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THE COMPARISON OF SIMPLE MOVING AVERAGE AND DOUBLE EXPONENTIAL SMOOTHING METHODS IN PREDICTING NEW DEBTORS

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Abstract: The realization of credit proposed by customers is one of the essential factors for a bank. Moreover, especially during the Covid-19 pandemic, credit realization shows the business conditions of prospective borrowers, whether they are in good condition or not. So, it is crucial to predict how many new debtors will achieve. In this article, forecasting the number of new debtors uses the Simple Moving Average and Double Exponential Smoothing methods based on actual data on the number of new debtors per month for 2019-2021. Furthermore, the performance of the two methods is compared by comparing the Mean Absolute Deviation and Mean Square Error values. The comparison results conclude that the Simple Moving Average method is better than the Double Exponential Smoothing for predicting the number of new debtors.

Keywords: double exponential smoothing; mean absolute deviation; mean square error; simple moving average; forecasting.

Abstrak: Realisasi kredit yang diajukan oleh nasabah adalah salah satu faktor yang penting di dunia perbankan. Terlebih disaat adanya pandemi Covid-19, realisasi kredit memperlihatkan kondisi usaha para calon debitur, apakah dalam keadaan baik atau tidak. Sehingga penting untuk memprediksi berapa capaian jumlah debitur baru. Dalam artikel ini dilakukan peramalan jumlah debitur baru dengan metode Simple Moving Average dan Double Exponential Smoothing berdasarkan data aktual jumlah debitur baru per bulan tahun 2019-2021. Selanjutnya, dilakukan perbandingan performa kedua metode tersebut dengan cara membandingkan nilai dari Mean Absolute Deviation dan Mean Square Error. Hasil perbandingan yang diperoleh mengarah pada sebuah kesimpulan, yaitu metode Simple Moving Average lebih baik daripada Double Exponential Smoothing untuk meramalkan jumlah debitur baru

Kata kunci: double exponential smoothing; mean absolute deviation; mean square error; simple moving average; peramalan.

INTRODUCTION

Mathematics is needed in various fields, including in the banking sector. One of the mathematics that can be used in the banking sector is the forecasting method. Forecasting methods can be used to predict a condition in the future based on the time series data obtained. According to Jay et al. Forecasting is a science and art that is used to predict future events based on previous data to minimize the effect of uncertainty. [1]. In general, the entire banking sector requires mathematics to predict achievement in the future, including the achievement of new debtors.

Commercial banks, both conven-

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tional and sharia-based business activities, must achieve targets for business continuity. One of the targets given to branch offices is the growth in the number of customer funds and the number of customers. Apart from the number of customers and the amount of customer funds, the board of directors of a bank also determines an increase in the number of new debtors so that the company's profits increase. In other words, the large amount of customer funds collected so far must also be channeled through credit to business customers. Several methods in mathematics can be used to observe and predict the growth of an aspect of banking. For example, the change in the number of new customers, the addition of home ownership loans, vehicle ownership, or even the growth in the expansion of working capital loans.

One of the forecasting methods is the Simple Moving Average (SMA), a time series analysis technique. SMA can be used when the time series has regular (seasonal or cyclical) fluctuations for the smooth evolution of the phenomena. [2]. This method shows the data trend by calculating the average value for a specific duration. According to Svetunkov and Petropoulus, SMA is a simple but efficient forecasting model widely used in practical applications [3]. Apart from SMA, the Exponential Smoothing method gives exponentially lower weights for more extended observations. Single Exponential Smoothing (SES) is ineffective when predicting data with specific trends [4]. However, Double Exponential Smoothing (DES) adds a trend component to the estimation and is considered more appropriate for data with a particular trend [5].

Several studies related to forecasting using SMA and DES have been carried out. For example, Biri et al. compared the SMA with Single Exponential Smoothing (SES) in forecast inflation movements in Palu City. The results indicate that the SES method provides a better predictive value than SMA [6]. Furthermore, to reduce the problem of shortages and surpluses of goods, Hayuningtyas (2017) predicts the supply of goods using the DES and Weighted Moving Average (WMA) methods. The results show that the forecasting results with the WMA method are better than the DES method [7].

