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PROVING THAT FORECASTING USING THE EXPONENTIAL SINGLE SMOOTHING METHOD IS USEFUL

STUDY ON THE PROCUREMENT OF OFFICE STATIONERY FOR HOSPITALS

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A B S T R A C T

Procurement involves numerous activities, consisting of many material and information flows, it is not as simple as to just convey a need from an internal customer to a supplier and then deliver the item to the internal customer. Based on initial observations the author observed several problems in the process of forecasting the demand for general consumables, particularly office stationery. The selection of these consumables is based on their vital role in supporting daily administrative activities within the hospital environment, making them a relevant subject for studying patterns of recurring and consistent demand. Currently, the process of forecasting the demand for general consumables is still carried out in a simple manner, namely by referring to the previous year's usage data and then adding 20% to the projection for the following year.

This research is an implementative form of forecasting formulas, so the data required in this research is dominated by secondary data. This study uses the single exponential smoothing forecasting method as the basis for data analysis. Single exponential smoothing (SES) is a simple yet effective time series forecasting technique, in which historical data is treated by assigning exponentially decreasing weights to past observations.

The forecasting results indicate that this method is quite effective in generating estimates of office stationery requirements, particularly for items with relatively stable demand patterns. This is evidenced by the low MAPE values for several items, such as F4 60g paper (5.31%), document keeper (5.70%), quarto 100 book (5.82%), folio 100 book (8.65%), and board marker (8.68%). A MAPE value below 10% indicates that the error rate is relatively small, so the forecasting results can be categorized as highly accurate. Conversely, there are several items that show a fairly high MAPE value, above 20%, including F4 70g paper (26.68%), permanent markers (24.21%), clear tape 5 cm (20.12%), and black ballpoint pens (20%). The high MAPE values for these items indicate that the forecasting model is unable to accurately capture demand patterns. This is due to high demand fluctuations and changes in consumption patterns.

1. Introduction

1.1 Background

Indonesia has a vision of achieving Indonesia Emas 2045, which aims to make Indonesia a sovereign, advanced, just, and prosperous country. To achieve this, one of the main focuses is on improving the quality of human resources through the education and health sectors (Bappenas, 2019). In this case, the transformation of the health system is a key pillar in ensuring

a healthy and productive society, which in turn contributes to national economic growth. A healthy and productive society is the key to achieving significant economic growth for more equitable social welfare. The healthcare industry is one of the industries with high potential to contribute to the economy. Therefore, it is very important to look at the determining factors that can improve the performance of healthcare organizations.

In order to achieve the goal of "providing healthcare efficiently and cost-effectively", one of the requisites of achieving medical excellence, numerous studies and investigations have been done on diagnostic and therapeutic techniques, advanced technology implementations and cost sharing. However, there is little or no research on the measurement of the results of the goals to be achieved, in this case the performance measurement of the system. Since the healthcare industry is a dynamic system, the evaluation of the performance of the individual areas can be difficult (Arun Kumar, 2005). It is the authors' opinion that there is no coherent method to measure the performance of the procurement process, and therefore it is hard for hospital purchasing departments in make appropriate decisions. This leads to the deterioration of the overall procurement performance and internal customer satisfaction, and at the same time incurs higher costs for patients (Arun Kumar, 2005). Therefore, it is in general interests of everyone to find a method of measuring procurement performance.

Alt (1997) points out that the increase in health care costs and inefficiencies are due to inadequate and tedious purchasing procedures. The health care cost escalation problem has been based on the explicit assumptions that medical supply purchasing information systems are inadequate, and that the delivery of health care has been inefficient. Dobler and Burt (1996) mentioned that "purchasing" and "procurement" are often used interchangeably, and Van Weele (2000) added that sometimes the term "supply management" or "logistics management" is also used. Inefficiencies in the health care supply chain could be significantly improved through the application of supply-chain best practices from other industries. Prior to the changes, there was an urgent need to assess the current performance and also develop a suitable performance measurement system for the health care industry (Arun Kumar, 2005).

1.2 Problem Statement

Procurement involves numerous activities, consisting of many material and information flows. It is not as simple as to just convey a need from an internal customer to a supplier and then deliver the item to the internal customer. Instead, this process consists of activities that are continuously changing in intensity, duration and quality, thus producing variations in performance, efficiency and effectiveness of the purchasing department's work (Knudsen, 1999). Since acquiring external sources in order to satisfy internal needs is a job with many varieties and options, it is important to consider the conditions and environment for procurement in order to produce good results. This also implies that a strategic plan for acquiring external sources has to exist, operating procedures have to be designed, customer needs have to be fulfilled and supplier markets have to be surveyed in advance (Kumar, 2005).

Based on initial observations at Ibnu Sina Regional General Hospital in Gresik Regency, the author observed several problems in the process of forecasting the demand for general consumables, particularly office stationery. The selection of these consumables is based on their vital role in supporting daily administrative activities within the hospital environment, making them a relevant subject for studying patterns of recurring and consistent demand. The timely

and adequate availability of office supplies directly impacts administrative work efficiency, which ultimately supports the smooth operation of the hospital as a whole.

