

Computer Sales Forecasting System Application Using Web-Based Single Moving Average Method

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Abstract—*Hamam Com Computer Store is one of the computer shops in the city of Surakarta. There is a change in the turnover of toy sales every year, management management in managing the store's financial statements. hence the need for a system that can forecast sales of goods for the coming year. The purpose of this research is to design a computer goods sales forecasting system by applying the Single Moving Average method. This method was chosen because it has the ability to observe, look for the average value as a forecast for the future period. Data collection techniques in this research are observation (observation), interviews (interviews) and literature study. In the design of this system is made with Context Diagram, HIPO, DAD, relations between tables. This application is made using the PHP programming language and the database uses MySQL. The final result is a sales data report and sales prediction results. The results of the tracking signal control chart error test results show a value of no more than 4 so the system is declared good.*

Keywords— Computer Store, Forecasting, Single Moving Average, HIPO.

I. INTRODUCTION

The Computer Store is one of the electronic stores in Surakarta City, the Hamam Com Computer Store is a store center that sells various computer facilities. This shop opened in 2009 with operating hours from 08.00 to 18.00. This computer shop has various types of hardware peripherals, so it's no wonder that the task of calculating inventory is very time consuming and tedious. In the process of recording transactions, both purchases, sales, and returns of goods, computer stores still use manual methods which can lead to uncontrolled inventory, recording errors and so on. The main problem The store manager has not been able to predict the sales of wholesale and retail goods based on the past 3 years. so it will be difficult to make decisions on the production of new goods every year[1].

From the explanation above, it can be seen that the Head of the Computer Store has difficulty in predicting the sale of computer inventory production so that the store has difficulty making decisions. The solution to this problem is to build a prediction system for wholesale and retail toy sales using the Single Moving Average method. This method was chosen because it is a forecasting method that uses a number of new actual demand data to generate forecast values for future demand[2].

The Moving Average method is a forecasting method that is carried out by taking a group of observed values, looking for the average value as a forecast for the future period, is the definition of a single moving average (Single Moving Average). This method is called a moving average because every time new observation data is

available, new numbers are calculated and used as forecasts for the next period[3].

The main purpose of using moving averages is to eliminate or reduce randomness in the time series. This goal can be achieved by refining a periodic data series, namely by using a single moving average (Single Moving Average Method) [4].

Therefore, researchers are interested in bringing this up in a study with the theme: Computer Sales Prediction System Using Web-Based Single Moving Average Method. Through this research, it is hoped that it can provide benefits for the store in making decisions to determine the amount of stock of goods sold in computer stores.

II. LITERATURE REVIEW

2.1 Forecasting System

Forecasting is a process of systematically estimating something that is most likely to happen in the future based on past and present information that is owned, so that the error (difference between something that happens and the forecast results) can be minimized. Prediction does not have to give a definite answer to what will happen, but tries to find an answer as close as possible to what will happen[5].

Understanding Prediction is the same as forecast or forecast. According to the Big Indonesian Dictionary, prediction is the result of predicting or forecasting or estimating future values using past data. Prediction shows what will happen in a given situation and is an input for planning and decision-making processes. Predictions can

be based on the scientific method or purely subjective. Take for example, weather predictions are always based on the latest data and information based on observations including by satellite. Likewise predictions of earthquakes, volcanic eruptions or disasters in general. However, predictions such as football matches, sports, etc. are generally based on subjective views with their own point of view predicting them. At the outset, although the in-depth study of alternative futures is a new discipline, perhaps people have been paying great attention to what will happen next since humans began to know things. The population of fortune-tellers and astrologers in ancient and medieval times was a manifestation of people's curiosity about their future. This concern about the future continued and even developed into a syndicated astrology column in 1973[6].

2.2 Forcasting (Forecasting)

Forecasting is a procedure for making factual information about future social situations on the basis of existing information on policy issues. Forecasts have three main forms: projections, predictions, and forecasts.

1. A projection is a forecast based on extrapolation of past and present trends into the future. Projections make assertive questions based on arguments obtained from certain methods and parallel cases.
2. A prediction is a forecast based on firm theoretical assumptions. These assumptions can take the form of theoretical laws (e.g. the law of diminishing value for money), theoretical propositions (e.g. the proposition that the dissolution of civil society is caused by a gap between expectations and abilities), or analogies (e.g. the analogy between the growth of government organizations and the growth of biological organisms).
3. An estimate (conjecture) is a forecast based on informative judgments or expert judgments about the future situation of society.