Meanwhile, the DES and Triple Exponential Smoothing (TES) methods estimate foreign tourist arrivals to Indonesia. The number of foreign tourists visiting Indonesia is predicted to increase next year. The forecasting results obtained with the TES method are greater than those using the DES method [8]. Whereas the amount of consumable medical materials is predicted using the Double Moving Average (DMA) and DES, which shows that the DMA method is better than DES [9].

In contrast to previous research, in Lauren and Harlili's study, SMA combined with news classification is used to predict stock trends [10]. Aini et al. used the SMA method to estimate the profit of laundry or carpet washing at CV. Homecare with a three-month moving average and a four-month moving average [11]. Meanwhile, Fatimah et al. used the same method to estimate the water used in PDAM Kota Samarinda, Bangkuring region [12]. In this case, the SMA method is not compared to other methods.

In this article, the SMA and DES methods are compared to predict the achievement of new debtors in 2022. A comparison of the SMA and DES methods for predicting the attainment of new debtors has never been made. It is neces-

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sary to correctly predict the achievement of new debtors because the target for realizing new debtors is an essential aspect of earning profits. The data used is case study data from a private bank in South Jakarta. The two methods are compared by comparing the Mean Absolute Deviation (MAD) and Mean Square Error (MSE) values to determine which method is better at predicting the achievement of new debtors.

METHOD

The first thing to do in this research is a literature study. A literature study was conducted to collect SMA, DES, MAD, and MSE theories. In addition, a literature study was carried out to collect the latest relevant articles. Then data collection was carried out using the document study method, which was obtained directly from the data source, namely the Branch Business Development Section at one of the private banks in South Jakarta. The data obtained is quantitative data on the number of new debtors each month in 2019, 2020, and 2021.

After obtaining the required data, the number of new debtors is forecasted using the SMA and DES methods. The SMA method is the simplest averaging method and does not use weighting in calculating closing price movements. Although simple, this method is quite effective in determining trends in the market [13]. On the other hand, the DES method is used when data has a particular pattern. The advantage of the DES method is that it can use a slight majority of data, fewer parameters, and easier data management; that is, no data changes are needed when the data is non-stationary, and there is no need to use autoregression analysis [14].

A comparative study was conducted by comparing the forecasting results of the two methods using a comparison of MAD and MSE as a measure of accuracy. MAD is used when measuring forecast error in the same units as the original series [15]. MAD is the total absolute value of the forecast error divided by the data or, more simply, the absolute cumulative value of the error divided by the period [16]. The smaller the MAD value, the higher the accuracy of the forecasting results. Mean Square Error (MSE) is used to evaluate a forecasting method.

Conversely, MSE is the average squared difference between the predicted and actual values [16]. The smaller the MSE value, the higher the accuracy of the forecasting results. Finally, drawing conclusions and giving suggestions are done after the comparative results are obtained.

RESULT AND DISCUSSION

The data collected is on the number of new debtors from January 2019 to December 2021. Since January 2019, the number of new debtors has fluctuated for three years. The highest number occurred in November 2019, June, and November 2021, with eight new debtors. Meanwhile, the lowest amount occurred in January 2021, with no new debtors. The trend for achieving new debtors worsened in 2020 until it reached the lowest point of 0 but improved again in 2021 (see Image 1). It may have something to do with the sluggish state of the Indonesian economy due to the Covid-19 pandemic [17]–[19].

The results of forecasting the number of new debtors using the SMA meth-

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od with the movement values for periods 3, 5, and 7 are shown in Table 1 and Image 2. Meanwhile, the results of forecasting the number of new debtors using the DES method by taking the parameter value $\alpha = 0.1$ are shown in Table 2 and Image 3.

