

# Comparison of Weighted Moving Average (WMA) and Single Exponential Smoothing (SES) Methods in Website-Based Sales Forecasting (Case Study: Adi Comp Store)

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## Abstract

This study aimed to compare two forecasting methods, namely Weighted Moving Average (WMA) and Single Exponential Smoothing (SES), in predicting sales at Toko Adi Comp through a web-based system. The WMA method used three periods with weights of 3, 2, and 1, while the SES method applies a smoothing parameter (Alpha) of 0.2. The forecasting process utilized historical sales data from January 2024 to April 2025, covering ten different laptop products. The system automatically calculates predictions and displays the Mean Squared Error (MSE) to evaluate the accuracy of each method. The test results showed that the SES method produces lower MSE values in 7 out of 10 analyzed products, such as the Hp 14-Ck0xxx, which has an MSE of 13.2282, compared to the WMA method with an MSE of 15.1068. Although generally less accurate, WMA performed well on some products such as Asus X442U. This comparison indicated that SES was more stable and responsive to gradual changes in sales trends. Therefore, SES was recommended as the primary forecasting method in the sales prediction system for Toko Adi Comp. This system is expected to support inventory planning, optimize stock levels, and improve sales decision-making.

**Keywords:** Forecasting, Sales, Website Weighted Moving Average, Single Exponential Smoothing, Mean Squared Error

## 1. Introduction

Adi Comp is a laptop store specializing in the sale of various types of laptops. As a technology retailer, Adi Comp strives to stay up-to-date with consumer needs by providing the latest and highest-quality products. Website-based technology has been proven to improve business efficiency through real-time and automated data management[1].

However, in its operations, Adi Comp faces challenges in anticipating consumer demand for specific laptop types, particularly when market trends fluctuate. The inability to predict demand often results in excess or shortages of stock, which results in increased storage costs and decreased customer satisfaction when products are unavailable[2], especially amidst intense competition in the technology market. With the wide variety of laptop specifications in demand, Adi Comp requires a systematic approach to analyze historical sales data and identify reliable demand patterns. Without an accurate forecasting strategy, the risk of missed sales opportunities and a decline in brand image is inevitable[3].

Laptops are increasingly essential technological devices in various sectors, from education to professional work. Compared to desktop computers, laptops offer high mobility, allowing users to work in various locations. Amidst rapid technological developments, the demand for laptops continues to grow, especially with the demand for lighter, more powerful, and more durable devices[4]. The high variety of consumer needs requires Adi Comp to be more careful in determining stock management strategies and responding to market trends in a timely manner.

To address these challenges, sales forecasting methods are one solution[5] that can help Adi Comp optimize its business strategy. To improve forecasting accuracy, the Weighted Moving Average (WMA) and Single Exponential Smoothing (SES) methods are often used due to their ability to leverage historical data to estimate future demand. The WMA method places greater weight on more recent data, making it relevant for identifying short-term sales trends, especially in dynamic businesses. Meanwhile, the SES method uses smoothing parameters to dampen fluctuations that can disrupt sales patterns, making it effective in conditions of fluctuating data. Several studies have shown that both methods are capable of producing good predictions, especially when the Mean Absolute Percentage Error (MAPE) and Mean Square Error (MSE) values are low, which are indicators of the level of forecast error[6].

The Weighted Moving Average (WMA) method is a forecasting technique that assigns different weights to historical data, with more recent data receiving a greater weighting, making it more responsive to recent pattern changes[7]. Its advantage lies in its ability to capture

seasonal patterns or short-term fluctuations, although it is less effective for long-term trends with complex patterns[6]. Meanwhile, Single Exponential Smoothing (SES) gives exponential weight to historical data with decreasing weight for older data, using the formula  $F_t = F_{t-1} + \alpha(Y_{t-1} - F_{t-1})$  with  $\alpha$  between 0 and 1. This method is simple and effective in smoothing data with small fluctuations or without strong patterns, but has limitations in capturing seasonal patterns or significant trends because it only relies on one smoothing parameter[6].

The selection of the WMA and SES methods in this study was based on Adi Comp's need to predict sales using fluctuating historical data while maintaining analytical simplicity. Both methods are suitable for forecasting short-term data with varying degrees of fluctuation[8]. WMA is more sensitive to short-term trend changes, while SES is more stable for data with minimal fluctuations. Both methods offer certain advantages in handling data with non-complex patterns, which is in line with the characteristics of Adi Comp's sales data.

Besides WMA and SES, there are other forecasting methods such as ARIMA (Auto-Regressive Integrated Moving Average), Linear Regression, or Neural Networks[9]. However, these methods typically require more complex data, additional parameters, or greater computational resources. In the context of this research, WMA and SES were chosen due to their simplicity of implementation, time efficiency, and relevance to the characteristics of Adi Comp data.