The purpose of holding policy forecasts is to obtain information about future changes that will affect the implementation of policies and their consequences. Therefore, before making recommendations, it is necessary to formulate policy forecasts so that truly accurate recommendations will be obtained to be implemented in the future. In predicting future needs based on the past, it takes someone who has high sensitivity and is able to read the possibilities in the future. Policy forecasting is also needed to control, in a sense, trying to plan and establish policies so that they can provide the best alternative actions that can be chosen among the various possibilities offered by the future. The future is also sometimes heavily influenced by the past. With reference to the future, policy analysis must be able to assess what values can or should guide future actions [7].

2.3 Single Moving Average Method

The single moving average method is a forecasting method that uses a number of new actual demand data to generate forecast values for future demand. The moving average method is suitable for long-term data. Concept and Application Moving average is a forecasting technique based on moving averages from past values, for example, 3-year, 4-month, 5-week moving averages, and so on. However, this technique is not recommended for time series data that shows the influence of trends and seasonality. Moving averages are divided into Single Moving Average and Double Moving Average. Single Moving Average has two special properties[8]:

- a. To make a forecast, you need historical data over a certain period of time.
- b. The longer the grading period, the smoother the forecast will be.

Formula used number 1.

$$S_{t+1} = \frac{X_1 + X_{t-1} + \dots + X_{t-n+1}}{n} \dots\dots\dots(1)$$

Information :

- S_{t+1} : forecasting for period t+1
- X_t : data on period t
- n : moving average timeframe

Variable n can be filled with numbers according to the wishes of the application user. Average Terms Moving is used because every time a new observation value appears, a new average value can be calculated by removing the oldest observation value and entering the observation value or data the latest. To find out the level of "accuracy" of the method, the error value or error can be calculated calculated using the Mean Absolute Deviation (MAD) method. Score deviation of sales data in the nth month with the forecasting that has been done previously, will be calculated and averaged. The error value is not considered positive sign and sign the negative. That is, deviations or errors will be converted into absolute values. For calculate the error or error value from forecasting, what needs to be done is to take actual data deducted by forecasting data that has been done previously[9].

The value can be plus or minus. After obtaining the error value, the error values can be averaged. The formula used to average the error values in formula 2.

$$MAD = \frac{|\sum F|}{n} \dots\dots\dots(2)$$

2.4 PHP Programming Language

At first PHP stands for Personal Home Page. As the name implies, PHP is used to create personal websites. Within a few years of its development, PHP has become a

powerful web programming language and is not only used to create simple web pages, but also popular websites used by millions of people.

PHP is a recurring abbreviation of PHP Hypertext Preprocessor, formerly known as Personal Home Page, first created by Rasmus Lerdorf in 1995. The most popular function of PHP is its ability as a Server Side Programming / Scripting Language in making Websites, or Website-based applications. Server Side Programming / Scripting is a language that runs on the server side (in this case the Web Server) so that our computer (Client / Web Browser) does not know what is happening inside the Web Server. We (Client/Web Browser) only receive output from the process generated by the Web Server [10].

2.5 MySQL Database

MySQL is a multithreaded, multi-user SQL database management system (DBMS) software. MySQL is an implementation of a relational database management system (RDBMS). MySQL was created by TcX and has been trusted to manage a system with 40 databases containing 10,000 tables and 500 of them having 7 million rows. MySQL AB is a Swedish commercial company that has sponsored and owns My SQL. The founders of MySQL AB are two Swedes named David Axmark, Allan Larsson and one Finn named Michael “Monty”. Every MySQL user can use it freely which is distributed free under the GPL license but may not make a commercial derivative product [11].

MySQL is one of the RDBMS (Relational Database Management System) products that we can enjoy for free. The data that we want to store will be treated by the RDBMS as tables that are interconnected / can be linked / or stand alone in the database. The database itself is essentially a collection of many tables. SQL itself stands for Structured Query Language, is the standard database language used today. With Query, we can perform operations on the Database. For example, creating tables, changing tables, deleting, entering data, creating table relations (connecting tables) etc. PHP has been famous for its ease of connecting / accessing databases, especially MySQL DB. then it is not wrong, if PHP and MySQL seem like a couple of this century [12].

