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Implementation of Single Moving Average Method for Fashion Forecasting

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ABSTRACT
Toko Mazaya is a business engaged in the sale of clothing, celada and bags. During its sales, there is often a shortage or accumulation of the number of products to be marketed, not in accordance with the number of requests from customers, there is no computerized system for trading. This research aims to implement the single moving average method for forecasting the stock of products to be provided to support proper decision making. By using historical sales data from January 2024 to January 2025 to forecast 6 month ahead. the results of forecasting clothes for the next 6 months to July 2025 with the smallest MAPE level of 9.52 in May 2025 with a forecast amount of 55. While the results of pants forecasting for the next 6 months to July 2025 with the smallest MAPE level of 9.41 in June 2025 with a forecast amount of 47.50 and the results of bag forecasting for the next 6 months to July 2025 with the smallest MAPE level of 8.89 in February 2025 with a forecast amount of 40.00.

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1. INTRODUCTION

The development of technology has significantly changed the way people live [1]. In recent decades, rapid advances in the fields of information technology, communication, and automation have brought great impact to various aspects of life [2]. The Internet, for example, has connected billions of people around the world, facilitated the exchange of information, and opened up business opportunities without geographical boundaries [3]. Smartphones and other smart devices are now an indispensable part of daily life, enabling quick access to various services and information [4].

The development of technology has opened up great opportunities to create innovative solutions, one of which is forecasting [5]. By utilizing information technology forecasting can analyze historical data to predict the future with high accuracy [6]. For example, in business, this technology can help predict market demand, optimize inventory, and plan marketing strategies and help businesses to make more informed decisions [7].

Like Mazaya Store, is a business engaged in the sale of clothes, pants and bag established in Dusun V Buntu Pane, Kec Buntu Pane, Asahan Regency, North Sumatra 21214 which was established in 2023. Currently, the Mazaya Store branch often runs out of inventory, even when data is entered manually and transactions are executed, the data is recorded in a ledger that can be lost at any time. Frequent shortages or accumulation of the number of products to be marketed, not in accordance with the number of requests from customers, The purpose of this study is to create a forecasting system by applying the single moving average method so that it can help store owners to predict the stock of goods to be sold in the following month based on previous historical data.

Forecasting is the process of estimating or predicting future events based on past data [8]. Forecasting is a technique commonly used by business people, especially in the field of production of goods and services [9]. Accurate predictions are required for business decisions Predictions can be qualitative or quantitative. Qualitative forecasting usually uses the opinions of experts in the field, while quantitative forecasting uses statistical and mathematical techniques. A good prediction is characterized by accuracy. Underestimates can lead to inventory shortages, pre-orders, lost sales, and lost customers. The prediction method uses the Single Moving Average (SMA) method [10].

The SMA method is a forecasting method performed on past data for one period that has an average pattern [11]. A way to modify the effect of past data on the moving average as a forecasting tool is to determine how many recent observations are included [12]. The Single Moving Average method is a method of calculating the average of the movement of a number of consecutive data within a certain period of time [13]. The purpose of this research is to build an information system using the SMA method for forecasting the purchase of stock items in the next period [14].

The Single Moving Average method or also abbreviated as SMA is one of the most efficient moving average methods in the calculation process [15]. Single Moving Average is a forecasting method that is carried out by taking a group of observation values, then finding the average as a forecast for the upcoming period. This method to estimate the future by taking the observation value of past data and the data from the past will be calculated to find an average to be able to do a calculation called Single Moving Average or can also be called a single moving average method, data from the past is utilized by the Single Moving Average method to be able to know the future.

The following is previous research on forecasting using the single moving average method: Research by Nia Kurnia in 2022 [16] concluded that using the SMA method at the dedeh retail grocery store has a high level of accuracy, namely movement 8 in rice with an accuracy rate of 83.91%, Mean Absolute Deviation (MAD) of 33.33, Mean Absolute Percentage Error (MAPE) of 16.09%, and Mean Squared Error (MSE) 1666.67 with a forecasting result of 475 (Kg) for the prediction accuracy of July 2022. So that the SMA method can provide solutions to predict the stock of basic food sales items in the prediction data of the dedeh retail grocery store so that the stocking of these items can be adjusted.

