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FORECASTING WITH WEIGHTED MOVING AVERAGE METHOD FOR PRODUCT PROCUREMENT STOCK

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ABSTRACT

Dhanty Store is a family start-up located in East Jakarta. It was initiated in 2018, engaged in retail with the main product in the form of women's clothing and accessories. One of the important processes in Dhanty Store operations is the product procurement process. Currently, Dhanty Store request products according to their wishes without looking at their sales data. This causes their product stock is not well controlled. When there is a lot of demand, sometimes Dhanty Shops run out of stock so their customers will move to other stores. In addition, the process of requesting and procuring products to suppliers also takes a long time so that it can further disrupt the operations of Dhanty Store. This study develops a forecasting application prototype with the Weighted Moving Average method to assist Dhanty Store in the process of requesting and procuring their products. Forecasting results in the period (t) of the 1st week of January were 275 products. In addition, this study predicts product stock with a 4-week moving average and the MAD tracking signal value is ranged from -1.51 to 3.86 and the MAPE value is 35.4%. As for the reliability and level of user acceptance of the prototype model in this study, tested using the System Usability Scale (SUS) method and it is known that the average value given by respondents was 82 with details 0% considered inappropriate, 40% considered neutral and 60% rated it according to need.

Keywords*: data mining, forecasting, weighted moving average, MAD, MAPE, SUS*

I. INTRODUCTION

Dhanty Store is a family start-up located in East Jakarta. The store was started in 2018 and is a business that is engaged in retail with its main products in the form of women's clothing and accessories. To increase its expansion, Dhanty Store also utilizes online media to market its products. Various online platforms are used such as Whatsapp, Instagram to national e-commerce to reach customers throughout Indonesia.

Based on an interview with the owner of the Dhanti Store [1], information was obtained that every day on average there are dozens of transactions for various types of products. The store continues to develop operational processes to reach customers throughout Indonesia. Currently, Dhanty Store has at least 15 employees consisting of warehouse and procurement, finance and customer service departments. The high demand for their products, especially online transactions, is not only due to the good quality but also the speed and ease of transactions. Dhanty Store strives to provide the best service to its customers.

One of the special concerns for Dhanty Store is the availability of product stock. They periodically procure products to anticipate stock outs. However, out of stock products still often occur so that their customer service must provide detailed explanations to their customers. This causes the operational activities of Dhanty Store can be disrupted and even causes their customers to move to other stores that have similar products.

Furthermore, [1] explains that the process required to request and procure a product is about 3-5 days. The process starts from requests to delivery of products from various suppliers. This will further aggravate the situation, because when the stock is empty, it can take several days for the product to be available. Moreover, currently the product request process is as desired, not based on data. Sometimes when they order a product, it doesn't meet the customer's demand.

Based on these problems, it is necessary to apply a forecasting system that can help Dhanty Store in the process of requesting and procuring their products. This forecast can be used to predict the number of products that need to be ordered at a time so that stock is continuously available and can meet customer demand. This is also to

anticipate the length of the process of requesting and shipping their products. Thus, operational activities and transactions at Dhanty Store are not disrupted, even more organized and scalable.

This study developed a prototype application for Procurement Stock Forecasting with the Weighted Moving Average Method. As explained earlier that the main product from Dhanty Store is clothing which is a basic need and is used by everyday people, so the Weighted Moving Average method, which is widely used to forecast trading commodities with fairly stable data, although slightly fluctuating, is very suitable in this research [2]. In addition, this method is easier to implement when compared to other methods such as trendlines [3].

Several previous studies related to stock forecasting using various methods such as the Weighted Moving Average method by Sundari, Susanto and Revianti [4], the Weighted Moving Average and Double Exponential Smoothing method by Hayuningtyas [5] and the Moving Average method by Nurlifa and Kusumadewi [6]. In this study, the focus of the method that will be applied by the author is the Weighted Moving Average with various advantages [7], [8], [9], [10]. Therefore, this study aims to apply the forecasting application model for procurement stock products properly and accurately by applying the Weighted Moving Average method at Dhanty Stores.

