FORECASTING SERVICE SALES TURNOVER USING DOUBLE EXPONENTIAL SMOOTHING METHOD (CASE STUDY: KINCLONG SUB)

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ABSTRACT

As the lifestyle of modern society develops, service companies are businesses in the form of services that sell special skills in order to make it easier for customers, one of which is shoe washing services. However, the problem that usually occurs is that the number of service requests is not certain which results in raw materials that sometimes accumulate or run out every month, errors in predicting the sales turnover of shoe washing services can result in owners experiencing losses if the target raw materials are not appropriate.
This study aims to create a forecasting system for the amount of turnover from each service sale by Kinclong Sub using the Double Exponential Smoothing method, so that the raw material needs needed every month can be optimal. The best turnover forecasting results for each service on Kinclong Sub for the following month, May 2022, were Rp. 10.006,248 with a MAPE value of 17.86% for DeepClean services. And Unyellowing got Rp. 1493,374 with a MAPE value of 17.18 %. So it can be concluded that the service that has the most turnover for the next month is DeepClean, the forecasting results can make it easier for Kinchlong Sub shop owners to provide raw materials from services that are most in demand by consumers.

Keywords: *Shoe washing services, Double Exponential Smoothing, Sales Turnover, Forecasting*

1.INTRODUCTION

A. Background

Service companies are businesses that often offer or sell special skills that are useful and facilitate customers in the form of services. One of them is shoe washing services that are developing lately, this is because along with the development of the lifestyle of modern people who tend to not have much time to wash their dirty shoes themselves. With many shoe washing services that have strong competitiveness, Kinclong Sub is one example. This shoe washing business is certainly one of the types of SMEs that consumers never stop looking for, and for that reason, this shoe washing service continues to grow at this time.

Kinclong Sub is a Small and Medium Enterprise (SME) that sells and offers products in the form of services in the form of washing shoes. Service companies often offer special skills that are useful and make it easier for customers, at Kinchlong Sub they offer services such as DeepClean, Repaint, Unyellowing, White Canvas Treatment. However, the problem that usually occurs is that the number of requests for services is not certain, which results in raw materials that sometimes accumulate or run out every month. This has an impact on the number of consumers who wait a long time or even consumers go looking for other places which will result in reduced profits if a lot of raw materials run out.requirements, increasing power factor and optimizing the operation of energy conversion equipment. Reducing electricity costs can be done by optimizing the use of the system. The audit results show the possibility of reducing electricity costs by 172 million rupiah per year" [1].

Planning to build a forecasting system for the amount of turnover from each sale of services by Kinclong Sub for each month is considered to be the best choice, because Kinclong Sub still uses random estimates to determine

sales turnover of services in the coming month, random turnover estimates are often wrong with the forecasting system will make it easier for the Kinclong Sub to predict the turnover of each service sale so that the raw material needs of each month can be optimal.

Based on the background of the problem that has been described previously, the problem can be formulated, namely how to predict the turnover of each sale of services in Kinclong Sub using the Double Exponential Smoothing method? In this research, problem boundaries are given so that the explanation will be more focused, directed and in accordance with what is expected. These limitations include:

1. The services used include Deepclean, Repaint, Unyellowing, White Canvas Treatment.
2. The data used is transaction data for each service in Kinclong Sub starting from January 2019 – April 2022.
3. The system will forecast services in a period per month.
4. The system to be built is a system with PHP programming language and MySQL database.
5. The resulting data output is a forecast of the amount of turnover in the future period from each service to be forecasted.
6. The method used in this study is the Double Exponential Smoothing method.

The objectives to be achieved in this study are: knowing the turnover of each service using the Double Exponential Smoothing method, knowing the level of accuracy of forecasting turnover using the Double Exponential Smoothing method.

2. SYSTEM ANALYSIS AND DESIGN

2.1 System Analysis

The system that will be developed is a system that implements the Double Exponential Smoothing method to predict the sales turnover of services at Kinclong Sub for the following month. The system will take data from services on Kinclong Sub every month which will later be managed as a result of forecasting turnover in the following month.

The Kinclong Sub party still makes random estimates without any prior calculations, the problem that usually occurs is the uncertain number of service requests which results in raw materials that sometimes accumulate or run out every month. This has an impact on the number of consumers who wait a long time or even consumers go looking for other places which will result in a reduction in profits if a lot of raw materials run out or are not available. With this forecasting system, it will be easier for Kinclong Sub to forecast the turnover of each service sale so that the raw material needs every month can be optimal.

