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Research Article

Single Moving Average (SMA) Analysis for Gold Jewelry Sales a Pegadaian Outlet Labuhan Ruku

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ABSTRACT

This study aims to analyze gold bullion sales at the Pegadaian Labuhan Ruku Outlet using the Single Moving Average (SMA) method as a forecasting tool. Forecasting, which involves estimating future events based on historical data, is essential in business decision-making, particularly in inventory and financial planning. The SMA method was chosen for its simplicity and effectiveness in identifying sales trends over time. Using monthly gold sales data from January 2024 to January 2025, this study predicts future sales to help the company respond to market demand. The results show that gold sales fluctuate due to factors such as global gold price changes and consumer purchasing behavior. The SMA method successfully produced accurate sales forecasts with a low error rate, proving its reliability for short-term prediction. In conclusion, implementing the SMA forecasting method can support Pegadaian in managing stock more efficiently, minimizing excess inventory, and improving responsiveness to market trends. This suggests that even simple forecasting techniques can provide valuable insights and play a strategic role in business operations.

Keywords: Gold Bullion; Pegadaian; Sales; Single Moving Average

1. INTRODUCTION

The rapid development of technology has had a significant impact on how individuals and organizations work. Especially in the business world, technology plays a crucial role in supporting business growth, as it can significantly reduce operational costs (Dorthy, 2022). Information systems and technology support accurate decision-making by utilizing available data. With information technology, data processing can be carried out more efficiently and effectively, producing fast and accurate information according to needs (Darwan,2022). Given the rapid technological advancements, companies must be able to adapt and maintain quality to remain competitive in an increasingly competitive market. One important aspect that can support a company's performance improvement (Utami, 2024) is having a system that can forecast future sales. Through this system, companies can monitor stock availability and ensure they remain competitive while meeting market demands promptly (Mustopa, 2022).

This research refers to studies related to the discussed topic, particularly the study titled "Implementation of the Single Moving Average (SMA) Method for Forecasting Silver Sales at Perak Nikita" (Maria, 2023). The study explains that an appropriate forecasting method can help companies manage stock and product sales more efficiently. By implementing the Single Moving Average (SMA) method, silver sales predictions can be made based on historical data (Roberta, 2023). Although this method facilitates stock demand estimation, challenges still arise in dealing with fluctuating demand. While forecasting stock using this method minimizes prediction errors, demand uncertainty remains a factor that companies must anticipate (Wulandari, 2022).

Forecasting is an activity aimed at predicting future events by analyzing historical data owned by a company. This activity focuses on estimating situations or conditions expected to occur in the future (Sari, 2021). The forecasting process uses the best available information to assess upcoming activities. In general, forecasting is categorized into two types: quantitative forecasting and qualitative forecasting. The Single Moving Average method is a forecasting technique used to predict future conditions (Diapoldo, 2021). This method falls under time series forecasting and is applied when historical data does not show trends or seasonal factors. The primary goal of implementing the single moving average method is to reduce or eliminate randomness in time series data. This is achieved by averaging multiple values in the data, minimizing both positive and negative errors (Bachtiar, 2022).

PT Pegadaian (Persero) is a non-bank financial institution that provides loan services to the public under specific terms and conditions, offering various services such as gold sales, gold savings, and other financial products. Pegadaian Outlet Labuhan Ruku, located at Jl. Imam Bonjol No. 14, Batu Bara Regency, is one of the outlets that offers similar services to

the local community, including pawn products and gold sales. Pegadaian Outlet Labuhan Ruku plays an important role in providing financial solutions to the public through flexible products tailored to customer needs. One of Pegadaian's flagship products is the Mulia Product, a service for selling gold bars to customers through cash or installment financing, with an easy process and flexible payment terms.

Pegadaian offers gold in various weights, ranging from 0.5 grams, 1 gram, 2 grams, 5 grams, 10 grams, 25 grams, 50 grams, 100 grams, 250 grams, 500 grams, up to 1 kilogram. This variety allows customers to adjust their gold investments according to their financial needs and capabilities. The Mulia Product is intended for long-term investment rather than short-term credit. Customers can purchase gold bars directly from Pegadaian or save gold. Gold purchases can be made in cash or installments with flexible installment periods ranging from 12 to 36 months.

