
PERFUME SALES FORECAST USING THE METHOD WEIGHTED MOVING AVERAGE AND SINGLE MOVING AVERAGE

Astuti Br. Mangunsong^{1*}, Juli Amanda², Nabiila Alya Maitsa³, Nurnilam Sari⁴,
Putri Lia Irawan⁵, Riska Maulida Tanjung⁶
^{1,2,3,4,5}Information System, Universitas Royal
email: ohminemineoh12345@gmail.com

Abstract: Sales forecasting is an important activity in business management because it helps companies estimate future sales conditions. This study aims to analyze perfume sales forecasting using the Weighted Moving Average (WMA) and Single Moving Average (SMA) methods based on monthly sales data from June 2025 to May 2026. The forecasting process was carried out using Microsoft Excel. The results showed that the Weighted Moving Average method produced better forecasting accuracy because it prioritizes the latest data through weighting calculations. Forecasting accuracy was measured using MAD, MSE, and MAPE. Based on the calculation results, the WMA method produced smaller error values than SMA, making it more suitable for perfume sales forecasting.

Keywords: forecasting; perfume sales; SMA; WMA

Abstract: Sales forecasting is an important activity in business management because it helps companies estimate future sales conditions. This study aims to analyze perfume sales forecasting using the *Weighted Moving Average* (WMA) and *Single Moving Average* (SMA) methods based on monthly sales data for the period June 2025 to May 2026. The forecasting calculation process was carried out using Microsoft Excel. The results showed that the *Weighted Moving Average method* produced a better level of accuracy because it prioritized the most recent data through calculation weighting. The level of forecasting accuracy was measured using MAD, MSE, and MAPE. Based on the calculation results, the WMA method produced a smaller error value than the SMA method so it is more suitable for use in perfume sales forecasting.

Keywords: forecasting; perfume sales; SMA; WMA

INTRODUCTION

The development of the cosmetics and personal care products industry, including perfume, has shown significant growth in recent years both globally and nationally. Perfume has become a necessity for modern society, not only as a body freshener but also as a reflection of the user's identity and

lifestyle. The increasing market demand for perfume products encourages business actors to continuously improve operational efficiency, including in terms of optimal inventory management. In this context, Khajehzadeh et al. [9] revealed that price and product quality factors are the main variables that influence the sales

of cosmetic products, including perfume, and accurate sales forecasting is a very important instrument throughout the supply chain of cosmetic companies, from the production process, distribution and logistics, to marketing and sales strategies.

One of the biggest challenges faced by business actors in the perfume industry is the uncertainty of market demand which fluctuates periodically. The inability to predict sales volume accurately can result in detrimental overstock conditions, or conversely, stock shortages that result in lost potential revenue and decreased customer satisfaction. Therefore, a systematic and measurable scientific approach is needed in conducting sales planning and inventory control. Gulo et al. [8] stated that in a dynamic business environment, inventory forecasting is very critical for companies in optimizing their inventory management, where the *Moving Average method* has been proven to be able to provide the information needed by management as a basis for decision making in future sales activities.

Forecasting is a scientific process for *estimating* future conditions or events based on available historical data. In operational management, sales forecasting is the main foundation for production planning, determining raw material requirements, budgeting, and overall resource management. Various quantitative forecasting methods based on time series data *have* been developed and widely applied in various industrial sectors. As stated by Kurnia [3], historical sales data can be used effectively to predict sales volume for the next period, with the level of accuracy measured by the MAPE, MAD, and MSE values as the standard for evaluating forecast feasibility.

Among the various forecasting methods available, the *Single Moving Average* (SMA) and *Weighted Moving Average* (WMA) methods are the two most frequently used techniques due to their ease of implementation and their ability to handle stationary sales data without complex trends or seasonality. The *Single Moving Average* (SMA) method works by calculating the average of a number of selected historical data to estimate the value in the future period, while the *Weighted Moving Average* (WMA) method gives different weights to each historical data where more recent data gets a higher weight. Auliasari et al. [4] explained that the implementation of the *Weighted Moving Average* (WMA) method in the inventory forecasting system produces a small MAPE value so that this method is suitable for use as a sales prediction tool for the future period, while also helping companies avoid conditions of shortages or excess inventory.