Table 1. Office Stationary Revenue and Expenditure Data for the Period January - September 2024

No	Office Stationary Inquiry	Year 2024					
		1st Quarter		2nd Quarter		3rd Quarter	
		Item received	Expenditure	Item received	Expenditure	Item received	Expenditure
1	Folio book 100 (pcs)	48	47	50	50	50	54
2	Quarto book 100 (pcs)	144	76	50	86	100	79
3	Black pen (pcs)	1140	492	-	648	1200	641
4	Document keeper (pcs)	60	31	30	33	-	30
5	Translucent tape 5cm (rol)	133	78	100	71	50	109
6	Paper F4 60 gr (rim)	1075	673	880	702	380	729
7	Paper F4 70 gr (rim)	50	36	100	56	15	51
8	Large clip no.5 (pack)	170	103	100	125	100	111
9	Board Marker (pcs)	104	78	36	247	48	310
10	Permanent Marker (pcs)	228	204	240	151	180	217

Source : Data on office stationaries received and expenditure on January – September 2024

Based on the above data, it can be concluded that the demand for office inquiry, which is predominantly needed by hospital management, always experiences a deficit in usage. This condition raises questions about the accuracy of the office inquiry procurement team in forecasting future office inquiry needs. The need for a new breakthrough in forecasting office inquiry needs that are close to actual consumption has become an issue in hospital procurement.

Currently, the process of forecasting the demand for general consumables at Ibnu Sina Regional General Hospital in Gresik Regency is still carried out in a simple manner, namely by referring to the previous year's usage data and then adding 20% to the projection for the following year. The absence of a systematic and data-driven forecasting method leads to inaccuracies in demand estimation, resulting in shortages on one hand or excess inventory that remains unused on the other. This situation is further highlighted by the statement from the Head of the Logistics Department, who noted that the current forecasting system is not accurate and often causes inefficiencies in inventory management.

These issues need to be identified so that they can be used as a basis for further improvement and development in the hospital management system, particularly in the Goods and Services Procurement Unit and the Assets and Logistics Unit. By clearly understanding the root causes of the problems, hospitals can design more appropriate strategies for managing goods requirements and supplies, improving operational efficiency, and ensuring the availability of logistics that support optimal health services.

1.3 Objectives and Scope

An effective forecasting system plays a very important role in ensuring smooth operations and the achievement of organizational goals. A good forecasting system not only serves to

anticipate risks, but also enables organizations to respond to changes more quickly and accurately. The lack of accurate forecasting in the process of identifying needs is often the main source of operational inefficiency in organizations. This is typically caused by the unavailability of accurate data, insufficient analysis, or the absence of structured methods for determining actual needs. As a result, organizations may face various issues, such as procuring goods that do not align with actual needs—both in terms of quantity and quality—as well as excessive waste of resources in efforts to meet improperly defined needs.

Without effective forecasting methods, organizations often struggle to prioritize and allocate resources optimally. Procurement becomes inefficient, either due to insufficient quantities leading to stockouts, or excessive quantities resulting in waste and overstocking. This excess inventory not only drains the budget but also hinders operational efficiency, causes waste of storage space, and reduces overall productivity. Ineffective inventory management can harm organizations in the long term, both financially and in terms of operational performance.

The Single Exponential Smoothing method is one of the time series forecasting techniques used to estimate future values by assigning exponentially decreasing weights to historical data, where the most recent observations have the greatest influence on the prediction results. This method is particularly suitable for stationary data, i.e., data that does not exhibit clear trends or seasonal patterns. The main advantage of this method is its simplicity and its ability to respond quickly to changes in data without requiring complex calculations. The Single Exponential Smoothing method provides accurate forecasting results for daily consumer goods sales data that tends to be stable and does not have significant seasonal fluctuations (Putri & Nugroho, 2021). This method is suitable for short-term forecasting of relatively stable data, such as forecasting routine demand for generic drugs. According to (Makridakis et al., 1998), this method is effective for data that fluctuates around a constant mean value without any trends or seasonal patterns. When applied to data with trends, the forecasting results tend to lag behind the actual trends. Nevertheless, this method remains the primary choice in many practical cases due to its ease of implementation and its ability to respond quickly to changes in data (Ramdhan & Sari, 2021).

This study is an implementative study of the single exponential smoothing forecasting theory applied to office stationery in hospitals as the subject of research. This study will assess the accuracy of the single exponential smoothing method in a hospital environment, which is known for its unpredictable conditions. The final results of this study will present the accuracy of the single exponential smoothing method when applied in a hospital organization environment.