The financial condition of PT Pegadaian Outlet Labuhan Ruku can be assessed through financial reports that indicate the company's financial growth. The company's financial stability is considered secure if the revenue meets the predetermined sales targets. Pawn products, specifically gold sales to customers using a credit system, significantly impact the company's financial health. Gold sales at PT Pegadaian Outlet Labuhan Ruku are unpredictable each month, leading to fluctuations in sales data that show instability and an upward-downward trend.

Table 1. Gold Sales Data at Pegadaian Outlet Labuhan Ruku

Month	Sales (gram)	Price Per Gram	Total Sales Value
January 2024	60	1.115.100	66.906.000
February 2024	92	1.110.207	102.139.000
March 2024	81,5	1.155.276	94.155.000
April 2024	77	1.304.169	100.421.000
May 2024	95	1.323.484	125.731.000
Juni 2024	57	1.341.294	76.453.758
July 2024	56	1.430.536	80.110.000
August 2024	47	1.403.593	65.968.871
September 2024	35,5	1.467.091	52.081.730
October 2024	59	1.425.542	84.107.000
November 2024	48	1.516.263	72.780.624
December 2024	47,5	1.254.270	59.577.825
January 2025	52	1.353.180	70.365.360

Based on the **Table 1**, the data on gold sales at PT Pegadaian Outlet Labuhan Ruku from January 2024 to January 2025 shows significant fluctuations in sales volume, both in terms of weight (grams) and total sales value. In January 2024, sales were recorded at 60 grams with a total sales value of IDR 66,906,000. Sales then increased in February 2024 to 92 grams with a total value of IDR 102,139,000. However, in March 2024, sales declined to 81.5 grams with a total value of IDR 94,155,000. The highest sales peak was recorded in May 2024, reaching 95 grams with a total value of IDR 125,731,000. However, a sharp decline followed in June 2024, with sales dropping to only 57 grams and a total value of IDR 76,453,758. The downward trend continued in July 2024 with sales of 56 grams, despite an increase in price per gram to IDR 1,430,536, resulting in a total sales value of IDR 80,110,000. Sales continued to decline in August 2024 to 47 grams, reaching the lowest point in September 2024 with only 35.5 grams sold. However, sales increased again in October 2024 to 59 grams with a total sales value of IDR 84,107,000. Sales declined again in November and December 2024 but rebounded in January 2025 with sales of 52 grams and a total value of IDR 70,365,360. This sales pattern illustrates fluctuations influenced by gold price variations throughout the year, with some months experiencing sharp declines, while others show significant increases.

The fluctuation in gold sales at PT Pegadaian Outlet Labuhan Ruku is influenced by several interconnected factors. One dominant factor is the change in gold prices in the global market, which affects consumer purchasing interest. When gold prices rise significantly, consumers tend to hold off on buying, whereas lower prices can increase demand (Fauzi, 2020). Additionally, unstable economic conditions, such as reduced purchasing power due to inflation or economic crises, also affect consumer tendencies to invest in gold. During economic downturns, people prioritize essential needs and delay gold purchases, impacting sales decline (Hartati, 2020). To assist the company in making more accurate and efficient future decisions, the development of a business forecasting system is essential. Forecasting serves various functions, including evaluating past and current company policies and their future impact, preparing the company for upcoming changes, and maintaining financial stability (Kusomo, 2021). Additionally, forecasting plays a role in determining business direction to increase company profits. Based on the background explanation above, the author will conduct research to help the company predict future sales outcomes. The method chosen for this study is the Single Moving Average, as it is suitable for sales forecasting (Reinardo, 2022) by applying smoothing values to available data to predict upcoming periods. Designing a

gold forecasting system using the Single Moving Average (Pajriati , 2021) method at PT Pegadaian Outlet Labuhan Ruku. Analyzing the effectiveness of the Single Moving Average method in predicting gold sales at PT Pegadaian Outlet Labuhan Ruku. Evaluating the extent to which the Single Moving Average method can address issues in gold sales forecasting at PT Pegadaian Outlet Labuhan Ruku.