The sales turnover data for this service is obtained based on sales book records at Kinchlong Sub from 2019 to the present, namely April 2022, which is then used as an excel file which will be used as a guide in this research and processed in making forecasting applications. Starting with the initialization of the alpha value, then determining the value of the level element, then proceeding with calculating the forecast and the error value level.

The stages of double exponential smoothing in the research are as follows:
1. Enter the actual data Xt in a certain period.
2. Calculating single smoothing by entering the alpha value multiplied by the actual data plus 1-alpha multiplied by the previous S't.
3. Calculating double smoothing by entering the alpha value multiplied by the result of S't plus 1-alpha multiplied by the previous S't.
4. Calculating the constants at and bt, the value at is obtained from the calculation of two times the result of S't minus S"t. And bt is obtained from alpha divided by 1-alpha multiplied by the result of subtracting S't and S't.
5. Add up the values of at and bt to get the forecasting result (Ft).
6. Perform error calculations with MAPE to find out the error rate.

2.2 System Design

System design aims to provide an overview of system planning to be built or developed. This stage will represent how the system flow works both in terms of the user interface or *flowchart*.

a. *Flowchart*

Flowcharts are used to analyze, draw or design, document and manage a program. The following is a flowchart of the system that will be created.

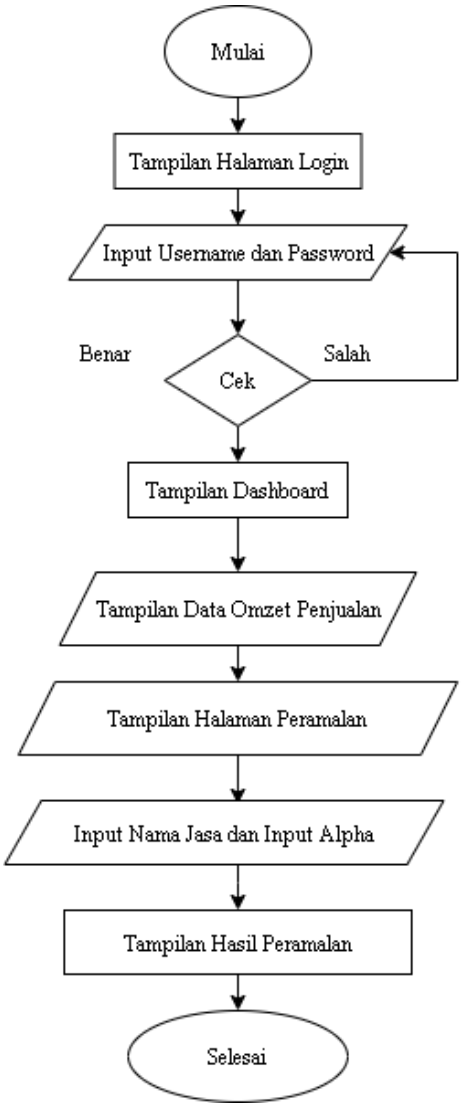


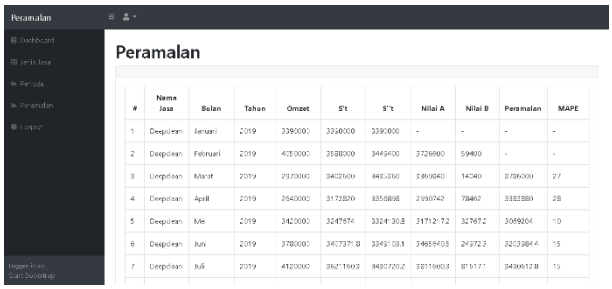
Figure 1. Flowchart of program flow

Flowchart explanation is as follows:

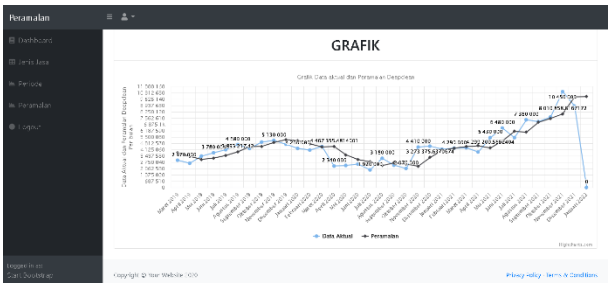
The system starts by logging in as admin. Admin can manage input sales turnover data that will be entered into the database. The inputted data will be used as data for forecasting in the coming month. After the input data is deemed sufficient, the admin can start the forecasting process by starting by selecting the name of the service to be forecasted and then inputting the value of . Forecasting results that appear are the number of turnovers that have been selected from the name of the service and along with the MAPE accuracy level with a comparison graph of the actual data and the data from the forecasting results.