MySQL is one of the RDBMS (Relational Database Management System) products that we can enjoy for free. The data that we want to store will be used by the RDBMS as tables that are interconnected / can be linked / or stand alone in the database. The database itself is essentially a collection of many tables. SQL itself stands for Structured Query Language, is the standard database language used today. With Query, we can perform operations on the Database. For example, create tables, modify tables, delete, insert, create table relations or connect tables [10].

III. RESEARCH METHODOLOGY

The research method is a step that is owned and carried out by researchers in order to collect information or data and conduct investigations on the data that has been obtained. The research method provides an overview of the research design which includes, among others: procedures and steps that must be taken, research time, data sources, and with what steps the data is obtained and then processed and analyzed. The research methods used in completing this research are as follows:

3.1 Data Collection Method

In conducting research, it begins with collecting useful data for further data processing. The data collection methods are as follows:

1. Interview

At this stage, the researcher interviewed the competent parties directly related to the problem of predicting the sale of goods

2. Observation

At this stage, the authors carry out a data collection by recording data and systematically observing the reports on sales of toys in the past years according to the needs of the research.

3. Literature Study

At this stage the author conducts a literature study, namely collecting reference materials from books, articles, journals, papers, and internet sites regarding a Toy Goods Sales Prediction System using the Single Moving Average Method and other sources that support the research objectives.

3.2 System Development Method

The following methods in system development are as follows:

1. System Analysis

At the system analysis stage, several actions are carried out such as: data collection, system analysis, selection process on system requirements.

2. System Design

In the system design stage there are system design processes such as: Context Diagram (CD), Hierarchy Input Process Output (HIPO), Data Flow Diagram (DAD), Use Case Diagrams, Activity Diagrams, Sequence Diagrams and Class Diagrams

3. System Design

In the system design stage, several designs are needed such as input design, output design, technology design and database design.

4. System Implementation

In system implementation, it is the process of making the entire system application from start to finish until it can be used with the Single Moving Average Method. The system is made using the PHP programming language and MySQL database.

5. System Test

The system testing is done in two ways, namely the functionality test and the validity test.

IV. RESULTS AND DISCUSSION

The results of this discussion are the overall system design data, namely as follows:

4.1 Single Moving Average Method Analysis

Single Moving Average method is a forecasting method that is carried out by taking a group of observation values, looking for the average value as a forecast for the future period, the Single Moving Average method is the definition of a single moving average (Single Moving Average). This method is called a moving average because every time new observation data is available, new numbers are calculated and used as forecasts for the future period. The formula used in the Single Moving Average method is as shown in formula 4.1

$$\text{Moving Average (n) periode} = \frac{\sum(\text{Penjualan dalam n - Periode Terdahulu})}{n} \dots(3)$$

Information

Where (n) is the number of periods in the Moving Average model. In this calculation, the researcher uses a 4-period moving average.

The steps in calculating the Single Moving Average method are as follows:

1. Identify historical patterns from actual demand data
2. Choose a forecasting model according to the historical pattern of the actual demand data
3. Perform data analysis based on the selected forecasting model
4. Choose the right forecasting model based on the smallest MAD (Mean Absolute Deviation)
5. Check the quality of the forecasting model according to the tracking signal control map.

4.2 System Planning

1. Contex Diagram

Context Diagram Is Part of the Data Flow Diagram (DF) that works mapped the environmental model, which is represented by a single circle that represents the whole system.

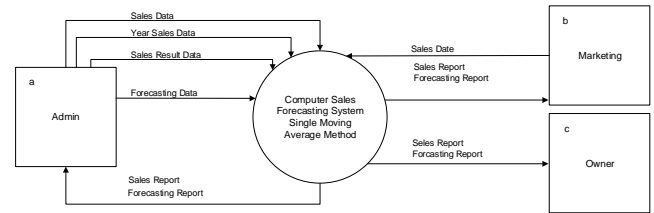


Figure 1. Context Diagram

4.2 HIPO

Hierarchy of Input Process Output (HIPO) is used as a tool for system development and program documentation techniques and their use has several objectives. The HIPO tiered chart is used for levels to provide a clear explanation of the inputs that must be used and the outputs that must be produced by each function in each level of the HIPO diagrams. The picture of HIPO Computer Store Sales Prediction System with Single Moving Average Method can be seen in Figure 2.