Through this study, researchers can gain deeper insights into data analysis using forecasting methods, particularly the Single Moving Average, which is beneficial for decision-making. Researchers can also see how theoretical knowledge acquired in academic settings can be applied in real-world business contexts. Additionally (Wijaya, 2023), researchers will gain experience in developing a system that can help businesses operate more effectively. With better planning, companies can more easily manage stock and sales strategies (Liyadi, 2022). Companies can make more informed decisions based on more accurate forecasting results. Improved planning will also ensure the availability of gold products for the public (Susandi, 2021). Consumers will find it easier to purchase gold according to their needs, whether for investment or other purposes, without worrying about stock shortages (Azhari, 2022).

2. RESEARCH METHOD

The research framework consists of the steps taken in conducting the research process. The purpose of this framework is to assist researchers in completing the study in an organized and systematic manner (Suwandi, 2020). Problem identification is the initial step in identifying the issue to be solved in the research. Data collection is a technique for obtaining the necessary information for the study (Wahyuni, 2024). Data analysis is the process of transforming raw data into information that can be interpreted in the research. System design is the stage of detailing how the system will operate. Once the design is complete, the next step is system development according to the specified requirements. System testing is the process of evaluating the developed software to ensure that its functions work as designed. System implementation is the final step, where the designed system is tested, installed, and put into use (kurnia, 2022).

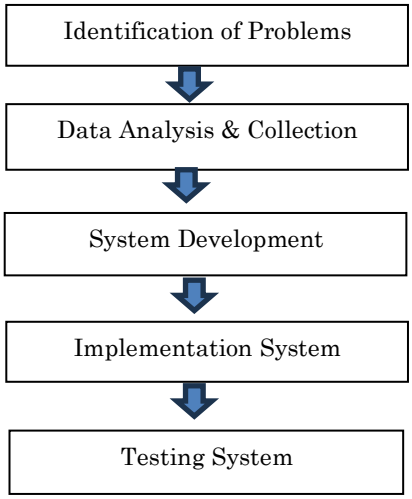

Figure 1. Research Frameworks

2.1 Research Method

The research method is a series of steps or a systematic approach used to conduct research. Every study requires a specific method as a technique or approach used by researchers to obtain data and solve problems. The method used in this research is the quantitative method. The quantitative method utilizes various mathematical models that rely on historical data or associative variables to forecast demand. The researcher chose this method because the study involves a calculation process in forecasting, where data is processed numerically or mathematically.

2.2 Data Collection Techniques

Data collection techniques are methods used by researchers to obtain data in the field. These techniques are systematic and objective, aiming to gather relevant and accurate information in detail. The data collection techniques used in this research are as follows:

1. Field Research
   The field research conducted by the researcher involves collecting and gathering necessary data directly from the research location. This method enables the researcher to obtain information directly from primary sources, ensuring that the results are more accurate and relevant to real-world conditions. The research was conducted through the

following methods:

2. Interview
   Interviews were conducted to collect the necessary information by interviewing Mr. Rachmad Yusuf, ST, the Branch Manager of PT. Pegadaian Labuhan Ruku. Several questions related to this research problem were asked. In this study, interviews were used to obtain data on Gold Sales from January 2024 to January 2025, which will serve as the basis for data processing.
3. Observation
   Observation is a data collection method carried out by directly observing the research object, PT. Pegadaian Outlet Labuhan Ruku, to gather the required data.
4. Literature Research
   Literature research was conducted by gathering information from various sources such as journals, books, and previous relevant studies. The data collected covers the period from 2020 to 2024, supplemented with data from PT. Pegadaian Outlet Labuhan Ruku to support this research.
5. Data Analysis Technique
   This study used the Single Moving Average (SMA) method to analyze and forecast gold bullion sales. A three-month moving average was applied to monthly sales data from January 2024 to January 2025 to identify trends and predict future sales. Forecast accuracy was evaluated using the Mean Absolute Percentage Error (MAPE), allowing for a straightforward assessment of the model's performance and its relevance in supporting inventory planning and decision-making.

3. RESULTS AND DISCUSSION

3.1 System Analysis

System analysis is the process of examining an existing information system and its environment to identify potential improvements that can enhance the system's capabilities. System analysis is used to identify and evaluate existing problems and expected requirements, allowing for proposed improvements to address issues within the new system specifications. The first step in developing this new system is to study the existing system at PT. Pegadaian Outlet Labuhan Ruku to gain a clear understanding of the issues related to gold sales.