Another study by Sam et al in 2022 [17] they concluded that based on the forecast of demand for oppo android smartphones using the 2-period SMA method at a Palopo City cellphone shop, it can be concluded that the demand for oppo android smartphones in 2021 is 362-units with Mean Absolute Deviation is 4393.13%, Mean Square Deviation is 62.00%, and Mean Absolute Percentage Error is 17.80%. From the forecasting results and the error rate, it is known that the smallest error rate is the Mean Absolute Percentage Error of 17.80%, which means that forecasting can be said to be a good forecasting model because the MAPE range value is 10%-20%.

The next research by Ilfan and Nurliana in 2022 [18] with the system created can help the IM Parfum Pekanbaru store to recap sales data every month where the data is stored in the database. And the application of the Single Moving Average method made to forecast the inventory of IM Parfum Pekanbaru in December 2021 is 1,542 bottles with an average MAD value of 242, an MSE value of 127073.4 and a MAPE value or forecasting error value of 17.3%, which means that the possibility of forecasting differences with reality in the field is not too much.

Meanwhile, research conducted by Liyadi et al in 2022 [19] from the results of forecasting using Single Moving Average and the use of actual data from December 2021 to June 2022, the forecasting results obtained in July/ subsequent months are 2,901 kg. From the MSE calculation, the error value obtained is 331.14. From this calculation, the error value is much smaller than the calculated value using actual data so that the value of this figure is still acceptable.

The same research was also conducted by Saraswati et al in 2023 [20] where the single moving average method was used to predict field demand in the next period, where the data processed was the data from the a priori calculation, on the AA Alkaline Battery item the number of predicted items requested in the 3-month period and the 3-month support period was 6.33 pcs and the AAA Alkaline Battery item the number of predicted items requested in the 3-month support period was 4 pcs.

Based on research on the single moving average method, it can be concluded that this method has the advantage of flattening the data over a period of time. As such, the single moving average method is able to reduce short-term fluctuations or disturbances in the data, making larger and more significant trends easier to identify.

2. RESEARCH METHOD

This type of research is quantitative with the following research stages as shown in Figure 1. There are several stages to this research: (1) Problem identification: The problem identified in this study is that there is no system that predicts product stock at Mazaya stores in the next beirkut peridoe, there is often a

shortage or accumulation of the number of products to be marketed, not in accordance with the number of requests from customers, and inventory purchase transactions at Mazaya stores do not use methods to predict the inventory of products purchased. (2) Collecting Data: Data collection is done by taking sales data from November 2023 to November 2024. (3) Analysis Data: At this stage the data that has been collected will be analyzed. The analysis carried out uses the Single Moving Average method analysis which will help forecast sales in the next month. (4) Design System: In system design, it will start from Unified Modeling Language (UML) design, namely use case diagrams, class diagrams, activity diagrams, sequence diagrams, Entity Relationship Diagram (ERD), flowcharts which are useful for making it easier to build systems. The activities carried out are designing the system and determining how to process the information system from the results of the system analysis so that it can meet the needs of the system to be built for users. (5) Build System: In building the system, the things that will be done are software preparation, namely Visual Studio Code, XAMPP, and MySql database and coding to apply the Software Configuration System (SES) method to the program. (6) System Testing : At this stage, namely activities in testing the system that has been built whether it is in accordance with system requirements or in accordance with the expected results. System trials are carried out to evaluate the advantages and disadvantages of the system created. (7) Implementation: System implementation, namely ensuring whether the application of the Single Exponential Smoothing method is in accordance with the system implementation. System implementation is carried out to complete the design in the document, namely the approved system design, test, install, start and use the new system or improved system.

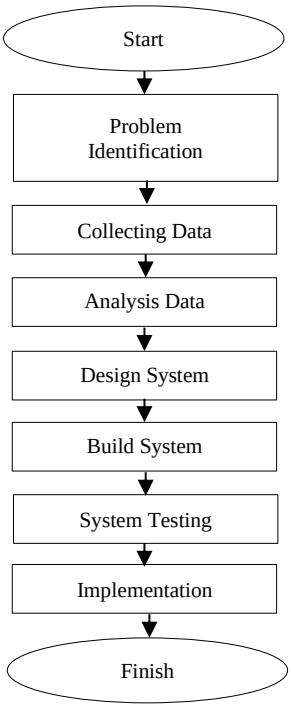

Figure 1. Stage of Research

2.1 Single Moving Average

The Single Moving Average method is a forecasting method that is done by taking a group of observation values, looking for the average value as a forecast for the coming period. Single moving average can be calculated using the formula (1) [15].

$$F_{t+1} = \frac{X_1 + \cdots X_T}{T} \quad (1)$$

Where to calculate forecasting is obtained from value of Ft+1 is period forecasting value t+1, value X is observation data of period t and T is Time.