The primary objective of comparing these two methods is to determine which method best suits the characteristics of Adi Comp's sales data. The comparison is based on accuracy, using the Mean Square Error (MSE). Previous studies have shown that WMA is superior in capturing rapid trends, while SES is effective in mitigating the impact of small fluctuations. The results of this study are expected to provide more specific and practical recommendations for Adi Comp Stores to support efficient data-driven decision-making[6].

Therefore, this study aims to compare the accuracy of two methods, Weighted Moving Average (WMA) and Single Exponential Smoothing (SES), in website-based sales forecasting at Adi Comp Store. The results of this study are expected to provide recommendations for a more appropriate method and support Adi Comp Store's business strategy.

## 2. Methodology

This study employs descriptive and quantitative approaches in data collection and analysis. Data were collected through interviews, observations, and analysis of various factors influencing sales predictions, including historical sales data[10]. The data obtained were then processed to design a sales forecasting system at Adi Comp Store using the website-based Weighted Moving Average (WMA) and Single Exponential Smoothing (SES) methods. Furthermore, this study also aims to compare the performance of the two methods.

## 3. Results and Discussion

In this research, system requirements analysis covers the elements necessary to build a system. These requirements include data collection from observations, formula use, system design, and the system implementation process.

### 3.1. Observation Data

The data in this study were obtained through three main methods: Interviews, Observation, and Analysis. Interviews involve the researcher interacting directly with the shop owner. Observation involves the researcher directly observing situations or behaviors related to the research topic. Analysis involves studying documents related to the research. Laptop sales data for this study is shown in the following table, where the researcher used 10 laptop products over a 16-month period as analytical material in developing the forecasting system.

**Table 1** : Adi Comp Store Sales Data for January 2024-April 2025

No	Month	Sales Data									
		Asus				Lenovo			Hp		
		X441N	X441S	X442U	X441M	Ideapad 110-14ast	Ideapad 100-15ibr	G40 Intel Celeron N2840	14-Af119au	14-Ck0xxx	Hp 15-D052tu
1	Jan-24	43	45	45	34	53	25	40	18	31	33
2	Feb-24	36	41	40	29	46	35	52	21	28	40
3	Mar-24	40	42	38	30	54	40	43	26	37	37
4	Apr-24	35	54	33	28	52	48	49	28	39	29
5	May-24	25	31	44	47	35	38	46	34	35	48
6	Jun-24	45	48	35	32	42	45	24	26	32	31
7	Jul-24	35	44	38	41	55	32	25	24	37	35
8	Aug-24	42	37	38	39	30	30	27	19	29	43
9	Sep-24	30	43	32	35	40	26	42	25	31	54
10	Okt-24	45	53	40	26	48	35	41	31	34	42
11	Nov-24	35	50	38	41	33	30	40	28	27	40
12	Des-24	48	35	44	37	37	28	36	32	31	34
13	Jan-25	38	52	35	51	42	38	39	27	35	29
14	Feb-25	28	45	40	46	45	42	37	24	35	31
15	Mar-25	43	37	35	39	27	28	34	22	32	36
16	Apr-25	38	40	33	35	38	40	36	25	29	21

### 3.2. Application of Forecasting

In this study, a forecasting formula was applied to calculate May 2025 sales predictions based on sales data from January 2024 to April 2025. As an example, the researcher used one type of laptop sales data, namely the HP 14-Ck0xxx. The calculation steps are as follows:

- a. Calculating the Weighted Moving Average along with Mean Squared Error

For May 2025, the Weighted Moving Average method calculation uses the previous 3 periods with weights of 3, 2, 1, the most recent data uses the largest weight, with the following formula:

$$WMA = \frac{\sum_{i=1}^n (x_i \cdot w_i)}{\sum_{i=1}^n w_i}$$

Where:

- $X_i$  = data value in period i.
- $w_i$  = weight assigned to the data in period i.
- $n$  = number of periods used in the wma calculation.

