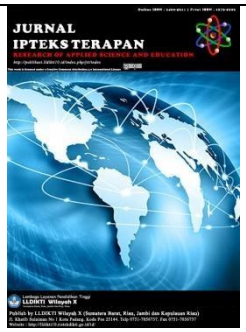

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ANALYSIS OF WMA METHOD FOR FORECASTING COOKING OIL STOCK AT AWI MARKET

Windy Antika Putri[*1)], Rizky Fauziah [2)], Adi Mas Afandi [3)]
[1,2,3]Sekolah Tinggi Manajemen Informatika dan Komputer Royal Kisaran
* Corresponding Email: windyantikaputri53@gmail.com

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Abstract

Cooking oil is a cooking ingredient made from palm oil. Cooking oil is one of the basic necessities used for the cooking process. Awi Market's sales of cooking oil have experienced fluctuations or ups and downs in cooking oil sales. This is because the instability of cooking oil sales makes Awi Market owners have difficulty in determining the amount of cooking oil stock that will be sold in the next period. The problem that occurs in Awi Market is that cooking oil stocks fluctuate every month where it is difficult to estimate sales to increase or not, which results in a lot of unsold cooking oil stocks or piling up in warehouses, resulting in accumulation and even expiration and Awi Market will experience losses. The purpose of this study is to predict the stock of cooking oil using the WMA method so that the stock of cooking oil in the following month can be fulfilled. The method used in this study is the Weighted Moving Average method. The results of applying the Weighted Moving Average method predict that cooking oil stocks at Awi Market in May 2022 will be available for 86.67 bimoli cooking oil stocks with an accuracy of 19.97% MAPE error, 93.33 fortune with 20% MAPE error accuracy, sunco 78 ,33 with MAPE error accuracy of 31.87%, tropicana slim as much as 53.33 with MAPE error accuracy of 29.74% and rose brand as much as 55 per pack with MAPE error accuracy of 26.27%. So it can be concluded that the WMA method can help the supply of cooking oil in the following month quickly and accurately.

Keywords: Cooking Oil, WMA Method, Forecasting, Stock

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INTRODUCTION

Cooking oil is a cooking ingredient made from palm oil. Cooking oil is one of the basic necessities used for the cooking process. Every community and business in the culinary field requires cooking oil to carry out food-making activities.

Awi Market is a large minimarket which is located at Jalan Besar Sei Silau Timur, Buntu Pane District, Asahan Regency, North Sumatra. Which at this Awi Market sells various cooking oils including Bimoli, Fortune, Sunco, Tropicana Slim and Rose Brand. The target of this writing is based on the results of observations and interviews with the owners of Awi Market, the process of collecting data on cooking oil stocks in the warehouse that has been carried out so far still uses manual recording and is recapitulated in the ledger, this makes the stock recording process take a long time and is inefficient . In addition, cooking oil sales have experienced fluctuations or ups and downs in cooking oil sales. This is due to the instability of cooking oil sales, making Awi Market owners have difficulty determining the amount of cooking oil stock that will be sold in the next period.

The problem that occurs in Awi Market is that cooking oil stocks fluctuate every month where it is difficult to estimate sales to increase or not which results in a lot of unsold cooking oil stocks or piling up in warehouses, resulting in accumulation and even expiration and Awi Market will experience losses.

Departing from this problem, researchers are interested in conducting a research process in order to get a solution to predict cooking oil stocks that can help Awi Market owners predict cooking oil stocks. Forecasting is one of the tools that can be used to predict a value in the future by utilizing past data or information as a reference for planning and decision making [1]. By forecasting, it will influence decisions in determining the amount of oil stock that will be provided in the following month.

The method used by the author in this study is the Weighted Moving Average method, which is a method that is widely used to determine the trend of a time series. This method is used for data whose changes are not fast. The moving average model uses a number of new actual demand data to generate forecast values for future demand [2]. With this method, researchers will predict the stock of cooking oil in the next month in 2022.

In the next stage, after the researchers got the results of forecasting cooking oil stocks. Then the researcher will search for the prediction accuracy value using the Mean Absolute Error and Mean Absolute Percentage Error methods. Mean Absolute Deviation is a method to evaluate forecasting results in determining prediction error. Of course, the expected minimum error results in other words the smaller the error value obtained, the more accurate the prediction results [3]. The purpose of this forecasting measurement is to determine the extent of the errors produced by the cooking oil stock forecast so that the level of accuracy of the cooking oil stock forecast is known in the following month.