b. Interface design

The interface is a form of graphical display that is directly related to the user (User). The user interface serves as a means of liaison between the user and the operating system. In the implementation of this interface, it will be explained how the interface will be displayed to users of the service sales turnover forecasting system using double exponential smoothing.



a. Forecasting results



b. Forecasting chart

3. TESTING AND DISCUSSION OF RESULTS

After making the sales turnover forecasting system at Kinclong Sub using the Double Exponential Smoothing method is complete, it is necessary to test the system. The purpose of testing this system is to find out whether the system that has been made functions according to what is planned and to determine the level of accuracy of the system that has been made.

3.1 Forecasting Testing Process

The author conducted several trials with DeepClean, Repaint, Unyellowing, White Canvas Treatment services, to find the best alpha with the smallest MAPE error rate value. The data to be tested is service sales data at Kinchlong Sub from January 2019 – April 2022, where there are Deepclean, Repaint, Unyellowing and White Canvas Treatment services.

Table1. DeepClean Service Actual Data

No	Bulan	Tahun	Omzet
1	Januari	2019	3390000
2	Februari	2019	4050000
3	Maret	2019	2970000
4	April	2019	2640000
5	Mei	2019	3420000
6	Juni	2019	3780000
7	Juli	2019	4120000
8	Agustus	2019	4680000
9	September	2019	4260000
10	Oktober	2019	4950000
11	November	2019	5130000
12	Desember	2019	4710000
13	Januari	2020	4260000
14	Februari	2020	4080000
15	Maret	2020	4470000
16	April	2020	2340000
17	Mei	2020	2400000
18	Juni	2020	2550000
19	Juli	2020	1920000
20	Agustus	2020	3180000
21	September	2020	2430000
22	Oktober	2020	2070000
23	November	2020	4410000
24	Desember	2020	4500000
25	Januari	2021	4170000
26	Februari	2021	4290000
27	Maret	2021	4320000
28	April	2021	3870000
29	Mei	2021	5430000
30	Juni	2021	6480000

31	Juli	2021	5430000
32	Agustus	2021	7380000
33	September	2021	7170000
34	Oktober	2021	7680000
35	November	2021	10450000
36	Desember	2021	8880000
37	Januari	2022	9480000
38	Februari	2022	8670000
39	Maret	2022	8940000
40	April	2022	9780000

Table 1 is the actual data for the type of DeepClean service in the period January 2019 – April 2022 which will be forecast for May 2022 by looking for the best alpha value from 0.1 – 0.9.