II. RESEARCH METHODOLOGY

The method in this study applies the CRISP-DM standard to analyze, design and evaluate the process as shown in Figure 1

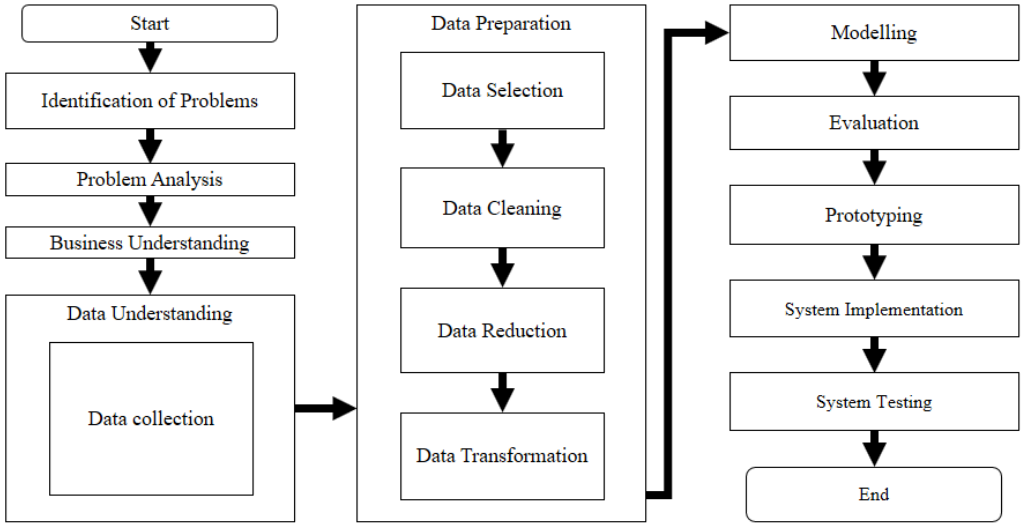

Figure. 1 Research methodology

A. Identification of Problems

The first step in this research is to identify the object of research and define the existing problems. At this stage, the authors conducted initial interviews with the person in charge of the research object. The results of the identification of these problems are summarized and written as in the background of this research which is then analyzed according to the CRISP-DM standard [11]. This is because the topic and problem in this research is data mining [12].

B. Problem Analysis

Based on the previous problems, the authors conducted a problem analysis by applying the standards and stages of CRISP-DM. The processes and stages are business understanding, data understanding, data preparation, modeling, and evaluation [13].

1. Business Understanding

The process of understanding the business on the object of research to find out in detail the existing problems. From this process, the author knows the business and solutions to existing problems. The results of the business understanding process become the basis for conducting data understanding as the next stage in CRISP-DM.

2. Data Understanding

The next step is understanding data. At this stage, the author also collects data related to the research topic. To get the data, the author uses several techniques

a. Interview
   The author again conducted an in-depth interview with Dhanty Store, including a discussion of the details of the existing data such as the origin and types of existing data.
b. Observation
   The authors also made observations to find out an overview of the operational process at Dhanty Store.
c. Internal data
   The internal data in this study is data on product sales in the Dhanty Store. The data will be processed further in solving the problems in this research.

C. Data Preparation

The next step is the preparation of the existing data. This stage is a continuation of the process and standard in CRISP-DM. This stage includes data selection, data cleaning, data reduction and data transformation

1. Data Selection
   At this stage, the authors select and determine the data set that will be used in this study. The data will be processed according to the objectives and needs in this study to forecast the stock of procurement products at the Dhanty Store. The data obtained in this stage is the population in general research.
2. Data Cleaning
   Data cleaning to ensure the data set meets the needs. The data is ensured that it is in good condition and there are no more missing values in it. Missing values include incomplete data, outliers (abnormal data) or data whose values are inconsistent. From the data cleaning stage, data is generated that no longer has a missing value, the data conditions are normal for the next stage.
3. Data Reduction
   Data reduction in data mining is the stage of selecting a sample in the population. The data generated at this stage is real data to be processed using the moving average method in this study.
4. Data Transformation
   At this stage, all data attributes are equated in both format and type. After performing this data transformation stage, the data is ready to be processed.

D. Modelling

The next stage according to the CRISP-DM standard is modeling. At this stage, the author begins to implement the data mining process using the weighted moving average method into a data set that has been prepared previously. The main purpose of this process is to forecast the stock of procurement products at the Dhanty Store. To maximize forecasting results, the author will apply 2 moving averages, 4-week moving average and 5-week moving average [14], [15]. The results of the implementation of the method will be evaluated and tested to determine the best forecasting results.

E. Evaluation

According to the CRISP-DM standard, the stages after the modeling process are evaluation and testing. To carry out the evaluation and testing of the methods and forecasting results of this study, the authors used the Mean Absolute Deviation (MAD) and Mean Absolute Percentage Error (MAPE) methods [16]. The results of this evaluation will determine the best method that can be used in the forecasting process.

F. System Implementation

In designing and developing a prototype application for stock forecasting for procurement of the weighted moving average method at Dhanty Store, the author uses the prototyping model developed by Pressman [17]. In this model, there are five main stages, namely communication, quick plan and quick plan modeling, construction of prototype and deployment delivery & feedback.