Several previous studies that have been carried out, namely research by Iwan Setiawan produced a system that can help

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XYZ Multipurpose Goods Shop in predicting stock purchases for the next period, so as to minimize errors in the number of stock purchases [4]. Research by Reza, et al resulted in forecasting sales of freight forwarding services for September 2017, namely 1215 requests or sales of freight forwarding services [5]. Research by Imam & Septa resulted in a forecasting weighted moving average (WMA) information system that can be processed using an information technology-based system so as to simplify and speed up decision making on stock predictions needed for sales [6]. Research by Akmal Nasution resulted in forecasting using the weighted moving average method of rubber production which has an error rate of 2.52% which is relatively small, so the level of accuracy is quite large[7]. Research by Suhendra, et al resulted in the forecasting of the Weight Moving Average method in January 2019 obtained spare parts inventory with actual data from January to December 2018 with a value of 33 compared to the average of 10 actual inventory items of 43 [8]. Research by Rahmawati, et al applies the Weighted Moving Average (WMA) method and using the program will make it easier to process the number of products in determining cosmetic inventory at Robin's Shop [9].

RESEARCH METHODS

The stages of this research are as follows:

1. Problem Identification

The problem identified in this study is the instability of cooking oil sales, making Awi Market owners have difficulty determining the amount of cooking oil stock that will be sold in the future.

2. Data Collection

Data collection was carried out by taking sample data in the form of cooking oil inventory data from May 2021 to April 2022 to forecast throughout 2022.

3. Data Analysis

At this stage the data that has been collected will be analyzed. By using the analysis of the Weighted Moving Average method which will help forecasting cooking oil stocks in the following month.

4. System Design

The system design will start from the UML design which is useful to make it easier to create the system.

5. System Build

In making the system, what will be done is the preparation of software, namely Sublime Text, XAMPP, and MySql databases and make PHP coding to apply the Weighted Moving Average method into the program.

6. System Trial

At this stage, the activity in testing the system that has been built is in accordance with system requirements or in accordance with the expected results. System testing is carried out to evaluate the advantages and disadvantages of the system created.

7. System Implementation

System implementation is carried out to complete the design in the document, namely the approved system design, testing, installing, starting and using a new system or an improved system.

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The data collection techniques in this study are:

1. Data Collection With Questionnaire

This collection stage will be carried out by giving questionnaires to members and related leaders to obtain data or information needed in research.

2. Field Research

In field research, researchers took sample data in the form of cooking oil stock data from April 2021 to March 2022 to be used as data processing. In addition, data collection was carried out by interview. Interviews were conducted by asking several questions in order to obtain additional information related to the research.

3. Library Research

This collection stage is done by collecting data from several sources such as books, journals that contain a number of theories related to research to support thesis writing.

Data collection

The following is the data used in this study as follows:

No	Month	Cooking Oil				
		Bimoli	Fortune	Sunco	Tropicana Slim	Rose Brand
1	Mei-21	150	150	200	150	150
2	Jun-21	200	180	150	150	100
3	Jul-21	150	150	150	200	150
4	Agu-21	200	150	180	180	120
5	Sep-21	180	150	180	180	100
6	Okt-21	150	170	150	150	120
7	Nov-21	150	150	150	150	100
8	Des-21	150	150	100	100	120
9	Jan-22	100	80	100	80	100
10	Feb-22	80	100	70	70	80
11	Mar-22	100	80	50	50	50
12	Apr-22	80	100	100	50	50

Table 1. Cooking Oil Stock Data

Forecasting is a picture of the situation in the company in the future. This picture is very important for company management because with this picture the company can predict what steps will be taken to meet consumer demand. Forecasting is not always 100% accurate, because the future contains uncertainty problems, but with the selection of the right method can make forecasts with a small error rate [10].

The Weighted Moving Average method is a method that is widely used to determine the trend of a time series. This method is used for data whose changes are not fast. The moving average model uses a new amount of actual demand data to generate forecast values for future demand. The Weight Moving Average (WMA) method is a method that is suitable for use on time-series data, namely data that changes from time to time.