2. Literature Review

2.1 Related Work

The results of this systematic review are based on research at Sida Waras Farma Pharmacy and Simpang F Pharmacy; forecasting was carried out using the (Single exponential Smoothing) SES method, which resulted in highly accurate forecasting, namely a MAPE value of <10%. The MAPE value <10% is considered highly accurate forecasting because the lower the MAPE value produced, the less the forecasting error (Sari et al., 2023; Sesario et al., 2022). Sesario et al. (2022) conducted forecasting using the SES method with an alpha constant (α) of 0.1. At the same time, the forecasting conducted by Sari et al. (2023) used a constant alpha (α) of 0.22. The alpha constant value determined using a genetic algorithm (application) produces more accurate

forecasting results than conventionally set values (Falani, 2018). The alpha constant is used as a smoothing parameter value or reduces the burden of forecasting error. The provisions for an excellent constant value for forecasting are $0 < \alpha < 1$ (Hudaningsih et al., 2020). The magnitude of the alpha value generated for each drug item does not indicate the forecasting quality but instead reflects the analyzed data pattern. α values close to 1 are used for random data, while α values close to zero are used for more stable data. A higher α value is given to more recent data so that the appropriate α parameter value will provide an optimal forecast with the smallest error value (Fachrurrazi, 2015).

The effect of the SES method on the MAD value depends on the smoothing constant used. A smaller smoothing constant will give greater weight to the most recent data and make the forecast more responsive to recent changes in the data (Wiedyaningsih, 2024). This can lead to more significant fluctuations in the forecast and, in turn, increase the MAD value. If a larger smoothing constant is used, the weight given to the most recent data will be smaller, and the forecast will be smoother and less responsive to recent changes. This can reduce forecast fluctuations and result in a lower MAD value. The selection of an appropriate smoothing constant should be based on analysis of historical data and an understanding of the patterns and trends in the data. An optimal smoothing constant can result in a lower MAD value and more accurate forecasting, resulting in a small error value (Nu et al., 2024). The effect of the SES method on the MSE (Mean Squared Error) value is that the smaller the α value, the slower the method reacts to trends and fluctuations in historical data. Thus, if the α value is meager, the SES method gives almost equal weight to all historical data, which can lead to forecasting that is less responsive to actual changes in the data. If the α value is very high, the method will give a higher weight to the most recent data, so the forecast will react more quickly to trend changes or new fluctuations. However, using too high a value of α can also lead to instability in forecasting and overreaction to random fluctuations. Thus, if the resulting forecast is very close to the actual value, the MSE value will be lower, indicating better forecasting quality (Box et al., 2015)

Based on the results of the systematic review, the forecasting method that produces highly accurate forecasts is the Single Exponential Smoothing (SES) method (Wiedyaningsih, 2024). Planning drug needs in healthcare facilities can be done using the Single Exponential Smoothing forecasting method because, in this method, short-term forecasting is carried out with data properties that fluctuate near a fixed mean value without trends and seasonality (Yuniarti, 2021). The SES method is a procedure that continuously improves estimates by averaging the past values of data in a decreasing (exponential) manner. This forecasting method is suitable for forecasting things that have random (irregular) fluctuations. Thus, this SES method can help plan and manage drug in each health service facility to predict the amount of drugs needed in the future (Gustriansyah, 2017).

2.2 Research Gap

Figure 1 shows the instability between the receipt and expenditure of office supplies in the process of identifying needs in hospitals, which can disrupt operational smoothness and have a negative impact on service quality. This imbalance indicates that needs planning is not yet optimal, which can lead to inaccuracies in the procurement of necessary items. This has the potential to hinder administrative activities and medical services that depend on the smooth operation of the hospital.

The lack of accurate forecasting of general consumables in hospital management can disrupt operational smoothness and reduce service efficiency. Inaccurate predictions of general consumables can lead to supply shortages or excess stock that cannot be used. Waste resulting from the accumulation of unmanaged inventory increases operational costs, reduces budget utilization efficiency, and may hinder the allocation of funds to more priority medical sectors. The long-term impact of weak planning can affect patient satisfaction, damage the hospital's reputation, and threaten the overall sustainability of hospital operations.

The mismatch between inventory and demand in hospitals is often caused by a lack of coordination and data integration between departments (see figure 2). This situation leads to inaccurate data on requirements, making it difficult to make decisions on procurement and inventory management efficiently. To address this issue, it is necessary to implement accurate forecasting methods based on historical data to identify needs accurately, as well as support more planned and responsive logistics management.

In an effort to identify office stationery forecasting needs, an analysis was conducted based on product categories. This identification aims to understand usage patterns in more detail, accurately estimate future needs, and optimize the office stationery procurement process to support work efficiency and effectiveness in the hospital environment. This approach is expected to minimize the risk of shortages or excess inventory and improve the overall quality of logistics management.