**Table 2 :** Calculating the Weighted Moving Average along with Mean Squared Error HP 14-Ck0xxx

Month	Hp 14- Ck0xxx	3-period Wma prediction	Mse
January 2024	31	-	-
February 2024	28	-	-
March 2024	37	-	-
April 2024	39	$(37 \times 3 + 28 \times 2 + 31 \times 1) / 6 = (111 + 56 + 31) / 6 = 33$	$(39 - 33) = (6)^2 = 36$
May 2024	35	$(39 \times 3 + 37 \times 2 + 28 \times 1) / 6 = (117 + 74 + 28) / 6 = 36,5$	$(35 - 36,5) = (-1,5)^2 = 2,25$
June 2024	32	$(35 \times 3 + 39 \times 2 + 37 \times 1) / 6 = (105 + 78 + 37) / 6 = 36,6667$	$(32 - 36,6667) = (-4,6667)^2 = 21,7778$
July 2024	37	$(32 \times 3 + 35 \times 2 + 39 \times 1) / 6 = (96 + 70 + 39) / 6 = 34,1667$	$(37 - 34,1667)^2 = (2,8333)^2 = 8,0278$
August 2024	29	$(37 \times 3 + 32 \times 2 + 35 \times 1) / 6 = (111 + 64 + 35) / 6 = 35$	$(29 - 35)^2 = (-6)^2 = 36$
September 2024	31	$(29 \times 3 + 37 \times 2 + 32 \times 1) / 6 = (87 + 74 + 32) / 6 = 32,1667$	$(31 - 32,1667)^2 = (-1,1667)^2 = 1,3611$
October 2024	34	$(31 \times 3 + 29 \times 2 + 37 \times 1) / 6 = (93 + 58 + 37) / 6 = 31,3333$	$(34 - 31,3333)^2 = (2,6667)^2 = 7,1111$
November 2024	27	$(34 \times 3 + 31 \times 2 + 29 \times 1) / 6 = (102 + 62 + 29) / 6 = 32,1667$	$(27 - 32,1667)^2 = (-5,1667)^2 = 26,6944$
December 204	31	$(27 \times 3 + 34 \times 2 + 31 \times 1) / 6 = (81 + 68 + 31) / 6 = 30$	$(31 - 30)^2 = (1)^2 = 1$
January 2025	35	$(31 \times 3 + 27 \times 2 + 34 \times 1) / 6 = (93 + 54 + 34) / 6 = 30,1667$	$(35 - 30,1667)^2 = (4,8333)^2 = 23,3611$
February 2025	35	$(35 \times 3 + 31 \times 2 + 27 \times 1) / 6 = (105 + 62 + 27) / 6 = 32,3333$	$(35 - 32,3333)^2 = (2,6667)^2 = 7,1111$
March 2025	32	$(35 \times 3 + 35 \times 2 + 31 \times 1) / 6 = (105 + 70 + 31) / 6 = 34,3333$	$(32 - 34,3333)^2 = (-2,3333)^2 = 5,4444$
April 2025	29	$(32 \times 3 + 35 \times 2 + 35 \times 1) / 6 = (96 + 70 + 35) / 6 = 33,5$	$(29 - 33,5)^2 = (-4,5)^2 = 20,25$
May 2025	-	$(29 \times 3 + 32 \times 2 + 35 \times 1) / 6 = (87 + 64 + 35) / 6 = 31$	-
Mse Results			$\frac{196,3889}{13} = 15,1068$

- b. Calculating the Single Exponential Smoothing along with Mean Squared Error

For May 2025, the Single Exponential Smoothing method calculation uses Alpha 0.2, with the following formula:

$$F_t = F_{t-1} + \alpha(Y_{t-1} - F_{t-1})$$

Where:

- $F_t$  = Forecast for period t.
- $F_{t-1}$  = Actual value for the current period.
- $Y_{t-1}$  = Actual data for the previous period.
- $\alpha$  = Alpha (a value between 0 and 1), (in this case,  $\alpha = 0.2$ ).

**Table 3 :** Calculating the Single Exponential Smoothing along with Mean Squared Error HP 14-Ck0xxx

Month	Hp 14- Ck0xxx	Ses Prediction (Alpha 0.2)	Mse
Januari 2024	31	$F1 = Y1$ (Inisialisasi) = 31	-
Februari 2024	28	$F2 = 31 + 0,2 \times (31 - 31) = 31 + 0 = 31$	-
Maret 2024	37	$F3 = 31 + 0,2 \times (28 - 31) = 31 + 0,2 \times (-3) = 31 - 0,6 = 30,4$	-