Several previous studies have proven the effectiveness of the *Single Moving Average* (SMA) and *Weighted Moving Average* (WMA) methods in various forecasting fields. Alex and Rahmawati [1] showed that selecting the right method based on the lowest error value, such as MAPE, is the main key in producing accurate and reliable predictions to support operational management. Fathoni et al. [5] also stated that the *Weighted Moving Average* (WMA) method is able to provide estimates of inventory needs that are close to actual conditions, making it the right choice for business actors in planning inventory and minimizing potential losses due to mismatches between supply and demand.

In the context of forecasting for inventory management, Puspitasari et

al. [2] stated that the WMA method is proven to be effective because it gives greater weight to the most recent data, resulting in predictions that are more responsive to changes in business trends. Merici and Saprudin [7] emphasized that determining the appropriate weight for each historical data period is a crucial factor that determines the level of precision and reliability of WMA prediction results in inventory management. Sulastris et al. [6] added that the accuracy of SMA predictions is highly dependent on selecting the optimal average order according to the company's historical data patterns.

The performance comparison between SMA and WMA methods has become an important topic in the current forecasting literature. Yel, Tundo, and Arinal [10] explain that determining the correct order for each method greatly influences the method's ability to optimally accommodate historical data trends, resulting in more accurate management recommendations. The selection of the best method is determined based on the smallest error value produced, either through the MAD, MSE, RMSE, or MAPE measures. In addition, Puspitasari et al. [2] also emphasize that accurate forecasting results can provide a strong basis for company management in responding to market dynamics more precisely and efficiently.

Based on the background description above, this study aims to analyze and compare the performance of the *Weighted Moving Average* (WMA) and *Single Moving Average* (SMA) methods in forecasting perfume sales. Historical sales data obtained from a perfume business unit will be processed using both methods to generate sales predictions for the next

period, with accuracy evaluation using MAD, MSE, and MAPE values to determine the most optimal method. The results of this study are expected to provide practical contributions for perfume business actors in conducting more structured and data-based sales planning [8], as well as provide scientific contributions in the development of sales forecasting studies in the cosmetics and personal care product industry sector in Indonesia.

METHOD

This study used monthly perfume sales data from June 2025 to May 2026. The data was obtained from a summary of perfume store sales in milliliters (ml). The study was conducted using Microsoft Excel to simplify forecasting calculations and data analysis.

Table 1. Perfume Sales Data for 2025–2026

Month	Sale
June	3,120
July	3,245
August	3,318
September	3,287
October	3,354
November	3,512
December	3,685
January	3,476
February	3,427
March	3,830
April	3,401
May	3,356

The forecasting methods used in this study are *Weighted Moving Average* (WMA) and *Single Moving Average* (SMA) with a calculation period of 3 months.

The Weighted Moving Average method is a forecasting method that uses

weighting for each previous data point. In this study, weights of 1, 2, and 3 were used, with the most recent data having the highest weight.

Weighted Moving Average (WMA) formula :

$$WMA_t = \frac{(3 \cdot X_{t-1}) + (2 \cdot X_{t-2}) + (1 \cdot X_{t-3})}{6} \quad (1)$$

Information:

WMA = forecast result

X_t = previous period sales data

1,2,3 = data weight value

The Single Moving Average (SMA) is a forecasting method that calculates the average of several previous periods without using any specific weighting. In this method, all data is assumed to have an equal influence on the forecast results.

Single Moving Average (SMA) formula :

$$SMA_t = \frac{X_{t-1} + X_{t-2} + X_{t-3}}{3} \quad (2)$$

Information:

SMA = forecasting results

X_t = previous period sales data

To determine the level of forecast accuracy, three error measurement methods are used, namely MAD, MSE, and MAPE.

MAD is used to calculate the average absolute error between actual data and forecast results.

MAD formula:

$$MAD = \frac{\sum_{t=1}^n |A_t - F_t|}{n} \quad (3)$$

MSE is used to calculate the mean square of the forecast error.

MSE formula:

$$MSE = \frac{\sum_{t=1}^n (A_t - F_t)^2}{n} \quad (4)$$

MAPE is used to calculate the average percentage of forecast error.

