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IMPLEMENTATION OF SINGLE EXPONENTIAL SMOOTHING METHOD DEMAND FOR HERBAL MEDICINE TO DC RIA SARI ANGGRIANI

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Abstract: Distributor Center (DC) Ria Sari, one of the official herbal medicine agents from PT HPAI (Herba Penawar Alwahida Indonesia) company. Sales of herbal medicines at the Ria Sari Anggriani Distributor Center (DC) often experience instability. Where in the period March 2022 to May 2022 there was a significant increase in sales. This resulted in the Ria Sari Anggriani Distributor Center (DC) being unable to serve requests for available herbal medicines. So that it becomes an obstacle in the stock of herbal medicines that must be prepared. If there are too many drug stocks but the demand for herbal medicines is decreasing then this will result in a loss, conversely if the demand for medicines increases but the stock of herbal medicines cannot be prepared then this will be a loss for DC Ria Sari Anggriani. For this reason, it is necessary to do a forecasting/prediction technique, using the *Single Exponential Smoothing Method* . The purpose of the forecasting/prediction will be to assist in terms of the supply of herbal medicines in the following month's period. The results of testing this method were obtained in the period June 2023, requests for 167 herbal medicines, 178 Extra foods, 189 Etta Goat Milk, 91 Herbal Toothpastes, 74 products of Propolis Soap.

Keywords: herbal medicine; prediction; single exponential smoothing

Abstrak: Distributor Center (DC) Ria Sari salah satu agen resmi obat herbal dari perusahaan PT HPAI (Herba Penawar Alwahida Indonesia). Penjualan obat herbal pada Distributor Center (DC) Ria Sari Anggriani sering terjadi ketidak stabilan. Dimana pada periode Maret 2022 sampai dengan Mei 2023 terjadi kenaikan penjualan yang seknifikan. Ini mengakibatkan Distributor Center (DC) Ria Sari Anggriani tidak dapat melayani permintaan akan obat herbal yang tersedia. Sehingga menjadi kendala dalam stok obat herbal yang harus disiapkan. Jika stok obat terlalu banyak namun permintaan akan obat herbal menurun maka ini akan manjedi kerugian, sebaliknya jika permintaan akan obat meningkat namun stok obat herbal tidak dapat disiapkan maka ini menjadi kerugian bagi DC Ria Sari Anggriani. Untuk itu perlu dilakukan suatu teknik peramalan/prediksi, menggunakan Metode *Single Exponential Smoothing (SES)*. Tujuan dari peramalan/prediksi nantinya dapat membantu dalam hal penyediaan akan obat herbal pada periode bulan berikutnya. Hasil dari pengujian terhadap metode ini diperoleh pada periode Juni 2023, perminaan akan obat herbal 167 , Extrafood 178, Etta Goat Milk 189, Pasta Gigi Herbal 91, Sabun Propolis 74 produk. Hasil simpulan dari penelitian ini koefisien nilai alpha (α) mempengaruhi seberapa besar pengaruh data masa lalu terhadap peramalan masa depan.

Kata Kunci: obat herbal; prediksi; single exponential smoothing

INTRODUCTION

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Herbal medicines come from plants that are processed or extracted into powders, pills or liquids without the use of any chemicals. As is known, herbal medicine can cure diseases with minimal side effects because it is different from synthetic drugs, herbal medicines are made from natural ingredients which can cause side effects immediately and in the long term [1]. The practice of using herbal medicines is widespread in many countries in the world, especially in countries with biodiversity such as Indonesia which has great potential in the development of traditional medicines[2]. The use of herbal medicines as traditional medicines has been widely consumed by the public at this time, and obtaining these drugs is also not difficult.

Distributor Center (DC) Ria Sari Anggriani is one of the agents or distributors for selling herbal medicines from the company PT HPAI (Herba Penawar Alwahida Indonesia) having its address in Hamlet I Desa Subur, Kec. Joman Water. This business has been in business for about 5 years. The herbal medicine business products include synergy herbal oil, *extrafood* , etta *goat milk*, herbal toothpaste and propolis soap.

In the process of selling herbal medicines at DC Ria Sari Anggriani a problem arose, the results of the discussions that were carried out were the instability of sales of herbal medicinal products every month. From 2022 sales data In early March to May the demand for herbal medicines suddenly increased. This can result in a decrease in service quality so that DC Ria Sari Anggriani can lose the trust and loyalty of its customers. Due to limited drug stock, customers are forced to look for other stores that sell the same product. If this continues to happen, DC Ria Sari Anggriani's customers will continue to decrease over time. Then in another condition, the demand for herbal medicines is at a low point, but DC Ria Sari Anggriani has provided as much product stock as possible, so that the existing supplies will not be sold out. This can be a loss for DC Ria Sari Anggriani because herbal medicines also have an expiration date like other medicines, and if that happens, expired medicines cannot be resold. Not to mention the cost of maintaining and storing herbal medicines to keep them in good condition and fit for use .

