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Application of the Single Moving Average Method to Forecast Sales and Determine Marketing Strategy

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***Abstract*— Tight business competition necessitates companies to accurately forecast sales, discern sales trends, and devise effective marketing strategies to boost sales. This research utilizes the Single Moving Average method to forecast product sales at Vacash in 2024. Vacash, located in Pontianak, West Kalimantan, Indonesia, operates in the printing sector and produces various products based on orders and has never conducted sales forecasting before. This research aims to help Vacash determine production quantities and gain insights into sales trends, ultimately identifying optimal marketing times. This research employs a quantitative forecasting method for Vacash's sales, using secondary data including monthly product sales from 2020 to 2023. The focus lies on products consistently produced each month over these four years, namely cake toppers and plaques. This research indicates that the forecast accurately predicts cake topper sales with an 87.5 percent accuracy rate, alongside accurate forecasts for the first four months of 2024. Furthermore, it reliably predicts plaque sales for January, February, and April. The forecast result unveils sales trends that help Vacash determine optimal marketing timing, particularly in months with declining sales. Overcoming the limitations of the single moving average method through more advanced and adaptive forecasting techniques will be essential for future research.**

Keywords—Marketing Management; Sales Forecasting; Single Moving Average; SME

I. INTRODUCTION

Increasingly tight business competition requires companies to forecast sales with high accuracy to plan effectively and make informed decisions, allowing them to stay competitive. The ability to accurately forecast sales is crucial for companies to understand sales patterns and to plan effective marketing strategies to increase sales. Sales forecasting is done by using previous sales data to predict future sales conditions or trends [1], [2]. In light of these conditions, Vacash, a printing sector business based in Pontianak, West Kalimantan, Indonesia that produces various products on demand is chosen as the research object due to its status as a small to medium-sized enterprise in Pontianak, providing easier access to relevant information for the study. The purpose of this research is to assist Vacash in forecasting product demand in 2024. This will aid Vacash in determining the necessary production quantity to meet market demand based on sales trends in the upcoming period, as well as identifying the optimal timing for marketing based on these trends. One of the methods that can be used for forecasting is the Single Moving Average.

One of the effective methods for sales forecasting is the Single Moving Average (SMA). The single moving average technique predicts future periods by calculating the average of actual values from several specific periods, as shown in studies by [3], [4], [5], [6]. The study by [7] compares the single moving average method and exponential smoothing to forecast demand sales for Softex 1400-M. The result of the study shows that the single moving average method gives a better forecast to predict product demand in 2022. Research by [8] has demonstrated that the single moving average method provides accurate sales forecasting for the e-commerce marketplace, exhibiting the smallest mean absolute deviation, mean absolute percentage error, and mean squared error compared to other forecasting methods such as dynamic linear regression and exponential smoothing. In a study by [9], the single moving average method was shown to predict the amounts of salt production, making it easier for companies to determine the total production within a specified time period. Similar research was done by [10] to show the ability of the single moving average method to smooth out fluctuations in historical data and help the company identify a clearer trend. Thus, sales forecasting using the single moving average method is carried out to understand sales trends of

restaurant menus. The research by [11] utilizing the single moving average method to forecast tempe sales, can expedite the process of generating sales forecasts, offering a streamlined approach to understanding market trends and preparing for future demand. [12] employs the single moving average method to predict stocks in a food production company. This method helps the business determine specific times when it is necessary to stock more products than at other times. In general, the simple moving average method demonstrates the ability of a single moving average to forecast sales.

Despite its effectiveness, the single moving average method has limitations, such as lagging behind trends and being less responsive to sudden market changes. The single moving average method is utilized to produce predictions when the data is unstable, has no trends, and does not use weighting on data [13]. The newness of this research lies in its application to Vacash, a company in the printing sector that has not previously implemented sales forecasting using the single moving average method. This study is novel in its objective to forecast sales for one year, providing Vacash with unprecedented insights into its future sales trends. By applying the single moving average method to Vacash's historical sales data, this research aims to generate accurate forecasts that will help Vacash optimize its production quantities and marketing strategies. Furthermore, this study contributes to the existing literature by demonstrating the practical application of the single moving average method in the printing sector, which has been less explored in previous research.

