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Article

Forecasting Sales of Salisil Talk Wangi 45 gr Using the Double Moving Average Method at PT X

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A B S T R A C T

PT X is a pharmaceutical manufacturing company producing cosmetics, household health supplies, medicines, and quasi-drugs. During the internship period of 8 months, various aspects of agro-industrial logistics were observed, including demand planning. The study focused on addressing recurring issues of stockouts of talcum powder, specifically Salisil Talk Wangi 45 grams, caused by inaccurate forecasting and manual estimation methods. To resolve this, the Double Moving Average method was applied to forecast demand for the product. The results showed that for the Blue variant of Salisil Talk Wangi 45 gr, the forecasting error was MAD = 1.236 and MAPE = 7%. For the Yellow variant, MAD = 1.109 and MAPE = 7%, and for the Green variant, MAD = 1.109 and MAPE = 8%. These results suggest that the Double Moving Average method is effective in supporting raw material planning for better production continuity.

1. BACKGROUND

1.1 Introduction

Forecasting plays a critical role in managing the operations of pharmaceutical companies, particularly in ensuring the availability of raw materials for continuous production. One such company, PT X, has been engaged in the production of pharmaceutical products including cosmetics, household health supplies, and generic medicines since 1979.

One of the recurring operational challenges faced by the company is the inconsistency in raw material availability, particularly for the production of Salisil Talk Wangi 45 grams, a well-known line of scented talcum powder. These issues are largely attributed to the company's current practice of relying on subjective estimation methods for inventory planning, rather than utilizing a structured, data-driven forecasting approach. As a result, the company frequently encounters raw material stockouts that lead to production delays, impacting supply chain performance and customer satisfaction.

In manufacturing environments where product demand varies monthly and lead times are critical, forecasting becomes a vital tool. It enables businesses to anticipate future demand and prepare resources accordingly. Poor forecasting can result in either overstocking, which increases storage costs and ties up capital, or understocking, which disrupts production and can lead to lost sales. Accurate demand forecasting is essential in supporting effective production planning and inventory control, allowing firms to proactively respond to market fluctuations and maintain optimal stock levels (Foci, et.al, 2024)

To mitigate these issues, this research explores the implementation of the Double Moving Average (DMA) method to forecast product demand, using historical sales data of Salisil Talk Wangi 45 gr from January to December 2024. The DMA method is known for its ability to smooth out short-term fluctuations and provide a clearer picture of demand trends, making it suitable for managing inventory of stable-demand products.

This study evaluates the application of the DMA method across the 3 color variants of Salisil Talk Wangi Blue, Yellow, and Green. The forecasting model is assessed based on two key performance indicators: Mean Absolute Deviation (MAD) and Mean Absolute Percentage Error (MAPE), both of which help measure the accuracy of the forecast.

The purpose of this research is not only to generate more accurate demand predictions but also to provide the company with a practical forecasting tool that can support better inventory planning and decision-making processes. Ultimately, the goal is to reduce the occurrence of material shortages, enhance production continuity, and improve overall supply chain efficiency at PT X.

1.2 Research Purposes

The objective of this research is to develop a more accurate and reliable forecasting model that can support raw material planning at PT X, specifically for the production of Salisil Talk Wangi 45 grams. The study aims to address the recurring issue of raw material stockouts caused by inaccurate demand estimation, which often disrupts production schedules. This research specifically intends to:

1. Apply the Double Moving Average (DMA) method to forecast the monthly sales of Salisil Talk Wangi 45 gr.
2. Evaluate the forecasting accuracy using MAD (Mean Absolute Deviation) and MAPE (Mean Absolute Percentage Error).
3. Provide a forecasting tool that enables more efficient raw material procurement planning.
4. Minimize the occurrence of raw material shortages and improve production continuity.

2. LITERATURE REVIEW

2.1 Forecasting

Forecasting refers to an effort to predict future conditions based on the analysis of past data (Handoko, 2015). The essence of forecasting lies in the estimation of future events based on historical patterns and the application of policies to project those patterns into the future. In general, forecasting techniques can be categorized into two main approaches: quantitative forecasting and qualitative forecasting. These approaches may be applied either separately or in combination.