April 2024	39	F4 = 30,4 + 0,2×(37 - 30,4) = 30,4 + 0,2×(6,6) = 30,4 + 1,32 = 31,72	(39 - 31,72) <sup>2</sup> = (7,28) <sup>2</sup> = 52,9984
Mei 2024	35	F5 = 31,72 + 0,2×(39 - 31,72) = 31,72 + 0,2×(7,28) = 31,72 + 1,456 = 33,176	(35 - 33,176) <sup>2</sup> = (1,824) <sup>2</sup> = 3,327
Juni 2024	32	F6 = 33,176 + 0,2×(35 - 33,176) = 33,176 + 0,2×(1,824) = 33,176 + 0,3648 = 33,5408	(32 - 33,5408) <sup>2</sup> = (-1,5408) <sup>2</sup> = 2,3741
Juli 2024	37	F7 = 33,5408 + 0,2×(32 - 33,5408) = 33,5408 + 0,2×(-1,5408) = 33,5408 - 0,30816 = 33,2326	(37 - 33,2326) <sup>2</sup> = (3,7674) <sup>2</sup> = 14,193
Agustus 2024	29	F8 = 33,2326 + 0,2×(37 - 33,2326) = 33,2326 + 0,2×(3,7674) = 33,2326 + 0,7535 = 33,9861	(29 - 33,9861) <sup>2</sup> = (-4,9861) <sup>2</sup> = 24,8613
September 2024	31	F9 = 33,9861 + 0,2×(29 - 33,9861) = 33,9861 + 0,2×(-4,9861) = 33,9861 - 0,9972 = 32,9889	(31 - 32,9889) <sup>2</sup> = (-1,9889) <sup>2</sup> = 3,9557
Oktober 2024	34	F10 = 32,9889 + 0,2×(31 - 32,9889) = 32,9889 + 0,2×(-1,9889) = 32,9889 - 0,3978 = 32,5911	(34 - 32,5911) <sup>2</sup> = (1,4089) <sup>2</sup> = 1,985
November 2024	27	F11 = 32,5911 + 0,2×(34 - 32,5911) = 32,5911 + 0,2×(1,4089) = 32,5911 + 0,2818 = 32,8729	(27 - 32,8729) <sup>2</sup> = (-5,8729) <sup>2</sup> = 34,4908
Desember 2024	31	F12 = 32,8729 + 0,2×(27 - 32,8729) = 32,8729 + 0,2×(-5,8729) = 32,8729 - 1,1746 = 31,6983	(31 - 31,6983) <sup>2</sup> = (-0,6983) <sup>2</sup> = 0,4876
Januari 2025	35	F13 = 31,6983 + 0,2×(31 - 31,6983) = 31,6983 + 0,2×(-0,6983) = 31,6983 - 0,1397 = 31,5586	(35 - 31,5586) <sup>2</sup> = (3,4414) <sup>2</sup> = 11,8429
Februari 2025	35	F14 = 31,5586 + 0,2×(35 - 31,5586) = 31,5586 + 0,2×(3,4414) = 31,5586 + 0,6883 = 32,2469	(35 - 32,2469) <sup>2</sup> = (2,7531) <sup>2</sup> = 7,5795
Maret 2025	32	F15 = 32,2469 + 0,2×(35 - 32,2469) = 32,2469 + 0,2×(2,7531) = 32,2469 + 0,5506 = 32,7975	(32 - 32,7975) <sup>2</sup> = (-0,7975) <sup>2</sup> = 0,6361
April 2025	29	F16 = 32,7975 + 0,2×(32 - 32,7975) = 32,7975 + 0,2×(-0,7975) = 32,7975 - 0,1595 = 32,638	(29 - 32,638) <sup>2</sup> = (-3,638) <sup>2</sup> = 13,2353
Mei 2025	-	F17 = 32,638 + 0,2×(29 - 32,638) = 32,638 + 0,2×(-3,638) = 32,638 - 0,7276 = 31,9104	-
Mse Results			$\frac{171.9665}{13} = 13,2282$

c. Comparison between the two methods

In this comparison, we use the Mean Squared Error as an evaluation method to measure the accuracy of the forecast results. The MSE value is calculated by summing the squares of the differences between the actual and predicted values (errors) for each period, then dividing by the number of periods. A model with a smaller MSE value is considered better because it has a smaller error[11]. The Mean Squared Error formula is as follows:

$$MSE = \frac{\sum_{t=1}^n (Y_t - \hat{Y}_t)^2}{n}$$

Where:

$Y_t$  = Actual sales data.

$\hat{Y}_t$  = Forecast results.

n = Number of forecast data.

**Table 4** : Comparison results between the two methods

Product	Wma		Ses	
	Prediction Results	Mse	Prediction Results	Mse
Hp 14- Ck0xxx	31	15.1068	31,9104	13,2282
Lenovo G40	35,5	75.1944	36.7451	68,1762
Asus X442U	34.8333	23.1111	37.0473	23.8112
Hp 14-Af119au	23,8333	25,656	25,4001	29,2844

Hp 15- D052tu	27,6667	80,6496	32,9623	79,4205
Lenovo Ideapad 100- 15ibr	36,3333	57,7821	34,7044	65,0163
Lenovo Ideapad 110-14ast	35,5	96,0748	38,9329	92,8528
Asus X441M	38,1667	74,2692	38,9695	60,8846
Asus X441S	39,8333	80,9487	42,865	61,6367
Asus X441N	38	76,0043	38,2938	60,348