In the Weighted Moving Average method, in addition to a simple calculation, the Weighted Moving Average technique is given a different weight for each available past historical data, assuming that the most recent or recent historical data will have a greater weight

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than the old historical data because the most recent or most recent data is the most relevant data for forecasting. Another advantage of this method is that the weight value can be adjusted, but determining the optimal weight is difficult [2].

$$\text{WMA} = \frac{\sum(\text{data} * \text{weight})}{\sum \text{weight}} \qquad (1)$$

Accuracy is the criterion that determines the best forecasting method. Thus, accuracy is the most important concern in evaluating forecast quality. The purpose of the estimate is to minimize error. The forecast error is the difference between the actual value and the estimated value. Accurate projection results are forecasts that can minimize forecast errors. The magnitude of the forecast error is calculated by subtracting the real data from the size of the forecast.

$$eror\ (e) = Y_t - F_t \qquad (2)$$

Information:
Yt : actual data for period t
Ft : forecast period t

In calculating the forecast error used:

A. Mean Squared Error (MSE)

Mean Squared Error is a method of averaging squared errors that amplifies the influence of large error numbers, but minimizes the number of small forecast errors (less than one unit).

$$MSE = \sum_{t=1}^{n} \frac{(Y_t - F_t)^2}{n} \qquad (3)$$

Information:
Yt = actual value in period t
Ft = forecast value in period t
n = number of periods

B. Mean Absolute Deviation (MAD)

A common method for measuring overall forecast error is that the MAD is calculated by dividing the sum of the absolute values of individual forecast errors by the sample size (number of forecast periods) as follows:

$$MAD = \sum_{t=1}^{n} \frac{|Y_t - F_t|}{n} \qquad (4)$$

Information:
Yt = actual value in period t
Ft = forecast value in period t
n = number of periods

C. Mean Absolute Percentage Error (MAPE)

Measurement of accuracy by means of the mean absolute percentage error (MAPE) shows the average absolute error of the forecast in the form of a percentage of the actual data.

$$MAPE = \left(\frac{1}{n}\right) \sum_{t=1}^{n} \frac{|Y_t - F_t|}{n} (100) \qquad (5)$$

Information:
Yt = actual value in period t
Ft = forecast value in period t
n = number of periods

MAPE units are expressed in percent [11].

RESULTS AND DISCUSSION

Cooking Oil Forecasting Results

The following is the result of the calculation of the Weighted Moving

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Average method for predicting cooking oil stocks as follows.

A. Cooking Oil Forecasting Results : Bimoli

In the calculation process, a manual calculation process will be carried out from this research, namely by calculating as many as 3 periods, which are calculated as stock in the previous 3 periods with weights according to the number of periods, namely 3, 2 and 1.

$$WMA(13) = \frac{(80 * 3) + (100 * 2) + (80 * 1)}{3 + 2 + 1} = 86{,}67$$

Then produce forecasts as shown in table 2 below.

No	Month	Actual	Forecasting	Error	MAD	MSE	MAPE
1	Mei-21	150					
2	Jun-21	200					
3	Jul-21	150					
4	Agu-21	200	166,67	33,33	33,33	1111,11	0,167
5	Sep-21	180	183,33	-3,33	3,33	11,11	0,019
6	Okt-21	150	181,67	-31,67	31,67	1002,78	0,211
7	Nov-21	150	168,33	-18,33	18,33	336,11	0,122
8	Des-21	150	155,00	-5,00	5,00	25,00	0,033
9	Jan-22	100	150,00	-50,00	50,00	2500,00	0,500
10	Feb-22	80	125,00	-45,00	45,00	2025,00	0,563
11	Mar-22	100	98,33	1,67	1,67	2,78	0,017
12	Apr-22	80	93,33	-13,33	13,33	177,78	0,167
13	Mei-22		86,67				
		MAD	201,67		22,41		
		MSE	7191,67			799,07	
		MAPE	1,80				19,97%

Table 2. Bimoli . Forecasting Results

In table 2 above, the forecasting results for bimoli cooking oil in May 2022 are 86.67 packs with an average MAPE error of 19.97%. Then the forecasting results obtained can be used as a reference for cooking oil supplies in the following month.

B. Cooking Oil Forecasting Results : Fortune

In the calculation process, a manual calculation process will be carried out from this research, namely by calculating as many as 3 periods, which is calculated as the stock in the previous 3 periods with weights according to the number of periods, namely 3, 2 and 1, the same as the calculation for bimoli cooking oil. .Then produce forecasts as shown in table 3 below.