G. System Testing

The author tested the system using the System Usability Scale (SUS) method to determine the functionality and usability as well as the level of user acceptance of the resulting application. The researcher gave the SUS questionnaire containing 10 questions to 5 employees at Dhanty Store.

III. RESULTS AND DISCUSSION

A. Business Understanding

As previously explained, some of the problems that Dhanty Store is currently facing regarding the operational process and product procurement are:

1. The demand and supply of products at the Dhanty Store has not been well controlled so that sometimes the stock runs out while customer demand is high. This causes Dhanty Store customers to move to other stores that offer similar products.
2. The request process until the delivery of products from suppliers takes 3-5 days so that when the stock runs out it will disrupt operations and transactions at the Dhanty Store. This causes a decrease in customer loyalty and even worsens the image of Dhanty Store.
3. The number of requests and product procurement at the Dhanty Store is still as desired without seeing the existing sales data. This causes sometimes goods will pile up in the warehouse or run out altogether.

B. Data Understanding

Based on the results of data collection by interview, observation and document study methods, the authors get raw data from Dhanty Stores to be processed in data preparation. The data is 3000 rows with 15 attributes. The research data samples are as in Table 1.

Table 1. Raw Data

Date	CS	Package	Delivery	Recipient
08/01/2021	Nia	1	COD	yanti sihotang
08/01/2021	Nia	2	COD	Agustina W
08/01/2021	Desi	1	COD	soffa
08/01/2021	Nia	1	COD	Endang Busar
08/01/2021	Desi	1	COD	Yuni Herawati
08/01/2021	Nia	1	COD	Hj Novita Liana
08/02/2021	Desi	1	COD	nur
08/02/2021	Nia	1	COD	Nunuk Listyowati
08/02/2021	Nia	1	COD	Ulfa nur fadhila
08/02/2021	Desi	1	COD	marlina
08/02/2021	Nia	1	COD	Eka Puspa Dewi
08/02/2021	Nia	1	COD	Ms.Ana
08/02/2021	Nia	1	COD	upi fatimah
08/02/2021	Desi	1	COD	Nilam sari
08/03/2021	Desi	1	COD	Ipah fauziah
08/03/2021	Nia	1	COD	made suadnyanan

C. Data Preparation

1. Data Selection

To perform data selection, the author selects the data as needed and adjusts it to the weighted moving average method that will be applied in this study. The author also coordinates directly with Toko Dhanty regarding the selection of this data. As a result, it is determined that the data to be used is transaction data in the last 20 weeks, from the 1st week of August 2021 to the 4th week of December 2021 as many as 3085 rows of data.

2. Data Cleaning

The author performs a data cleaning process to ensure that the data is in good condition and there are no more missing values in it. From the data cleaning results, it was found that there were 53 incomplete data lines and 1431 inconsistent data lines. The author then cleans the data and equates the format to get the correct data as needed.

3. Data Reduction

Based on the data cleaning process in the previous stage, finally the existing data was reduced. The data reduction process is done by removing 53 lines of incomplete data so that the total data to be applied to the moving

average algorithm is 3032 lines of data.

4. Data Transformation

In the data reduction process, the existing data is still in the daily time series, while the data requirements for the application of the weighted moving average method are weekly. Therefore, at this stage, the author transforms the data into a weekly time series

D. Attribute and Dataset Selection

Not all data transformation results can be used in the application of the weighted moving average method and algorithm. Therefore, the next step is to select attributes based on the transformation data by looking at existing needs and conditions. As a result, the authors determine two attributes that will be used and applied further in this study, namely the period and the total package.

Thus, the dataset that the author defines is based on the existing data as shown in Table 2.

Table 2. Research Data and Attributes

Period	**Index (t)**	**Actual Data (A)**
1st week of August	1	32
2nd week of August	2	97
3rd week of August	3	76
4th week of August	4	120
1st week of September	5	60
2nd week of September	6	60
3rd week of September	7	39
4th week of September	8	65
1st week of October	9	86
2nd week of October	10	80
3rd week of October	11	56
4th week of October	12	117
1st week of November	13	308
2nd week of November	14	381
3rd week of November	15	356
4th week of November	16	411
1st week of December	17	343
2nd week of December	18	354
3rd week of December	19	341
4th week of December	20	170

E. Weighted Moving Average (WMA) Method

The application of the Weighted Moving Average (WMA) method at this stage is a modeling process in CRISP-DM. To get maximum forecasting results, good and accurate conditions with this method, the authors apply 2 WMA algorithms, namely 4 and 5 week moving averages. The aim is to compare forecasting results and select the best algorithm.