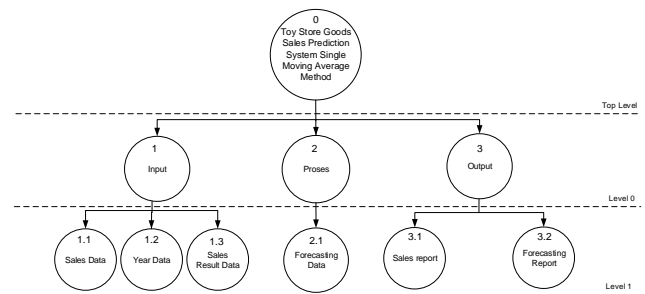


Figure 2. HIPO

4.3 DAD (Data Arud Diagram)

Data Arus Diagram (DAD) is a diagram that uses notations to describe the flow of system data, the use of which is very helpful for understanding the system logically, structured and clear. DAD which describes the flow from data to the system, DAD helps to understand the system logically, structured and clear. The following is the DAD level 0 for the Toy Store Sales Prediction System with the Single Moving Average Method. The description of DAD Level 0 can be seen in Figure 3.

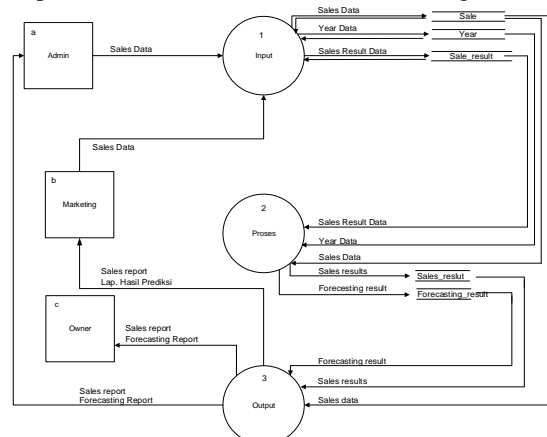


Figure 3. DAD Level 0

4.3 System Implementation

System implementation is the process of making a system in the form of designing a Computer Sales Forecasting System application with the Single Moving Average Method.

1. Enter sales data

The input data display used to input sales data into the application program can be shown in Figure 4.



Figure 4. Sales Data Input Form

2. Sales List View

After the sales data input is complete, the sales data will appear as shown in Figure 5.



Figure 5. Sales Data

3. Prediction Process

The process menu is used to carry out the sales prediction process (click Prediction Menu >> Poses), shown in Figure 6.

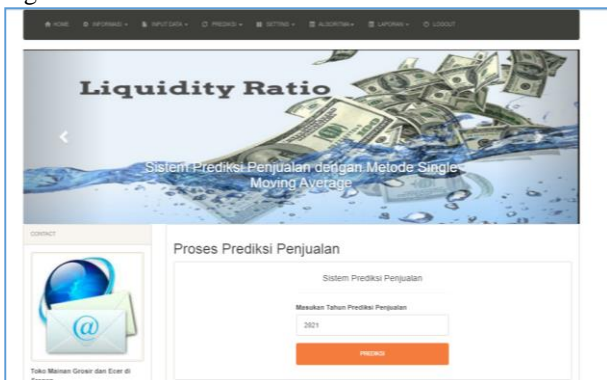


Figure 6. Prediction Process

4. Prediction Results

After entering the Predicted Year and then clicking Predict, it will automatically display the data as shown in Figure 7.

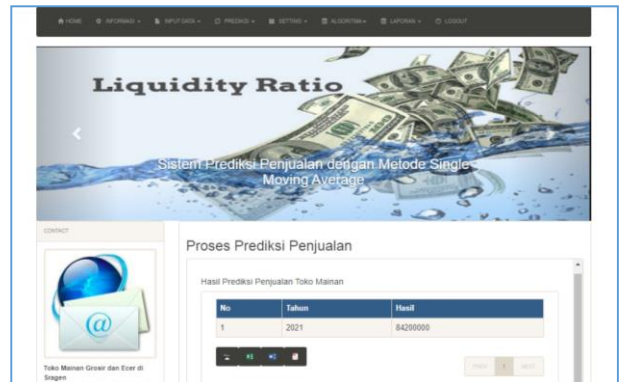


Figure 7. Prediction Results

5. Report View

Display the results of the Computer Sales Forecasting System report with the Single Moving Average Method as shown in Figure 8.