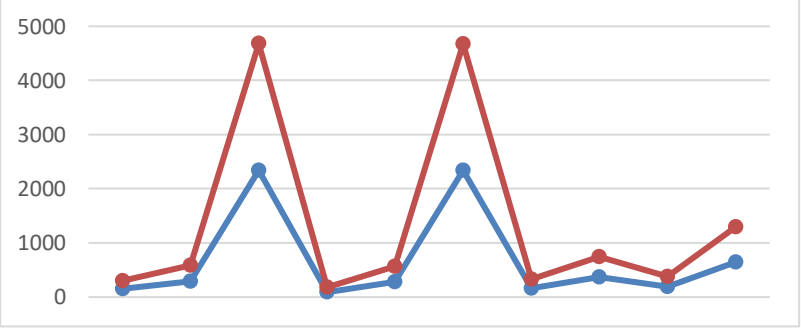

Fig 1. Instability between the receipt and expenditure of office supplies

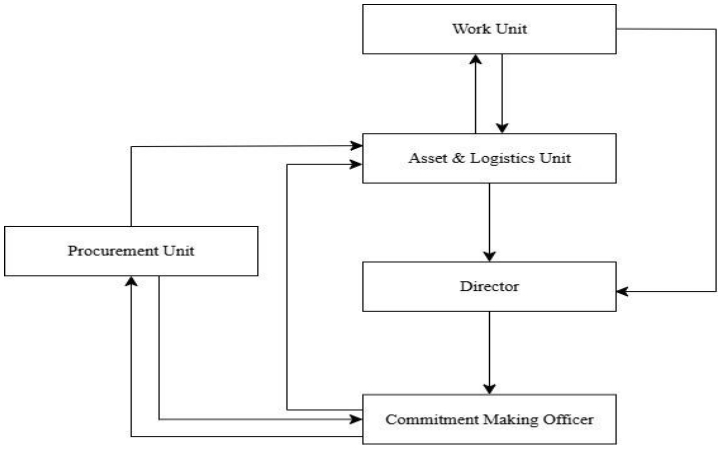

Fig 2. Procurement workflow in purchasing department

The Single Exponential Smoothing method was chosen because of its simplicity in forecasting drug usage patterns with mild to moderate fluctuations. The drugs used in this study are essential generic drugs with relatively stable demand, so the Single Exponential Smoothing method can provide sufficiently accurate predictions to support hospital procurement planning and inventory management.

In a case study at one hospital, the use of the Single Exponential Smoothing forecasting method was proven to be more accurate than the consumption method in predicting drug needs. The study results indicate that the application of the Single Exponential Smoothing method can reduce medication stock discrepancies by up to 20% compared to the consumption method, which is based solely on historical data without considering data trends. This finding suggests that the Single Exponential Smoothing method can help improve inventory management efficiency and minimize the risk of medication shortages or surpluses (Ardiansyah et al., 2019).

3. Methodology

3.1 Data Collection

This research is an implementative form of forecasting formulas, so the data required in this research is dominated by secondary data. Documentary data is used in this study, which consists of historical data and administrative records related to the use and procurement of office supplies, such as daily or monthly usage reports, stock levels, order history, and information related to office supply demand patterns. This data serves as the primary basis for applying the Single Exponential Smoothing method to forecast office supply needs and is used to strengthen the analysis results in this study.

Furthermore, the form of data documenter is used, among others, for internal agency documents, such as drug usage reports, procurement records, historical stock data, and monthly drug request summaries. This data serves as the basis for calculations in the application of the Single Exponential Smoothing method. Other data documentation includes scientific literature and references related to forecasting methods, particularly Single Exponential Smoothing, which are used to compare research analysis results with relevant theories and previous studies of a similar nature.

3.2 Analysis Techniques

This study uses the single exponential smoothing forecasting method as the basis for data analysis. Single Exponential Smoothing (SES) is a simple yet effective time series forecasting technique, in which historical data is treated by assigning exponentially decreasing weights to past observations. This means that the most recent data is given greater weight than previous data, allowing changes to be reflected more quickly in the forecast results (Aulia & Kurniawan, 2022).

The basic SES formula can be expressed as follows :

$$F_t + 1 = \alpha A_t + (1 - \alpha) F_t$$

Description :

$F_t + 1$ = Forecast value for the period $t + 1$
A_t = Actual value in period t
F_t = Forecast values for the previous period

A = Smoothing constant, with range $0 < \alpha < 1$

The smoothing constant (α) value is determined manually or using a trial and error approach in the range of $0 < \alpha < 10$. This alpha value will affect the sensitivity of the forecast to historical data. Several alpha values will be tried to see which one produces the best accuracy.

This method requires a smoothing constant (α) as the main parameter. The selection of the appropriate α value greatly affects the accuracy of the forecast results, because a larger α weight will make the forecast more responsive to changes in the latest data. Typically, the value of α is determined through a trial-and-error process by comparing prediction error metrics such as Mean Absolute Deviation (MAD) or Mean Squared Error (MSE) within a range of 0.1 to 0.9.To evaluate the accuracy level of the forecasting method used, this study applied three types of forecasting error measures, namely Mean Absolute Deviation (MAD), Mean Squared Error (MSE), and Mean Percentage Error (MPE). These three indicators aim to measure the extent to which the forecast results are close to the actual data (Makridakis et al., 1997).