Based on the existing dataset, the forecast value (F) of the weighted moving average method is calculated based on the equation:

$$WMA_{t+1} = \frac{(kX + (k-1)X_{t-1} + \ \ldots + \ X_{t-(n-1)}}{k + (k-1) \ + \cdots + 1}$$

Where:
k = number of periods or range of forecasting numbers
X_t = time series data value at point t

For the first stage, the WMA algorithm used is a 4-week moving average so that the forecast value will be

calculated starting from (t) = 5, namely the 1st week of September with a weighting coefficient of 10. The calculation results are:

F(5) = ((4*120)+(3*76)+(2*97)+(1*32))/10 = 93
F(6) = ((4*60)+(3*120)+(2*76)+(1*97))/10 = 85
F(7) = ((4*60)+(3*60)(2*120)+(1*76))/10 = 74
.
.
.
F(20) = ((4*341)(3*354)+(2*343)+(1*411))/10 = 352

The next stage, the author applies the 5-week moving average algorithm as a comparison for the forecast results of the previous 4-week moving average algorithm. Due to a 5-week movement, the data to be forecast starts from (t) = 6, the 2nd week of September with a weighting coefficient of 15. The calculation results are:

F(6) = ((5*60)+(4*120)+(3*76)+(2*97)+(1*32))/15 = 82
F(7) = ((5*60)+(4*60)+(3*120)+(2*76)+(1*97))/15 = 77
F(8) = ((5*39)+(4*60)+(3*60)+(2*120)+(1*76))/15 = 62
.
.
.
F(20)=((5*341)+(4*354)+(3*343)+(2*411)+(1*356))/15=355

The results of the calculation for forecasting the stock of procurement products at the Dhanty Store with the 4 and 5 week moving average algorithm are as shown in Table 3.

Table 3. The Result for Forecasting Data

Period	**Index (t)**	**Actual Data (A)**	***Forecast* (F) 4-week moving average**	***Forecast* (F) 5-week moving average**
1st week of August	1	32	-	-
2nd week of August	2	97	-	-
3rd week of August	3	76	-	-
4th week of August	4	120	-	-
1st week of September	5	60	93	-
2nd week of September	6	60	85	82
3rd week of September	7	39	74	77
4th week of September	8	65	58	62
1st week of October	9	86	56	60
2nd week of October	10	80	68	66
3rd week of October	11	56	75	72
4th week of October	12	117	70	68
1st week of November	13	308	88	86
2nd week of November	14	381	178	161
3rd week of November	15	356	274	245
4th week of November	16	411	330	301
1st week of December	17	343	378	357
2nd week of December	18	354	370	366
3rd week of December	19	341	362	365
4th week of December	20	170	352	355

F. Algorithm Evaluation

To evaluate the forecasting results of the 4-week and 5-week weighted moving average algorithm, then the authors apply the Mean Absolute Deviation (MAD) algorithm to obtain the tracking signal value and calculate the Mean Absolute Percentage Error (MAPE) value. Testing with the MAD method has several stages such as calculating the error value, Running Sum of Forecast Error (RSFE), absolute error value and absolute cumulative

error. Later, the quality of the MAD results will be determined by measuring the existing tracking signal, the value is in the range of 4 to -4. As for testing with the MAPE method, there are also several stages, namely calculating the error value and absolute error. The results of this test will determine the best weighted moving average method algorithm that can be used by Dhanty Stores to forecast their product stock in the following weeks.

Details of the calculation results of the MAD tracking signal value in each period (t) based on a dataset with a 4-week moving average algorithm as shown in Table 4. Meanwhile, the detailed MAPE value calculation results are based on a dataset with a 4-week moving average algorithm as shown in Table 5. For evaluation results using the MAD and MAPE methods are based on a dataset with a 5-week moving average algorithm as shown in Table 6 and Table 7.

Table 4. Tracking Signal MAD Value 4 Week Moving Average Algorithm

Period	Index (t)	Actual Data (A)	Forecast (F)	Error (E)	RSFE	Absolute Error	Cumulative Absolut Error	MAD	Tracking Signal
1st week of August	1	32	-	-	-	-	-	-	-
2nd week of August	2	97	-	-	-	-	-	-	-
3rd week of August	3	76	-	-	-	-	-	-	-
4th week of August	4	120	-	-	-	-	-	-	-
1st week of September	5	60	93	-33	-33	33	33	33	-1,00
2nd week of September	6	60	85	-25	-58	58	92	46	-1,27
3rd week of September	7	39	74	-35	-93	93	185	62	-1,51
4th week of September	8	65	58	7	-86	86	270	68	-1,27
1st week of October	9	86	56	30	-55	55	325	65	-0,85
2nd week of October	10	80	68	12	-43	43	368	61	-0,70
3rd week of October	11	56	75	-19	-62	62	430	61	-1,00
4th week of October	12	117	70	47	-15	15	445	56	-0,26
1st week of November	13	308	88	220	205	205	650	72	2,84
2nd week of November	14	381	178	204	409	409	1058	106	3,86
3rd week of November	15	356	274	82	491	491	1549	141	3,49
4th week of November	16	411	330	81	572	572	2121	177	3,24
1st week of December	17	343	378	-35	537	537	2657	204	2,63
2nd week of December	18	354	370	-16	521	521	3178	227	2,29
3rd week of December	19	341	362	-21	500	500	3678	245	2,04
4th week of December	20	170	352	-182	317	317	3995	250	1,27

