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Single Moving Average Method Forecasting to Predict Skincare Sales

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ABSTRACT
Nada Nadine Skincare Store is a business engaged in the sale of beauty skincare. Nada Nadine Skincare Store was established in 2023 and is located on Jalan Lingkungan IV Air Joman, Asahan Regency. The problem at Nada Nadine Skincare Store is that it has difficulty in estimating the level of demand for beauty skincare (Wardah) for inventory because it is still guessing and experience from the production department of Nada Nadine Skincare Store and there is no beauty skincare sales forecasting system that will make it easier for Nada Nadine Skincare Store to determine the amount of beauty skincare (Wardah) inventory. The purpose of this system is to be able to apply the single moving average method to the beauty skincare (Wardah) sales demand forecasting system at the Nada Nadine Skincare Store and to be able to design a website-based beauty skincare (Wardah) sales demand forecasting system at the Nada Nadine Skincare Store using the PHP programming language and MySql database. From the problem analysis, the author tries to predict the amount of beauty skincare demand using the Single Moving Average (SMA) method. The conclusion that can be drawn from research on the Single Moving Average (SMA) based skincare sales forecasting system forecasts the sales demand for beauty skincare (wardah) at the Nada Nadine Skincare Store so The system calculation results are the same as the manual calculation forecast July 2024 is 33,50, forecast August 2024 is 32,75, MAD value is 2,70, MSE value is 11,31 and MAPE value is 8,84%.

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1. INTRODUCTION

Technological advances are currently developing very rapidly so that it is possible if every trader uses information technology as a tool in their business such as recording the inventory of goods in the shop forecasting how many goods need to be supplied in the following month and printing reports on the stock of goods in their shop [1]. The issue of information about inventory is important for users of relevant information to make decisions when making inventory records to understand the inventory needed by a store [2]. An uncertain number of sales can cause the company's business processes to be inefficient so that the company must be careful in determining sales. Therefore, companies must be able to manage inventory data with inventory allowing company management to organize production and sales procurement activities more flexibly minimizing the possibility of the company failing to meet customer demand and there is no accumulation and stock of goods that can cause losses in the store [3]. Data processing carried out by most stores is still in a manual way so that the level of difficulty experienced in data management is higher.

Therefore, a system is needed to assist business owners in providing stock items to reduce losses in their business [4].

Toko Nada Nadine Skincare is a business engaged in the sale of beauty skincare. Nadine Skincare Nada Shop was founded in 2023 and is located on Jalan Lingkungan IV Air Joman, Asahan Regency. The problem at Toko Nada Nadine Skincare is that it has difficulty in estimating the level of demand for beauty skincare (wardah) for inventory because it is still guessing and practicing from the production department of Toko Nada Nadine Skincare and there is no beauty skincare sales forecasting system that will make it easier for the Nada Nadine Skincare Store to determine the amount of beauty skincare inventory (wardah).

Nada Nadine Skincare shop in the production process is faced with uncertainty in demand for beauty skincare which results in an uncertain amount of beauty skincare produced. Which results in the possibility of losses caused by the accumulation of skincare or profits being not optimal when skincare stock is reduced. So that the creation of a beauty skincare sales forecasting system will make it easier for the Nada Nadine Skincare Store to determine the amount of beauty skincare production in order to be able to meet the needs of consumer demand in the future [5].

The forecasting method is one of the methods used to control production. This method is quite commonly used by large companies. However, some small and medium-sized businesses still do not understand how to determine the number of goods that should be produced [6]. The forecasting method plays an important role in a business. Forecasting is the right way to minimize losses due to overproduction [7]. In determining how many goods to produce, Forecasting uses historical data as a reference [8]. The forecasting method is the best way to overcome anomalies in consumer demand in certain seasons. Without forecasting, the company will find it difficult to grow because its production capacity never matches consumer demand in the field [9]. Forecasting is usually done by the marketing division to predict the amount of demand [10]. The forecasting results are then used by the company to plan the company's production or operational activities. Data forecasting methods are used to make production when running a business more effective [11].