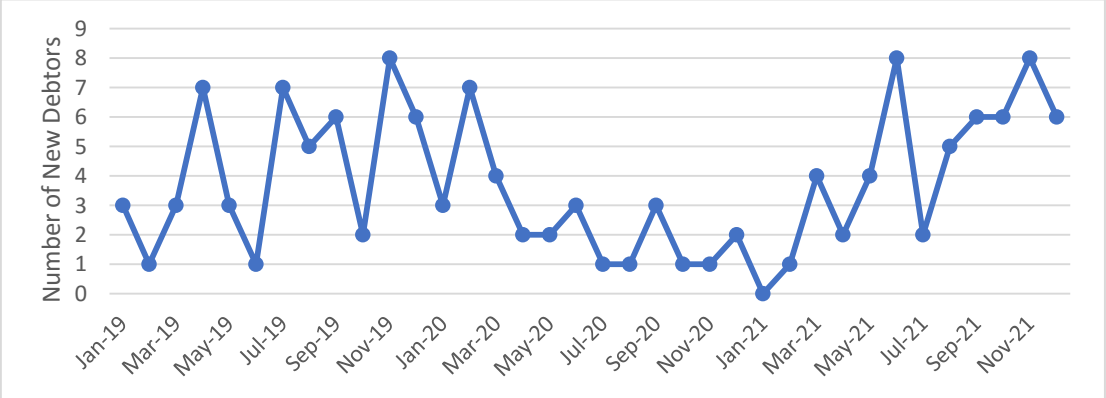

Image 1. Graph of New Debtors Growth (January 2019-December 2021)

Table 1. Forecasting Results of the Number of New Debtors with the SMA Method

No	Month	Number of New Debtors	MA_{t+1} Price			No	Month	Number of New Debtors	MA_{t+1} Price		
			$n = 3$	$n = 5$	$n = 7$				$n = 3$	$n = 5$	$n = 7$
1	Jan-19	3				19	Jul-20	1	2,00	2,40	3,14
2	Feb-19	1				20	Aug-20	1	1,67	1,80	2,86
3	Mar-19	3	2,33			21	Sep-20	3	1,67	2,00	2,29
4	Apr-19	7	3,67			22	Okt-20	1	1,67	1,80	1,86
5	May-19	3	4,33	3,40		23	Nov-20	1	1,67	1,40	1,71
6	Jun-19	1	3,67	3,00		24	Des-20	2	1,33	1,60	1,71
7	Jul-19	7	3,67	4,30	3,57	25	Jan-21	0	1,00	1,40	1,29
8	Aug-19	5	4,33	4,60	3,86	26	Feb-21	1	1,00	1,00	1,29
9	Sep-19	6	6,00	4,40	4,57	27	Mar-21	4	1,67	1,60	1,71
10	Okt-19	2	4,33	4,20	4,43	28	Apr-21	2	2,33	1,80	1,57
11	Nov-19	8	5,33	5,60	4,57	29	May-21	4	3,33	2,20	2,00
12	Des-19	6	5,33	5,40	5,00	30	Jun-21	8	4,67	3,80	3,00
13	Jan-20	3	5,67	5,00	5,29	31	Jul-21	2	4,67	4,00	3,00
14	Feb-20	7	5,33	5,20	5,29	32	Aug-21	5	5,00	4,20	3,71
15	Mar-20	4	4,67	5,60	5,14	33	Sep-21	6	4,33	5,00	4,43
16	Apr-20	2	4,33	4,40	4,57	34	Okt-21	6	5,67	5,40	4,71
17	May-20	2	2,67	3,60	4,57	35	Nov-21	8	6,67	5,40	5,57
18	Jun-20	3	2,33	3,60	3,86	36	Des-21	6	4,67	5,00	5,00

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Table 2. Forecasting Results of New Debtors Numbers with the DES Method ($\alpha = 0.1$)