Table 5. MAPE Value 4 Week Moving Average Algorithm

Period	Index (t)	Actual Data (A)	Forecast (F)	Error (E)	Absolute Error	Absolute Error – Actual Data
1st week of August	1	32	-	-	-	-
2nd week of August	2	97	-	-	-	-
3rd week of August	3	76	-	-	-	-
4th week of August	4	120	-	-	-	-
1st week of September	5	60	93	-33	33	0,6
2nd week of September	6	60	85	-25	25	0,4
3rd week of September	7	39	74	-35	35	0,9
4th week of September	8	65	58	7	7	0,1
1st week of October	9	86	56	30	30	0,4
2nd week of October	10	80	68	12	12	0,2
3rd week of October	11	56	75	-19	19	0,3
4th week of October	12	117	70	47	20	0,2
1st week of November	13	308	88	220	43	0,4
2nd week of November	14	381	178	204	93	0,5
3rd week of November	15	356	274	82	68	0,3

Period	Index (t)	Actual Data (A)	Forecast (F)	Error (E)	Absolute Error	Absolute Error – Actual Data
4th week of November	16	411	330	81	13	0,1
1st week of December	17	343	378	-35	44	0,4
2nd week of December	18	354	370	-16	150	0,5
3rd week of December	19	341	362	-21	67	0,3
4th week of December	20	170	352	-182	24	0,1
Total						**5,7**
n						**16**
MAPE						**35,4**

Table 6. Tracking Signal MAD Value 5 Week Moving Average Algorithm

Period	Index (t)	Actual Data (A)	Forecast (F)	Error (E)	RSFE	Absolute Error	Cumulative Absolut Error	MAD	Tracking Signal
1st week of August	1	32	-	-	-	-	-	-	-
2nd week of August	2	97	-	-	-	-	-	-	-
3rd week of August	3	76	-	-	-	-	-	-	-
4th week of August	4	120	-	-	-	-	-	-	-
1st week of September	5	60	-	-	-	-	-	-	-
2nd week of September	6	60	82	-22	-22	22	22	22	-1,00
3rd week of September	7	39	77	-38	-60	60	82	41	-1,46
4th week of September	8	65	62	3	-57	57	139	46	-1,23
1st week of October	9	86	60	26	-31	31	170	43	-0,73
2nd week of October	10	80	66	14	-17	17	187	37	-0,45
3rd week of October	11	56	72	-16	-33	33	219	37	-0,89
4th week of October	12	117	68	49	16	16	235	34	0,47
1st week of November	13	308	86	222	238	238	474	59	4,02
2nd week of November	14	381	161	220	458	458	931	103	4,42
3rd week of November	15	356	245	111	568	568	1500	150	3,79
4th week of November	16	411	301	110	678	678	2178	198	3,43
1st week of December	17	343	357	-14	664	664	2842	237	2,80
2nd week of December	18	354	366	-12	652	652	3494	269	2,42
3rd week of December	19	341	365	-24	628	628	4122	294	2,13
4th week of December	20	170	355	-185	443	443	4565	304	1,46

Table 7. MAPE Value 5 Week Moving Average Algorithm

Period	Index (t)	Actual Data (A)	Forecast (F)	Error (E)	Absolute Error	Absolute Error – Actual Data
1st week of August	1	32	-	-	-	-
2nd week of August	2	97	-	-	-	-
3rd week of August	3	76	-	-	-	-
4th week of August	4	120	-	-	-	-
1st week of September	5	60	93	-33	33	0,6
2nd week of September	6	60	82	-22	22	0,4
3rd week of September	7	39	77	-38	38	1,0
4th week of September	8	65	62	3	3	0,0
1st week of October	9	86	60	26	26	0,3
2nd week of October	10	80	66	14	14	0,2
3rd week of October	11	56	72	-16	16	0,3
4th week of October	12	117	68	49	49	0,4
1st week of November	13	308	86	222	222	0,7
2nd week of November	14	381	161	220	220	0,6

Period	**Index (t)**	**Actual Data (A)**	**Forecast (F)**	**Error (E)**	**Absolute Error**	**Absolute Error – Actual Data**
3rd week of November	15	356	245	111	111	0,3
4th week of November	16	411	301	110	110	0,3
1st week of December	17	343	357	-14	14	0,0
2nd week of December	18	354	366	-12	12	0,0
3rd week of December	19	341	365	-24	24	0,1
4th week of December	20	170	355	-185	185	1,1
Jumlah						**5,7**
n						**15**
MAPE						**37,8**

Based on the test results on the forecasting value using the weighted moving average method on both algorithms, the 4-week moving average and the 5-week moving average, the data is generated as shown in Table 8.

