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Optimizing Pharmaceutical Logistics through Sales Forecasting to Support Competitive Advantage at PT X

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ABSTRACT

The pharmaceutical industry faces increasing pressure to maintain efficient supply chain operations amid dynamic market conditions. This study aims to identify the most accurate sales forecasting method to optimize pharmaceutical logistics and support the competitive advantage of PT "X" in producing Black Cough Syrup 100 ml. Using historical monthly sales data from August 2023 to January 2025, the study applies four quantitative forecasting techniques: Single Moving Average (SMA), Weighted Moving Average (WMA), Single Exponential Smoothing (SES), and Linear Regression. Forecast accuracy is evaluated using Mean Absolute Deviation (MAD) and Mean Absolute Percentage Error (MAPE). The results reveal that the 3-period SMA method yields the lowest forecast error (MAD: 954; MAPE: 21.09%) and is the most suitable model for the case. These findings highlight the strategic importance of integrating forecasting methods into pharmaceutical logistics to improve production planning, reduce stockout risks, and enhance customer satisfaction. By adopting accurate forecasting tools, PT "X" can strengthen interdepartmental coordination, improve inventory turnover, and build a sustainable competitive edge in the pharmaceutical market.

1. BACKGROUND

1.1. Introduction

In the increasingly competitive pharmaceutical industry, companies must continuously optimize their operational processes to achieve superior performance. One critical aspect is forecasting product demand accurately to ensure smooth production and distribution. Errors in demand forecasting can lead to stockouts or overstock, resulting in financial losses and disrupted supply chains. Therefore, the integration of forecasting techniques into pharmaceutical logistics is a strategic necessity.

Sales forecasting enables pharmaceutical companies to anticipate demand, plan production more efficiently, and ensure product availability when needed. The implementation of accurate forecasting tools contributes to minimizing inventory costs and optimizing logistics operations. According to Rizaldy et al. (2024), hybrid forecasting models can significantly enhance pharmaceutical supply chain efficiency. Similarly, Haider (2022) emphasized the role of EMA models in strengthening supply chain planning in the pharmaceutical sector.

However, many pharmaceutical firms still struggle with accurate demand forecasting due to lack of historical data analysis or inappropriate method selection. Thus, this study fills the gap by applying several forecasting methods to determine the best model for PT "X" in forecasting Black Cough Syrup 100 ml sales. This research is also aligned with the work of Wardah & Iskandar (2020) who validated exponential smoothing as a reliable method for short-term sales prediction. Furthermore, Gaspersz (2019) stressed the importance of integrating forecasting with inventory control to reduce operational inefficiencies.

This study aims to demonstrate how proper demand forecasting can support efficient pharmaceutical logistics and help the company build competitive advantage through improved planning and responsiveness. In recent years, the pharmaceutical industry has faced significant disruptions due to global pandemics, regulatory shifts, and supply chain bottlenecks. These challenges have underscored the urgent need for companies to adopt data-driven forecasting techniques. Forecasting is no longer a support function but a core strategy to manage uncertainty, reduce lead times, and build resilience in the supply chain. For PT "X", aligning production schedules with market demand through forecasting can directly enhance customer satisfaction and operational agility.

Furthermore, logistics activities such as procurement, storage, and distribution are intricately tied to demand forecasting. Any inaccuracies in forecasting can lead to over-purchasing raw materials or understocking finished goods, both of which incur substantial costs. By embedding accurate forecasting methods into logistics workflows, PT "X" can enhance visibility across its supply chain, improve coordination among departments, and streamline inventory turnover.

Another critical aspect is the role of technology and digital transformation in improving forecasting accuracy. Advanced analytics, machine learning, and ERP systems provide real-time insights that can refine forecast models. Although this study focuses on traditional quantitative methods, it sets the foundation for future integration of digital forecasting tools, which will be essential in maintaining competitiveness in a digital economy.

Moreover, research on forecasting in pharmaceutical logistics remains limited in the Indonesian context. While global literature supports its benefits, local empirical studies are necessary to tailor forecasting techniques to unique market dynamics, regulatory frameworks, and customer behavior in Indonesia. This paper contributes to that knowledge base by offering insights from a real-world case study of PT "X".

Ultimately, the strategic use of demand forecasting is more than just a planning tool; it is a mechanism for achieving logistical excellence and sustainable competitive advantage. As the pharmaceutical industry becomes more customer-centric, the ability to respond quickly and accurately to demand shifts will define the market leaders.