2.2 Mean Absolute Error (MAD)

MAD is a statistical metric that measures the average of the absolute difference between each data value and the average value of the data. To measure the error value using MAD can be calculated using the formula (2).

$$\text{MAD} = \frac{\sum|\text{Yt}-\text{Ft}|}{\text{n}} \quad (2)$$

Where to calculate MAD is obtained from value Yt is Actual Data, value Ft is observation data of period and value n isTotal Period.

2.3 Mean Sequence Error (MSE)

MSE is another method to evaluate forecasting methods. Each error or residual is squared. It is then summed and divided by the number of observations. This approach manages large forecasting errors because the errors are squared. can be calculated using the formula (3).

$$\text{MSE} = \frac{\sum|\text{Yt}-\text{Ft}|^2}{\text{n}} \quad (3)$$

Where to calculate MSE is obtained from value Yt is Actual Data, value Ft is observation data of period and value of n is Total Period.

2.4 Mean Absolute Error (MAPE)

MAPE is calculated by using the absolute error in each period divided by the real observed value for that period. Then, averaging the absolute percentage errors. MAPE is an error measurement that calculates the size of the percentage deviation between actual data and forecasting data. MAPE can be calculated using the formula (4).

$$\text{MAPE} = \frac{\sum|\text{Yt}-\text{Ft}|(100)}{|\text{Yt}|} \quad (4)$$

Where to calculate MAPE is obtained from value Yt is Actual Data and value of Ft is observation data of period.

2.5 System Design

This system is made using the PHP programming language and uses mysql as a database for data storage. In this system there are 2 people who can use the system, namely the admin and the shop owner. The admin is in charge of inputting sales data and carrying out the forecasting process, while the shop owner can only see the forecasting results that have been processed by the system and these results can be printed to be kept as an archive by the shop owner. With this forecasting system, it can help Mazaya Stores to forecast fashion stocks in the following month quickly so that they can maximize sales.

3 RESULTS AND ANALYSIS

To forecast the stock in the next month, data is needed for the history. The data used is stock data for the previous 1 year, namely stock data from February 2024 to January 2025 where the data is used to forecast the stock that must be provided in the following month, namely February 2025. Product fashion stock data can be seen in Figure 2.

3.1 Forecasting

The results of the needs analysis obtained are the input data needed in predicting the amount of clothing inventory from February 2024 to Januari 2025. The input data will be processed using the SMA method to calculate data using manual methods and system calculations. Meanwhile, the analysis of output needs in the form of a web-based program display that can be used when you have activated the local server, namely XAMPP. The interface design of this application program uses Microsoft Visio 2010 supporting software. This is the initial sales data, namely data for the previous 1 year from February 2024 to Januari 2025 where from this data we will forecast the stock for February 2025 until July 2025. After obtaining sales data for one year earlier, it can be calculated forecasting using the formula (1). The 6-month forecast results can be seen in Table 1.

Table 1. Forecasting 6 Month Result

No	Period	Clothing Stock	Pants Stock	Bag Stock
1	Feb-24	65	40	45
2	Mar-24	50	55	45
3	Apr-24	60	45	40
4	May-24	55	50	40

No	Period	Clothing Stock	Pants Stock	Bag Stock
5	Jun-24	65	45	45
6	Jul-24	45	55	40
7	Aug-24	60	50	45
8	Sep-24	55	55	40
9	Oct-24	65	65	45
10	Nov-24	50	50	45
11	Dec-24	60	60	40
12	Jan-25	55	55	40
13	Feb-25	65	40	45
14	Mar-25	50	55	45
15	Apr-25	60	45	40
16	May-25	55	50	40
17	Jun-25	65	45	45
18	Jul-25	45	55	40