Table 2. Forecasting Test Results For DeepClean Services

Periode	Data Aktual	S't	S"t	At	Bt	Forecast
Jan-19	3390000	3390000	3390000	-	-	-
Feb-19	4050000	3588000	3449400	3726600	59400	-
Mar-19	2970000	3402600	3435360	3369840	14040	3786000
Apr-19	2640000	3173820	3356898	2990742	78462	3383880
Mei-19	3420000	3247674	3324130.8	3171217.2	32767.2	3069204
Jun-19	3780000	3407371.8	3349103.1	3465640.5	24972.3	3203984.4
Jul-19	4120000	3621160.3	3430720.2	3811600.3	81617.1	3490612.8
Aug-19	4680000	3938812.2	3583147.8	4294476.5	152427.6	3893217.4
Sep-19	4260000	4035168.5	3718754	4351583	135606.2	4446904.1
Okt-19	4950000	4309618	3896013.2	4723222.7	177259.2	4487189.2
Nov-19	5130000	4555732.6	4093929	5017536.1	197915.8	4900481.9
Des-19	4710000	4602012.8	4246354.2	4957671.5	152425.1	5215451.9
Jan-20	4260000	4499409	4322270.6	4676547.3	75916.4	5110096.6
Feb-20	4080000	4373586.3	4337665.3	4409507.2	15394.7	4752463.8
Mar-20	4470000	4402510.4	4357118.8	4447902	19453.5	4424901.9
Apr-20	2340000	3783757.3	4185110.4	3382404.2	172008.5	4467355.5
Mei-20	2400000	3368630.1	3940166.3	2797093.9	244944.1	3554412.7
Jun-20	2550000	3123041.1	3695028.7	2551053.4	245137.6	3042038
Jul-20	1920000	2762128.7	3415158.7	2109098.8	279870	2796191
Aug-20	3180000	2887490.1	3256858.1	2518122.1	158300.6	2388968.8
Sep-20	2430000	2750243.1	3104873.6	2395612.5	151984.5	2676422.7
Okt-20	2070000	2546170.2	2937262.6	2155077.7	167611	2547597.1
Nov-20	4410000	3105319.1	2987679.5	3222958.7	50417	2322688.8
Des-20	4500000	3523723.4	3148492.7	3898954.1	160813.2	3273375.6
Jan-21	4170000	3717606.4	3319226.8	4115985.9	170734.1	4059767.2
Feb-21	4290000	3889324.5	3490256.1	4288392.8	171029.3	4286720
Mar-21	4320000	4018527.1	3648737.4	4388316.8	158481.3	4459422.1
Apr-21	3870000	3973969	3746306.9	4201631.1	97569.5	4546798.1
Mei-21	5430000	4410778.3	3945648.3	4875908.3	199341.4	4299200.6
Jun-21	6480000	5031544.8	4271417.3	5791672.4	325769	5075249.7
Jul-21	5430000	5151081.4	4535316.5	5766846.2	263899.2	6117441.3
Aug-21	7380000	5819757	4920648.6	6718865.3	385332.1	6030745.5
Sep-21	7170000	6224829.9	5311903	7137756.7	391254.4	7104197.4
Okt-21	7680000	6661380.9	5716746.4	7606015.4	404843.4	7529011.1
Nov-21	10450000	7797966.6	6341112.4	9254820.8	624366.1	8010858.8
Des-21	8880000	8122576.6	6875551.7	9369601.6	534439.3	9879186.9
Jan-22	9480000	8529803.7	7371827.3	9687780	496275.6	9904040.8
Feb-22	8670000	8571862.6	7731837.9	9411887.2	360010.6	10184055.6

Mar-22	8940000	8682303.8	8016977.6	9347629.9	285139.8	9771897.8
Apr-22	9780000	9011612.7	8315368.1	9707857.2	298390.5	9632769.7
Mei-22						10006247.7

Table 2 is the result of the calculation of Double Exponential Smoothing for May 2022 from DeepClean services starting from January 2019 – April 2022. After the best parameter value is known, namely = 0.3 with a value of 10006248, a Double Exponential Smoothing calculation is carried out with parameter values = 0.3.

With the following calculation :

A. Determine the first smoothing value:

S't = Xt + (1-) S't-1

1. For t = 1
   Because at t = 1 the value of S't is not yet available, then to overcome this problem it can be done by setting the value of S't equal to the value of the first period data (Xt) of 3390000
2. For t = 2
   S'2 = X2 + (1-) S'2-1
   = (0.3 . 40500000) + (1-0.3) 3390000
   = 3588000
3. For t = 3
   S'3 = X3 + (1-) S'3-1
   = (0.3 . 2970000) + (1-0.3) 3588000
   = 3402600

and so on until the calculation of S't for t = 40 is as follows:

4. For t = 40
   S'40 = X40 + (1-) S'40-1
   = (0.3 . 9780000) + (1-0.3) 8682303.8
   = 9011612.7

The complete results can be seen in Table 2

B.Determine the second smoothing value:

S”t = S't + (1-) S”t-1
For t = 1
Because at t = 1 the value of S't is not yet available, then to overcome this problem it can be done by setting the value of S"t equal to the value of the first period data (Xt) of 3390000

1. For t = 2
   S”2 = S'2 + (1-) S”2-1
   = (0.3 . 3588000) + (1-0.3) 3390000
   = 3449400
2. For t = 3
   S”3 = S”3 + (1-) S”3-1
   = (0.3 . 3402600) + (1-0.3) 3449400
   = 3435360

and so on until the calculation of S "t for t = 40 is as follows:

3. For t = 40
   S”40 = S”40 + (1-) S”40-1
   = (0.3 . 9011612.7 + (1-0.3) 8016977.6
   = 8315368.1

The complete results can be seen in Table 2

C. Determine the magnitude of the constant (at)

α_t = S't + (S't – S”t) = 2S't – S”t

1. For t = 1
   α_1 = S't + (S't – S”t) = 2S'1 – S”1
   = 2(3390000) – 3390000
   = 3390000
2. For t = 2
   α_2 = S't + (S't – S”t) = 2S'2 – S”2
   = 2(3588000) – 3449400
   = 3726600