From the comparison results obtained, it can be seen that the MSE (Mean Squared Error) value produced by the SES method tends to be lower in most products compared to the WMA method. On the Hp 14-Ck0xxx product, the SES method produces an MSE of 13.2282, smaller than the MSE of the WMA method of 15.1068. A similar thing is also seen on the Lenovo G40 product, where the SES method produces an MSE of 68.1762 compared to WMA which reaches 75.1944. Products such as the Asus X441M, Asus X441S, and Asus X441N also show similar results, with the MSE value of the SES method being lower than WMA. However, not all products show uniform results. For the Asus X442U, for example, the WMA method had an MSE of 23.1111, slightly lower than the SES method's MSE of 23.8112, indicating better accuracy for that product.

Overall, of the 10 products analyzed, the Single Exponential Smoothing (SES) method produced lower MSE values for seven products, while the Weighted Moving Average (WMA) method was superior for the remaining three. This indicates that the SES method has better overall accuracy in forecasting sales at the Adi Comp Store. The lower the MSE value, the lower the prediction error, resulting in a closer match between the forecast and the actual data.

### 3.3. System Design

This process design is the system design for this research, which uses a process-based approach. Therefore, in the system design, the researcher applied a DFD (Data Flow Diagram). DFD serves as a tool for mapping data flows and processes within a system. The stages involved in this system design include creating flowcharts, diagrams at levels 0 and 1, cdm, pdm.

a. Flowchart

This system flowchart consists of three main parts that describe the forecasting process using each method as well as the stage of comparing the prediction results.

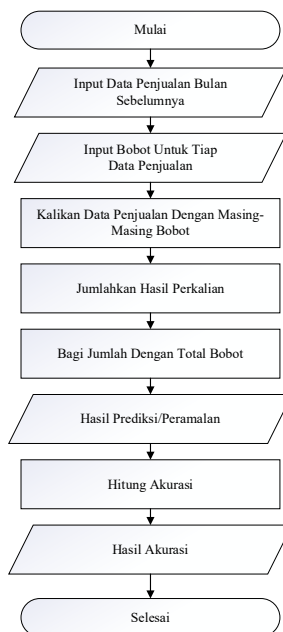


Fig. 1: Flowchart Weighted Moving Average

The Weighted Moving Average (WMA) method flowchart begins with inputting historical sales data and the weights to be used for the calculation. This sales data typically includes data from several previous periods, with weights assigned based on the importance of each period in influencing the prediction. Next, the calculation process is carried out by multiplying each sales data by its respective weight, then adding all the results [12]. This sum is then divided by the total weight to obtain the predicted value. After the prediction is calculated, the results are displayed as the initial output. Next, accuracy is calculated using the Mean Squared Error (MSE). MSE is calculated by calculating the average of the squares of the differences between the actual data and the predicted results. The results of this MSE calculation are then displayed as an indicator of prediction accuracy. This process is complete after the predicted and accuracy values are obtained and displayed for further analysis.

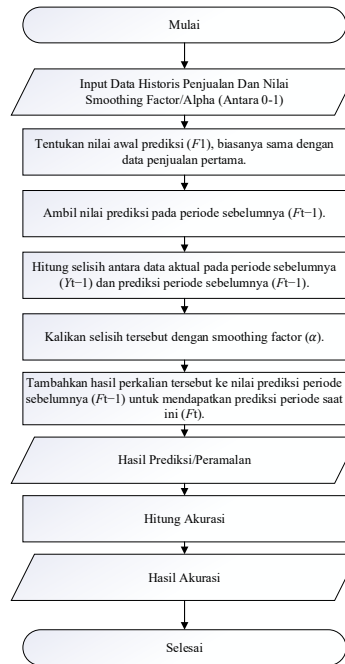


Fig. 2: Flowchart Single Exponential Smoothing

The Single Exponential Smoothing (SES) method flowchart begins by entering historical sales data and a smoothing factor ( $\alpha$ ), a value between 0 and 1 used to adjust the smoothing level of the data[13]. Next, the initial predicted value ( $F_1$ ) is determined, which is usually the same as the sales data in the first period. The process continues by calculating the prediction for the next period ( $F_t$ ) with the following steps: first, take the predicted value in the previous period ( $F_{t-1}$ ). Second, calculate the difference between the actual data in the previous period ( $Y_{t-1}$ ) and the prediction for the previous period ( $F_{t-1}$ ). Third, multiply the difference by the smoothing factor ( $\alpha$ ). Fourth, add the result of this multiplication to the predicted value for the previous period ( $F_{t-1}$ ) to obtain the prediction for the current period ( $F_t$ ).