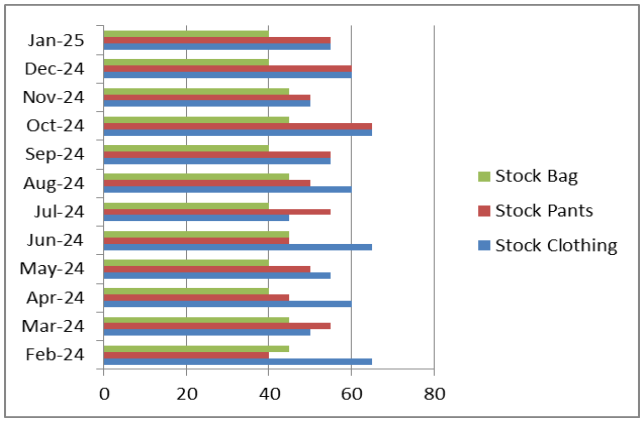

Figure 2. Product Sales Data 1 Year Before

3.2 MAD, MSE and MAPE

This analysis aims to evaluate the forecasting performance for three product categories: clothing, pants, and bags. The evaluation is conducted using three key metrics: Mean Absolute Deviation (MAD), Mean Squared Error (MSE), and Mean Absolute Percentage Error (MAPE). MAD measures the average absolute deviation between actual and predicted values. MSE evaluates the magnitude of errors by giving greater penalties to extreme deviations, while MAPE expresses the error as a percentage of the actual value, making it easier to interpret accuracy. By comparing these three metrics across each product category, the analysis identifies the model's accuracy level and highlights areas that require improvement to enhance forecasting performance in future periods. Then the result of MAD, MSE and MAPE using the formula (2), (3) and (4) can be seen in Table 2,3,4.

Table 2. MAD, MSE and MAPE Clothing Result

No	Period	Actual	Ft	Error	Abs Error	Error^2	e/Yt	APE
1	Feb-24	65	0,00					
2	Mar-24	50	0,00					
3	Apr-24	60	57,50	-2,50	2,50	6,25	0,042	4,17
4	May-24	55	55,00	0,00	0,00	0,00	0,000	0,00
5	Jun-24	65	57,50	-7,50	7,50	56,25	0,115	11,54
6	Jul-24	45	60,00	15,00	15,00	225,00	0,333	33,33
7	Aug-24	60	55,00	-5,00	5,00	25,00	0,083	8,33
8	Sep-24	55	52,50	-2,50	2,50	6,25	0,045	4,55
9	Oct-24	65	57,50	-7,50	7,50	56,25	0,115	11,54
10	Nov-24	50	60,00	10,00	10,00	100,00	0,200	20,00
11	Dec-24	60	57,50	-2,50	2,50	6,25	0,042	4,17
12	Jan-25	55	55,00	0,00	0,00	0,00	0,000	0,00
13	Feb-25	65	57,5	-7,50	7,50	56,25	0,115	11,54
14	Mar-25	50	60	10,00	10,00	100,00	0,200	20,00
15	Apr-25	60	57,5	-2,50	2,50	6,25	0,042	4,17
16	May-25	55	55	0,00	0,00	0,00	0,000	0,00
17	Jun-25	65	57,5	-7,50	7,50	56,25	0,115	11,54
18	Jul-25	45	60	15,00	15,00	225,00	0,333	33,33
		TOTAL			95,00	925,00	97,62	178,20
		MAD			5.94			
		MSE				57.81		
		MAPE						11.14%

The table 2 presents the prediction results for clothing sales, with MAD at 5.94, MSE at 57.81, and MAPE at 11.14%. The moderate MAD value indicates that the average absolute error is around 6 units from the actual values. The relatively high MSE suggests the presence of large deviations in certain months, such as July 2024 and July 2025, which reached errors of 15 units. A MAPE above 10% shows that the model's accuracy is moderate, and improvements are needed to reduce errors, especially in extreme periods.

Table 3. MAD, MSE and MAPE Pants Result

No	Period	Actual	Ft	Error	Abs Error	Error^2	e/Yt	APE
1	Feb-24	40	0,00					
2	Mar-24	55	0,00					
3	Apr-24	45	47,50	2,50	2,50	6,25	0,056	5,56
4	May-24	50	50,00	0,00	0,00	0,00	0,000	0,00
5	Jun-24	45	47,50	2,50	2,50	6,25	0,056	5,56
6	Jul-24	55	47,50	-7,50	7,50	56,25	0,136	13,64
7	Aug-24	50	50,00	0,00	0,00	0,00	0,000	0,00
8	Sep-24	55	52,50	-2,50	2,50	6,25	0,045	4,55
9	Oct-24	65	52,50	-12,50	12,50	156,25	0,192	19,23
10	Nov-24	50	60,00	10,00	10,00	100,00	0,200	20,00
11	Dec-24	60	57,50	-2,50	2,50	6,25	0,042	4,17
12	Jan-25	55	55,00	0,00	0,00	0,00	0,000	0,00
13	Feb-25	40	57,50	17,50	17,50	306,25	0,438	43,75
14	Mar-25	55	47,50	-7,50	7,50	56,25	0,136	13,64
15	Apr-25	45	47,50	2,50	2,50	6,25	0,056	5,56
16	May-25	50	50,00	0,00	0,00	0,00	0,000	0,00
17	Jun-25	45	47,50	2,50	2,50	6,25	0,056	5,56
18	Jul-25	55	47,50	-7,50	7,50	56,25	0,136	13,64
		TOTAL			77,50	768,75	1,55	154,82
		MAD			4.84			
		MSE				48.05		
		MAPE						9.68%