3. For t = 3
   α_3= S't + (S't – S"t) = 2S'3 – S"3
   = 2(3402600) – 3435360
   = 3369840

and so on until the calculation of t for t = 40 is as follows:

4. For t = 40
   α_{40} = S't + (S't – S"t) = 2S'40 – S"40
   = 2(9011612.7) – 8315368.1
   = 9707857.2

The complete results can be seen in Table 2

D. Determining the Slope Value (bt)

$b_t = \frac{\alpha}{(1-\alpha)} (S'_t - S''_t)$

1. For t = 1
   $b_1 = \frac{0,3}{(1-0,3)} (3390000 - 3390000)$
   = 0
2. For t = 2
   $b_2 = \frac{0,3}{(1-0,3)} (3588000 - 3449400)$
   = 59400
3. For t = 3
   $b_3 = \frac{0,3}{(1-0,3)} (3402600 - 3435360)$
   = 14040

and so on until the calculation of bt for t = 40 is as follows:

4. For t = 40
   $b_{40} = \frac{0,3}{(1-0,3)} (9011612.7 - 8315368.1)$
   = 298390.5

Based on the results of the calculations in Table 2, it is possible to forecast turnover for the next 1 month. To calculate the forecast value can use equation (1.5) as follows:

$S_{t+m} = \alpha_t + b_t m$

1. Forecast period 41 (m = 1), namely for the month of May 2022:
   $S_{t+m} = \alpha_t + b_t m$
   $S_{41} = a_{40} + b_{40} (1)$
   S_{41} = 9707857.2 + 298390.5 (1) = 10006247.7

In Table 2 above it can be concluded that the results of the number of forecasts in the next period in May 2022 are 10006248 in Rupiah using an alpha value of 0.3

3.2 Error Testing Process

Tests were carried out to find the best alpha using MAPE starting from 0.1-0.9 from the DeepClean service.

Table 3. DeepClean Service Test Results with alpha 0.1-0.9

Alfa	Forecast	MAPE
0,1	9222690	24,86 %
0,2	10130112	19,89 %
0,3	10006248	17,86 %
0,4	9846781	18,13 %
0,5	9825862	18,28 %
0,6	9928378	18,78 %
0,7	10102099	19,68 %
0,8	10297443	20,81 %
0,9	10478399	22,76 %

In Table 3 are MAPE results from DeepClean services from alpha testing from 0.1 to 0.9. After obtaining the best parameter value, it is known that = 0.3 with a MAPE value of 17.86 %, then the MAPE calculation is as follows:

$$\textbf{MAPE} = \sum_{t=1}^{n} \frac{PEt}{n}$$

MAPE = $\frac{679}{38}$ = 17,86

So it can be concluded that the forecasting results for the next period from January 2019 - April 2022 for May 2022 are 10006248 with an error accuracy rate obtained is Mean Absolute Percentage Error (MAPE) with the smallest reference error 17.86 % of <20%, which means This forecasting has good accuracy. The criteria for evaluating the error value can be seen in table 3.

4. CONCLUSIONS AND SUGGESTIONS

4.1 Conclusions

The conclusions that can be drawn from the results of this study include the following:

1. The best turnover forecasting results for each service on Kinclong Sub for the following month, May 2022, were Rp. 10.006,248 with a MAPE value of 17.86% for DeepClean services. And Unyellowing got Rp. 1493,374 with a MAPE value of 17.18 %.

2. Of the four services that have been forecasted including DeepClean, Repaint, Unyellowing and White Canvas Treatment, it was found that DeepClean and Unyellowing services received forecasting results with a good level of accuracy (MAPE percentage below 20%). While Repaint and Unyellowing get forecasting results with a decent level of accuracy (MAPE percentage 20-50%). Where the smaller the MAPE value, the more accurate the method used.

4.2 Suggestions

As for suggestions so that further research can improve this research, there are several suggestions for the development of a better application system, including:

1. It is hoped that the forecasting of service sales turnover at Kinclong Sub will not only use the Double Exponential Smoothing method but can be further developed with the Single Exponential Smoothing, Triple Exponential Smoothing method.

2. It is hoped that this system can be further developed in terms of improving the interface and adding features that can support the process of selling services at Kinclongsub.

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