept (a). These two values are used to form a regression line equation that represents the relationship between the time period and the number of sales.

Once the equation is formed, the system will generate a predicted sales value for a certain period. This flowchart also includes an evaluation stage, where the predicted results are compared with actual data using the Mean Absolute Percentage Error (MAPE) accuracy measure. With this structured flow, the Least Square method can be implemented more systematically and is easily understood, both by system developers and management who utilize the prediction results.

3. Results and Discussion

The results and discussion section of this study presents the implementation and performance of the motorcycle sales prediction system developed using the Least Squares method, which has been designed, tested, and evaluated at Dony Jaya Motor. This stage aims to explain in detail how the system processes historical sales data, transforms it into analytical information, and generates accurate and reliable sales projections that align with real-world business conditions. Historical sales data from May 2024 to April 2025 were systematically entered into the system and then processed through a linear regression model. The model calculates the slope and intercept of the regression line, which serve as the foundation for forecasting sales trends in subsequent periods. By applying the Least Squares method, the system is able to identify underlying trends in the data and minimize prediction errors, ensuring that the resulting forecasts are both meaningful and quantitatively sound.

Furthermore, the website-based system developed in this research offers a comprehensive set of features designed to support the entire prediction workflow. These features include data entry modules for storing and organizing motorcycle sales records, automated prediction calculations executed through embedded regression algorithms, as well as real-time visualization of sales trends presented in the form of interactive graphs. The graphical representations allow users to easily observe fluctuations, compare sales performance across months, and interpret prediction outcomes more intuitively. In addition to visualization, the system also provides forecasting reports that summarize prediction results, accuracy evaluations, and data patterns, all of which can be used by management as a reference in planning stock availability, adjusting marketing strategies, and making evidence based decisions.

To ensure data security and controlled access, the system incorporates a login page that serves as the initial authentication layer. This login mechanism ensures that only authorized users such as managers or designated staff can access the sales database and utilize system features. The presence of this authentication system helps protect sensitive business information, prevents unauthorized modifications to sales records, and maintains the overall integrity of the database. By implementing structured access control, the prediction system not only supports operational efficiency but also upholds confidentiality and strengthens the reliability of the information presented.

Overall, the implementation results demonstrate that the system functions effectively in processing data, generating predictions, and supporting managerial decision-making. The combination of automated calculations, data visualization, secure access, and real-time reporting highlights the system’s potential as a valuable technological tool for improving stock management, forecasting accuracy, and operational planning at Dony Jaya Motor.

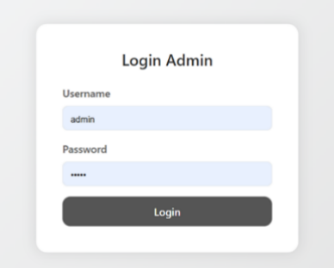

Fig. 3: User Login Page

Image of the login page, which serves as the main entry point for users to access the sales forecasting system. On this page, users are required to enter their registered username and password to access the system. The login page's function is to maintain sales data security while restricting access to authorized parties. The page's layout is simple, with an easy-to-understand input form, making it easy for users to authenticate. Through this dashboard page, users not only obtain a summary of sales data but also access the system's key features more efficiently. The dashboard serves as a crucial starting point for supporting data analysis and sales forecasting activities at Dony Jaya Motor.

Fig. 4: Dashboard Page

Image of the dashboard display as the main page after successfully logging in to the system. The dashboard serves as an information center, presenting a summary of sales data, trend graphs, and a navigation menu for other features. The dashboard's design is interactive so users can quickly understand the information. This page provides users with an overview of sales conditions over a specific period, facilitating initial decision-making before conducting more detailed analysis. With this report page, the system can provide analytical documents ready for management consideration. The information displayed is not just data, but also accurate forecast results, thus supporting more effective and efficient planning.