3.2 Process Analysis

3.2.1 Data Analysis

Data analysis consists of input data analysis and output data analysis. The input data required for predicting gold sales covers the period from January 2024 to January 2025. This input data will be processed using the Single Moving Average method, both through manual calculations and system-based calculations. The input data will then be entered into the system, which is designed and developed using the PHP programming language and MySQL database.

Table 2. Gold Sales Data at Pegadaian Outlet Labuhan Ruku

Month	Sales (gram)	Price Per Gram	Total Sales Value
January 2024	60	1.115.100	66.906.000
February 2024	92	1.110.207	102.139.000
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November 2024	48	1.516.263	72.780.624
December 2024	47,5	1.254.270	59.577.825
January 2025	52	1.353.180	70.365.360

3.2.2 Calculation Using the Single Moving Average Method

The sales forecast for Gold Bullion in February 2025 is calculated using the Single Moving Average method. This forecasting calculation follows a three-month moving average model, starting with the calculation from January, February, and March, resulting in a forecasted sales value of 77.83 for April. The three-month moving average calculation is then repeated for subsequent periods. To determine the forecasting error, the actual sales data's three-month average is subtracted from the forecasted sales value.

Table 3. Gold Bullion Sales Forecast

No	Month	Actual Data	3 Month Forecast
1	January 2024	60	
2	February 2024	92	
3	March 2024	81,5	
4	April 2024	77	77,83
5	May 2024	95	83,50
6	Juni 2024	57	84,50
7	July 2024	56	76,33
8	August 2024	47	69,33
9	September 2024	35,5	53,33
10	October 2024	59	46,16
11	November 2024	48	47,16
12	December 2024	47,5	47,50
13	January 2025	52	51,50

Forecasting the sales of Gold Bullion using the Single Moving Average method (n=3) is as follows:

January 2024 = 60

February 2024 = 92

March 2024 = 81,5

April 2024 = 77 = $\frac{60+92+81,5}{3}$ = 77,83

May 2024 = 95 = $\frac{92+81,5+77}{3}$ = 83,50

Juni 2024 = 57 = $\frac{81,5+77+95}{3}$ = 84,50

July 2024 = 56 = $\frac{77+95+57}{3}$ = 76,33

August 2024 = 47 = $\frac{95+57+56}{3}$ = 69,33

September 2024 = 35,5= $\frac{57+56+47}{3}$ = 53,33

October 2024 = 59 = $\frac{56+47+35,5}{3}$ = 46,16

November 2024 = 48 = $\frac{47+35,5+59}{3}$ = 47,16

December 2024 = 47,5 = $\frac{35,5+59+48}{3}$ = 47,50

January 2025 = 52 = $\frac{59+48+47,5}{3}$ = 51,50

The calculation of Gold Bullion sales forecasting using the Single Moving Average method (n=3) is as follows:

Table 4. Recapitulation of Emas Mulia Sales Forecasting Results

No	Month	Actual Data	3 Month Forecast	MAD	MSE	MAPE (%)
1	January 2024	60	-	-	-	-
2	February 2024	92	-	-	-	-
3	March 2024	81,5	-	-	-	-
4	April 2024	77	77,83	0,83	0,69	1,08
5	May 2024	95	83,50	11,50	132,25	12,10
6	Juni 2024	57	84,50	27,50	756,25	48,24
7	July 2024	56	76,33	20,33	413,44	36,30
8	August 2024	47	69,33	22,33	498,77	47,51
9	September 2024	35,5	53,33	17,83	318,02	50,23
10	October 2024	59	46,16	12,83	164,69	21,75
11	November 2024	48	47,16	0,83	0,69	1,73
12	December 2024	47,5	47,50	0	0	0
13	January 2025	52	51,50	0,50	0,25	0,96
	Total		637,1667	114,50	2285,08	219,94

$$MAD = \frac{\sum |\text{Actual} - \text{forecast}|}{n} = \frac{114{,}50}{10} = 11{,}45$$

$$MSE = \frac{\sum_{t=1}^{n}(A_t - F_t)^2}{n} = \frac{2285{,}08}{10} = 228{,}508$$

$$MAPE = \frac{1}{n}\sum_{t=1}^{n}\frac{|X_t - F_t|}{X_t} \times 100 = \frac{219{,}94}{10} = 21{,}994\ \%$$

3.2.3 Design System

The Use Case Diagram is a diagram that illustrates the flow of a system or application, showing the people, organizations, or other systems that interact with it. This diagram also represents the basic flow of what the system or application does. The use of this diagram is an effective way to communicate complex ideas in a relatively simple manner. Below is an illustration of the use case diagram for the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku.