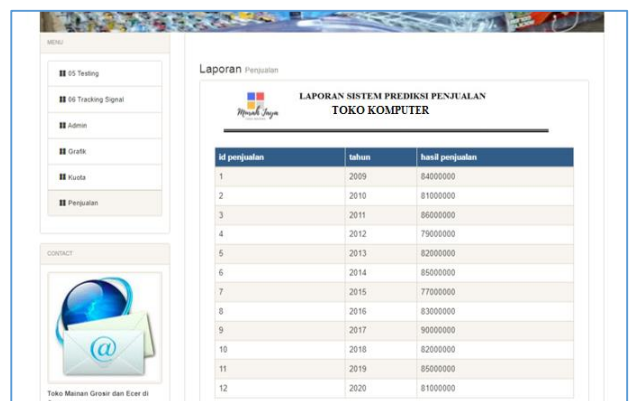


Figure 8. Sales Data Report

b. Prediction Result Report

This report is useful for providing information from the computer sales forecasting process, so that it can assist managers in making decisions, shown in Figure 9.

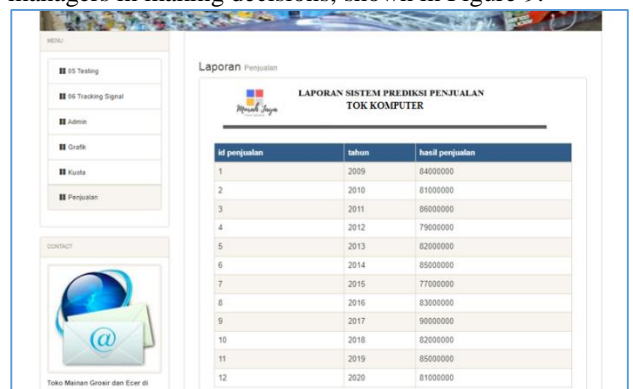


Figure 9. Prediction Result Report

4.7 System Test

System testing is carried out with 2 test stages, namely functionality testing and validity testing. The recap of the functional test results can be seen in table 1.

Table 1. Functionality Test

No	Jenis Uji	Komponen Sistem yang diuji	Skenario Uji	Hasil yang diharapkan	Hasil yang dihasilkan	Status Uji	Hasil Pengeujian
1	Uji Normal	Form Input Data Penjualan	Masukan data penjualan secara lengkap dan benar	Data tersimpan dengan baik dan benar	Muncul pesan "Penyimpanan Berhasil" Tersimpan dengan baik	Normal	Diterima
	Uji Salah	Form Input Data Penjualan	Masukan data penjualan secara tidak lengkap	Tidak bisa menyimpan	Tidak bisa disimpan	Normal	Diterima
2	Uji Normal	Form Input Data Prediksi	Masukan data prediksi secara lengkap dan benar	Data karyawan tersimpan dengan baik dan benar	Muncul pesan "Penyimpanan Berhasil" Tersimpan dengan baik	Normal	Diterima
	Uji Salah	Form Input Data Prediksi	Masukan data prediksi secara tidak lengkap	Tidak bisa menyimpan	Tidak bisa disimpan	Normal	Diterima
3	Uji Normal	Form Input Data Tahun	Masukan data tahun secara lengkap dan benar	Data karyawan tersimpan dengan baik dan benar	Muncul pesan "Penyimpanan Berhasil" Tersimpan dengan baik	Normal	Diterima
	Uji Salah	Form Input Data Tahun	Masukan data tahun secara tidak lengkap	Tidak bisa menyimpan	Tidak bisa disimpan	Normal	Diterima
4	Uji Normal	Form Input Hasil Penjualan	Masukan data hasil penjualan secara lengkap dan benar	Data karyawan tersimpan dengan baik dan benar	Muncul pesan "Penyimpanan Berhasil" Tersimpan dengan baik	Normal	Diterima
	Uji Salah	Form Input Hasil Penjualan	Masukan data hasil penjualan secara tidak lengkap	Tidak bisa menyimpan	Tidak bisa disimpan	Normal	Diterima

In addition to testing the system by testing the functionality of the researchers, they also tested the system by testing the validity.

The validity test is to compare the results of manual calculations with computerized results. The following is a manual calculation of the Single Moving Average Method:

The steps in the sales forecasting process using the Single Moving Average Method are as follows:

1. Conversion of Values

The first step that must be prepared is to convert the value of sales data from past years as shown in table 2.