Table 8. Comparison of 4 and 5 Week Moving Average Algorithm Test Results

Period	**Index (t)**	**Actual Data (A)**	***Forecast* (F) 4-week moving average**	***Forecast* (F) 5-week moving average**
1st week of August	1	32	-	-
2nd week of August	2	97	-	-
3rd week of August	3	76	-	-
4th week of August	4	120	-	-
1st week of September	5	60	93	-
2nd week of September	6	60	85	82
3rd week of September	7	39	74	77
4th week of September	8	65	58	62
1st week of October	9	86	56	60
2nd week of October	10	80	68	66
3rd week of October	11	56	75	72
4th week of October	12	117	70	68
1st week of November	13	308	88	86
2nd week of November	14	381	178	161
3rd week of November	15	356	274	245
4th week of November	16	411	330	301
1st week of December	17	343	378	357
2nd week of December	18	354	370	366
3rd week of December	19	341	362	365
4th week of December	20	170	352	355
Tracking Signal MAD			**-1.51 – 3.86**	**-1.46 – 4.42**
MAPE			**35.4**	**37.8**

From Table 8, it is known that the 4-week moving average algorithm produces better values based on testing using the Mean Absolute Deviation (MAD) method, which is in the signal range -1.51 to 3.86. This value indicates that the algorithm can be applied properly and accurately for forecasting the stock of procurement products at the Dhanty Store because it is still within the normal point of the MAD signal, which is between -4.00 to 4.00. The tracking signal graph is as shown in Figure 2.

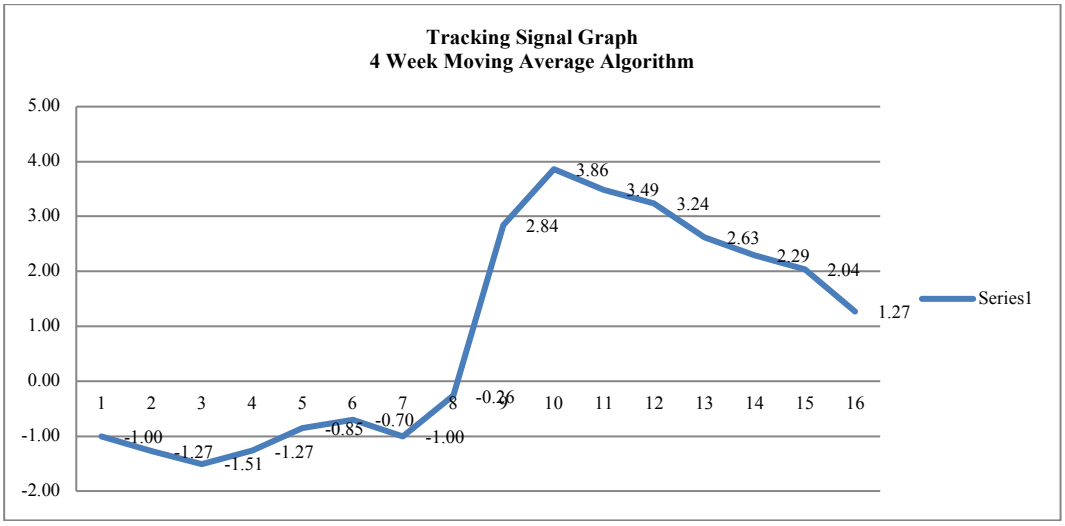

Figure. 2 Tracking signal graph 4-week moving average algorithm

Meanwhile, in the 5-week moving average algorithm the signal is between -1.46 to 4.42. This value exceeds the normal limit of the MAD signal even though it is only about 0.42 so it is not suitable to be applied in forecasting models. The tracking signal graph is as shown in Figure 3.