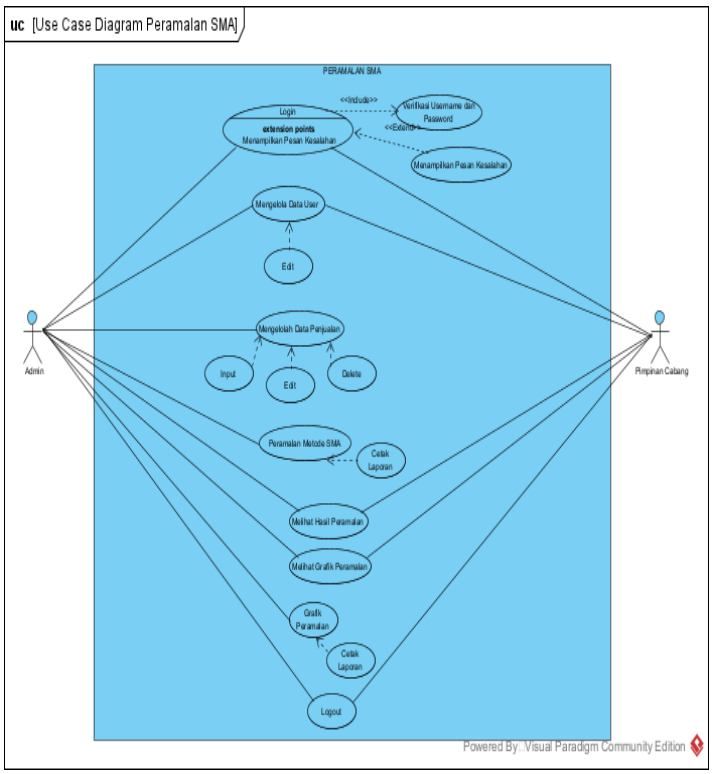

Figure 2. Use Case Diagram

In the use case, there are two actors: the Admin, who uses the system and has full access to the gold sales forecasting system portal at PT. Pegadaian Outlet Labuhan Ruku, and the Branch Manager, who utilizes the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku.

3.3 System Implementation

System implementation is the application of a designed system, with the goal of ensuring whether the system is suitable for deployment. Before it can be fully utilized by users, the system must first go through an evaluation phase and testing to ensure that no critical issues arise when users operate the system. Based on the completed design, this section will discuss the implementation of the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku using the Single Moving Average method. The main menu interface of the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku using the Single Moving Average method consists of six menu options: Home, Sales Data, Forecasting, Forecasting Graph, Change Password, and Logout. Each menu has its own function for processing data and generating information. The following is the main menu interface of the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku.

Figure 3. Main Menu Form Display

The login form in the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku using the Single Moving Average method consists of two text fields: Username and Password, along with a single button labeled Login. Below is the login form interface of the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku.

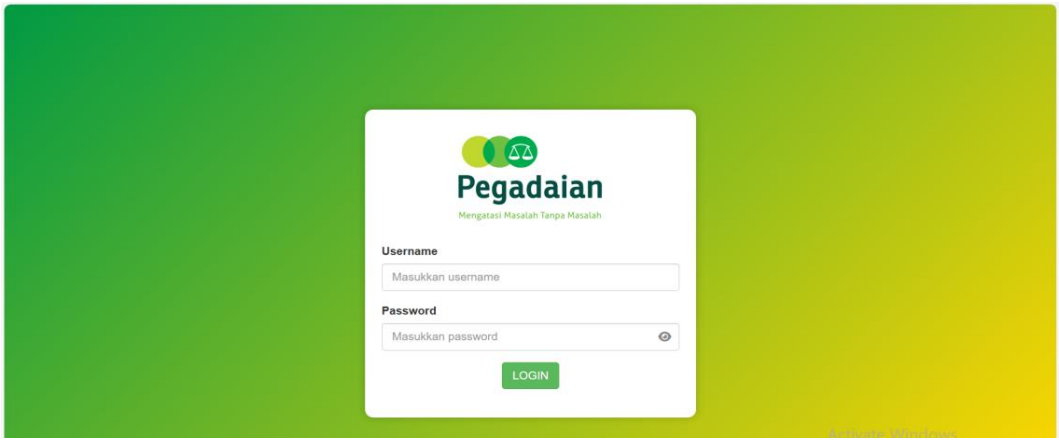

Figure 4. Login Form Display

The sales data form in the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku using the Single Moving Average method includes three buttons: Add, Edit, and Delete. Below is the sales data form interface of the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku.