MAD is the average measure of the absolute difference between the actual value and the forecast value. MAD is used to see the magnitude of the forecast error without regard to the direction of the error (positive or negative). The smaller the MAD value, the more accurate the forecast (Hyndman & Athanasopoulos, 2021). The use of MAD has advantages because it is easier to interpret and is not too sensitive to extreme values (outliers). Therefore, MAD is often used as a basic measure in evaluating the performance of forecasting models.

$$MAD = (1/n) \sum |At - Ft|$$

Description :
At = Actual value in period t
Ft = Forecast value in period t
N = Jumlah periode pengamatan

MSE is a measure of forecasting error obtained from the average square difference between actual values and forecast values. MSE places greater emphasis on large errors due to the use of squares in its calculation (Chai & Draxler, 2014). MSE is often used in statistical analysis and machine learning because it clearly shows the impact of large forecasting errors. The smaller the MSE value, the better the accuracy of the forecasting model used.

$$MSE = (1/n) \sum (At - Ft)^2$$

Mean Absolute Percentage Error (MAPE) measures error in percentage form by calculating the average of the absolute percentage difference between the actual value and the forecast result. MAPE is widely used because it is easier to understand in practical terms in percentage form (Makridakis et al., 1998). The weakness of MAPE is that it cannot be used when the actual value is zero, and it can become very large when the actual value is very small. In evaluating the accuracy of forecasting methods, the MAPE classification guidelines proposed by Lewis (1982) can be used as a reference. This classification provides an objective benchmark for assessing the level of error relative to actual data. Therefore, a MAPE value in

the range of 30–40% is still tolerable in the context of pharmaceutical inventory management, particularly in hospitals facing demand uncertainty.

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

3.3 Validation

Since this study uses a formula to answer the phenomenon, the validation used is document validation. This document validation is proven by directly requesting data on the availability of office stationery used in the year the study was conducted. The implementing unit is procurement, which is capable of providing up-to-date and validated data on the needs for office supplies used. Additionally, the use of log history data also supports the validity of the data collected, thereby making the data presentation more comprehensive.

4. Results and Discussion

4.1 Key Findings

Based on the data presented in Table 1 and the SES formula, the calculations for the 10 office stationery items that were the subject of this study are described in the following table. It is important to note that in this study, the value $\alpha = 30$ was used because office stationery items do not require a high level of accuracy. Therefore, any discrepancies between the forecast results and actual usage will not cause fatal consequences in service processes or endanger patients.

This calculation will attempt to forecast office stationery requirements for the fourth quarter by combining actual usage data from the previous quarter. As a form of validation for the forecast results, the researcher has requested actual usage data for the fourth quarter from the procurement department as a comparison between the SES calculation and the consumption patterns typically used by the hospital. It is hoped that this figure will serve as a comparison of the feasibility of using SES in a hospital environment, particularly for office supply usage.

Table 2. Results of Forecasting for Folio Books 100

Consumption Periode	Actual A_t	Smoothed Value S_t	Forecast F_t	Absolute Error $A_t - F_t$	Squared Error $(A_t - F_t)^2$	Percent Error $\frac{A_t - F_t}{A_t}$
2024						
1st Quarter	47	47	–	–	–	–
2nd Quarter	50	47,90	47	3,00	9,00	6,00%
3rd Quarter	54	49,73	47,90	6,10	37,21	11,30%
2024						
4th Quarter			49,73	–	–	–
				MAD 4,55	MSE 23,11	MAPE 8,65%
Real consumption				91		
Alfa error (%)				45,35		

Source : Data processing results, 2025

Based on the data in Table 2 above, it can be concluded that the MAPE value of the forecast results for the fourth quarter is 8.65%, which indicates that SES is capable of providing prediction values that are close to accurate (<10%). However, on the other hand, the alpha error value shows a figure of 45.35%, which means that the actual use of this item is higher

than the forecast value. This may be due to fluctuations in variables that cannot be continuously predicted, as the demand for the item can surge at any time. Nevertheless, the SES calculation has proven its reliability in calculating the accuracy of demand forecasts for the current quarter.

Table 3. Results of Forecasting for Quarto Books 100

Consumption Periode	Actual A_t	Smoothed Value S_t	Forecast F_t	Absolute Error $A_t - F_t$	Squared Error $(A_t - F_t)^2$	Percent Error $\frac{A_t - F_t}{A_t}$
2024						
1st Quarter	76	76	–	–	–	–
2nd Quarter	86	79	76	10	100	11,63%
3rd Quarter	79	79	79	0	0	0%
2024						
4th Quarter			79	–	–	–
				MAD 5	MSE 50	MAPE 5,82%
Real consumption				161		
Alfa error (%)				50,93		

Source : Data processing results, 2025

Based on the data in Table 3 above, it can be concluded that the MAPE value of the forecast results for the fourth quarter is 5.82%, which indicates that SES is capable of providing prediction values that are close to accurate (<10%). However, on the other hand, the alpha error value shows a figure of 50.93%, which means that the actual use of this item is higher than the forecast value. This may be due to fluctuations in variables that cannot be continuously predicted, as the demand for the item can surge at any time. Nevertheless, the SES calculation has proven its reliability in calculating the accuracy of demand forecasts for the current quarter.