For this reason, measurement is needed as a solution to predict herbal medicine stocks and help DC Ria Sari Anggriani to overcome problems in terms of maintaining stability of herbal medicine stocks using forecasting techniques. The purpose of this forecasting measurement is later to find out how far the level of accuracy generated by forecasting herbal medicine stocks is so that the accuracy of forecasting herbal medicine stocks is known in the next month.

One technique that can be used to predict a value or event in the future is forecasting using past data or information as a reference for planning and decision making [3]. Accurate forecasting is one of the essential elements for effective management. The purpose of forecasting is to reduce uncertainty and to provide *benchmarks* (benchmark) to monitor actual performance [4]. The goal of forecasting is to get predictions that can minimize forecast errors *which* are usually measured by *Mean Absolute Deviation* (MAD) and *Mean Squre Error* (MSE) [5].

The method used in the forecasting used in this study uses the *Single Exponential Smoothing* method . *Single exponential smoothing* method used be-

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cause the technique used to record past data is very small and assumes data that fluctuates or is not settled[6].

Forecast accuracy is something that is very important in forecasting because it measures the suitability of existing data with forecasting data. In this study, researchers performed calculations of predictive value determination by calculating the mean squared error value (Mean Squared Error (MSE), and the absolute percent *error*. average *(Mean Absolute Percentage Error (MAPE)*[7]. The purpose of this study is to find out how far the level of accuracy generated by forecasting on DC Ria Sari Anggriani's herbal medicine stock is known so that the accuracy of forecasting herbal medicine stocks in the next month is known based on past sales data.

Much research on forecasting have been carried out, among others. In Handokos research (2019) the single exponential smoothing method can be used to predict the number of new student admissions so that the predicted value can be known in the next period [8]. According to Nangi (2018), the results of his research are predictive applications of drug stock data in the pharmaceutical installations of RSUD Kab. MUA was successfully constructed by applying the triple exponential smoothing (TES) method [9]. According to Fahrunnisa (2021) in his research applying the Single Exponential Smoothing method was able to provide predictions of hypertension in the Rawang Panca Arga Health Center the following month[10]. In research Fachrurrazi (2015) also explained that by applying the Single Exponential Smoothing method it can be used to predict the amount of drug inventory, in predicting sales of the Ambeven drug in March 2015 there were 49 tablets, at the Bintang Geuruguk drug store[11]. Indah (2018) also explained in her research that SES is a single smoothing method with parameters alpha 0.2 and alpha 0.4, Single Exponential Smoothing makes comparisons in determining alpha to produce the smallest forecasting error and the minimum forecasting error that will be selected for look for forecasts for the next period [5].

METHOD

Methodology is a stage or theoretical framework intended to carry out research in certain ways to obtain truth. This research methodology applies quantitative research, namely an approach in research that uses data in the form of numbers or quantitative data to collect information, analyze phenomena, and look for patterns and relationships between the variables studied.

This approach focuses on collecting drug sales data through statistical methods and mathematical analysis to generate conclusions or generalizations. The stages in this study contain a research framework with several stages including problem identification, problem analysis, goal setting, literature study, what data is collected, data analysis, analysis of the SES and UMK methods, model design, system implementation, testing of results and results and discussion. The single exponential smoothing method uses the formula equation in equation (1):

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

Where:

Ft+1 = Forecast for period t+1
Xt = real value of t period

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α = Weight indicating smoothing constant ($0 < \alpha < 1$)
Ft-1 = Forecast for period t-1

Furthermore, to measure the level of error, it can be tested using MSE, the smaller the *Mean Squared Error* (MSE) value, the more accurate the prediction. The Mean Squared Error (MSE) calculation formula can use equation 2

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

Where:

MSE : Mean Squared Error
Xt : Actual value in period t
Ft : Forecasting value in period t
n : The amount of data

RESULTS AND DISCUSSION

The first step is to analyze the system. Historical data on demand for herbal medicines will be calculated using the *Single Exponential Smoothing* method to look for predictions of the number of requests for herbal medicines in the following period/month. Then the predicted value will be tested or the error value calculated using the *Mean Squared Error* (MSE) method. so that in the end the prediction value with the smallest error will be obtained. As for the data that will be used in this study, historical data on the number of requests for herbal medicines at DC Ria Sari Anggriani, from January 2022 to May 2023. The data on demand for herbal medicines can be seen in table 1.