1.2. Research Purposes

Based on the above problems, the following problem formulation can be made:

1. What is the most accurate forecasting method for predicting the sales of Black Cough Syrup 100 ml at PT "X"?
2. How can sales forecasting support the planning of pharmaceutical logistics and enhance the competitive advantage of the company?

2. LITERATURE REVIEW

2.1. Pharmaceutical Logistics

Pharmaceutical logistics is a specialized branch of logistics that deals with the planning, implementation, and control of the flow of

pharmaceutical goods—from the procurement of raw materials, production processes, and storage, to the distribution of finished products to customers such as hospitals, pharmacies, and clinics. According to Merkurjeva et al. (2025), pharmaceutical logistics not only demands cost efficiency but also requires the preservation of product quality, timely delivery, and compliance with both national and international pharmaceutical standards and regulations. In light of increasing market complexity due to global pandemics, supply chain disruptions, and demand fluctuations, pharmaceutical companies must develop adaptive, data-driven logistics systems to ensure the continuity of vital drug supplies. Therefore, integrating pharmaceutical logistics with other operational strategies such as forecasting and inventory management becomes a crucial factor in achieving sustainable competitive advantage (Tucker & Daskin, 2021).

2.2. Sales Forecasting

Sales forecasting is a systematic process of estimating future product demand based on the analysis of historical data, market trends, and other relevant variables. In the pharmaceutical industry, sales forecasting plays a strategic role in supporting decision-making across various areas, including production planning, inventory management, raw material procurement, and logistics distribution. Haider (2022) notes that accurate forecasting methods can enhance operational efficiency, reduce the risks of overstock or stockouts, and improve customer service through better product availability. Moreover, modern forecasting approaches involve time-series-based quantitative methods such as moving averages, exponential smoothing, and regression models, selected based on their accuracy levels (e.g., MAPE, MAD) when applied to historical data. In the digital era, sales forecasting has evolved beyond a mere planning tool to become a core element of risk management strategies in facing volatile pharmaceutical demand.

2.3. Inventory Management

Inventory management in the context of pharmaceutical logistics refers to the process of monitoring and controlling stock levels of medicines and raw materials within a company's supply chain. The effectiveness of inventory management determines how well a company can meet demand without facing excess or insufficient stock. According to Gaspersz (2019), effective inventory control must consider demand dynamics, procurement lead times, warehouse capacity, and product shelf life—particularly crucial in the pharmaceutical industry, which is highly time-sensitive and regulated. By integrating forecasting

results into the inventory management system, companies can improve inventory turnover rates, reduce storage costs, and minimize the risks of damage or expiration. Additionally, the use of technologies such as real-time inventory tracking and ERP systems further enhances transparency and accuracy in pharmaceutical inventory operations.

2.4. Supply Chain

The pharmaceutical supply chain encompasses all activities involved from the acquisition of raw materials, production, packaging, and storage to the final distribution of products to end consumers. According to Kechagias et al. (2021), the pharmaceutical supply chain must be designed to ensure product safety, regulatory compliance, and responsiveness to sudden shifts in demand. The complexity of pharmaceutical supply chains has increased due to the involvement of multiple stakeholders such as active ingredient manufacturers, distributors, regulatory bodies, and healthcare service providers. Therefore, a robust system of coordination and information integration is essential, including the use of sales forecasting and data-driven logistics planning. With an adaptive and integrated supply chain, pharmaceutical companies can enhance operational visibility, cost efficiency, and resilience to external disruptions such as pandemics or changes in international regulations (Sabogal De La Pava & Tucker, 2023).

2.5. Competitive Advantage

Competitive advantage refers to a company's superior position over its rivals in the same market. In the context of pharmaceutical logistics, competitive advantage can be achieved through operational efficiency, fast response to demand, process innovation, and higher levels of customer satisfaction. James (2025) argues that the integration of forecasting data, inventory control, and efficient distribution systems forms the foundation for building sustainable competitive advantage in the pharmaceutical sector. Furthermore, a company's ability to anticipate and respond to market uncertainty through digital technologies and data-driven strategies offers significant added value. Companies like PT "X" can achieve such advantage by strengthening their accurate forecasting systems, which in turn supports precise production planning, reduces logistics costs, and increases customer satisfaction through consistent product availability.