No	Month	Actual	Forecasting	Error	MAD	MSE	MAPE
1	Mei-21	150					
2	Jun-21	180					
3	Jul-21	150					
4	Agu-21	150	160,00	-10,00	10,00	100,00	0,067
5	Sep-21	150	155,00	-5,00	5,00	25,00	0,033
6	Okt-21	170	150,00	20,00	20,00	400,00	0,118
7	Nov-21	150	160,00	-10,00	10,00	100,00	0,067

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8	Des-21	150	156,67	-6,67	6,67	44,44	0,044
9	Jan-22	80	153,33	-73,33	73,33	5377,78	0,917
10	Feb-22	100	115,00	-15,00	15,00	225,00	0,150
11	Mar-22	80	101,67	-21,67	21,67	469,44	0,271
12	Apr-22	100	86,67	13,33	13,33	177,78	0,133
13	Mei-22		93,33				
		MAD	175,00		19,44		
		MSE	6919,44			768,83	
		MAPE	1,80				20,00%

Table 3. Fortune Forecasting Results

In table 3 above, the results of forecasting fortune cooking oil in May 2022 are 93.33 packs with an average MAPE error of 20.00%. Then the forecasting results obtained can be used as a reference for cooking oil supplies in the following month.

C. Cooking Oil Forecasting Results : Sunco

In the calculation process, a manual calculation process will be carried out from this research, namely by calculating as many as 3 periods, which is calculated as the stock in the previous 3 periods with weights according to the number of periods, namely 3, 2 and 1, the same as the calculation for bimoli cooking oil. .Then produce forecasts as shown in table 4 below.

No	Month	Actual	Forecasting	Error	MAD	MSE	MAPE
1	Mei-21	200					
2	Jun-21	150					
3	Jul-21	150					
4	Agu-21	180	158,33	21,67	21,67	469,44	0,120
5	Sep-21	180	165,00	15,00	15,00	225,00	0,083
6	Okt-21	150	175,00	-25,00	25,00	625,00	0,167
7	Nov-21	150	165,00	-15,00	15,00	225,00	0,100
8	Des-21	100	155,00	-55,00	55,00	3025,00	0,550
9	Jan-22	100	125,00	-25,00	25,00	625,00	0,250
10	Feb-22	70	108,33	-38,33	38,33	1469,44	0,548
11	Mar-22	50	85,00	-35,00	35,00	1225,00	0,700
12	Apr-22	100	65,00	35,00	35,00	1225,00	0,350
13	Mei-22		78,33				
		MAD	265,00		29,44		
		MSE	9113,89			1012,65	
		MAPE	2,87				31,87%

Table 4. Results of Forecasting Sunco

In table 4 above, the forecast for Sunco cooking oil in May 2022 is 78.33 packs with an average MAPE error of 31.87%. Then the forecasting results obtained can be used as a reference for cooking oil supplies in the following month.

D. Cooking Oil Forecasting Results : Tropicana Slim

In the calculation process, a manual calculation process will be carried out from this research, namely by calculating as many as 3 periods, which is calculated as the stock in the previous 3 periods with weights according to the number of periods, namely 3, 2 and 1, the same as the calculation for bimoli cooking oil. .Then

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produce forecasts as shown in table 5 below.

No	Month	Actual	Forecasting	Error	MAD	MSE	MAPE
1	Mei-21	150					
2	Jun-21	150					
3	Jul-21	200					
4	Agu-21	180	175,00	5,00	5,00	25,00	0,028
5	Sep-21	180	181,67	-1,67	1,67	2,78	0,009
6	Okt-21	150	183,33	-33,33	33,33	1111,11	0,222
7	Nov-21	150	165,00	-15,00	15,00	225,00	0,100
8	Des-21	100	155,00	-55,00	55,00	3025,00	0,550
9	Jan-22	80	125,00	-45,00	45,00	2025,00	0,563
10	Feb-22	70	98,33	-28,33	28,33	802,78	0,405
11	Mar-22	50	78,33	-28,33	28,33	802,78	0,567
12	Apr-22	50	61,67	-11,67	11,67	136,11	0,233
13	Mei-22		53,33				
		MAD	223,33		24,81		
		MSE	8155,56			906,17	
		MAPE	2,68				29,74%

Table 5. Tropicana Slim Forecasting Results

In table 5 above, the forecast for Sunco cooking oil in May 2022 is 53.33 packs with an average MAPE error of 29.74%. Then the forecasting results obtained can be used as a reference for cooking oil supplies in the following month.

E. Cooking Oil Forecasting Results : Rose Brand

In the calculation process, a manual calculation process will be carried out from this research, namely by calculating as many as 3 periods, which is calculated as the stock in the previous 3 periods with weights according to the number of periods, namely 3, 2 and 1, the same as the calculation for bimoli cooking oil. .Then produce forecasts as shown in table 6 below.