Table 1. Herbal Medicine Demand Data in January 2022 - May 2023

No	Month	Types of Herbal Medicines				
		Synergy Herbal Oil	*Extrafood*	Etta Goat Milk	Herbal Toothpaste	Propolis Soap
1	January 2022	170	175	165	92	81
2	February 2022	175	180	178	99	83
3	March 2022	200	195	185	103	95
4	April 2022	195	225	200	111	93
5	May 2022	193	200	190	106	92
6	June 2022	180	180	175	97	86
7	July 2022	175	179	170	94	83
8	August 2022	170	170	180	100	81
9	September 2022	168	165	170	94	80
10	October 2022	170	178	173	96	81
11	November 2022	165	170	170	94	79
12	December 202 2	162	180	175	97	77
13	January 2023	160	179	180	96	80
14	February 2023	165	173	186	100	75
15	March 2023	170	175	185	95	73
16	April 2023	167	180	189	93	70
17	May 2023	168	185	190	90	75

Source: DC Ria Sari Anggriani (2023)

System analysis

Based on historical data on demand for herbal medicines from January 2022 to May 2023, researchers will look

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for predictions of demand for herbal medicines in the upcoming June 2023 period. The predicted value will be searched using the *Single Exponential Smoothing method* with an alpha value of 0.1 to 0.9. Then because the value of a prediction still contains errors. Then the error value will be searched using the *Mean Squared Error method* for each alpha value.

Synergy Herbal Oil Demand Forecasting

In the calculation of synergy herbal oil forecasting the alpha value used is 0.9 for the number of requests data because of all the alpha values that have been calculated that the value α = 0.9 has a small *error* .

Table 2. Synergy Herbal Oil Demand Forecasting Analysis

No	Period	(xt)	(ft)
1	Jan 2022	170	
2	Feb 2022	175	170.00
3	March 2022	200	174.50
4	April 2022	195	197.45
5	May 2022	193	195.25
6	June 2022	180	193.22
7	Jul2022	175	181.32
8	August 2022	170	175.63
9	Sept 2022	168	170.56
10	Oct 2022	170	168.26
11	Nov 2022	165	169.83
12	Dec 2022	162	165.48
13	Jan 2023	160	162.35
14	Feb2023	165	160.23
15	Mar2023	170	164.52
16	Apr 2023	167	169.45
17	May 2023	168	167.25
18	June 2023	-	167.92

$Ft_{+18} = \alpha Y_{17} + (1-\alpha) F_{17}$
$= (0.9*168)+(1-0.9)167.25$
$= 151.2+16.725$
$= 167.925$

Demand Forecasting Extrafood

Extrafood forecasting calculation the alpha value used is 0.1 for the number of requests data because of all the alpha values that have been calculated that the value α = 0, 1 has a small *error* .

Table 3. Extrafood Demand Forecasting Analysis

No	Period	(xt)	(ft)
1	January 2022	175	
2	February 2022	180	175.00
3	March 2022	195	175.50
4	April 2022	225	177.45
5	May 2022	200	182.21
6	June 2022	180	183.98
7	July 2022	179	183.59
8	August 2022	170	183.13
9	September 2022	165	181.81
10	October 2022	178	180.13
11	November 2022	170	179.92
12	December 2022	180	178.93
13	January 2023	179	179.04
14	February 2023	173	179.03
15	March 2023	175	178.43
16	April 2023	180	178.09
17	May 2023	185	178.28
18	June 2023	-	178,949

$Ft_{+18} = \alpha Y_{17} + (1-\alpha) F_{17}$
$= (0.1*185)+(1-0.1)178.28$
$= 18.5+160.452$
$= 178.95$

Etta Goat Milk Demand Forecasting

Etta Goat Milk forecasting calculation the alpha value used is 0.9 for the number of requests data because of all the alpha values that have been calculated that the value α = 0.9 has a small *error* .

$F_{t+18} = \alpha Y_{17} + (1-\alpha) F_{17}$
$= (0.9*190)+(1-0.9)188.60$
$= 171+18.86$
$= 189.86$

Table 4. Etta Goat Milk Demand Forecasting

No	**Period**	**(xt)**	**(ft)**
1	Jan 2022	165	
2	Feb 2022	178	165.00

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3	March 2022	185	176.70
4	April 2022	200	184.17
5	May 2022	190	198.42
6	June 2022	175	190.84
7	July 2022	170	176.58
8	Aug 2022	180	170.66
9	Sept 2022	170	179.07
10	Oct 2022	173	170.91
11	Nov2022	170	172.79
12	Dec 2022	175	170.28
13	Jan 2022	180	174.53
14	Feb2022	186	179.45
15	March 2022	185	185.35
16	April 2022	189	185.03
17	May 2022	190	188.60
18	June 2023	-	189.86

Forecasting Herbal Toothpaste Demand

In the forecasting calculation of Herbal Toothpaste the alpha value used is 0.6 for the number of requests data because of all the alpha values that have been calculated that the value α = 0.6 has a small *error* .