2.6. Forecasting Methods

According to Makridakis et al. (1999), forecasting methods can be classified into the following categories:

1. **Qualitative Forecasting**

This method is used when no mathematical model is available, typically due to the lack of sufficient and representative data to predict future conditions (commonly for long-term forecasting). Qualitative forecasting relies on expert opinions and subjective judgment from individuals with specialized knowledge in the relevant field. The advantages of this method include its low cost (as it does not require data) and the speed at which it can be implemented.

2. **Quantitative Forecasting**

This method uses a variety of mathematical models based on historical data to predict future demand. Quantitative forecasting is more objective and data-driven.

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

a. **Time Series Data**

Time series data are data that are presented over time, such as monthly, weekly, or daily figures. Forecasting techniques using time series data include:

• **Single Moving Average**

This method involves taking a group of observed values, calculating their average, and using that average as the forecast for the next period. It is referred to as "moving average" because the average is recalculated each time new data becomes available, and the result is used as the input for the next forecasting period.

• **Double Moving Average**

This technique is used for time-series data with a specific pattern. It involves calculating a first moving average group and then computing a second group based on the results of the first.

• **Weighted Moving Average**

Similar to the previous moving average methods, but with one key difference: the analyst or management assigns specific weights to the data. These weights reflect the relative importance or confidence level of data from each period. The weight assignment is subjective and typically based on the analyst's experience and judgment.

• **Exponential Smoothing**

This method weighs data using an exponential function (Heizer & Render, 2015). It is based on the calculation of exponentially smoothed averages from past data, continuously updated with the latest available data. Each data point is assigned a weight using a smoothing

constant (α), where $0 \leq \alpha \leq 1$. Commonly, the α value ranges from 0.1 to 0.5. The optimal α minimizes forecast errors and is often determined through a trial-and-error process. This method is particularly suitable for unstable or highly volatile data patterns.

b. **Cross-Sectional Data**

This second type of data is not organized chronologically, but instead represents values collected at a single point in time.

2.7. Forecasting Error

According to Yamit (2008), the level of forecasting error provides a measure of accuracy as well as a basis for comparing alternative forecasting methods. Forecasting errors can be calculated using Mean Absolute Deviation (MAD), Mean Square Error (MSE), and Mean Absolute Percentage Error (MAPE). The following are definitions of forecasting errors based on Yamit (2008):

1. **Mean Absolute Deviation (MAD)**

MAD is the average of the absolute values of forecasting errors, without considering whether the errors are positive or negative.

Formula:

$$MAD = \sum \frac{|A_t - F_t|}{n}$$

Where:

- A_t = Actual observation in period t
- F_t = Forecast value for period t
- n = Number of forecasting periods
- \sum = Summation symbol

2. **Mean Square Error (MSE)**

Mean Square Error is the average of the squared differences between the forecasted values and the actual observed values. MSE penalizes larger errors more heavily, thereby amplifying the impact of large deviations while minimizing the influence of smaller forecasting errors within a unit range.

Formula:

$$MSE = \sum \frac{(A_t - F_t)^2}{n}$$

3. **Mean Absolute Percentage Error (MAPE)**

MAPE is a measure of relative error. It is generally considered more meaningful than MAD because it expresses the forecast error as a percentage of the actual demand over a specific period. This provides information on whether the forecasting error is excessively high or low.

Formula:

$$MAPE = \left(\frac{100}{n}\right) \sum \left| \frac{At - Ft}{At} \right|$$

Explanation:

- At = Actual demand in period *t*
- Ft = Forecasted demand in period *t*
- n = Number of forecasting periods involved

MAPE values can be interpreted into four categories:

- <10% = Very accurate
- 10–20% = Good
- 20–50% = Reasonable

2.8. Production Planning

According to Rusdian (2014:168), production planning is the process of generating product ideas and following through until the product is introduced to the market. Meanwhile, Assauri (2011:128) states that the objectives of production planning are:

1. To achieve a certain level of profit.
2. To gain control over the market.
3. To ensure that the company operates at a certain level of efficiency.
4. To maintain and sustain existing jobs and employment opportunities at their current levels.

3. METHODOLOGY

3.1. Research Location and Time

This research was conducted at PT “X”, a pharmaceutical manufacturer located in West Sumatra. The research period covered January 2025.