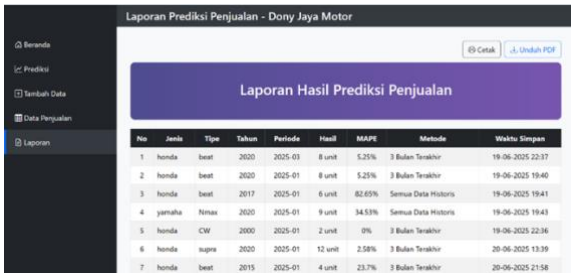

Fig. 5: Report Page

Image of a report page designed to present the final results of sales predictions in a more structured format. This page allows users to view actual data, prediction calculation results, and an evaluation of their accuracy, all clearly displayed. The primary function of the report is to provide comprehensive information that management can use in developing inventory procurement strategies and sales planning. The report's layout is neatly organized with supporting tables and graphs, making it easy to understand for non-technical users. The following table shows the results of motorcycle sales prediction calculations using the Least Squares method. The data displayed includes actual sales values, estimated prediction results, and the error margin calculated as an error. This table serves as the basis for evaluating the performance of the method used because it shows a direct comparison between historical data and forecast results. Presenting data in tabular format facilitates the analysis process, particularly in assessing the consistency of the prediction model.

Table. 1: Calculation Results

Jenis	Tipe	Tahun	a	b	Hasil
Honda	Beat	2015	4,33	0,5	6
Honda	Vario	2018	0,67	0,5	3
Honda	Scoopy	2019	2,33	0	3
Honda	Beat	2017	1	0	1
Honda	PCX	2022	1	0	1
Honda	Supra	2010	1	0	1
Yamaha	Mio	2012	1	0	1
Yamaha	Mio	2016	1,33	0,5	3
Yamaha	Nmax	2018	1	0	1
Yamaha	Nmax	2021	1	0	1
Yamaha	R15	2017	1	0	1

From the table, it can be concluded that the Least Squares method is capable of producing prediction results that closely match the actual data. This information reinforces that the web-based system developed in this study has functioned well and is suitable for use as a decision support tool for business operations at Dony Jaya Motor. The research findings indicate that the implementation of the Least Squares method in the web-based motorcycle sales prediction system at Dony Jaya Motor is able to achieve a high level of accuracy, with an average Mean Absolute Percentage Error (MAPE) value below 10%. The developed system can automatically process historical sales data, display sales trend graphs, and provide accurate and easy-to-understand prediction reports.

For example, for the Honda Beat 2015 model, the predicted sales for May 2025 were 5.67 units, compared to the actual sales of 6 units, resulting in a MAPE value of 4.67%. The main advantage of this system lies in its web-based accessibility, which allows users to perform data analysis and monitoring in real time from various devices without location constraints. Compared to previous manual methods, this system has proven to be more efficient, faster, and capable of minimizing the risk of input or calculation errors. With prediction results that closely reflect actual values, the system is considered reliable for supporting stock management, determining sales strategies, and assisting in more measurable, data-driven decision-making. The application of the Least Squares method has demonstrated significant benefits for Dony Jaya Motor in improving business effectiveness and operational efficiency in the digital era.

When compared with previous research, the findings of this study align with the work of Ridwan (2020), who developed a web-based prediction system in the sports sector, where the Least Squares method was shown to produce accurate and practical results [7]. Research by Mulyani (2021) in the automotive industry also supports these findings by confirming that this method consistently identifies sales patterns over time [6]. However, what distinguishes this study is the integration of a more interactive web-based system, complete with reporting features and real-time data visualization. This provides added value for Dony Jaya Motor because management can immediately utilize the available information without performing manual calculations. Thus, this study not only reinforces previous findings but also expands the application of the Least Squares method within the context of small and medium enterprises, particularly motorcycle dealerships.

4. Conclusion

Based on the research results, it can be concluded that the Least Squares method is effective for predicting motorcycle sales at Dony Jaya Motor. The developed website-based system is able to present sales data, prediction results, trend graphs, and forecasting reports in real-time with a high level of accuracy. Based on the test results, the average Mean Absolute Percentage Error (MAPE) value is below 10%, which indicates that the prediction error rate is very low and the model works well in following actual sales patterns.

For example, for the 2015 Honda Beat type, the predicted result for May 2025 is 5.67 units with actual data of 6 units, resulting in a MAPE value of 4.67%, while other types such as the 2019 Honda Scoopy and the 2016 Yamaha Mio also show small differences between the predicted results and the actual value. This success proves that the system is able to help companies manage stock more efficiently, reduce the risk of overstock and understock, and support more accurate data-based decision making.

As a recommendation, further research could develop the prediction system by comparing it with other methods such as ARIMA or Exponential Smoothing to achieve a broader accuracy comparison. Furthermore, the development of a mobile version is also recommended to make the system more flexible for use by management and operational staff in the field.

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