Table 5. Herbal Toothpaste Demand Forecasting

No	Period	(xt)	(ft)
1	January 2022	92	
2	February 2022	99	92.00
3	March 2022	103	96.20
4	April 2022	111	100.28
5	May 2022	106	106.71
6	June 2022	97	106.28
7	July 2022	94	100.71
8	August 2022	100	96.69
9	September 2022	94	98.67
10	October 2022	96	95.87
11	November 2022	94	95.95
12	December 2022	97	94.78
13	January 2022	96	96.11
14	February 2022	100	96.04
15	March 2022	95	98.42
16	April 2022	93	96.37
17	May 2022	90	94.35
13	January 2023	-	91.74

$F_{t+18} = \alpha Y_{17} + (1-\alpha) F_{17}$
$= (0.6*90)+(1-0.6)94.35$
$= 54+37.74$
$= 91.74$

Forecasting the Demand for Propolis Soap

In forecasting calculations for Propolis Soap the alpha value used is 0.9 for the number of requests data because of all the alpha values that have been calculated that the value α = 0.9 has a small *error* .

Table 6. of Analysis Forecasting Demand for Propolis Soap

No	Period	(xt)	(ft)
1	January 2022	81	
2	February 2022	83	81.00
3	March 2022	95	82.80
4	April 2022	93	93.78
5	May 2022	92	93.08
6	June 2022	86	92.11
7	July 2022	83	86.61
8	August 2022	81	83.36
9	September 2022	80	81.24
10	October 2022	81	80.12
11	November 2022	79	80.91
12	December 2022	77	79.19
13	January 2023	80	77.22
14	February 2023	75	79.72
15	March 2023	73	75.47
16	April 2023	70	73.25
17	May 2023	75	70.32
18	June 2023	-	74.53

$F_{t+18} = \alpha Y_{17} + (1-\alpha) F_{12}$
$= (0.9*75)+(1-0.9)70.32$
$= 67.5+7.032$
$= 74.53$

Calculation Results and *Forecasting Errors*

The results of the calculation and the value of *the Error Forecasting* Forecasting Demand for Herbal medicines at DC Ria Sari Anggriani can be seen in the table 7.

Table 7. Forecasting Results and *Forecasting Error Values*

No	Types of Herbal Medicines	Results January 2023	Alpha (α)	*Error* Result
1	Synergy Herbal Oil	167.92	0.9	3.09 %

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2	Extrafood	178.95	0.1	5.21 %
3	Etta Goat Milk	189.86	0.9	3.92 %
4	Herbal Toothpaste	91.74	0.6	4.35 %
5	Propolis Soap	74.53	0.9	3.97 %

System Testing

Testing this system aims to explain the several steps that need to be carried out in using the herbal medicine request application program at DC Ria Sari Anggriani. After successfully loggi-ng in, there are several features on the main menu page, such as inputting drug data types, periods, calculations, changing passwords, profiles, and logging out (Image 1).

Image 1. Main Menu Page

To start the calculation process, the user first inputs the type of drug data he wants to predict, period data, and data on the number of values in each period. Like picture 2. After the input data is finished, then calculate the forecast and error values according to the weight and type of data you want to predict. forecasting calculations and error values in the herbal medicine demand system at DC Ria Sari Anggriani as shown in the picture 3.

Image 2. Display Of Period Data And Total Values

Image 3. Error Value Form For Requesting Herbal Medicines

The following is the result of a forecast report on the demand for herbal medicines at DC Ria Sari Anggriani as shown in the Image 4.

Image 4. Forecast Report

CONCLUSION

Based on the results of sample testing using a (0.1 to 0.9) the smallest error value is obtained using 0.9 which obtains an error value of 3.09% with the forecasting results for the June 2023 period which

is 167.92 for Herbal Oils. Forecasting calculations that have been carried out and based on the Error Forecastin results table, several conclusions can be drawn, namely the Single Exponential Smoothing Method can be used to predict the number of requests for herbal medicines at DS Ria Sari Anggriani, so that the predicted demand value can be known in the following month's period. As well as the Mean Squared Error (MSE) method can be used to find the error value (error) in each alpha value so that the smallest error value will be obtained.

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