No	Month	Number of New Debtors	X_{t+m} Price				
			S_t'	S_t''	α_t	b_t	X_{t+m}
1	Jan-19	3	3,00	3,00	3,00	-	3,00
2	Feb-19	1	2,80	3,00	2,60	-0,02	2,58
3	Mar-19	3	2,82	2,98	2,66	-0,02	2,64
4	Apr-19	7	3,24	2,96	3,51	0,03	3,54
5	May-19	3	3,21	2,99	3,44	0,02	3,46
6	Jun-19	1	2,99	3,01	2,97	-	2,97
7	Jul-19	7	3,39	3,01	3,78	0,04	3,82
8	Aug-19	5	3,55	3,05	4,06	0,06	4,11
9	Sep-19	6	3,80	3,10	4,50	0,08	4,57
10	Okt-19	2	3,62	3,17	4,07	0,05	4,12
11	Nov-19	8	4,06	3,21	4,90	0,09	4,99
12	Des-19	6	4,25	3,30	5,20	0,11	5,31
13	Jan-20	3	4,13	3,39	4,86	0,08	4,94
14	Feb-20	7	4,41	3,47	5,36	0,11	5,46
15	Mar-20	4	4,37	3,56	5,18	0,09	5,27
16	Apr-20	2	4,13	3,64	4,63	0,05	4,68
17	May-20	2	3,92	3,69	4,15	0,03	4,18
18	Jun-20	3	3,83	3,72	3,94	0,01	3,96
19	Jul-20	1	3,55	3,73	3,37	-0,02	3,35
20	Aug-20	1	3,29	3,71	2,87	-0,05	2,83
21	Sep-20	3	3,26	3,67	2,86	-0,04	2,81
22	Okt-20	1	3,04	3,63	2,45	-0,07	2,38
23	Nov-20	1	2,83	3,57	2,10	-0,08	2,02
24	Des-20	2	2,75	3,49	2,00	-0,08	1,92
25	Jan-21	0	2,47	3,42	1,53	-0,11	1,42
26	Feb-21	1	2,33	3,33	1,33	-0,11	1,22
27	Mar-21	4	2,49	3,23	1,76	-0,08	1,68
28	Apr-21	2	2,44	3,15	1,74	-0,08	1,66
29	May-21	4	2,60	3,08	2,12	-0,05	2,07
30	Jun-21	8	3,14	3,03	3,25	0,01	3,26
31	Jul-21	2	3,03	3,04	3,01	-	3,01
32	Aug-21	5	3,22	3,04	3,41	0,02	3,43
33	Sep-21	6	3,50	3,06	3,94	0,05	3,99
34	Okt-21	6	3,75	3,10	4,40	0,07	4,47
35	Nov-21	8	4,18	3,17	5,18	0,11	5,29
36	Des-21	6	3,76	3,27	4,25	0,05	4,30

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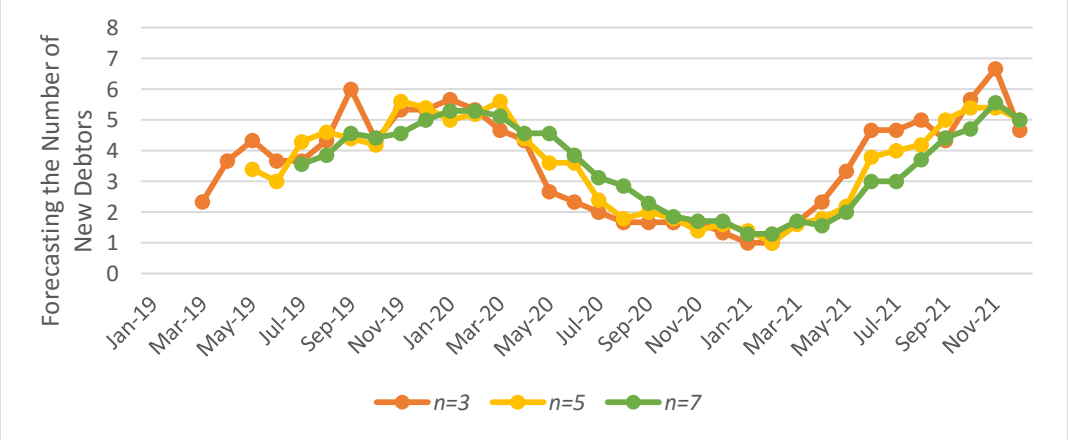