Table 2. Conversion of Sales Value

No	Year	Time Index (t)	Sales Results (p)
1	2009	1	84
2	2010	2	81
3	2011	3	86
4	2012	4	79
5	2013	5	82
6	2014	6	85
7	2015	7	77
8	2016	8	83
9	2017	9	90
10	2018	10	82
11	2019	11	85
12	2020	12	81
13	2021	13	?

2. Calculation Algorithm

In the calculation of the Single Moving Average method, it is carried out using reference data for a 4-year period and a 5-year period. This can be seen in table 3.

Table 3. Calculation of the Single Moving Average Method

Month	Time Index	Sales Results	Moving Averages 4 tahun (Ft MA4)	Moving Averages 5 tahun (Ft MA5)
2009	1	84	-	-
2010	2	81	-	-
2011	3	86	-	-
2012	4	79	-	-
2013	5	82	$(84+81+86+79)/4=82,5$	-
2014	6	85	$(81+86+79+82)/4=82$	$(84+81+86+79+82)/5=82,4$
2015	7	77	$(86+79+82+85)/4=83$	$(81+86+79+82+85)/5=82,6$
2016	8	83	$(79+82+85+77)/4=80,75$	$(86+79+82+85+77)/5=81,8$
2017	9	90	$(82+85+77+83)/4=81,75$	$(79+82+85+77+83)/5=81,2$
2018	10	82	$(85+77+83+90)/4=83,75$	$(82+85+77+83+90)/5=83,4$
2019	11	85	$(77+83+90+82)/4=83$	$(85+77+83+90+82)/5=83,4$
2020	12	81	$(83+90+82+85)/4=85$	$(77+83+90+82+85)/5=83,4$
2021	13	???	$(90+82+85+81)/4=84,5$	$(83+90+82+85+81)/5=84,2$

Based on calculations from the Moving Average Method Analysis for taking predictions from 4 and 5 years ago, a sales prediction in 2021 can be obtained for a 4-year period, namely 84.5 and a 5-year period, which is 84.2. So that it can be obtained the results of grouping the prediction section as shown in table 3.

3. Prediction Results of the Moving Average Method

Based on the calculation model with a period of 4 years and 5 years, the calculation results are obtained as shown in table 4.

Table 4. Forecasting Results Single Moving Average Method

Year	Time Index	Sales Results	(Ft MA4)	(Ft MA5)
2009	1	84	-	-
2010	2	81	-	-
2011	3	86	-	-
2012	4	79	-	-
2013	5	82	82,5	-
2014	6	85	82	82,4
2015	7	77	83	82,6
2016	8	83	80,75	81,8
2017	9	90	81,75	81,2
2018	10	82	83,75	83,4
2019	11	85	83	83,4
2020	12	81	85	83,4
2021	13	???	84,5	84,2

4. Selecting the smallest MAD Mode

In finding the smallest MAD value using the moving Average method, namely by subtracting the actual demand value with the actual forecast, then adding up all of them and dividing by the number of existing periods, this is shown in table 5.

Table 5. Absolute deviation values for MA 4 and MA 5

Time Index	Actual Request	Ft MA4	Absolute Deviation Period MA 4	Ft MA5	Absolute Deviation Period MA 5
5	82	82,5	0,5	-	
6	85	82	3	82,4	2,6
7	77	83	6	82,6	5,6
8	83	80,75	2,25	81,8	1,2
9	90	81,75	8,25	81,2	8,8
10	82	83,75	1,75	83,4	1,4
11	85	83	2	83,4	1,6
12	81	85	4	83,4	2,4
			MAD = 3,47		MAD = 3,37

Information :

$$\text{MAD for MA 4} = (0.5+3+6+2.25+8.25+1.75+2+4)/8 = 3.47$$

$$\text{MAD for MA 5} = (2.6+5.6+1,2+8.8+1.4+1.6+2.4)/7 = 3.37$$

Based on Table 5, the Mean Absolute Deviation calculation value for a 5-period Moving Average is preferred because it has a Mean Absolute Deviation value that is smaller than the Mean Absolute Deviation for a 4-period Moving Average.

5. Test Tracking Signal Control Map

To find out how far the reliability of the selected forecasting model is, the tracking signal control map method is used.