Table 4. Results of Forecasting for black pen

Consumption Periode	Actual A_t	Smoothed Value S_t	Forecast F_t	Absolute Error $A_t - F_t$	Squared Error $(A_t - F_t)^2$	Percent Error $\frac{A_t - F_t}{A_t}$
2024						
1st Quarter	492	492	–	–	–	–
2nd Quarter	648	538,80	492	156	24.336	24,07%
3rd Quarter	641	569,46	538,80	102,20	10.443,84	15,94%
2024						
4th Quarter			569,46	–	–	–
				MAD 129,1	MSE 17.389,92	MAPE 20%
Real consumption				1449		
Alfa error (%)				60,69		

Source : Data processing results, 2025

Based on the data in Table 4 above, it can be concluded that the MAPE value of the forecast results for the fourth quarter is 20%, which indicates that SES is unable to provide accurate predictions (<10%). However, on the other hand, the alpha error value shows a figure of 60.69%, which means that the actual use of this item is higher than the forecast value. This may be due to fluctuations in variables that cannot be continuously predicted, as the demand for the item can surge at any time. Nevertheless, the SES calculation has proven its reliability

in calculating the accuracy of demand forecasts for the current quarter.

Table 5. Results of Forecasting for document keeper

Consumption Periode	Actual A_t	Smoothed Value S_t	Forecast F_t	Absolute Error $A_t - F_t$	Squared Error $(A_t - F_t)^2$	Percent Error $\frac{A_t - F_t}{A_t}$
2024						
1st Quarter	31	31	–	–	–	–
2nd Quarter	33	31,60	31	2,00	4,00	6,06%
3rd Quarter	30	31,12	31,60	1,60	2,56	5,33%
2024						
4th Quarter			31,12	–	–	–
				MAD 1,80	MSE 3,28	MAPE 5,7%
Real consumption				67		
Alfa error (%)				53,55		

Source : Data processing results, 2025

Based on the data in Table 5 above, it can be concluded that the MAPE value of the forecast results for the fourth quarter is 5.7%, which indicates that SES is capable of providing prediction values that are close to accurate (<10%). However, on the other hand, the alpha error value shows a figure of 53.55%, which means that the actual use of this item is higher than the forecast value. This may be due to fluctuations in variables that cannot be continuously predicted, as the demand for the item can surge at any time. Nevertheless, the SES calculation has proven its reliability in calculating the accuracy of demand forecasts for the current quarter.

Table 6. Results of Forecasting for translucent tape 5 cm

Consumption Periode	Actual A_t	Smoothed Value S_t	Forecast F_t	Absolute Error $A_t - F_t$	Squared Error $(A_t - F_t)^2$	Percent Error $\frac{A_t - F_t}{A_t}$
2024						
1st Quarter	78		–	–	–	–
2nd Quarter	71	75,90	78	7	49	9,86%
3rd Quarter	109	85,83	75,90	33,10	1095,61	30,37%
2024						
4th Quarter			85,83	–	–	–
				MAD 20,05	MSE 572,31	MAPE 20,12%
Real consumption				159		
Alfa error (%)				46,01		

Source : Data processing results, 2025

Based on the data in Table 6 above, it can be concluded that the MAPE value of the forecast results for the fourth quarter is 20.12%, which indicates that SES is unable to provide accurate predictions (<10%). However, on the other hand, the alpha error value shows a figure of 46.01%, which means that the actual use of this item is higher than the forecast value. This may be due to fluctuations in variables that cannot be continuously predicted, as the demand for the item can surge at any time. Nevertheless, the SES calculation has proven its reliability in calculating the accuracy of demand forecasts for the current quarter.

Table 7. Results of Forecasting for F4 Paper 60 Gr

Consumption Periode	Actual A_t	Smoothed Value S_t	Forecast F_t	Absolute Error $A_t - F_t$	Squared Error $(A_t - F_t)^2$	Percent Error $\frac{A_t - F_t}{A_t}$
2024						
1st Quarter	673	673	–	–	–	–
2nd Quarter	702	681,7	673	29	841	4,13%
3rd Quarter	729	695,89	681,7	47,3	2237,29	6,49%
2024						
4th Quarter			695,89	–	–	–
				MAD 38,15	MSE 1539,15	MAPE 5,31%
Real consumption				462		
Alfa error (%)				-50,62		

Source : Data processing results, 2025

Based on the data in Table 7 above, it can be concluded that the MAPE value of the forecast results for the fourth quarter is 5.31%, which indicates that SES is capable of providing prediction values that are close to accurate (<10%). However, on the other hand, the alpha error value shows a figure of -50.62%, which means that the actual use of this item is lower than the forecast value. This may be due to the unpredictable fluctuations of the variable, as the demand for the item can change at any time. Nevertheless, the SES calculation has proven its reliability in calculating the accuracy of demand forecasts for the current quarter.

Table 8. Results of Forecasting for F4 Paper 70 Gr

Consumption Periode	Actual A_t	Smoothed Value S_t	Forecast F_t	Absolute Error $A_t - F_t$	Squared Error $(A_t - F_t)^2$	Percent Error $\frac{A_t - F_t}{A_t}$
2024						
1st Quarter	36	36	–	–	–	–
2nd Quarter	56	42,0	36	20	400	35,71%
3rd Quarter	51	44,7	42,0	9	81	17,65%
2024						
4th Quarter			44,7	–	–	–
				MAD 14,5	MSE 340,5	MAPE 26,68%
Real consumption				55		
Alfa error (%)				18,72		

Source : Data processing results, 2025

Based on the data in Table 8 above, it can be concluded that the MAPE value of the forecast results for the fourth quarter is 26.68%, which indicates that SES is unable to provide accurate predictions (<10%). However, on the other hand, the alpha error value shows a figure of 18.72%, which means that the actual use of this item is higher than the forecast value. This may be due to fluctuations in variables that cannot be continuously predicted, as the demand for the item can surge at any time. Nevertheless, the SES calculation has proven its reliability in calculating the accuracy of demand forecasts for the current quarter.