The Single Moving Average method or also abbreviated as SMA is one of the most efficient moving average methods in the calculation process [12], 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 [13]. 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 [14].

The following is previous research on forecasting using the single moving average method:

1. Research conducted by Nurul et al in 2021 [15] The conclusion generated in this study is that the SMA method can be used to predict the amount of revenue at the NANISHOP354 cosmetics store, then further research is recommended to use a combination of forecasting methods in order to obtain better accuracy.
2. Research conducted by Nurhidayanti et al [16] The conclusions that can be drawn by the author / researcher who has been carried out at Momy's Cake and Bread are as follows: (1) With the construction of a forecasting system for the use of cake and bread raw materials at Momy's Cake and Bread using the web-based Single Moving Average method using the PHP programming language and MySQL database..., (2) Application of the Single Moving Average method of using cake and bread raw materials at Momy's Cake and Bread, based on the calculation of the Single Moving Average forecasting method in July 2021, the results of MAD = 9.5874, MSE = 18225.39162 and MAPE = 30%., (3) With the existence of forecasting using the Single Moving Average method, it can help Momy's Cake and Bread estimate raw materials in the following month.
3. Research conducted by Saefuding et al in 2021 [17] The sales forecasting system for block lots using the Single Moving Averaged method is made to assist the company in determining the amount of production in the next period. The results of the calculation of forecasting sales of block lots using the single moving average method are tested for accuracy using MAD, MSE and MAPE. From the test results, a significant value is obtained and can be used as a reference to determine the amount of production for the next period.
4. The next research researched by Kukuh et al in 2022 [18] From the results of forecasting using Single Moving Average and using actual data from December 2021 to June 2022, the forecasting results obtained in July / next month are 2,901 kg. From the MSE (Mean Squared Error) 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.
5. The next research by Nurliana and Ilfan in 2022 [19] Based on research conducted at IM Parfum Pekanbaru, it can be concluded that with the system created, it 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.

From research on the single moving average method, it can be concluded that the single moving method has the advantage that by averaging data over a period of time, the single moving average helps reduce short-term fluctuations or noise in the data, so that larger and more significant trends become easier to identify.

2. RESEARCH METHOD

This type of research is quantitative with the following research stages as shown in Figure 1.

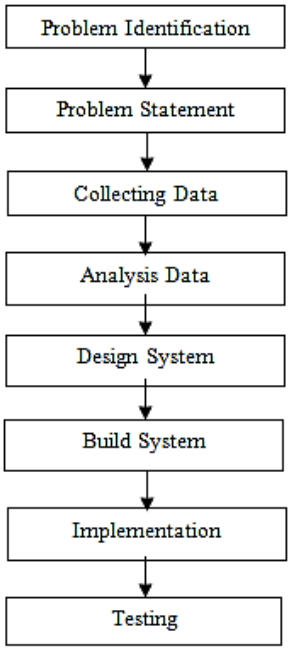

Figure 1. Stage of Research

There are several stages to this research: (1) Problem identification: is the first step where at this stage looking for problems that occur in the field through direct observation to the Nada Nadine Skincare shop. (2) Problem Statement: formulate problems obtained in the field based on the results of observations and interviews. (3) Collecting Data: collect necessary data such as skincare sales data and other data that is considered important. (4) Analysis Data: namely analyzing the data that has been obtained using the SMA method. (5) Design System: is a pattern or description of the user interface of the application to be made using Microsoft Visio and using a use case diagram as a system user design. (6) Build System: Convert the design to an application using the sublime text editor and mysql database. (7) Implementation: apply the system that has been made on the object of research. (8) Testing: Test the system as a whole to make sure it runs well.

2.1 Data Analysis

The results of the needs analysis obtained are the input data needed in predicting the amount of clothing inventory from July 2022 to June 2024. 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 3 year from July 2022 to June 2024 where from this data we will forecast the stock for July and August 2024.