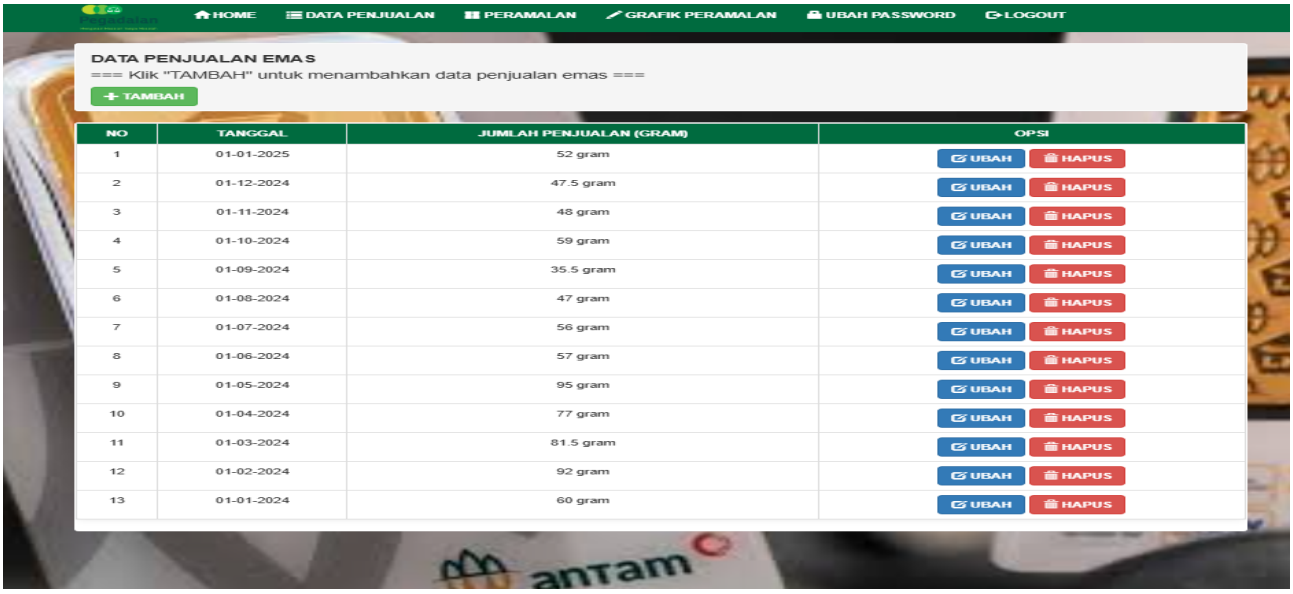

Figure 5. Sales Data Form Display

The forecasting form in the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku using the Single Moving Average method includes one button: Print Report. Below is the forecasting form interface of the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku.