Table 9. Results of Forecasting for large clip

Consumption Periode	Actual A_t	Smoothed Value S_t	Forecast F_t	Absolute Error $A_t - F_t$	Squared Error $(A_t - F_t)^2$	Percent Error $\frac{A_t - F_t}{A_t}$
2024						
1st Quarter	103	103	–	–	–	–
2nd Quarter	125	109,60	103	22	484	17,60%
3rd Quarter	111	110,02	109,60	1,40	1,96	1,26%
2024						
4th Quarter			110,02	–	–	–
				MAD 11,70	MSE 242,98	MAPE 9,43%
Real consumption				204		
Alfa error (%)				45,08		

Source : Data processing results, 2025

Based on the data in Table 9 above, it can be concluded that the MAPE value of the forecast results for the fourth quarter is 9.43%, which indicates that SES is capable of providing accurate predictions (<10%). However, on the other hand, the alpha error value shows a figure of 45.08%, which means that the actual use of this item is higher than the forecast value. This may be due to fluctuations in variables that cannot be continuously predicted, as the demand for the item can surge at any time. Nevertheless, the SES calculation has proven its reliability in calculating the accuracy of demand forecasts for the current quarter.

Table 10. Results of Forecasting for board marker

Consumption Periode	Actual A_t	Smoothed Value S_t	Forecast F_t	Absolute Error $A_t - F_t$	Squared Error $(A_t - F_t)^2$	Percent Error $\frac{A_t - F_t}{A_t}$
2024						
1st Quarter	61	61	–	–	–	–
2nd Quarter	60	60,70	61,00	1,00	1,00	1,67%
3rd Quarter	72	64,59	60,70	11,30	127,69	15,69%
2024						
4th Quarter			64,59	–	–	–
				MAD 6,15	MSE 64,35	MAPE 8,68%
Real consumption				114		
Alfa error (%)				43,34		

Source : Data processing results, 2025

Based on the data in Table 10 above, it can be concluded that the MAPE value of the forecast results for the fourth quarter is 8.68%, which indicates that SES is capable of providing accurate predictions (<10%). However, on the other hand, the alpha error value shows a figure of 43.34%, which means that the actual use of this item is higher than the forecast value. This may be due to fluctuations in variables that cannot be continuously predicted, as the demand for the item can surge at any time. Nevertheless, the SES calculation has proven its reliability in calculating the accuracy of demand forecasts for the current quarter.

Table 11. Results of Forecasting for permanent board marker

Consumption Periode	Actual A_t	Smoothed Value S_t	Forecast F_t	Absolute Error $A_t - F_t$	Squared Error $(A_t - F_t)^2$	Percent Error $\frac{A_t - F_t}{A_t}$
2024						
1st Quarter	204		–	–	–	–
2nd Quarter	151	188,10	204	53	2809	35,10%
3rd Quarter	217	196,77	188,10	28,90	835,21	13,32%
2024						
4th Quarter			196,77	–	–	–
				MAD 40,95	MSE 1822,11	MAPE 24,21%
Real consumption				292		
Alfa error (%)				32,61		

Source : Data processing results, 2025

Based on the data in Table 11 above, it can be concluded that the MAPE value of the forecast results for the fourth quarter is 24.21%, which indicates that SES is unable to provide accurate predictions (<10%). However, on the other hand, the alpha error value shows a figure of 32.61%, which means that the actual use of this item is higher than the forecast value. This may be due to fluctuations in variables that cannot be continuously predicted, as the demand for the item can surge at any time. Nevertheless, the SES calculation has proven its reliability in calculating the accuracy of demand forecasts for the current quarter.

4.2 Interpretation of Results

Based on the results of forecasting using the Single Exponential Smoothing method in the previous table, the following is a summary of the forecast results for each office stationery procurement.

Table12 Results of forecasting office stationery needs using the exponential smoothing

No.	List of Office Stationaries	*Forecast*	MAD	MSE	MAPE
1.	Folio book 100 (pcs)	49,73	4,55	23,11	8,65%
2.	Quarto book 100 (pcs)	79	5	50	5,82%
3.	Black pen (pcs)	569,46	129,1	17.389,92	20%
4.	Document keeper (pcs)	31,12	1,80	3,28	5,70%
5.	Translucent tape 5cm (rol)	85,83	20,05	572,31	20,12%
6	Paper F4 60 gr (rim)	695,89	38,15	1539,15	5,31%
7	Paper F4 70 gr (rim)	44,7	14,5	240,5	26,68%
8	Large clip no.5 (pack)	110,02	11,70	242,98	9,43%
9	Board Marker (pcs)	64,59	6,15	64,35	8,68%
10	Permanent Marker (pcs)	196,77	40,95	1822,11	24,21%

Source : Data processing results, 2025

Based on the results presented in Table 12, it is known that the Single Exponential Smoothing method has been applied to forecast the demand for eleven types of office stationery. Model performance evaluation was carried out using three error measures, namely Mean Absolute Deviation (MAD), Mean Squared Error (MSE), and Mean Absolute Percentage Error (MAPE).