3.2. Research Variables

Research variables are the fundamental elements that guide the structure and direction of a study. According to Sugiyono (2019), variables are all attributes or characteristics that can be measured and observed in a study, serving as key factors that influence or are influenced by the phenomena being analyzed. In the context of this research, the variables are categorized into dependent and independent variables.

The dependent variable in this study is the forecasted sales volume of Black Cough Syrup 100 ml. This variable is the primary focus and output of the forecasting model and serves as a critical indicator for logistics planning and inventory management.

The independent variables are the historical monthly sales data from August 2023 to Jan 2025, which are used to build the forecasting models.

These data points are essential for identifying patterns and trends in customer demand, which will support the selection of the most suitable forecasting method.

The accuracy of the forecasting methods is evaluated using two performance metrics: Mean Absolute Deviation (MAD) and Mean Absolute Percentage Error (MAPE). As stated by Makridakis, Wheelwright, and Hyndman (2018), these metrics are widely used in time series forecasting to assess the precision of prediction models.

The identification and measurement of these variables help ensure that the forecasting process is methodologically sound and can provide relevant insights for optimizing pharmaceutical logistics and achieving competitive advantage.

3.3. Data Collection Techniques

Data collection is a critical step in any research study as it determines the quality and accuracy of the results obtained. According to Creswell (2014), effective data collection ensures that the variables under study are measured accurately and consistently. In this study, data were collected using quantitative techniques, particularly through the acquisition of secondary data.

The main source of data is historical sales records of Black Cough Syrup 100 ml from PT “X,” covering a 17-month period from August 2023 to Jan 2025. These records were obtained from the company’s internal database, specifically from the sales and distribution department. The data include monthly sales volumes, which are essential for building accurate forecasting models.

Table 1 Black cough medicine sales data

No.	Period	OBH Sales Data
1	August 2023	4.210
2	September 2023	5.744
3	October 2023	4.200
4	November 2023	6.000
5	December 2023	6.400
6	January 2024	4.120
7	February 2024	5.670
8	March 2024	6.600
9	April 2024	5.200
10	May 2024	4.110
11	June 2024	6.700
12	July 2024	5.210
13	August 2024	4.500
14	September 2024	3.400
15	October 2024	3.300
16	November 2024	3.500
17	December 2024	3.900
18	January 2025	
Jumlah		82.764

Secondary data collection was chosen due to the availability and reliability of past sales records, which are crucial in time series forecasting. As stated by Sekaran and Bougie (2016), secondary data provides a cost-effective and time-efficient method for gathering information, especially when the data are already systematically recorded and maintained.

Additionally, to ensure data validity and consistency, the collected sales data were cross-verified with monthly inventory movement reports and financial summaries to eliminate discrepancies. This process enhances the credibility of the dataset and supports robust model development.

The data collection process adhered to ethical research principles, including obtaining permission from PT "X" for data usage and ensuring confidentiality of all proprietary information..

3.4. Data Processing

Data processing involves organizing, analyzing, and interpreting the collected data to generate meaningful insights that align with the research objectives. In this study, data processing focuses on applying various quantitative forecasting methods to the historical sales data in order to identify the most accurate model.

According to Makridakis et al. (2018), time series forecasting is an essential technique used to model and predict future values based on past observations. The data processing steps in this research include: (1) organizing the monthly sales data into a tabulated form, (2) plotting the data to visualize trends and patterns, (3) applying multiple forecasting methods, and (4) evaluating the accuracy of each method using MAD and MAPE.

The forecasting methods applied in this study are Single Moving Average (SMA), Weighted Moving Average (WMA), Single Exponential Smoothing (SES), and Linear Regression. Each method is systematically calculated to produce forecast values, which are then compared to the actual sales data to determine forecasting accuracy.

To ensure objectivity and precision, all computations were performed using Microsoft Excel. Excel was chosen due to its flexibility and widespread usage in business analytics. The software enabled efficient formula application, data visualization, and performance analysis of each forecasting model.

The outcome of the data processing phase is the identification of the most appropriate forecasting technique for Black Cough Syrup 100 ml, which will inform inventory planning and logistics strategies. The results also serve as a foundation for formulating recommendations to optimize the pharmaceutical supply chain at PT "X."

4. Result and Discussion

4.1. Forecasting Using Single Moving Average

The Single Moving Average (SMA) method is a simple forecasting technique that calculates the average of actual sales data over a specific number of periods. This method updates the forecast as new actual data becomes available by dropping the oldest data point and incorporating the newest. The updated average is then used as the prediction for the upcoming period.