This study is structured as follows: Section II will detail the data collection process and the application of the single moving average method to the sales data. In Section III, we will present the findings from the sales forecast and analyze their implications for Vacash's production and marketing strategies. Finally, Section IV will summarize the main findings, discuss the limitations of the study, and suggest areas for future research.

II. RESEARCH METHODS

This research employs a collection of secondary data to forecast sales. The research data was collected and compiled from product sales data per month for four years, spanning from 2020 to 2023, totaling 4494 sales. The focus of this research is on products that have been consistently produced over four years. Data on the most frequently produced products each month were collected and analyzed. Therefore, this research focused on two products: cake toppers and plaques.

The method employed in this research is a quantitative approach. Quantitative forecasting methods are utilized to address research problems involving numerical data and statistics. The moving average is one of the time series methods that provide a prediction approach based on the historical behavior of data that will be projected into the future by utilizing statistical and mathematical equations. This research employs the moving average method, specifically the Single Moving Average (SMA) approach. The single moving average method is used to predict demand by calculating the average of the actual demand values from several previous periods [14]. Each new prediction is set for a long period and replaced with data from a new period, causing the calculation to move over time, as implied by the name of this method, the moving average [15]. The single moving average method is used for unstable data, data without trends, and data that does not require weighting [13], [16]. The equation for the single moving average method is as follows:

$$y_j(i) = \frac{1}{p}\sum_{i}^{i+p} x_j(i) \tag{1}$$

Where y represents the single moving average, p represents the forecasting period, and j represents the month.

The sales forecast is done by calculating the moving average with a two-year interval for each month. After obtaining the moving average values for each month over a two-year period, the difference between each moving average value is calculated according to equation (2):

$$\Delta y(i) = y_j(i+1) - y_j(i) \tag{2}$$

Then, the grand mean is calculated from the difference between each moving average value, which will be used in predictions, using the equation (3):

$$\overline{x_y} = \frac{1}{p} \sum_{n}^{i=n} \Delta y(i) \tag{3}$$

The upper limit for predictions is calculated by adding twice the absolute value of the grand mean calculation, using the equation (4):

$$ub = \Delta y(i) + 2\left(\overline{x_y}\right) \tag{4}$$

Next, the lower limit for prediction is calculated by subtracting twice the absolute value of the grand mean calculation, using the equation (5):

$$lb = \Delta y(i) - 2\left(\overline{x_y}\right) \tag{5}$$

The prediction results are derived from the moving average value of the previous period. By providing both the upper and lower limits of sales forecasting values, this information enables Vacash to establish product supply limits to meet market demand.

III. RESULT AND DISCUSSION

The monthly sales data from the last four years is analyzed using a single moving average method at two-year intervals to identify sales trends and make predictions for the next period. The focus of this research is on historical data from cake topper and plaque sales from 2020 until 2023. Based on the results, the data is visualized by creating three different types of line diagrams to illustrate average sales prediction values, lower sales limits, and upper sales limits.

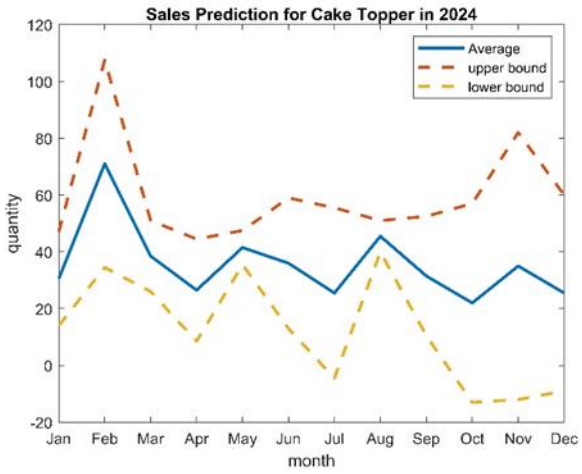

Figure. 1. Cake Topper Sales Forecast for 2024

Based on the sales forecasting results for cake topper in 2024, accurate prediction can be observed for cake topper sales from January to April. The forecast indicates that cake topper sales in January will range between 14 and 47 units, with actual sales data showing 37 units sold. In February, the forecast predicts sales between 34 and 107 units, with 34 units sold according to the actual sales data. For March, the forecast predicts sales in the range of 26 to 51 units, with 43 units sold. In April, the sales forecast is between 8 and 44 units, with actual sales data showing 29 units sold. The forecasting results also indicated a declining sales trend in March, April, July, October, and September. Additionally, the results show a fluctuating trend with peaks in February, May, August, and November.