In general, the forecasting results indicate that this method is quite effective in generating estimates of stationery requirements, particularly for items with relatively stable demand patterns. This is evidenced by the low MAPE values for several items, such as F4 60g paper (5.31%), Document keeper (5.70%), Quarto 100 book (5.82%), Folio 100 book (8.65%), and

Board marker (8.68%). A MAPE value below 10% indicates that the error rate is relatively small, so the forecasting results can be categorized as highly accurate. Conversely, there are several items that show a fairly high MAPE value, above 20%, including F4 70g paper (26.68%), permanent markers (24.21%), clear tape 5 cm (20.12%), and black ballpoint pens (20%). The high MAPE values for these items indicate that the forecasting model is unable to accurately capture demand patterns. This is due to high demand fluctuations and changes in consumption patterns.

Based on the classification (Lewis, 1982), MAPE values between 20% and 50% are considered reasonably accurate, especially when applied to data with high variability or fluctuating patterns, such as seasonal demand data, sales data affected by sudden trends, or medical data with irregular usage patterns. In this context, although the relative error rate is not considered low, the forecasting model is still deemed suitable for providing a general overview of historical data trends.

From these findings, it can be concluded that the Single Exponential Smoothing method works optimally on data that has no trend and is stationary. To improve accuracy for items with more dynamic demand patterns, it is recommended to explore alternative forecasting methods, such as Holt's Linear Trend Method for data containing trends, or Winter's Method for seasonal data. Additionally, the smoothing parameter settings (alpha value) also need to be further considered so that the model can adapt to changes in demand patterns.

5. Discussion

Interpret and analyze the implications of your findings in a broader context. Compare with previous studies and consider any limitations.

5.1 Comparison with Prior Research

Hospital planning involves various critical aspects, including resource management, facility management, and cost management. Forecasting patient numbers is integral to effective health service management as it enables hospitals to manage resources more efficiently and aids hospital administrators in making informed decisions (Larabi-Marie-Sainte et al., 2022). Exponential smoothing, a time series forecasting method that uses past data to predict future events, has been shown to be effective for data with random fluctuations without trends or seasonality (Favorov et al., 2012). For instance, research by Rachman et al. (2024) demonstrated that the single exponential smoothing method effectively forecasted cataract patient visits at Undaan Eye Hospital Surabaya, Indonesia, which had fluctuations without discernible trends. Similarly, Rahayu (2022) highlighted the utility of this method in predicting malaria cases, emphasizing its adaptability and ease of application for health centers.

Another study conducted by Pasengoran (2024) found that the application of the Single Exponential Smoothing method in a goods usage prediction system can minimize errors in goods overstocking and understocking based on goods usage prediction calculations. When the prediction process approaches accurate values, the goods stock provided by the company will be more precise and in line with demand. Furthermore, Pasengoran mentions in his research that to determine the stock of goods that will be used within one year using historical data or previous data, one can use the Single Exponential Smoothing forecasting method, taking into account the available data.

This study provides results consistent with several of the above studies. The MAPE value in this study has a small prediction figure (<10%), which provides accurate information that the prediction results are feasible for use and representative of previous usage results.

5.2 Limitations

The results of these forecasts cannot be generalized to other hospital units or subjects. These results are only valid for the hospitals in this study, and the results are only valid for the current year.

5.3 Future Research

Further research is needed in the same field and area, but with different forecasting analysis units tailored to the needs of the organization. Justification of the α level is necessary because this value will affect the sensitivity of the forecasting results. It is recommended that the maximum α used is 0.3 (30%), which is a reasonable figure for forecasting office stationery requirements.

6. Conclusion

The author observes that the forecasting system for general consumables, particularly office stationery, is still not optimal. The forecasting process to date has only relied on adding 20% to the previous year's demand without being based on accurate scientific methods. As a result, there is often a mismatch between the quantity of goods received and dispensed, which impacts operational inefficiency, whether in the form of stockouts or excess unused goods (overstock).

After conducting an analysis, the author proposes the application of the single exponential smoothing method. It was found that the historical data-based forecasting approach is able to provide more accurate and adaptive results to fluctuating demand patterns. This method also allows the procurement department to determine the estimated needs for each category of office stationery by considering the forecast value with the mean absolute deviation value, so that procurement can be carried out more accurately and efficiently.

7. Recommendation

It is recommended that the Goods and Services Procurement Unit begin adopting more scientific and historical data-based forecasting methods, such as single exponential smoothing, in determining requirements.

It is necessary to conduct training for procurement staff on the basics of inventory management and forecasting techniques. With a better understanding, staff can apply appropriate forecasting methods and conduct regular evaluations of the effectiveness of the methods used.

It is recommended to conduct regular evaluations of procurement procedures and policies to ensure their suitability to actual needs and the effectiveness of the forecasting methods used. These evaluations can also serve as a basis for continuous improvement in hospital procurement systems.

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