The steps in calculating the 5-month moving average tracking signal are as follows:

1. Enter data in the period column, sequentially starting from the first period to the eighth period
2. The forecast column is derived from the calculation of the 5-month Moving Average in the previous table.
3. The Actual Column (A3) is derived from the actual demand, starting from the sixth month (June) to the twelfth month (December).
4. 2. The error column contains the subtraction of the actual column with the forecast column.
5. The RSFE column is obtained from the cumulative (sum) error column. The table below shows that the value of -1.4 is obtained by adding up $-4.8 + 3.4 = -1, 4$.
6. The absolute error column is obtained by absoluteing the value in the error column What is meant by absolute is that a negative value turns into a positive value.
7. The cumulative absolute error column contains the cumulative (sum) value of the absolute error column.
8. The MAD column is derived from dividing the absolute cumulative error column by the period column.
9. The value in the tracking signal column is obtained by dividing the RSFE column by the MAD column.
10. The results of the calculation of the tracking signal moving Average can be seen in table 6.

Table 6. Map of 5 period MA tracking signal control

Periode, n(1)	Forecast, F(2)	Aktual, A(3)	Error, E=A-F, (4)=(3)-(2)	RSFE (5)-kumulatif dari(4)	Absolut Error (6)= Absolut dari (4)	Kumulatif Absolut Error(7)= kumulatif dari (6)	MAD (8)=(7)/(1)	Tracking Signal (9)=(5)/(8)
1	82,4	85	2,6	2,6	2,6	2,6	2,60	1
2	82,6	77	-5,6	-3	5,6	8,2	4,10	-0,73
3	81,8	83	1,2	-1,8	1,2	9,4	3,13	-0,57
4	81,2	90	8,8	7	8,8	18,2	4,55	1,54
5	83,4	82	-1,4	5,6	1,4	19,6	3,92	1,43
6	83,4	85	1,6	7,2	1,6	21,2	3,53	2,04
7	83,4	81	-2,4	4,8	2,4	23,6	3,37	1,42

From the calculation of table 4.8 above, we show the tracking signal control map, where in the tracking signal control map distribution it is seen that the moving value does not exceed ± 4 . So it can be concluded that the Sales of Wholesale and Retail Toy Stores in Sragen in 2021 is predicted to be 84.2 million or rounded up to 84 million. From the calculation of the 5-period MA tracking signal, it can be described in a signal graph as shown in Figure 10.

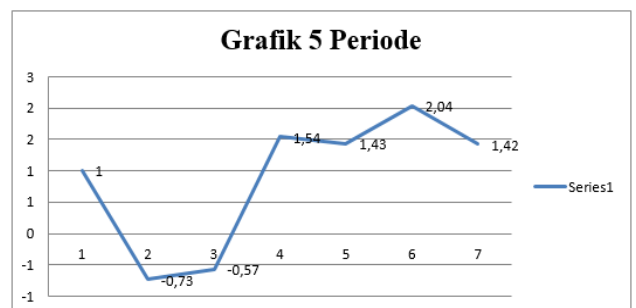


Figure 10. 5-period MA tracking signal chart

Based on the graphic above, it shows that the distribution of the tracking signal control map shows that the moving value does not exceed ± 4 . so it can be concluded that the sales of goods in wholesale and retail toy shops in Sragen in 2021 amounted to: 84.2 million (Rp. 84.200.000,00) Based on the results of the manual calculations above, then they are compared with the results of the calculations in the program as follows shown in Figure 11.



Figure 11. Prediction Results in the Program

Based on the description of the calculation of the single moving average algorithm on the prediction system for sales of toys at the goris and retail toy stores, the same results are obtained between manual calculations and in the application program, so that the system is declared valid 100%.

V. CONCLUSION

Based on the results of the discussion that has been carried out so as to produce conclusions.

1. The research that has been done has been able to fulfill the research objectives, namely the formation of a system in the form of a script and software application Prediction System for Sales of Wholesale and Retail Toys with the Single Moving Average method in Sragen.
2. System testing carried out on the functionality test shows the results that indicate the data is accepted or successful and the validity test has shown valid results, which are the same between the results of manual calculations (algorithms) and programmed calculations.
3. Based on the graphic above, it shows that the distribution of the tracking signal control map shows that the moving value does not exceed ± 4 . so it can be concluded that the sales of goods in wholesale and retail toy shops in Sragen in 2021 amounted to: 84.2 million (Rp. 84.200.000,00)

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