The formula used is:

$$F_{t+1} = \frac{X_1 + X_2 + \dots + X_t}{n}$$

Where:

F_{t+1} : Forecast for the next period

X_t : Actual data in period

n : Number of periods used for moving average

Forecasting Using 3-Period and 5-Period SMA:

- Forecast for November 2023 using 3-period SMA:

$$\begin{aligned} F_{t+1} &= \frac{4210 + 5744 + 4200}{3} \\ &= \frac{14.154}{3} \\ &= 4.718 \end{aligned}$$

The results of the sales forecast for Black Cough Medicine (OBH) 100ml, calculated from August 2023 to January 2025 with 3 periods as in the table below:

Table 2: Results of Forecasting Sales of Black Cough Medicine 3 periods

No.	Period	OBH Sales Data	Forecast
1	August 2023	4.210	-
2	September 2023	5.744	-
3	October 2023	4.200	-
4	November 2023	6.000	4.718
5	December 2023	6.400	5.315
6	January 2024	4.120	5.533
7	February 2024	5.670	5.507
8	March 2024	6.600	5.397
9	April 2024	5.200	5.463
10	May 2024	4.110	5.823
11	June 2024	6.700	5.303
12	July 2024	5.210	5.337
13	August 2024	4.500	5.340
14	September 2024	3.400	5.470
15	October 2024	3.300	4.370
16	November 2024	3.500	3.733
17	December 2024	3.900	3.400
18	January 2025	-	3.567

So the sales forecast for the Black Cough Medicine product 100 ml in January 2025 using the 3-period single moving average method is 3567 dozens.

$$\begin{aligned}
 2. \quad F_{t+1} &= \frac{4210+5744+4200+6000+6400}{5} \\
 &= \frac{26.554}{5} \\
 &= 5.311
 \end{aligned}$$

The results of the sales forecast of Black Cough Medicine 100ml, calculated from August 2023 to January 2025 with 5 periods as in the table below:

Table 3: Results of the Black Cough Medicine sales forecast for 5 periods

No.	Period	OBH Sales Data	Forecast
1	August 2023	4.210	-
2	September 2023	5.744	-
3	October 2023	4.200	-
4	November 2023	6.000	-
5	December 2023	6.400	-
6	January 2024	4.120	5.311
7	February 2024	5.670	5.293
8	March 2024	6.600	5.278
9	April 2024	5.200	5.758
10	May 2024	4.110	5.598
11	June 2024	6.700	5.140
12	July 2024	5.210	5.656
13	August 2024	4.500	5.564
14	September 2024	3.400	5.144
15	October 2024	3.300	4.784
16	November 2024	3.500	4.622
17	December 2024	3.900	3.982
18	January 2025	-	3.720

So the sales forecast for the Black Cough Medicine product 100 ml in January 2025 using the 5-period single moving average method is 3720 dozens

4.2. Forecasting Using Single Exponential Smoothing

The reason for using α is because the α area is between 0.1 and 0.5.

The formula is as follows:

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

Description:

- F_{t+1} : Forecasting for period (t+1)
- F_t : Forecasting value for period t
- α : Smoothing constant for data
- (0 < α < 1) X_t : Real demand data for period t

Because there is no forecast for February, the first data is used, namely X_{jan} 4210. The following is the sales forecast for Nov 2024 using $\alpha = 0.2$ and $\alpha = 0.5$:

$$\begin{aligned}
 1. \quad F_{\text{November 2024}} &= 0.2 \times 3900 + (1-0.2) \times 4323 \\
 &= 780 + (0.8) \times 4323 \\
 &= 780 + 3,458.4 \\
 &= 4238
 \end{aligned}$$

Table 4: Sales Forecast Results of Black Cough Medicine α 0.2

No.	Period	OBH Sales Data	F _t 0,2
1	August 2023	4.210	-
2	September 2023	5.744	4.210
3	October 2023	4.200	4.517
4	November 2023	6.000	4.453
5	December 2023	6.400	4.763
6	January 2024	4.120	5.090
7	February 2024	5.670	4.896
8	March 2024	6.600	5.051
9	April 2024	5.200	5.361
10	May 2024	4.110	5.329
11	June 2024	6.700	5.085
12	July 2024	5.210	5.408
13	August 2024	4.500	5.368
14	September 2024	3.400	5.195
15	October 2024	3.300	4.836
16	November 2024	3.500	4.529
17	December 2024	3.900	4.323
18	January 2025	-	4.238

So the sales forecast for Black Cough Medicine (OBH) 100 ml using the Single Exponential Smoothing method with a constant of 0.2 is 4238 dozens in January 2025. Because the forecast for February does not yet exist, the first data is used, namely X_{jan} 4210.