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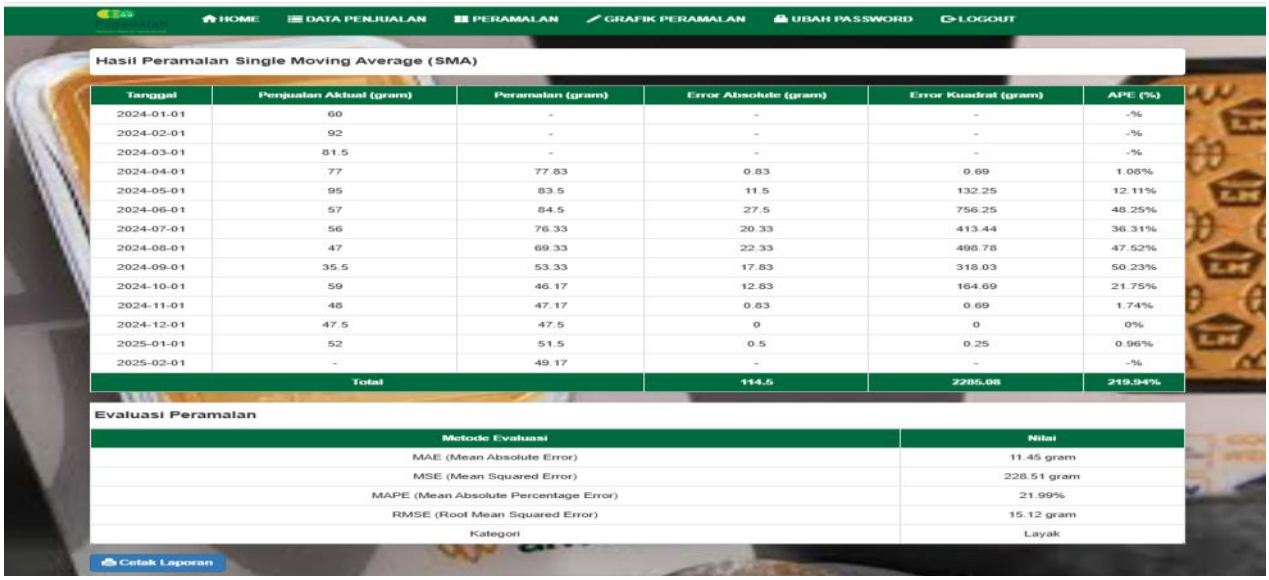
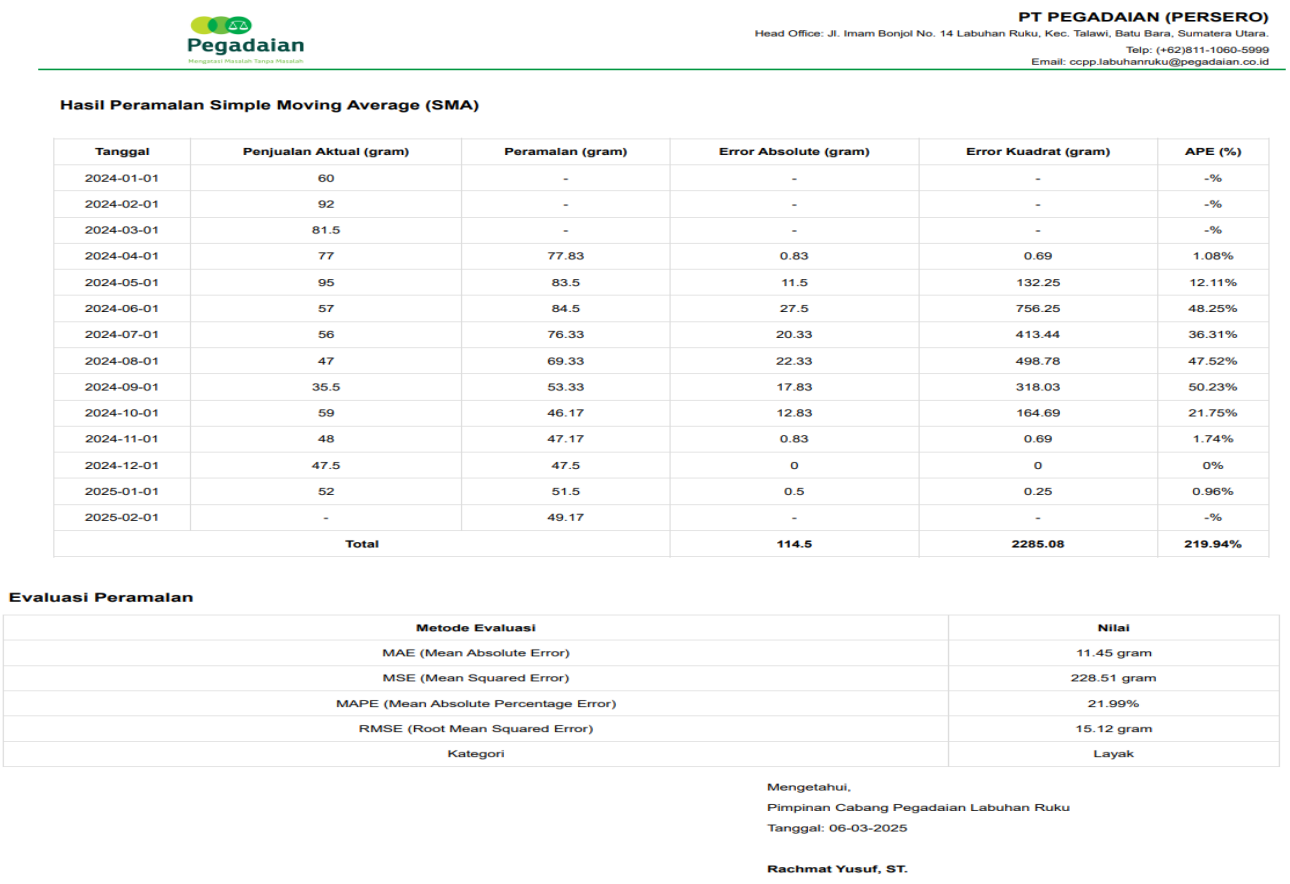