According to Heizer and Render (2015), companies or organizations typically employ three primary types of forecasting for planning future operations:

1. Economic forecasting addresses business cycles by predicting indicators such as inflation rates, money supply, housing starts, and other planning-related metrics.
2. Technological forecasting concerns the pace of technological advancement that may result in the development of new and more attractive products, requiring new equipment.
3. Demand forecasting involves estimating the future demand for a company's products or services. Effective forecasting is essential for decision-making, requiring timely and accurate demand information.

Forecasting plays a critical role in the decision-making process. Good decisions are based on informed projections about future circumstances at the time the decision is implemented. Inaccurate forecasting can pose significant challenges (Ginting Rosnani, 2007).

Based on the time horizon, forecasting can be divided into three types (Herjanto, 2008):

1. Long-term forecasting, which spans periods longer than 18 months. It is typically used for investment planning, facility planning, and research and development activities.
2. Medium-term forecasting, which covers 3 to 18 months, and is commonly used for inventory planning, production planning, and temporary labor planning.
3. Short-term forecasting, which spans less than 3 months, and is used for material purchasing, work scheduling, and employee assignments.

Forecasting methods are generally divided into two categories:

a. Qualitative Forecasting

This method is used when no mathematical model is available, typically due to insufficient or non-representative data for long-term forecasting. Qualitative forecasting relies on expert judgment and opinions. The main advantages of this method are its low cost (no data required) and speed of implementation.

b. Quantitative Forecasting

Quantitative forecasting involves the use of mathematical models based on historical data to project future demand.

According to Santoso (2009), quantitative forecasting relies on two types of data:

1. Time Series Data

Time series data are recorded over time intervals such as daily, weekly, or monthly. Common time series forecasting techniques include:

a. Single Moving Average:
This method calculates the average of a specific number of past observations and uses that average as the forecast for the next period. The moving average is recalculated with each new data point.
Formula :

$$Ft+1 = X_1 + Xt_1 + Xt_2 + \ldots + Xt_{n+1}$$

where:
Ft+1 : Forecast for period t+1
Xt : Actual data in period t
n : Number of periods used for the moving average

b. Double Moving Average
This method calculates a second moving average from the first set of moving averages to adjust for trends.

c. Weighted Moving Average
Similar to the previous methods, but applies predetermined weights to past data, reflecting the analyst's confidence in the data for each period. The weights are assigned based on subjective judgment.

d. Exponential Smoothing
This method applies exponentially decreasing weights to past observations. Each new forecast is calculated using the previous forecast and the most recent actual data, with a smoothing constant (α) between 0 and 1. A suitable α value minimizes forecasting error and is usually determined through trial and error. This method is particularly suitable for unstable or highly variable data patterns.

2. Cross-Sectional Data

Cross-sectional data are collected at a single point in time and are not time-based. According to Yamit (2008), the level of forecast error indicates the accuracy of a forecasting model and helps compare alternative methods. Common measures of forecast error include:

a. Mean Absolute Deviation (MAD)
The average of the absolute differences between actual and forecasted values, regardless of direction.
Formula:

$$MAD = \sum | At - Ft \; n$$

where:
Σ : Summation
At : Actual observed value at period t
Ft : Forecasted value at period t

b. Mean Squared Error (MSE)
The average of the squared differences between actual and forecasted values. MSE penalizes larger errors more heavily
Formula:

$$MSE = \sum (At - Ft)2 \; n$$

where:
Σ : Summation
At : Actual observed value at period t
Ft : Forecasted value at period t

c. Mean Absolute Percentage Error (MAPE)
A relative error measure expressed as a percentage, offering better interpretability than MAD. MAPE shows how far off the forecast is from actual demand in percentage terms.
Formula:

$$MAPE = (100 \; n) \sum |At - Ft \; At$$

where:
At : Actual demand in period t
Ft : Forecasted demand in period t
n : Number of forecasting periods involved

A well-executed forecasting process follows systematic procedures. According to Gasperz, there are nine steps to ensure the effectiveness and efficiency of a forecasting system:

1. Define the forecasting objective
2. Select the independent demand item to be forecasted
3. Determine the forecasting time horizon (short, medium, or long term)
4. Select the appropriate forecasting model(s)
5. Collect the required data
6. Validate the forecasting model
7. Generate the forecast
8. Implement the forecast results
9. Monitor the reliability of forecast outcomes

To evaluate forecast accuracy, MAPE is often used with the following interpretation ranges:

a. < 10% : Excellent forecasting accuracy
b. 10% – 20% : Good forecasting accuracy
c. 20% – 50% : Reasonable forecasting accuracy
d. > 50% : Poor forecasting accuracy

3. Methodology

a. Research Location and Time

This research was conducted at PT X, a pharmaceutical manufacturing company located at Jalan Raya Padang–Bukittinggi Km 25, Sungai Buluh, Batang Anai District, Padang Pariaman Regency, West Sumatra. This research took place over a four-month period, starting from January 3, 2022, to April 29, 2022.

b. Research Variables

A research variable refers to the element or characteristic that is studied, measured, and evaluated in order to answer research questions and draw meaningful conclusions. In this study, the research is focused on a single variable: product demand forecasting for Salisil Talk Wangi 45 grams using the Double Moving Average (DMA) method.

By focusing on this single variable, the research aims to improve the accuracy of demand estimation and enhance inventory planning processes, thereby minimizing stockout occurrences and ensuring continuous production.

c. Data Collection Techniques

The data collection techniques in this study are:

1. Interview

   Informal interviews were conducted with key personnel involved in inventory management and production planning, including supervisors and warehouse staff. These interviews provided qualitative insights into current challenges related to forecasting and stock availability, and helped validate the necessity of applying a structured forecasting method.

2. Observation

   Direct observation was carried out during the internship at PT X. This included observing the sales process, inventory management practices, and warehouse activities related to the Salisil Talk Wangi 45 gr product. The observations allowed for a better understanding of the real-time flow of information and operations.

3. Literature studies

   Historical sales data for Salisil Talk Wangi 45 gr (Blue, Yellow, and Green variants) from January to December 2024 was collected from company records. In addition, relevant literature and previous studies were reviewed to understand the principles and application of the Double Moving Average method, as well as to establish benchmarks for evaluating forecasting accuracy using MAD and MAPE.

d. Data Processing

The focus of this research is forecasting product demand using the Double Moving Average (DMA) method for Salisil Talk Wangi 45 gr in three variants: Blue, Yellow, and Green. The data used includes monthly sales records from January to December.

The steps of data processing are as follows:

1. Data Collection and Compilation
   Monthly sales data for Salisil Talk Wangi 45 grams was collected from internal records at PT X. This data includes actual sales figures for the Blue, Yellow, and Green variants throughout the 12-month period.
2. First Moving Average Calculation
   For each product variant, the first moving average was calculated using a predefined interval. This step smooths out the short-term fluctuations and reveals the underlying sales trend.
3. Second Moving Average Calculation
   The results from the first moving average were used to compute a second moving average. This step further reduces the effects of random variation and prepares the data for more accurate forecasting.
4. Calculation of Forecast Constants and Slope
   Constants (a) and slope (b) were calculated to form the basis of the DMA forecasting formula. These values are essential for projecting future sales trends based on historical data.
5. Forecasting Future Demand
   Using the calculated constants and slope, future demand values were forecasted for each variant. The forecast values were then compared with actual sales to determine the accuracy of the method.

6. Error Measurement: MAD and MAPE
The Mean Absolute Deviation (MAD) and Mean Absolute Percentage Error (MAPE) were used to evaluate forecasting accuracy:
a) Blue variant: MAD = 1.236, MAPE = 7%
b) Yellow variant: MAD = 1.109, MAPE = 7%
c) Green variant: MAD = 1.109, MAPE = 8%

4. Result and Discussion

This sales data was obtained from the product demand submitted by the distributor of PT X, namely PT ST, in the year 2024. The following is the sales data for Salisil Talk Wangi 45 grams, presented in dozens:

Table 1. Sales Data Product of Salisil Talk Wangi 45 gr

Bulan	STW Kuning	STW Biru	STW Hijau
Januari	17.650	16.710	16.250
Februari	17.635	16.923	17.543
Maret	16.755	17.897	16.680
April	18.250	18.765	18.354
Mei	17.150	15.537	16.450
Juni	16.437	20.156	16.754
Juli	14.383	16.810	15.650
Agustus	16.824	18.720	16.250
September	19.295	15.384	19.295
Oktober	16.250	17.510	16.250
November	17.255	17.250	17.255
Desember	19.255	16.520	19.255

Based on the table above, the sales of Salisil Talk Wangi 45 gr experienced fluctuations. Therefore, the data will be forecasted using the Double Moving Average method. In this method, the first step is to calculate the first moving average, with the result placed in the final period. Then, the second moving average is calculated, followed by generating the forecast.

a. Determining the first moving average

This is done using a 3-month moving average, so the calculation is carried out for the period from March to December.

b. Determining the first moving average

The second moving average is calculated using a 3-month moving average, based on the results of the first moving average calculation. This process is carried out for the period from May to December.

c. Determining forecasting

Following the calculation of the second moving average, the constant and slope are determined as the basis for the forecasting process. Table X presents a summary of the forecasting results for STW Blue, Yellow, and Green.

Table 2 Summary of Forecasting Data for STW

No	Period	Forecasting		
		STW Blue	STW Yellow	STW Green
1	Januari	17792	17792	17792
2	Februari	17895	17895	17895
3	Maret	17998	17998	17998
4	April	18101	18101	18101
5	Mei	18203	18203	18203
6	Juni	18306	18306	18306
7	Juli	18409	18409	18409
8	Agustus	18512	18512	18512
9	September	18614	18614	18614
10	Oktober	18717	18717	18717
11	November	18820	18820	18820
12	Desember	18923	18923	18923
13	Januari 2024	17792	17792	17792

d. Determining the Forecasting Error Rate

Inaccurate forecasting can lead to high production costs. For example, overestimating demand may result in excessive inventory levels, thereby increasing storage costs. Conversely, underestimating demand may cause stock shortages, leading to lost opportunities for profit. Although forecasting inherently involves a certain degree of error, efforts should still be made to ensure the forecasts are as accurate as possible.

Table 3 Summary Forecasting Error Rate

No	Periode	Tingkat Kesalahan		
		STW Biru	STW Kuning	STW Hijau
1	Januari	3	0	9
2	Februari	3	0	2
3	Maret	2	6	8
4	April	7	3	1
5	Mei	13	4	11
6	Juni	12	9	9
7	Juli	6	24	18
8	Agustus	4	7	14
9	September	17	7	4
10	Oktober	3	11	15
11	November	5	5	9
12	Desember	10	6	2
Jumlah		**87**	**81**	**102**
Rata-rata		**7**	**7**	**8**

5. CONCLUSION

Based on the forecasting results using the Double Moving Average method, the author employed a moving average value of 3. The forecasting outcomes for the products are as follows:

1. Salisil Talk Wangi Blue 45 gr: From January to December, the forecasting error accuracy levels were MAD = 1.236 and MAPE = 7%.. Salisil Talk Wangi Yellow 45 gr: From January to December, the forecasting error accuracy levels were MAD = 1.109 and MAPE = 7%. Salisil Talk Wangi Green 45 gr: From January to December, the forecasting error accuracy levels were MAD = 1.109 and MAPE = 8%.
2. Based on the observations conducted, PT X has implemented several strategies to improve its production, including enhancing product quality, maintaining customer loyalty, and providing excellent service.
3. The Double Moving Average method can be considered sufficiently effective in forecasting the sales of Salisil Talk Wangi 45 grams, as it produced forecast results that were relatively close to the actual data—an important criterion of a good forecasting method.
4. PT X, as a growing pharmaceutical and cosmetic industry, has conducted its production processes in accordance with Good Manufacturing Practices (GMP).
5. The company has also demonstrated its contribution to education by collaborating with various educational institutions to serve as a site for industrial internships and academic research.
6. PT X plans its production based on the sales reports from the previous month and adjusts accordingly to customer demand.

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