The following is the sales forecast for January 2025 using $\alpha = 0.5$.

$$\begin{aligned}
 2. \quad F_{\text{November 2024}} &= 0.5 \times 3900 + (1-0.5) \times 3624 \\
 &= 1950 + (0.5) \times 3624 \\
 &= 1950 + 1,812 \\
 &= 3762
 \end{aligned}$$

The results of the sales forecast for Black Cough Medicine 100 ml for the next few months, starting from August 2023 to January 2025 with $\alpha = 0.5$ as in the table below.

Table 5 Results of Forecasting Sales of Black Cough Medicine α 0.5

No.	Period	OBH Sales Data	F_t 0,5
1	August 2023	4.210	-
2	September 2023	5.744	4.210
3	October 2023	4.200	4.977
4	November 2023	6.000	4.589
5	December 2023	6.400	5.294
6	January 2024	4.120	5.847
7	February 2024	5.670	4.984
8	March 2024	6.600	5.327
9	April 2024	5.200	5.963
10	May 2024	4.110	5.582
11	June 2024	6.700	4.846
12	July 2024	5.210	5.773
13	August 2024	4.500	5.491
14	September 2024	3.400	4.996
15	October 2024	3.300	4.198
16	November 2024	3.500	3.749
17	December 2024	3.900	3.624
18	January 2025	-	3.762

So the sales forecast for Black Cough Medicine 100 ml using the Single Exponential Smoothing method with a constant of 0.5 is 3762 dozens in January 2025.

4.3. Forecast Error

The Mean Absolute Deviation (MAD) measured is only the magnitude of the absolute error. Usually the effect in the operation of the error is a little not serious and will be smoothed out by demand or overtime. Large errors will be difficult, a few large errors are the same as many small errors. As a result, the error measurement method that punishes large errors requires calculation. Mean Square Error (MSE) is a type of error measurement by diverting each forecast error by its square. Mean Absolute Percentage Error (MAPE) states the percentage error of the forecast results to actual demand during a certain period which will provide information on the percentage of errors that are too high or too low. The following is a table of sales forecast errors at PT "X":

1. Results of sales forecast errors for Black Cough Medicine 3 periods

Table 6 Results of Sales Forecast Errors for Black Cough Medicine 3 Periods

No.	Period	OBH Sales Data	Forecast	Error	MAD	MAPE
1	August 2023	4.210	-	-	-	-
2	September 2023	5.744	-	-	-	-
3	October 2023	4.200	-	-	-	-
4	November 2023	6.000	4.718	1.282	1.282	21
5	December 2023	6.400	5.315	1.085	1.085	17
6	January 2024	4.120	5.533	- 1.413	1.413	34
7	February 2024	5.670	5.507	163	163	3
8	March 2024	6.600	5.397	1.203	1.203	18
9	April 2024	5.200	5.463	- 263	263	5
10	May 2024	4.110	5.823	- 1.713	1.713	42
11	June 2024	6.700	5.303	1.397	1.397	21
12	July 2024	5.210	5.337	- 127	127	2
13	August 2024	4.500	5.340	- 840	840	19
14	September 2024	3.400	5.470	- 2.070	2.070	61
15	October 2024	3.300	4.370	- 1.070	1.070	32
16	November 2024	3.500	3.733	- 233	233	7
17	December 2024	3.900	3.400	500	500	13
18	January 2025	-	3.567	-	-	-
Total					13.361	298
Total					954	21
Total					MAD	MAPE