Table 1. Sales Data 3 Year Before

No	Period	Aktual
1	Jul-22	32
2	Aug-22	33
3	Sep-22	30
4	Oct-22	30
5	Nov-22	31
6	Dec-22	26
7	Jan-23	31
8	Feb-23	25
9	Mar-23	36
10	Apr-23	33
11	May-23	35
12	Jun-23	32
13	Jul-23	32
14	Aug-23	33
15	Sep-23	30
16	Oct-23	30
17	Nov-23	31
18	Dec-23	26
19	Jan-24	31
20	Feb-24	25
21	Mar-24	36
22	Apr-24	33
23	May-24	35
24	Jun-24	32
25	Jul-24	?
26	Aug-24	?

2.2 Forecasting 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.

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

2.3 Mean Absolute Deviation (MAD)

Mean Absolute Deviation (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 Mean Absolute Deviation (MAD) can be calculated using the formula 2.

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

2.4 Mean Sequence Error (MSE)

Mean Squared Error (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.

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

2.5 Mean Absolute Percentage Error (MAPE)

Mean Absolute Percentage Error (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.

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

2.6 System Design

The results of the use case diagram design aim to help identify and document the main functionality of the system. In addition, it provides an overview of how users or actors will interact with the system. This

use case has two actor, namely the admin to manage the system and owner to check the forecast result. The system design can be seen in Figure 2.

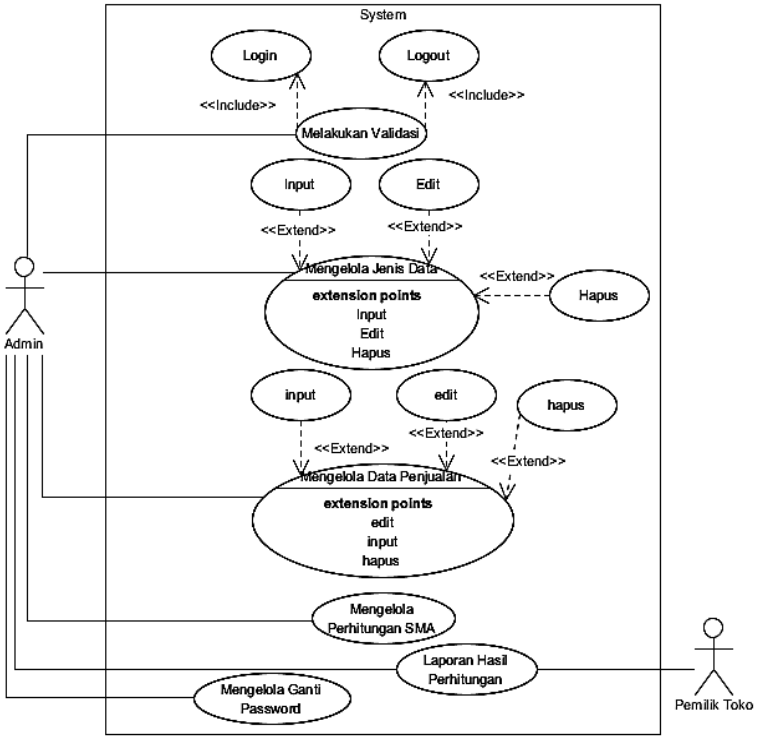

Figure 2. Use Case Diagram

From Figure 2, it can be seen that there are 2 users of the skincare forecasting system, namely the admin and the shop owner.

3. RESULTS AND ANALYSIS

3.1. Forecast dan Sistem Page

The forecasting page is a menu used by the admin to perform the skincare forecasting process based on the sales data that has been previously entered. the results can be printed to archive. The system calculation results are the same as the manual calculation results as shown in table 2 below with forecast July 2024 is 33,50, forecast August 2024 is 32,75, MAD value is 2,70, MSE value is 11,31 and MAPE value is 8,84%.