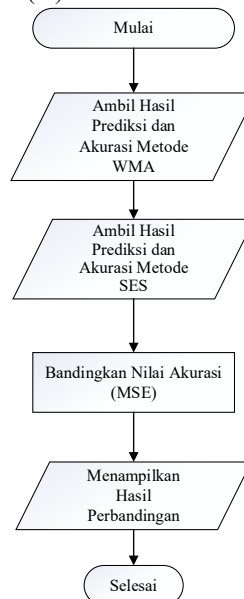


Fig. 3: Flowchart Accuracy Comparison

The Accuracy Comparison Flowchart explains the accuracy comparison workflow between the Weighted Moving Average (WMA) and Single Exponential Smoothing (SES) methods. The process begins by obtaining the prediction and accuracy results from the WMA method. Next, the prediction and accuracy results from the SES method are also obtained. Once both results are obtained, the next step is to compare the accuracy values using the Mean Squared Error (MSE). Finally, the comparison results are displayed to determine the method with the higher accuracy level.

b. Data Flow Diagram (DFD)

A data flow diagram is a network that visualizes a system, whether automated or computerized, manual, or a combination of the two. This representation is organized as a collection of interrelated system components according to applicable rules.

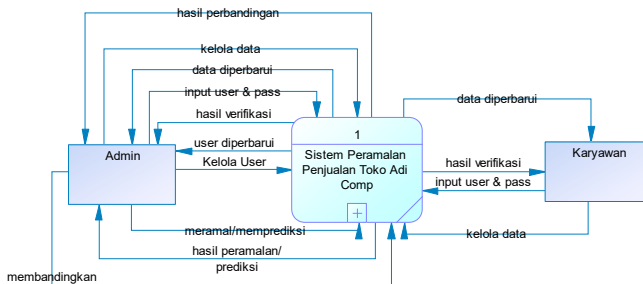


Fig. 4: Data Flow Diagram Level 0

The image above is a Level 0 diagram or context diagram for the web-based sales prediction system at Adi Comp, depicting the overall data flow. This system interacts with two external entities: the admin and the employees. The admin is responsible for managing user data (managing users) and sales data to be processed in the system. The admin can predict/forecast sales by selecting one of the methods, namely the Weighted Moving Average (WMA) or Single Exponential Smoothing (SES). After the system generates forecast results from both methods, the admin can compare the forecast results to determine the method with the highest level of accuracy. The system will provide the forecast results and the accuracy comparison results to the admin.

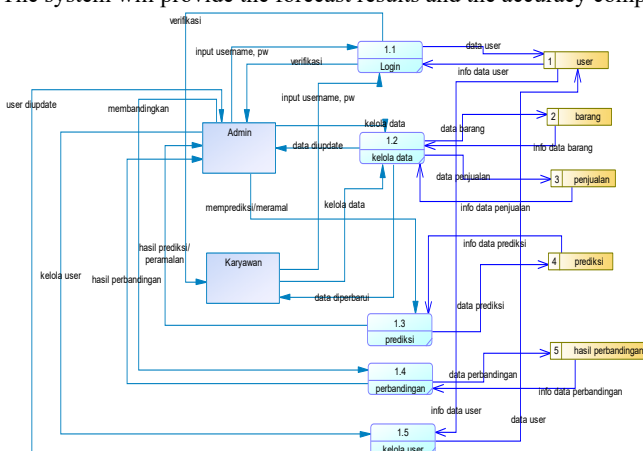


Fig. 5: Data Flow Diagram Level 1

The image above shows a Level 1 Data Flow Diagram (DFD) that outlines the main processes in a website-based sales prediction system. This diagram explains in more detail the processes within the context DFD, as well as depicting in more detail the data flow between users, processes, and data repositories within the system. The process begins with Login (1.1), where both admins and employees authenticate by entering a username and password. After successful verification, the system will direct them to features appropriate to the user's access rights. After successfully logging in, admins or employees can access Manage Data (1.2), which is used to manage master data such as sales data and also update necessary information. This process interacts directly with the goods and sales entities. Next, for the forecasting process, Admins can access Prediction (1.3). In this process, the available sales data will be processed using the Weighted Moving Average (WMA) and Single Exponential Smoothing (SES) methods to generate prediction data. The results of this process are stored in the prediction entity. The next process is Comparison (1.4), which is performed to compare the prediction results from both methods based on the Mean Squared Error (MSE) value. This process aims to determine which method provides the most accurate prediction results. The output of this process is stored in the comparison results entity. Finally, there is the Manage User process (1.5), which provides the opportunity for admins to manage user data. In this process, admins can add, change, or delete user information. This process is directly related to the user entity.

c. Conceptual Data Model (CDM)