2. Results of sales forecast errors for Black Cough Medicine 5 periods

Table 7 Results of Sales Forecast Errors for Black Cough Medicine 5 Periods

No.	Period	OBH Sales Data	Forecast	Error	MAD	MAPE
1	August 2023	4.210	-	-	-	-
2	September 2023	5.744	-	-	-	-
3	October 2023	4.200	-	-	-	-
4	November 2023	6.000	-	-	-	-
5	December 2023	6.400	-	-	-	-
6	January 2024	4.120	5.311	- 1.191	1.191	29
7	February 2024	5.670	5.293	377	377	7
8	March 2024	6.600	5.278	1.322	1.322	20
9	April 2024	5.200	5.758	- 558	558	11
10	May 2024	4.110	5.598	- 1.488	1.488	36
11	June 2024	6.700	5.140	1.560	1.560	23
12	July 2024	5.210	5.656	- 446	446	9
13	August 2024	4.500	5.564	- 1.064	1.064	24
14	September 2024	3.400	5.144	- 1.744	1.744	51
15	October 2024	3.300	4.784	- 1.484	1.484	45
16	November 2024	3.500	4.622	- 1.122	1.122	32
17	December 2024	3.900	3.982	- 82	82	2
18	January 2025	-	3.720	-	-	-
Total					12.438	288
Total					1.036,5	24,0
Total					MAD	MAPE

3. Results of sales forecasting errors for Black Cough Medicine Constant 0.2

Table 8 Forecasting Error Results

No.	Period	OBH Sales Data	Fr 0,2	Error	MAD	Error (%)
1	August 2023	4.210	-	-	-	-
2	September 2023	5.744	4.210	1.534	1.534	27
3	October 2023	4.200	4.517	- 317	317	8
4	November 2023	6.000	4.453	1.547	1.547	26
5	December 2023	6.400	4.763	1.637	1.637	26
6	January 2024	4.120	5.090	- 970	970	24
7	February 2024	5.670	4.896	774	774	14
8	March 2024	6.600	5.051	1.549	1.549	23
9	April 2024	5.200	5.361	- 161	161	3
10	May 2024	4.310	5.329	- 1.219	1.219	30
11	June 2024	6.700	5.085	1.615	1.615	24
12	July 2024	5.210	5.408	- 198	198	4
13	August 2024	4.500	5.368	- 868	868	19
14	September 2024	3.400	5.195	- 1.795	1.795	53
15	October 2024	3.300	4.836	- 1.536	1.536	47
16	November 2024	3.500	4.529	- 1.029	1.029	29
17	December 2024	3.900	4.323	- 423	423	11
18	January 2025	-	4.238	-	-	-
Total					17.170,2279	365,7676283
					1,073,1	22,9
					MAD	MAPE

4. Result of Black Cough Medicine Sales Forecast Error Constant 0,5

Table 9 Black Cough Medicine Sales Forecasting Error Results Constant 0.5

No.	Period	OBH Sales Data	Fr 0,2	Error	MAD	Error (%)
1	August 2023	4.210	-	-	-	-
2	September 2023	5.744	4.210	1.534	1.534	27
3	October 2023	4.200	4.977	- 777	777	19
4	November 2023	6.000	4.589	1.411,5	1.412	24
5	December 2023	6.400	5.294	1.105,75	1.106	17
6	January 2024	4.120	5.847	- 1.727,13	1.727	42
7	February 2024	5.670	4.984	686,4375	686	12
8	March 2024	6.600	5.327	1.273,219	1.273	19
9	April 2024	5.200	5.963	- 763,391	763	15
10	May 2024	4.110	5.582	- 1.471,7	1.472	36
11	June 2024	6.700	4.846	1.854,152	1.854	28
12	July 2024	5.210	5.773	- 562,924	563	11
13	August 2024	4.500	5.491	- 991,462	991	22
14	September 2024	3.400	4.996	- 1.595,73	1.596	47
15	October 2024	3.300	4.198	- 897,865	898	27
16	November 2024	3.500	3.749	- 248,933	249	7
17	December 2024	3.900	3.624	275,534	276	7
18	January 2025	-	3.762	-	-	-
Total					17.176,7181	358,6446367
					1,074	22
					MAD	MAPE

4.4. Optimal Forecasting Method

Based on the calculation results of the single moving average and single exponential smoothing methods, the error value obtained is known. The selection of the forecasting method is done by comparing the error value, where the forecasting method with the smallest error value is chosen as the best forecasting method that is most appropriate for predicting the sales of Black Cough Medicine 100 ml size at the company PT "X". Comparison of the error value of Black Cough Medicine 100 ml size with the forecasting method is shown in the table below:

Table 10 Results of Comparison of Black Cough Medicine Sales Forecast Errors

No.	Metode	MAD	MAPE
1	Single Moving Average 3 Periode	954	21,09
2	Single Moving Average 5 Periode	1.037	24
3	Single Exponential Smoothing $\alpha = 0,2$	1.073	22,86
4	Single Exponential Smoothing $\alpha = 0,5$	1.074	22

So the results of the 100 ml Black Cough Medicine sales forecasting error using the 3-period single moving average method produce a Mean Absolute Deviation (MAD) value of 954, Mean Absolute Percentage Error (MAPE) of 21.09%. The 5-period single moving average produces a Mean Absolute Deviation (MAD) of 1037, and a Mean Absolute Percentage Error (MAPE) of 24%. In the single exponential smoothing method with a constant of 0.2, it produces a Mean Absolute Deviation (MAD) of 1037, and a Mean Absolute Percentage Error (MAPE) of 22.86%. At a constant of 0.5, it produces a Mean Absolute Deviation (MAD) of 1074, and a Mean Absolute Percentage Error (MAPE) of 22%. So, the program that must be carried out by PT "X" is to create sales forecasting software that can use applications such as Streamline etc. which can make it easier for the PT to find out the forecast for the next month because every sales data will be updated in the application.

4.5. Implications for Pharmaceutical Logistics

The accurate forecasting of pharmaceutical products, such as Black Cough Syrup 100 ml, plays a vital role in managing logistics operations. By utilizing Linear Regression for demand prediction, PT "X" can improve its production scheduling, raw material procurement, and inventory management. This leads to reduced stockouts, lower holding costs, and better allocation of logistics resources. Moreover, it ensures that the right quantity of product is available at the right time, thereby enhancing service levels and operational efficiency.

4.6. Competitive Advantage

Effective forecasting strengthens PT "X" competitiveness in the pharmaceutical market. Accurate predictions enable faster response to market demand, support timely deliveries, and enhance customer satisfaction. Additionally, it allows for better resource allocation and cost control, contributing to higher profitability and sustainable growth. By integrating forecasting with logistics planning, PT "X" gains a strategic edge over competitors who may still rely on reactive or less precise planning methods.

4.7. Comparison with Previous Research

The findings of this research are consistent with previous studies. Rizaldy et al. (2024) highlighted that regression-based forecasting models are effective in the pharmaceutical industry, particularly in capturing seasonal and trend components in sales data. Haider (2022) emphasized the importance of forecasting accuracy for inventory control and customer service improvements. The present study aligns with these conclusions and further demonstrates how forecasting contributes to logistics optimization and competitive advantage.

5. CONCLUSION

This study demonstrates that integrating forecasting methods into the pharmaceutical logistics system significantly impacts supply chain effectiveness and efficiency. Forecasting sales of 100 ml Black Cough Medicine products in January 2025 using the Single Moving Average (SMA) method for 3 periods, namely 3567 dozen products, and 5 periods, namely 3720. While using the Single Exponential Smoothing (SES) method using a constant of 0.2, namely 4238, and using a constant of 0.5, namely 3762.

The correct forecast for sales of 100 ml Black Cough Medicine products in June 2025 is to use the Single Moving Average 3 Period method because the forecast error rate is smaller than other methods which produce MAD 954, and MAPE 21% because the MAPE value can be interpreted or interpreted into 4 categories, namely: <10% = very accurate. 10-20% = good. 20-50% = fair and A smaller MAD error value indicates a better method used in data.

Through this study, the author suggests: PT "X" should apply the Single Moving Average forecasting method to predict the sales level of Black Cough Medicine 100 ml in the June 2025 period because this method has the lowest error rate compared to the Single Moving Average method. And then, the calculation results using the Single Moving Average method can also help companies in planning the production of Black Cough Medicine 100 ml products to minimize the discrepancy between production planning and actual releases.

These forecasting results are highly useful in supporting operational decisions such as determining the quantity of drug production, planning raw material requirements, and scheduling timely distribution. Consequently, the company can avoid waste due to overstock and losses from stockouts, allowing for optimal logistics efficiency.

Furthermore, utilizing forecasting results in logistics planning becomes a key driver in creating a competitive advantage for the company. Accurate production and distribution planning directly

impact increased customer satisfaction and strengthen the company's market position. Therefore, integrating forecasting data into logistics strategies should be part of sustainable strategic planning in the pharmaceutical industry.

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