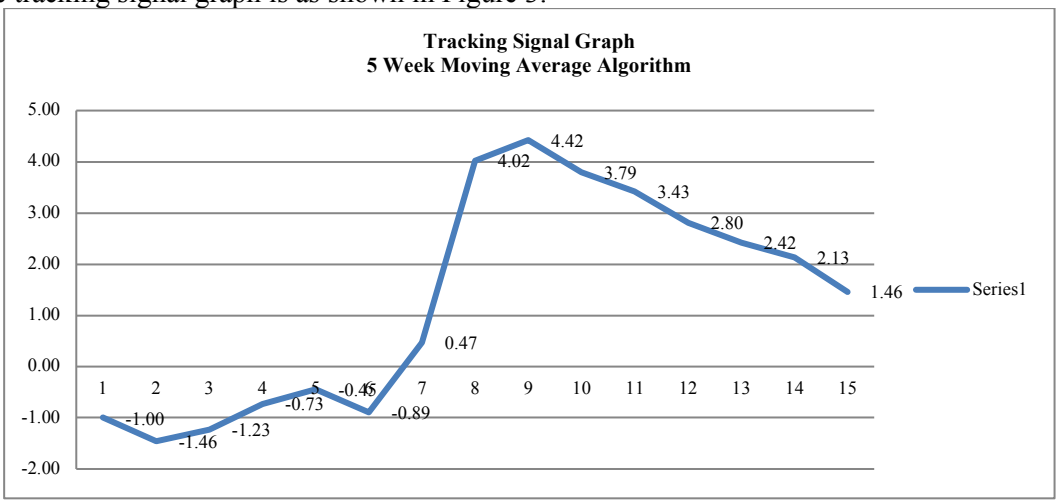

Figure. 3 Tracking signal graph 5-week moving average algorithm

The same result is also seen in the test using the Mean Absolute Percentage Error (MAPE) method where the value for the 4-week moving average algorithm is 35.4% better than the 5-week moving average algorithm of 37.8%. However, in terms of data, actually the difference between the two is not too far, it is still in the same range, which is good and feasible to use.

However, in general, based on testing the MAD and MAPE methods, the 4-week moving average algorithm is better and more accurate to use than the 5-week moving average. So, for the prototype development stage, the author will apply the weighted moving average method with a 4-week moving average algorithm. There are several things that affect the results, including the number of datasets used and the high volatility of the existing data. If the training data is added, the forecasting results may be better in both algorithms. Regarding data fluctuations, this is reasonable because product sales data at Dhanty Stores for clothing and accessories are highly volatile based on trends and customer demand in a period (t).

G. Prototype Implementation

At this stage, the author uses the Unified Modeling Language (UML) tool in general system design. The results of this design can be used as documentation in the development of the application in the future. The use case diagram for the application of stock forecasting for procurement products using the weighted moving average method at the Dhanty Store in this study is as shown in Figure 4.

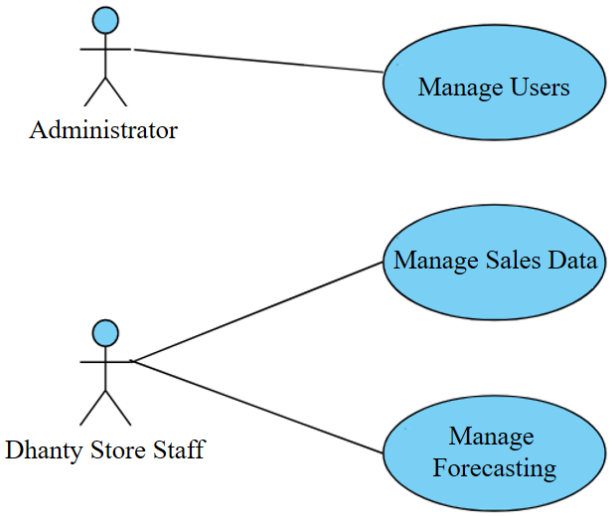

Figure. 3 Use case diagram

The activity diagram of the procurement inventory forecasting application in this study is as shown in Figure 4.