No	Month	Actual	Forecasting	Error	MAD	MSE	MAPE
1	Mei-21	150					
2	Jun-21	100					
3	Jul-21	150					
4	Agu-21	120	133,33	-13,33	13,33	177,78	0,111
5	Sep-21	100	126,67	-26,67	26,67	711,11	0,267
6	Okt-21	120	115,00	5,00	5,00	25,00	0,042
7	Nov-21	100	113,33	-13,33	13,33	177,78	0,133
8	Des-21	120	106,67	13,33	13,33	177,78	0,111
9	Jan-22	100	113,33	-13,33	13,33	177,78	0,133
10	Feb-22	80	106,67	-26,67	26,67	711,11	0,333
11	Mar-22	50	93,33	-43,33	43,33	1877,78	0,867
12	Apr-22	50	68,33	-18,33	18,33	336,11	0,367
13	Mei-22		55,00				
		MAD	173,33		19,26		
		MSE	4372,22			485,80	
		MAPE	2,36				26,27%

Table 6. Rose Brand Forecasting Results

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In table 5 above, the forecast for Sunco's cooking oil in May 2022 is 55.00 packs with an average MAPE error of 26.27%. Then the forecasting results obtained can be used as a reference for cooking oil supplies in the following month.

UML Design

Unified Modeling language (UML) is a collection of diagrams that already have standards for building object-based software" [12]. UML (Unified Modeling Language) is one of the standard languages that are widely used in the industrial world to define requirements, make analysis and design, and describe architecture in object-oriented programming [13]. The following is a UML one of which is a Use Case Diagram.

A use case diagram is a series or description of a group that is interrelated and forms a regular system that is carried out or supervised by an actor [14]. The following is a use case diagram in this study as shown in Figure 1 below.

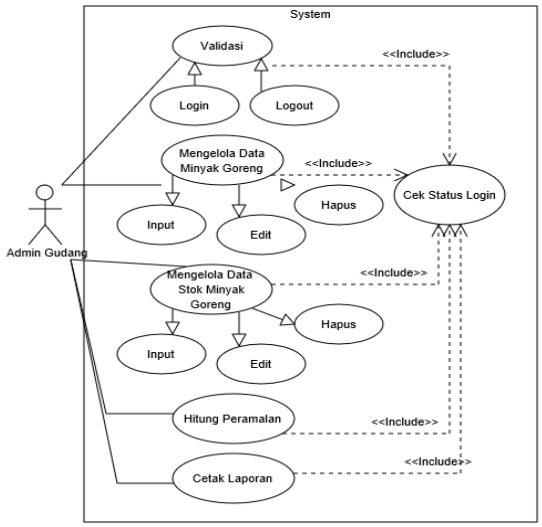

Figure 1. Use Case Diagram

Next, the class diagram will be displayed. Class diagram is a model that describes the structure and description of classes and can connect between other classes. The class diagram describes the model used in designing the attributes and functions that will be used to build a new system [15]. The following class diagram in this study is shown in Figure 2 below.

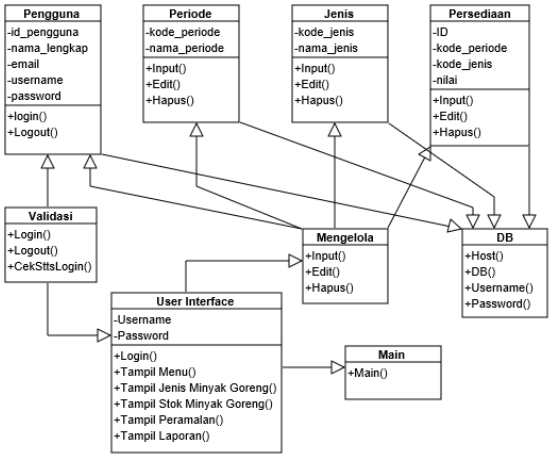

Figure 2. Class Diagram

System Implementation

System implementation is a stage of system design that has been carried out and then system development is carried out. After that, the implementation of the system is carried out to ensure that the system is in accordance with the design made.

The login menu display is the display where the admin first opens the program and performs the login process to be able to enter using this system.

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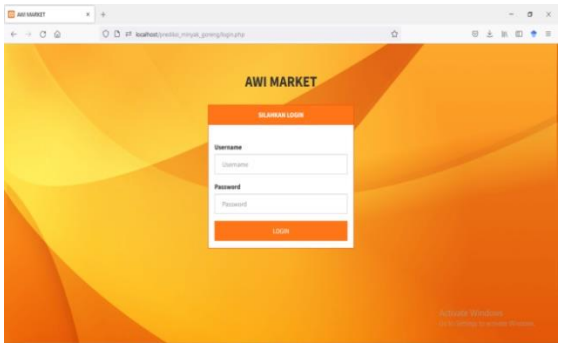

Figure 3. Login Display

After logging in, you will enter the main menu. The main menu display is the display where after logging in and there are menus to run the system.