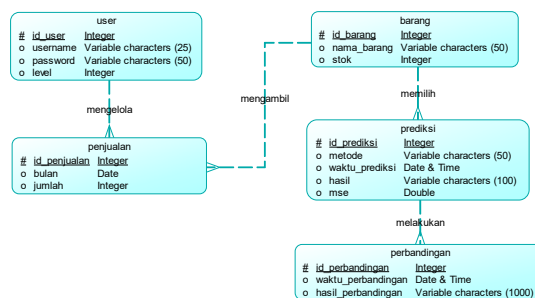


Fig. 6: Conceptual Data Model

A Conceptual Data Model (CDM) is a concept related to a user's perspective on the data stored in a database[14]. A CDM is created in the form of tables without data types that describe the relationships between tables for database implementation purposes, as shown in the image above.

d. Physical Data Model (PDM)

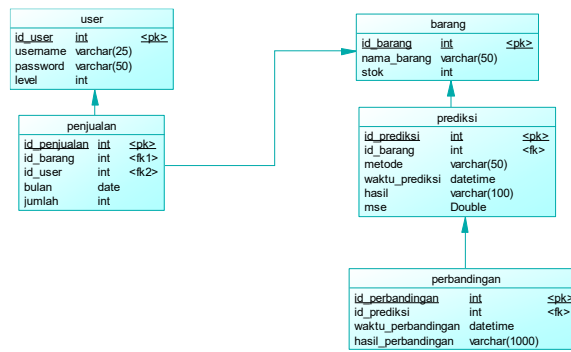


Fig. 7: Physical Data Model

A Physical Data Model (PDM) is a concept that explains in detail how data is stored in a database. A PDM is the physical representation of a database design ready for implementation in a Database Management System (DBMS). At this stage, the table structure, table names, attribute (column) names, data types, relationships between tables, and primary and foreign keys have been fully and thoroughly defined [15], as described in the figure above.

3.4. System Implementation

This implementation is very helpful in explaining the workflow and process of the sales prediction system at Adi Comp Store. This section explains how each feature in the application works, specifically in predicting sales at Adi Comp Store using the Weighted Moving Average (Wma) and Single Exponential Smoothing (Ses) methods. The main features implemented include login, dashboard, data management, user management, prediction calculations, and comparisons.

a. Login Page

The login page consists of several columns: username, password, and a login button. This feature provides access to the system application used to manage product data, sales data, user data, predict sales, and compare prediction results.



Fig. 8: Login Page

b. Dashboard Page

On this page, users can view a visualization of Adi Comp Store sales data, which presents sales information in bar graph form to facilitate data analysis. Furthermore, on the left side of the page, there's a sidebar that serves as the system's main navigation. This sidebar contains important menus such as Dashboard, Manage Data, Manage Users, Predictions, Compare, and others, making it easy for users to access all the features available in the application.

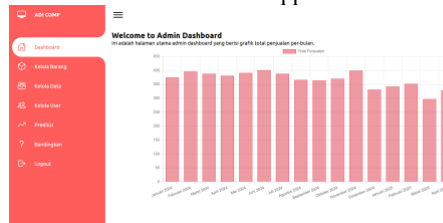


Fig. 9: Dashboard Page

c. Manage Items Page

This page displays a list of all items entered into the system, complete with their serial number, item name, and possible actions. There are two action buttons on each item row: the Edit button, which updates the item information, and the Delete button, which removes the item from the system. Additionally, in the upper right corner, there's a (+ Tambah Barang) button that allows users to enter new item data into the system.

No	Nama Barang	Stok	Aksi
1	Abus 10071	62	[Edit] [Delete]
2	Abus 10072	48	[Edit] [Delete]
3	Abus 10022	24	[Edit] [Delete]
4	Abus 10011	53	[Edit] [Delete]
5	Lenovo (Model T10-F46G)	23	[Edit] [Delete]
6	Lenovo (Model T10-F16G)	21	[Edit] [Delete]
7	Lenovo (Model T10-F16G)	55	[Edit] [Delete]
8	Hip 14-071-100	37	[Edit] [Delete]
9	Hip 14-0300x	31	[Edit] [Delete]
10	Hip 14-00020x	21	[Edit] [Delete]

Fig. 10: Manage Items Page

d. Manage Data Page

This page provides CRUD (Create, Read, Update, Delete) features that allow admins to add, modify, and delete sales data per product each month. It also includes a search feature to make it easier for users to find specific product data.