Pants sales prediction at table 4 achieved MAD of 4.84, MSE of 48.05, and MAPE of 9.68%. A MAPE below 10% indicates that the model's accuracy is relatively good. The largest error occurred in February 2025 with an absolute error of 17.5 units, which significantly contributed to the MSE. Compared to clothing, both MAD and MSE are lower, indicating better model stability for this category. However, large deviations in certain months still need to be addressed to maintain consistent performance.

Table 4. MAD, MSE and MAPE Bag Result

No	Period	Actual	Ft	Error	Abs Error	Error^2	e/Yt	APE
1	Feb-24	45	0,00					
2	Mar-24	45	0,00					
3	Apr-24	40	45,00	5,00	5,00	25,00	0,125	12,50
4	May-24	40	42,50	2,50	2,50	6,25	0,063	6,25
5	Jun-24	45	40,00	-5,00	5,00	25,00	0,111	11,11
6	Jul-24	40	42,50	2,50	2,50	6,25	0,063	6,25
7	Aug-24	45	42,50	-2,50	2,50	6,25	0,056	5,56
8	Sep-24	40	42,50	2,50	2,50	6,25	0,063	6,25
9	Oct-24	45	42,50	-2,50	2,50	6,25	0,056	5,56
10	Nov-24	45	42,50	-2,50	2,50	6,25	0,056	5,56
11	Dec-24	40	45,00	5,00	5,00	25,00	0,125	12,50
12	Jan-25	40	42,50	2,50	2,50	6,25	0,063	6,25
13	Feb-25	45	40,00	-5,00	5,00	25,00	0,111	11,11
14	Mar-25	45	42,50	-2,50	2,50	6,25	0,056	5,56
15	Apr-25	40	45,00	5,00	5,00	25,00	0,125	12,50
16	May-25	40	42,50	2,50	2,50	6,25	0,063	6,25
17	Jun-25	45	40,00	-5,00	5,00	25,00	0,111	11,11
18	Jul-25	40	42,50	2,50	2,50	6,25	0,063	6,25
		TOTAL			55,00	212,00	1,41	130,56
		MAD			3.44			
		MSE				13.28		
		MAPE						13.06%

The bag sales prediction shows MAD of 3.44, MSE of 13.28, and MAPE of 13.06%. The low MAD and MSE values indicate that the model is quite precise, with an average deviation of only around 3 units. However, the relatively high MAPE (above 13%) suggests that while the absolute difference is small, the percentage error against the actual value is significant likely due to the lower overall sales volume for bags

compared to other categories. This implies that the model performs well in absolute terms but needs adjustment to reduce percentage errors.

After calculating the forecasts for the next 6 months, namely until July 2025, the comparison results for all forecasts for each month can be seen in Table 5.

Table 5. Comparison of Forecasted Item Results 6 Months Later

Period	Items	Forecast	MAD	MSE	MAPE
Feb-25	Clothing	57,5	5,45	48,86	9,92
Mar-25		60	5,83	53,13	10,76
Apr-25		57,5	5,58	49,52	10,26
May-25		55	5,18	45,98	9,52
Jun-25		57,5	5,33	46,67	9,66
Jul-25		60	5,94	57,81	11,14
Feb-25	Pants	57,50	5,23	58,52	10,59
Mar-25		47,50	5,42	58,33	10,84
Apr-25		47,50	5,19	54,33	10,43
May-25		50,00	4,82	50,45	9,69
Jun-25		47,50	4,67	47,50	9,41
Jul-25		47,50	4,84	48,05	9,68
Feb-25	Bag	40,00	3,41	13,07	8,89
Mar-25		42,50	3,33	12,50	9,44
Apr-25		45,00	3,46	13,46	10,69
May-25		42,50	3,39	12,95	11,32
Jun-25		40,00	3,50	13,75	12,43
Jul-25		42,50	3,44	13,28	13,06

3.3 Forecasting Graphs

Figure 4 is the result of a comparison of fashion product forecasting for the next 6 months, namely February 2025 to July 2025.

