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SINGLE EXPONENTIAL SMOOTHING IN FORECASTING TOOLS AND MEDICINE STOCKS

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Abstract

Problems that arise when acquiring equipment and pharmaceuticals include procurement delays caused by waiting for genuine data from the storage area, as well as surplus stock of various types of drugs. This is due to the fact that administrative documents are still kept in the traditional manner. In this article, we provide forecasting tool and medicine stock based on the demand ratio in order to overcome stock delays and surplus stock. Because of the needs (in the month of forecasting carried out and the amount of data held), single exponential smoothing with alpha 0.1 is utilized. The prediction findings are also considered accurate because the forecasting smoothing computation with an average error value of MAD (21,4), MSE (710,4), and MAPE (7%) was assessed as very good.

Keywords: Single Exponential Smoothing, Forecasting, Tools and Medicines Stocks

1. INTRODUCTION

A smart stock management procedure takes media recording variables and stock calculation approaches into account. Numerous businesses have adopted a computerized system to make it simpler to keep track of incoming and outgoing items, as well as the difference between goods and the estimation of future purchases[1]. Have not utilized forecasting methods to determine the disparity between products to be acquired in the following quarter. At the Sida Waras Farma pharmacy, tools and regular medicine stocks are planned and procured [2], but there are still problems in locating information on stock items to be allocated to pharmacies and information that will be utilized to make judgments on the number of sluggish stock procurements.

Some of the issues at the Sida Waras Farma pharmacy are a result of the recording method employed, which entails counting each month's stock requests for medical devices and pharmaceuticals individually. The quantity of instruments and medications on hand is used to estimate the number of requests for the following month. Therefore, based on the data, it is possible to assess how much the procurement of instruments and pharmaceuticals may cost. The procurement process is highly reliant on the recapitulation of the amount of availability; consequently, there is frequently a misinterpretation of the difference in items, leading to inaccuracies in the number of under-stocked and over-stocked procurements.

Based on several earlier studies that use the Single Exponential Smoothing Method in various fields, particularly sales [3][4], this method has a smoothing technique as applied in research [5][6]. The research objective is based on the fundamental issue in the supply of medical devices and drugs. which can forecast stock prices as well as sales profits[7][8]. As a result, we use the Single Exponential Smoothing approach in this article to forecast the sales of pharmaceuticals and medical devices [9] at Sida Waras Farma pharmacies. This method, which is basic and straightforward to use and competitive with more complex forecasting models [11], is extremely effective in forecasting seasonal patterns of data with contemporaneous trend aspects [10]. Additionally, by performing a

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smoothing process and generating forecast data with a lower error value, the exponential smoothing process is utilized to anticipate the future[12][13].

2. METHOD

2.1 Forecasting

Forecasting is a crucial decision-making factor. The precision of the prediction is dependent on the target and other variables. However, this does not imply that the forecast is unimportant[14].. Forecasting is widely used and aids management in numerous ways for forecasting purposes, including short-, medium-, and long-term planning, monitoring, and decision support[15].

2.2 Single Exponential Smoothing

Exponential smoothing is an advanced yet simple weighted moving average forecasting approach. This method is rarely used to record historical data. This model is based on the assumption that the data swings around a constant mean and does not follow a pattern or trend. Simple exponential smoothing can be used to forecast phenomena that change randomly[16].

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

Information :

F_{t+1} = Forecast for time period t+1
X_t = Real value for period t
α = Smoothing constant weight
F_{t-1} denotes the forecast for period t-1.

Calculating the Value of the Alpha Constant (α)

It is important to choose an appropriate value for the alpha constant () in order to calculate the Single Exponential Smoothing method's minimum error value [17] when making a forecast. The accuracy of a forecast increases as the margin of error decreases.

$$\alpha = 2/(n+1) \quad (2)$$

There:

α = Constant Alpha
n = Total amount of time

The difference between the query results and the actual query is used to calculate the accuracy of the forecast results. Several methods have been used to demonstrate the inaccuracies produced by various forecasting techniques. The majority of these metrics employ the average of a function of the difference between the true and anticipated values. The residual is the discrepancy between the actual and projected values. The following formula is used to calculate the original error or residual value for each prediction period[18]:

$$e_t = X_t - S_t \quad (3)$$

Keterangan :
e_t = forecasting error in period t
X_t = period t data
S_t = forecasting data in period t

Some of the calculations usually used to compute the total forecast inaccuracy. This calculation can be used to evaluate different forecasting models as well as to monitor forecasts to ensure that they are operating correctly. The following are three well-known predicting error calculations[18][19]:

Mean Absolute Deviation (MAD)

This value is computed by summing the absolute values of each forecasting inaccuracy and dividing by the number of data periods (n):

$$MAD = \frac{\sum_{t-1}^{n} |Xt - Ft|}{n} \quad \sum_{t-1}^{n} |Yt - Ft| \quad (4)$$

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There:

Xt = actual data period t
Ft = forecast value for period t
n = number of data points

Mean Squared Error **(MSE)**

This measures overall forecasting inaccuracy. MSE is the average difference between anticipated and observed squares. Formula:

$$MSE = \sum_{t-1}^{n} \frac{(Xt-Ft)^2}{n} \quad (5)$$

Mean Absolute Percentage Error (MAPE) is computed by dividing absolute error by observed value. Average the error percentage. MAPE measures the variance between actual and forecasted data. MAPE is determined if n periods have forecasted and actual values.