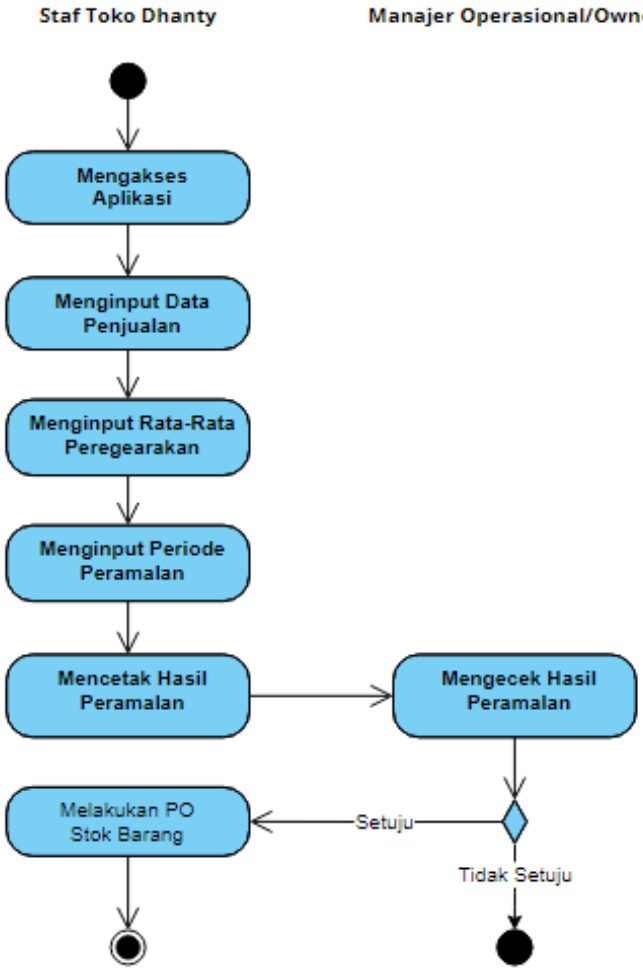

Figure. 4 Activity diagram

H. Prototype Testing

Testing the prototype using the System Usability Scale (SUS) method which aims to check the reliability and level of user acceptance with the application for forecasting the stock of procurement products using the weighted moving average method. This test uses the SUS questionnaire which contains 10 questions. In addition, testing

with the SUS method involved five respondents from Dhanty Store. The results of filling out the questionnaire are as shown in Table 9.

Table. 9 SUS Testing Questionnaire Results

No	Questions	Scale 1	2	3	4	5
1	I think that I would like to use this system frequently.			1	3	1
2	I found the system unnecessarily complex.	3		2		
3	I thought the system was easy to use.			1	3	1
4	I think that I would need the support of a technical person to be able to use this system.	2	2	1		
5	I found the various functions in this system were well integrated.				4	1
6	I thought there was too much inconsistency in this system.	3		2		
7	I would imagine that most people would learn to use this system very quickly.			1	2	2
8	I found the system very cumbersome to use.	4		1		
9	I felt very confident using the system.			1	2	2
10	I needed to learn a lot of things before I could get going with this system.	4	1			

Based on Table 9, questions in odd sequence numbers (positive meaning), the test score is calculated by reducing the position scale value by 1 (xi-1). Meanwhile, for questions on even sequence numbers (with negative meaning), the score is calculated by subtracting 5 from the positional scale value (5-xi). The score of each respondent is added up and multiplied by 2.5 so that the value will be in the range of 0-100. Details of the results of the test calculations are as in Table 10.

Table. 9 SUS Testing Result

Score Result										Total	Value
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10		(Total x 2.5)
4	4	4	4	3	2	3	4	3	4	35	88
3	2	3	2	3	2	4	2	4	4	29	73
3	2	3	3	3	4	2	4	3	3	30	75
3	4	3	3	4	4	3	4	2	4	34	85
2	4	2	4	3	4	4	4	4	4	35	88
Average Score (Final Result)											82

Based on the test results in Table 9, it is known that the average value of respondents to the application is 82. The details of the assessment are 0% of respondents who consider it inappropriate, 2 respondents (40%) rate neutral and 3 respondents (60%) rated it appropriate. Thus, based on the average value of the test results of the SUS method, it is known that respondents can accept forecasting applications in this study.

IV. CONCLUSION

The conclusion of the research results of Forecasting with Weighted Moving Average Method for Product Procurement Stock are:

1. The Weighted Moving Average method can be applied to good and accurate forecasting of the stock of procurement goods at the Dhanty Store. Based on this research obtained:
   a. This study shows that the 4-week moving average algorithm is better applied than the 5-week moving average algorithm. From the existing dataset, it is found that forecasting in the period (t) of the 1st week of January 2022 is estimated that there will be sales of 275 items so that the Dhanty Store can make Purchase Orders (PO) around that amount.
   b. This study resulted in an evaluation or testing of the 4-week moving average algorithm with the Mean Absolute Deviation (MAD) signal tracking method in the range between -1.51 to 3.86. These results

indicate that the algorithm can be applied well to the forecasting model because it is still in accordance with the signal point threshold, which is between -4 to 4. In addition, the test using the Mean Absolute Percentage Error (MAPE) method shows a value of 35.4 which indicates that the forecasting model algorithm is good and feasible to use.

2. The development of Forecasting Application with Weighted Moving Average Method for Product Procurement Stock can make good and accurate predictions on the Dhanty Store according to the needs and can be accepted by its users. Based on the results of testing the prototype using the System Usability Scale (SUS) method, it is known that the average value of the respondents is 82 with details 0% of respondents assessing it is not appropriate, 40% of respondents assessing neutral and 60% of respondents assessing the application is appropriate and running well.

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