MAPE formula:

$$MAPE = \left(\frac{1}{n} \sum_{t=1}^n \left| \frac{A_t - F_t}{A_t} \right| \right) \times 100\% \quad (5)$$

RESULTS AND DISCUSSION

Based on the perfume sales data obtained, a forecasting process was conducted using the *Weighted Moving Average* and *Single Moving Average* methods. The forecasting results were then compared to determine which method had the best accuracy.

Forecasting Using a *Weighted Moving Average* (WMA). The *Single Moving Average* (SMA) method uses weights of 1, 2, and 3, with the most recent data having the highest weight. This is because the most recent data is considered more relevant in predicting sales for the next period.

Example of September forecast calculation using the WMA method:

WMA September

$$\begin{aligned} &= ((3120 \times 1) + (3245 \times 2) + (3318 \times 3)) / 6 \\ &= (3120 + 6490 + 9954) / 6 \\ &= 19564 / 6 \\ &= 3260.67 \end{aligned}$$

Table 2. WMA Method Forecasting Results

Month	Current	Forecasting
June	3,120	-
July	3,245	-
August	3,318	-
September	3,287	3260.67
October	3,354	3290.33
November	3,512	3325.67
December	3,685	3421.83
January	3,476	3572.17
February	3,427	3551.67
March	3,830	3486.33
April	3,401	3636.67

May	3,356	3548.33
June	-	3450

The June forecast is obtained using sales data for March, April, and May with weightings of 1, 2, and 3.

June forecast calculation:

WMA June

$$\begin{aligned}
 &= ((3830 \times 1) + (3401 \times 2) + (3356 \times 3)) / 6 \\
 &= (3830 + 6802 + 10068) / 6 \\
 &= 20700 / 6 \\
 &= 3450
 \end{aligned}$$

the Weighted Moving Average (WMA) forecasting results, perfume sales fluctuate monthly. The highest forecast occurred in April, at 3,636.67 ml, while the lowest forecast occurred in September, at 3,260.67 ml.

The Weighted Moving Average (WMA) method shows quite good forecasting results because it can track changes in sales patterns. This is because *the Weighted Moving Average (WMA)* method prioritizes the most recent data, making it more responsive to sales changes.

Forecasting Using a *Single Moving Average (SMA)*. The SMA method calculates the average sales from the previous three periods without using any specific weighting.

Example of September forecast calculation using the SMA method:

September High School

$$\begin{aligned}
 &= (3120 + 3245 + 3318) / 3 \\
 &= 9683 / 3 \\
 &= 3227,676
 \end{aligned}$$

Table 3. SMA Method Forecasting Results

Month	Current	Forecasting
June	3,120	-
July	3,245	-
August	3,318	-
September	3,287	3227.67

October	3,354	3283.33
November	3,512	3319.67
December	3,685	3384.33
January	3,476	3517
February	3,427	3557.67
March	3,830	3529.33
April	3,401	3577.67
May	3,356	3552.67
June	-	3529

The June forecast using the SMA method is obtained from the average sales for March, April, and May.

June High School

$$\begin{aligned}
 &= (3830 + 3401 + 3356) / 3 \\
 &= 10587 / 3 \\
 &= 3529
 \end{aligned}$$

Based on the SMA forecasting results, the forecast values appear more stable than those of *the Weighted Moving Average (WMA)* method because all data has the same influence. However, the SMA method is less responsive to sudden changes in sales because it does not prioritize the most recent data. Calculating the Forecasting Error Rate

After forecasting using *the Weighted Moving Average (WMA)* and SMA methods, the next stage is to calculate the error rate using MAD, MSE, and MAPE.

Table 4. Results of Forecasting Error Calculation

Method	MAD	MSE	MAPE
WMA	170.22	38239.02	4.8%
SENIOR HIGH SCHOOL	163.19	34994.54	4.6%

The Mean Absolute Deviation (MAD) is used to determine the average absolute error between actual data and forecast results. Based on the calculation results, the WMA method produces a MAD value of 170.22, while

the SMA method produces a MAD of 163.29. This indicates that the *Weighted Moving Average* (WMA) method has a smaller absolute error rate than the SMA method.

Mean Squared Error (MSE) is used to calculate the average squared error of the forecast. The *Weighted Moving Average* (WMA) method produces an MSE value of 38,239.02, while the SMA method produces 34,994.54. A smaller MSE value indicates that the *Weighted Moving Average* (WMA) method has a lower forecasting error rate.