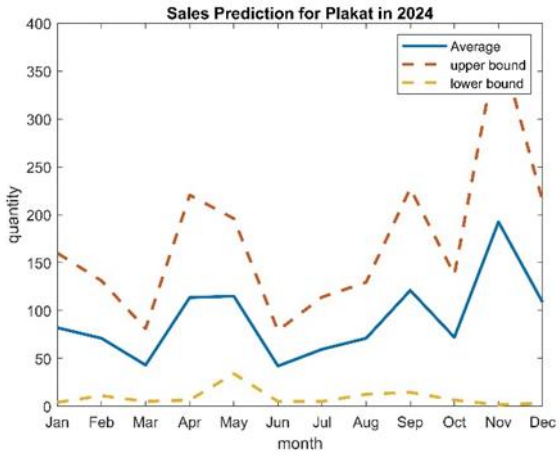

Figure. 2. Plaque Sales Forecast for 2024

Based on the sales forecasting results for plaque in 2024, accurate forecasts for plaque sales in January, February, and April can be identified. The forecasting results state that plaque in January will range from 4 to 160 units, with actual sales data showing 144 units sold. In February, the forecast predicts sales between 11 and 131 units, with 61 units sold. For April, the forecasted range is 6 to 220 units, with 217 units sold. The forecasting results also indicate a declining sales trend in March, June, July, October, and December. The forecast for plaque exhibits significant peaks in April, September, and November. The conclusion from these results shows that the single moving average method can forecast sales of cake toppers and plaques with an accuracy of 87.5 percent.

The single moving average method forecast for cake toppers shows a fluctuating trend with peaks in February, May, August, and November. Cake topper sales trends in 2024 show a decline in March, April, July, October, and September. The upper and lower bounds indicate the range of expected sales, providing Vacash with a confidence interval for planning purposes. The forecast suggests that Vacash should prepare for higher demand in the early and later months of the year, with a notable peak in August, likely due to seasonal events. The result provides insights for Vacash to implement marketing strategies to boost sales during declining months. The forecast for plaque exhibits significant peaks in April, September, and November, with the highest peak in November. The sales trend for plaques in 2024 shows a decline in March, June, July, and October. The upper and lower bounds provide a forecast range, assisting Vacash in managing inventory and production. The data suggest that Vacash should anticipate and prepare for both increased and decreased demand during these peak and decline periods. The results indicate that the simple moving average method effectively captures the seasonal trends and provides Vacash with actionable insights for production planning and marketing strategies.

IV. CONCLUSION

In this research, the single moving average method becomes an important tool for Vacash to predict total sales, making it easier for Vacash to determine the amount of production needed within a specific period. Vacash's product sales forecasting using the single moving average method has an accuracy of 87.5 percent. The results of cake topper sales forecasting accurately predict sales for January, February, March, and April 2024. On the other hand, the results of plaque sales forecasting accurately predict sales for January, February, and April 2024. The single moving average method forecast for cake toppers shows a fluctuating trend with peaks in February, May, August, and November. The forecast for plaque exhibits significant peaks in April, September, and November, with the highest peak in November. The data suggest that Vacash should anticipate and prepare for increased demand during the peak periods. Cake topper sales trends in 2024 show a decline in March, April, July, October, and September. Furthermore, the sales trend for plaques in 2024 shows a decline in March, June, July, and October. This information helps Vacash implement marketing strategies to increase sales during those months. The accuracy of the single moving average method heavily relies on the quality and the quantity of historical sales data. Any gaps in the historical data can affect the accuracy of the forecasts. Overcoming the limitations of the single moving average method through more advanced and adaptive forecasting techniques will be essential for future research.

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