Image 2. Forecasting Results of New Debtors Numbers with the SMA Method

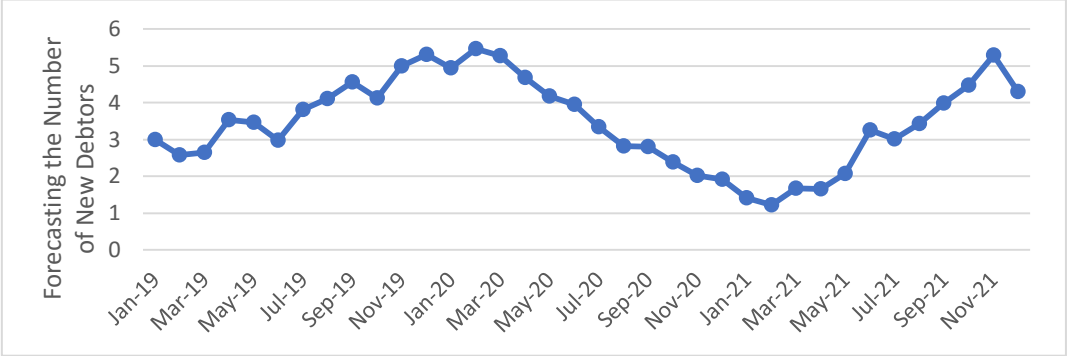

Image 3. Forecasting Results in New Debtors Numbers with the DES Method ($\alpha = 0.1$)

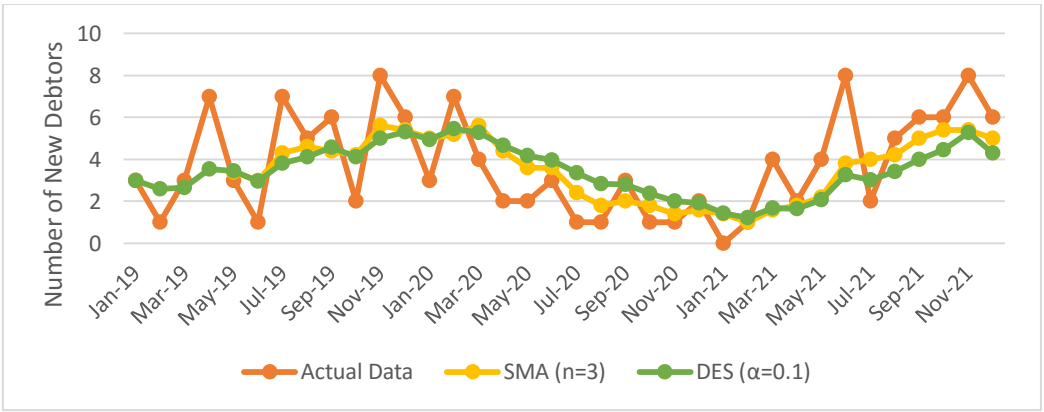

Image 4. Comparison of forecasting results with actual data

Comparison of Forecasting Results

To compare the performance of forecasting new debtors for 2019-2021 using the SMA and DES methods, MAD and MSE values are used. In general, the MAD and MSE values of the SMA method are smaller than the MAD and MSE values of the DES method. The lowest MAD and MSE values come from the SMA method with $n = 5$. In comparison, the largest MAD and MSE

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values come from the DES method with $\alpha = 0.1$ (see Table 3).

Therefore, it can be concluded that the SMA method is better than the DES method for predicting the number of new debtors because it has a better level of accuracy (smaller error value). It is clarified by Image 4, which illustrates the results of forecasting with the SMA method (especially with $n = 5$) closer to the actual data than the forecasting results with the DES method.

Table 3. Performance Comparison of SMA and DES

	SMA (n=3)	SMA (n=5)	SMA (n=7)	DES (α=0,1)
MAD	0,162	0,143	0,269	0,317
MSE	2,746	2,575	3,311	3,685

CONCLUSION

Based on the results obtained, it can be concluded that the SMA method is better than the DES method in terms of MAD and MSE values for predicting the number of new debtors. Therefore, with the forecasting method for achieving new debtors, the bank can help make it easier for branches to determine strategies for finding potential debtors for the future. For further research, other forecasting methods can be compared to predict the number of new debtors to obtain the best method.

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