The *Mean Absolute Percentage Error* (MAPE) is used to calculate the average percentage error in forecasting. The calculation results show that the *Weighted Moving Average* (WMA) method has a MAPE value of 4.15%, while the SMA method has a MAPE value of 4.72%. These values indicate that the *Weighted Moving Average* (WMA) method has a better level of forecasting accuracy than the SMA method.

Based on the results of the error measurements, it can be concluded that the *Weighted Moving Average* (WMA) method produces a higher level of accuracy than the *Single Moving Average* method on the perfume sales data used in this study.

This occurs because the *Weighted Moving Average* (WMA) method gives greater weight to recent data, making it more capable of tracking monthly changes in sales patterns. Meanwhile, the SMA method uses a simple average, so changes in recent data don't significantly impact forecasting results.

Furthermore, forecasting results show that perfume sales fluctuate monthly. The highest sales occurred in March, at 3,830 ml, while the lowest sales occurred in June, at 3,120 ml.

With forecasting, perfume stores can estimate sales volume for the following period, thus assisting in determining sales strategies and more optimal inventory management.

The calculation steps using Microsoft Excel include entering all sales data into a Microsoft Excel table, creating a *Weighted Moving Average* (WMA) and SMA forecast column. Use the following formula:

Weighted Moving Average (WMA)

formula :

$$=((B2*1)+(B3*2)+(B4*3))/6$$

Single Moving Average (SMA) formula

:

$$=AVERAGE(B2)$$

Absolute Error Formula:

$$=ABS(\text{Actual}-\text{Forecast})$$

Quadratic Error Formula:

$$=(\text{Actual}-\text{Forecast})^2$$

Percentage Error Formula:

$$=ABS((\text{Actual}-\text{Forecast})/\text{Actual})*100$$

Use the *average function* to calculate the MAD, MSE, and MAPE values.



Figure 1. Actual Perfume Sales Graph

The actual sales chart shows that perfume sales fluctuate monthly. The highest sales occurred in March, at 3,830 ml, while the lowest sales occurred in June, at 3,120 ml.

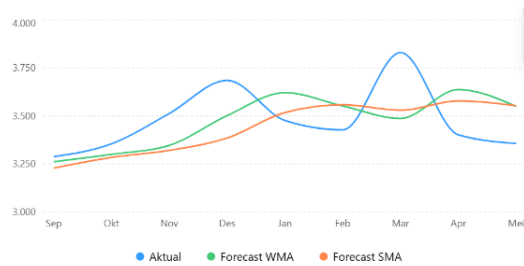


Figure 2. Comparison Chart of WMA and SMA Forecasting

The forecasting comparison chart shows that the *Weighted Moving Average* (WMA) method is better able to track changes in sales patterns than the SMA method. This is because the *Weighted Moving Average* (WMA) method gives greater weight to recent data, resulting in more responsive forecasting results.

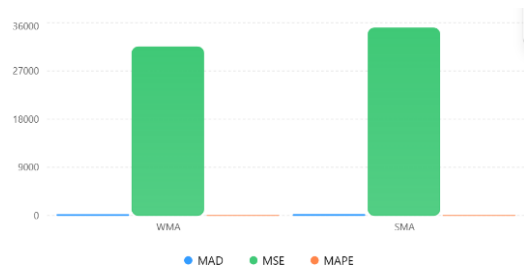


Figure 3. Comparison Graph of Forecasting Errors

The forecasting error comparison chart shows that the *Weighted Moving Average* (WMA) method has smaller MAD, MSE, and MAPE values than the SMA method. This indicates that the *Weighted Moving Average* (WMA) method has a better level of forecasting accuracy.

CONCLUSION

Based on the research conducted, the *Weighted Moving Average* (WMA) and *Single Moving Average* (SMA) methods can be used to forecast perfume sales. However, the *Weighted*

Moving Average (WMA) method produces a better level of accuracy than the *Single Moving Average* method due to its lower MAD, MSE, and MAPE values.

The *Weighted Moving Average* (WMA) method is more effective for perfume sales forecasting because it gives greater weight to the most recent data, making the forecasting results more responsive to changes in sales patterns.

With forecasting, perfume shops can estimate the number of sales in the next period, thus helping in determining sales strategies, managing inventory, and making business decisions more optimally.

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