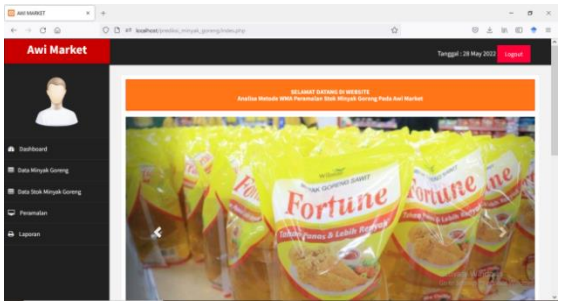

Figure 4. Main Display

After that the user will input the cooking oil data as shown in the following image.

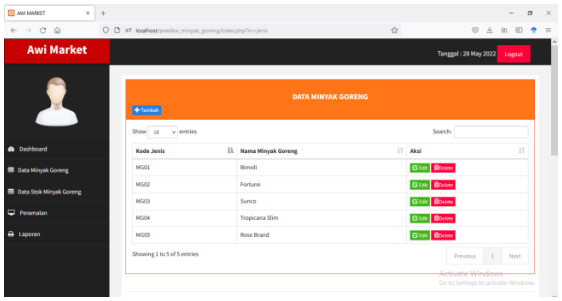

Figure 5. Display of Cooking Oil Data

After that the user will input the cooking oil stock data as shown in the following image.

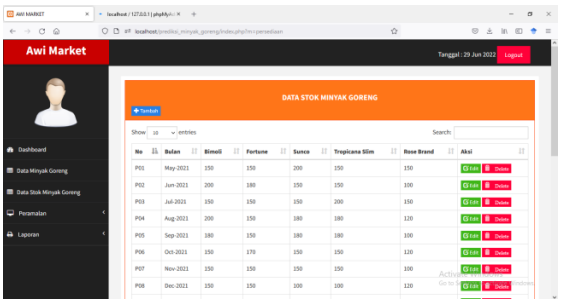

Figure 5. Cooking oil stock display

After that the user will carry out the forecasting calculation process so as to produce the forecast shown in the following figure.

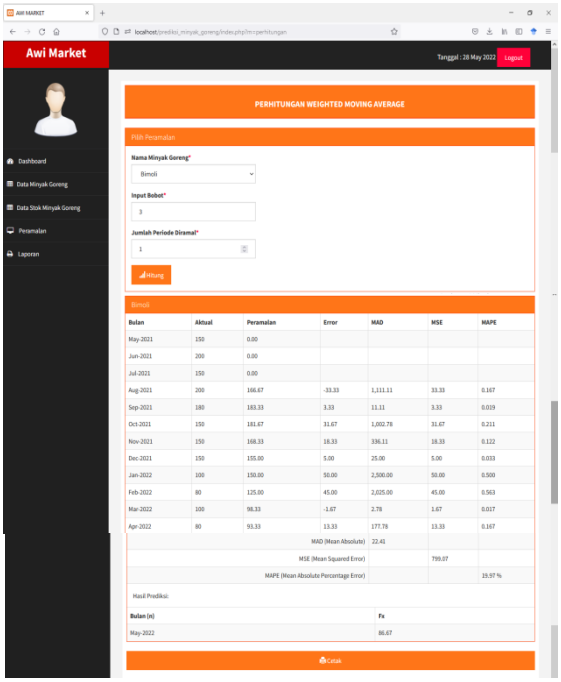

Figure 6. Forecasting Display

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CONCLUSION

The results of applying the Weighted Moving Average method to predict cooking oil stocks at Awi Market that have been carried out, get predictions in May 2022 that there will be 86.67 bimoli cooking oil stocks with an accuracy of MAPE error of 19.97%, fortune as much as 93.33 with accuracy MAPE error is 20%, sunco is 78.33 with MAPE error accuracy 31.87%, tropicana slim is 53.33 with MAPE error accuracy is 29.74% and rose brand is 55 per pack with MAPE error accuracy 26.27%.

The results of building the Awi Market cooking oil stock forecasting system using the PHP programming language and MySQL database will result in a fast and accurate forecasting process and can help the cooking oil stock inventory process easily.

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