Table 2. Forecast Calculation With System

No	Period	Aktual (Yt)	Ft
1	Jul-22	32	0.00
2	Aug-22	33	0.00
3	Sep-22	30	32.50
4	Oct-22	30	31.50
5	Nov-22	31	30.00
6	Dec-22	26	30.50
7	Jan-23	31	28.50
8	Feb-23	25	28.50
9	Mar-23	36	28.00
10	Apr-23	33	30.50
11	May-23	35	34.50
12	Jun-23	32	34.00
13	Jul-23	32	33.50
14	Aug-23	33	32.00
15	Sep-23	30	32.50
16	Oct-23	30	31.50
17	Nov-23	31	30.00
18	Dec-23	26	30.50
19	Jan-24	31	28.50
20	Feb-24	25	28.50
21	Mar-24	36	28.00

No	Period	Aktual (Yt)	Ft
22	Apr-24	33	30.50
23	May-24	35	34.50
24	Jun-24	32	34.00
25	Jul-24	?	33.50
26	Aug-24	?	32.75
		Total	59.50
		MAD	2.70
		MSE	11.31
		MAPE	8.84

A low MAPE below 10% to 20% is desirable in forecasting, as it indicates that the model used has good accuracy. Conversely, a high MAPE indicates that the forecasting results are less reliable and may need to be reviewed or improved [20].

3.2. Forecast Graphic

After the system displays the forecasting calculation for the supply of Creamy Wash in the following month with graphics, the results can be printed to archive.

Month (n)	Fx
Jul-2024	34
Aug-2024	33

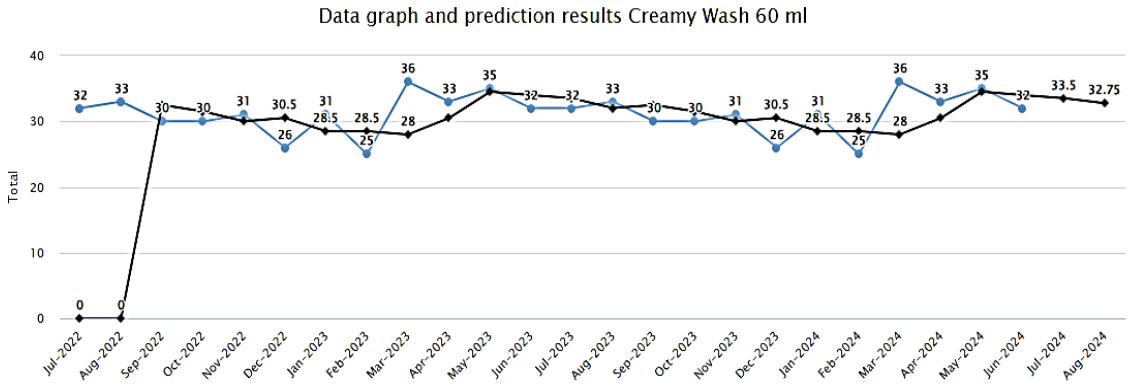

Figure 3. Graphics Forecast

On the forecasting graph, there are two lines. The blue line explains the number of sales of Creamy Wash products each month and the black line explains about sales forecasting in the following month. From the graph it can be seen that the second error has a gap that is not too far away, which means that the level of forecasting error using the SMA method is also small.

3.3. System Testing

In order for the system to function optimally, the system must first be tested to identify weaknesses and errors, which will then be evaluated. The test results using black box testing, as shown in table 3.

Table 3. Black Box Testing

Input Data	Expected Process	Conclusion
Entering complete username and password data	Can enter the system through the login form	Successful
Enter Type in full	The system saves the input data into the database	Successful
Editing type data	The system changes the type data in the database	Successful
Add data	The system changes the data in the database	Successful
Edit data	The system changes the period data in the database	Successful
Click link delete on data form	The system deletes the data in the database	Successful
Enter Complete calculation data	The system saves the input data into the database	Successful
Click link print on the calculation result data form	The system executes the output process	Successful
Enter	The system saves the input data into the database	Successful

Input Data	Expected Process	Conclusion
Complete password change data Not filling out the form completely	The system rejects the process	Successful

4. CONCLUSION

The conclusion that can be drawn from research on the Single Moving Average (SMA) based skincare sales forecasting system forecasts the sales demand for Creamy Wash at the Nada Nadine Skincare Store so The system calculation results are the same as the manual calculation results forecast July 2024 is 33,50, forecast August 2024 is 32,75, MAD value is 2,70, MSE value is 11,31 and MAPE value is 8,84%.

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