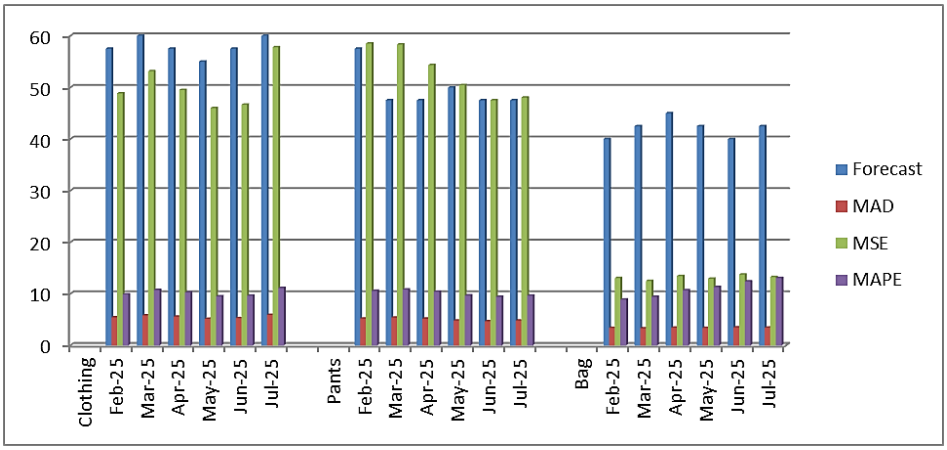

Figure 4. Forcast 6 Month Later

3.4 Discussion

The single moving average forecasting method has shown its effectiveness in forecasting clothes, pants, and bags for the next 6 months, namely February 2025 to July 2025. This forecasting is suitable for forecasting in the short term with data that is quite simple, easy to understand, and quick to apply without requiring complex calculations. The difference between this research and other research is in the amount of forecasting. The research that has been referred to in previous references only forecasts the next 1-2 months while this research forecasts up to the next 6 months. This research is important to do as one of the methods that has the potential to reduce losses due to uncertain market demand. However, to optimize this method, a large amount of data is required. It is recommended that future research test this method using more data such as the previous three to five years of data.

The evaluation results from the MAD, MSE, and MAPE metrics strengthen the finding that the single moving average method performs differently across product categories. For clothing, the model achieved a MAD of 5.94, MSE of 57.81, and MAPE of 11.14%, indicating a moderate level of accuracy. While the absolute error is acceptable, the relatively high MSE shows that the model is sensitive to sudden demand spikes, such as in July 2024 and July 2025, where prediction errors were large. This suggests that for

products with more volatile demand patterns, additional smoothing or hybrid forecasting approaches could further improve accuracy.

For pants, the results were more promising, with MAD at 4.84, MSE at 48.05, and MAPE at 9.68%, reflecting better stability and accuracy compared to clothing. This lower MAPE value indicates that the single moving average is more suited for categories with relatively consistent sales trends. However, extreme deviations such as in February 2025 with an absolute error of 17.5 units still had a considerable impact on MSE. This highlights the importance of outlier detection or adaptive averaging techniques to mitigate sudden prediction gaps.

In the case of bags, the model recorded the lowest MAD (3.44) and MSE (13.28), showing high precision in absolute terms, but also the highest MAPE (13.06%). This reveals a common issue in forecasting low-volume products, where even small absolute deviations can result in high percentage errors. Therefore, while the model is reliable for predicting the actual number of units, percentage-based accuracy metrics may need to be interpreted with caution. Combining the single moving average with other methods, such as weighted moving averages or exponential smoothing, may address this limitation and improve overall performance

4 CONCLUSION

From the research that has been done at Mayaza Shop, it can be concluded that the results of forecasting clothes for the next 6 months to July 2025 with the smallest MAPE level of 9.52 in May 2025 with a forecast amount of 55. While the results of pants forecasting for the next 6 months to July 2025 with the smallest MAPE level of 9.41 in June 2025 with a forecast amount of 47.50 and the results of bag forecasting for the next 6 months to July 2025 with the smallest MAPE level of 8.89 in February 2025 with a forecast amount of 40.00. This study reveals that the forecasting method used can help Mazaya Stores make the right and quick decisions. By using this single moving average method, the store can predict the stock of goods that must be provided for the following month. Researchers realize that there are limitations in this study, such as the lack of data used for forecasting. Therefore, the development of this research should test with more data.

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