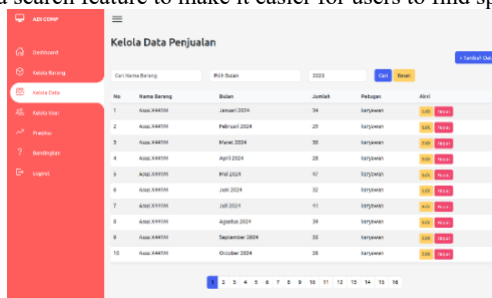


Fig. 11: Manage Data Page

e. Manage User Page

This page is used to manage users who can log in/access the system. This page displays a list of registered users in the system along with information such as usernames and user status (e.g., Admin or Employee). There are two action buttons: Edit to update user information, and Delete to remove user data from the system. Additionally, there is a (+ Tambah User) button in the top right corner that functions to add a new user to the system.

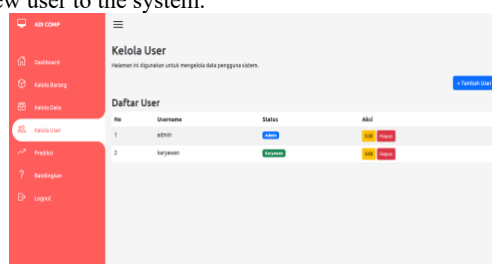


Fig. 12: Manage User Page

f. Prediction Page

The Prediction page serves as the core of the system for predicting sales at Adi Comp Store. This page is designed to allow users to easily make predictions based on available sales data. At the top of the page, there is a dropdown menu for selecting the item name for which sales are to be predicted. After that, users can determine the prediction method to be used through the second dropdown menu, namely Weighted Moving Average (Wma) or Single Exponential Smoothing (Ses). In this study, the weights and periods for the Wma method and the Alpha value for the Ses method are predetermined and cannot be changed by the user. The Wma period is 3, and the weights are 3, 2, 1, with the most recent data being given the greatest weight. Meanwhile, for the Ses method, the Alpha ( $\alpha$ ) value used is 0.2 and is predetermined to maintain consistency in comparisons between methods. Furthermore, this page also features a prediction history feature, which displays a list of previous prediction results. Each history is equipped with a Details button to view the complete prediction results, and a Delete button to delete the history data if it is no longer needed.

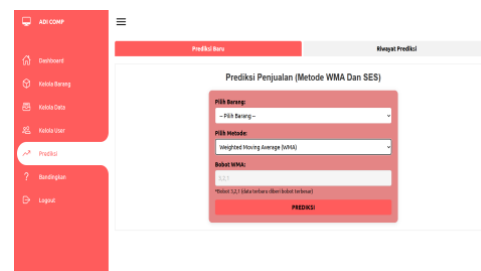


Fig. 13: Prediction Page

g. Compare Page

On this page, users simply select the item name from the dropdown menu provided. The system will automatically retrieve the MSE value from the most recent prediction performed on the previous prediction page. The method with the lowest MSE value will be considered the best method for predicting sales for that item. However, if no previous predictions have been made for that item, the comparison process cannot be performed, and the system will display a notification that prediction data is not yet available. In addition to the comparison feature, this page also includes a comparison history, which records the results of previous comparisons.

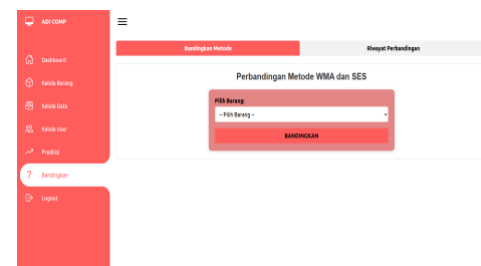


Fig. 14: Compare Page

## 4. Conclusion

Based on the results of the study on the comparison of the Weighted Moving Average (Wma) and Single Exponential Smoothing (Ses) methods in sales forecasting at the Adi Comp website-based store, it can be concluded that both methods were successfully implemented well in the system. The WMA method was implemented using three periods and weights of 3, 2, 1, which was able to produce predictions based on historical data with a fairly good level of accuracy, especially for certain products such as the Asus X442U which had an MSE value of 23.1111, lower than the SES method. In general, this method is more suitable for use on stable sales data and is not too influenced by short-term trend changes. Meanwhile, the SES method with an Alpha parameter of 0.2 has also proven effective in responding to slow changes in sales trends. For the Hp 14-Ck0xxx product, for example, the SES method produced an MSE value of 13.2282 which was lower than the WMA, thus being able to provide better forecasting results for stock planning and management decision making. Furthermore, the results of the accuracy comparison show that SES has a lower MSE value on 7 of the 10 products tested, including Hp 14-Ck0xxx, Hp 15-D052tu, Lenovo G40, Lenovo Ideapad 110-14ast, Asus X441M, Asus X441S, and Asus X441N. This indicates that the SES method is more accurate and superior than WMA in projecting sales, so it is recommended as the main method in the sales forecasting system at Adi Comp Store to support more effective and efficient stock management.

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