Figure 6. Forecasting Form Display

The Forecasting Output Form in the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku using the Single Moving Average method is the output of the forecasting form. Below is the forecasting output form interface of the gold sales forecasting system at PT. Pegadaian Outlet Labuhan Ruku.



Pegadaian
Mengatasi Masalah Tanpa Masalah

PT PEGADAIAN (PERSERO)
Head Office: Jl. Imam Bonjol No. 14 Labuhan Ruku, Kec. Talawi, Batu Bara, Sumatera Utara.
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Hasil Peramalan Simple Moving Average (SMA)

Tanggal	Penjualan Aktual (gram)	Peramalan (gram)	Error Absolute (gram)	Error Kuadrat (gram)	APE (%)
2024-01-01	60	-	-	-	-%
2024-02-01	92	-	-	-	-%
2024-03-01	81.5	-	-	-	-%
2024-04-01	77	77.83	0.83	0.69	1.08%
2024-05-01	95	83.5	11.5	132.25	12.11%
2024-06-01	57	84.5	27.5	756.25	48.25%
2024-07-01	56	76.33	20.33	413.44	36.31%
2024-08-01	47	69.33	22.33	498.78	47.52%
2024-09-01	35.5	53.33	17.83	318.03	50.23%
2024-10-01	59	46.17	12.83	164.69	21.75%
2024-11-01	48	47.17	0.83	0.69	1.74%
2024-12-01	47.5	47.5	0	0	0%
2025-01-01	52	51.5	0.5	0.25	0.96%
2025-02-01	-	49.17	-	-	-%
Total			**114.5**	**2285.08**	**219.94%**

Evaluasi Peramalan

Metode Evaluasi	Nilai
MAE (Mean Absolute Error)	11.45 gram
MSE (Mean Squared Error)	228.51 gram
MAPE (Mean Absolute Percentage Error)	21.99%
RMSE (Root Mean Squared Error)	15.12 gram
Kategori	Layak

Mengetahui,
Pimpinan Cabang Pegadaian Labuhan Ruku
Tanggal: 06-03-2025

Rachmat Yusuf, ST.

Figure 7. Forecast Output Form Display

3.4 System Testing

The black box testing approach has been widely used in software testing due to its ability to evaluate application functionality from the end-user's perspective without requiring knowledge of the system's internal structure. According to Beizer (1995), black box testing is effective in identifying functional errors, interface issues, and other external behavior defects that may be overlooked by white box testing. This makes the method particularly useful during the software validation phase to ensure the system operates according to the initial specifications..

4. CONCLUSION

Based on the explanation in the previous chapter, several key points can be observed regarding the Gold Sales Forecasting System at PT. Pegadaian Outlet Labuhan Ruku using the Single Moving Average (SMA) method. The gold sales forecasting system is designed using the Single Moving Average (SMA) method, which utilizes historical sales data to project future sales trends. The Single Moving Average method predicts gold sales by calculating the average historical sales over a specific period, helping to forecast future sales. The implementation of this method provides an accurate representation of sales conditions, particularly in stable market conditions. The application of the Single Moving Average method has proven beneficial for the company in stock planning and minimizing sales forecasting errors, thereby improving operational efficiency. This method provides accurate results in projecting sales trends based on historical data.

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