Mean Absolute Percent Error **(MAPE)**

Mean Absolute Percentage Error (MAPE) is computed by dividing absolute error by observed value. Average the error percentage. MAPE measures the variance between actual and forecasted data. MAPE is determined if n periods have forecasted and actual values.

$$MAPE = \left(\frac{100\%}{n}\right) \sum_{t-1}^{n} \frac{(Xt-Ft)^2}{n} \quad (6)$$

3. RESULTS AND DISCUSSION

3.1 Data Analysis

As example data for forecasting computations, this study analyzes data on pill demand from Sida Waras Farma pharmacies from September 2021 to August 2022. Calculations will be conducted based on this data to predict the amount of stock that will be held for the next month.

Table 1. The Total Number Of Requests

Month	*Period*	*Number of Request*
1	September	325
2	October	300
3	November	350
4	December	320
5	January	335
6	February	400
7	March	371
8	April	333
9	May	350
10	June	320
11	July	400
12	August	377

After doing the calculations, the alpha value, which is (= 0.1), is established.

3.2. Forecasting Calculation

to ascertain the data's inaccuracy rate. The following is the demand pill stock forecasting data utilizing the alpha constant calculation (0.1).

Table 2. Calculation of Forecasting Error, Squared and Absolute

Month	*Period*	*Number of Request*	*Forecast*	*Error*	*Absolute*	*Squared*
1	September	325	325	0	0	0
2	October	300	338	-38	38	1444

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3	November	355	362	-7	7	49
4	December	337	356	-19	19	361
5	January	335	320	15	15	225
6	February	420	370	50	50	2500
7	March	361	351	10	10	100
8	April	362	331	31	31	961
9	May	365	365	0	0	0
10	June	320	334	-14	14	196
11	July	360	400	-40	40	1600
12	August	377	344	7	7	1089
	Next Month		365			
	Total		4561	21	257	8525

The percentage error of the forecasting data can be calculated by dividing the absolute value by the demand data.

Table 2. Forecasting Percentage Calculation

Month	*Period*	*Number of Request*	*Forecast*	*Error*	*Absolute*	*Squared*	*Percentage*
1	September	325	325	0	0	0	0%
2	Oktober	300	338	-38	38	1444	13%
3	November	355	362	-7	7	49	2%
4	Desember	337	356	-19	19	361	6%
5	Januari	335	320	15	15	225	4%
6	Februari	420	370	50	50	2500	12%
7	Maret	361	351	10	10	100	3%
8	April	362	331	31	31	961	9%
9	Mei	365	365	0	0	0	0%
10	Juni	320	334	-14	14	196	4%
11	Juli	360	400	-40	40	1600	11%
12	Agustus	377	344	7	7	1089	9%
		Next Month	365				
		Total	4561	21	257	8525	72%

Table 2 explains that the MAD, MSE, MAPE and Standar Error can be calculated by dividing the distribution of the average error by the total number of requests.

Table 3. Smoothing Forecast Calculation

Month	*Period*	*Number of Request*	*Forecast*	*Error*	*Absolute*	*Squared*	*Percentage*
1	September	325	325	0	0	0	0%
2	Oktober	300	338	-38	38	1444	13%
3	November	355	362	-7	7	49	2%
4	Desember	337	356	-19	19	361	6%
5	Januari	335	320	15	15	225	4%
6	Februari	420	370	50	50	2500	12%
7	Maret	361	351	10	10	100	3%
8	April	362	331	31	31	961	9%
9	Mei	365	365	0	0	0	0%
10	Juni	320	334	-14	14	196	4%
11	Juli	360	400	-40	40	1600	11%
12	Agustus	377	344	7	7	1089	9%
	Next Month		365				
	Total		4561	21	257	8525	72%
				2	21,4	710,4	7%

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	refraction	MAD	MSE	MAPE

Table 3 shows that the forecasting calculation's error rate can be regarded as accurate. because the data is the outcome of the alpha constant computation that has the smallest error rate. The outcomes of MAD and MSE are already accurate outcomes. It qualifies as a very good forecast because its MAPE value is less than 10%.

4. CONCLUSION

The Single Exponential Smoothing forecasting method has been used successfully in producing projections for tool and medicine stock. Based on the forecasting accuracy calculation findings, this technique is the most suited because it has a MAPE value of 7%. MAPE values less than 10% are considered very good since the lower the resulting MAPE value, the lower the number of forecasting errors made.

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