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Forecasting the Number of BMT NU Lenteng Branch Customers Using the Single Exponential Smoothing Method

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ABSTRACT

The presence of financial institutions greatly helps the country in terms of the economy, including Islamic financial institutions such as BMT NU Lenteng Branch which was established in 2014. For BMT NU, the existence of customers greatly influences the continuity of the work process. Therefore, in order to facilitate the preparation of the next work plan, a customer forecasting technique is needed to determine the number of saving customers in the next period, which can fluctuate every year. For this study, data on the number of savers was used from 2014 to 2023, then for forecasting using the Single Exponential Smoothing method, a method that focuses on finding stability values. The advantage of this method lies in its ease of operation which is relatively simple. To determine the level of accuracy obtained from the forecasting results, the Mean Absolute Deviation (MAD), Mean Squared Error (MSE), and Mean Absolute Percentage Error (MAPE) methods are used. From the results of the research that has been carried out, it was found that the best alpha value for forecasting is at alpha 0,9 with a forecasting result of 10.065,3. The error calculation obtained for the last 10 years of data is MAD = 1.050,037676, MSE = 1.622.018,167, and MAPE = 25%. While for the last 5 years of data, MAD = 1.415,6342, MSE = 2.528.041,621, and MAPE = 19%.

Keyword: *BMT NU; customers; forecasting; Single Exponential Smoothing*

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1. INTRODUCTION

The economy is an important part of a country because the level of welfare can be measured through it, like Indonesia, which is a developing country and needs a bank as a place to conduct financial transactions. One part of a financial institution is an Islamic financial institution, which operates according to Islamic law and uses a profit-sharing system, not usury. For most people, Islamic financial institutions are considered safer and more comfortable for conducting financial transactions (Zulhazmi & Auwalin, 2020). Islamic financial institutions collect funds from the community through financing to improve the quality of life of the community and help people who have more funds with people who lack funds. This organization is run according to Islamic principles. Baitul Maal Wa Tamwil (BMT) is included among Islamic financial institutions. BMT combines the concepts of baitul tanwil and baitul maal with cooperative principles and Islamic principles in its operations. By improving the quality of economic efforts, BMT aims to improve the welfare of members and society. BMT avoids usury in its operating system because it uses a profit-sharing system rather than an interest system (Meranti & Yazid, 2021).

As with the existence of BMT NU East Java Gapura, which has several branches and is spread across various regions, one of its branches is BMT NU Lenteng Branch, which is located in front of Lenteng market and was founded on January 20, 2014. KSPPS BMT NU Lenteng Branch is an alternative institution based on Islamic law that aims to foster and improve the welfare of its members and create a more prosperous society, especially for entrepreneurs and traders in a developing and advanced economy. For BMT NU Lenteng Branch, the existence of customers is something important to have. Based on data on the number of savers obtained from the BMT NU Lenteng Branch office, from 2014-2023, it has increased every year. So, to find out the level of increase or decrease in the following year, forecasting techniques will be used. Forecasting the number of customers can provide important information in making decisions and for making better designs.

Forecasting is a calculation method to predict something that will happen in the future by using previous data to reduce the impact of uncertainty. Forecasting is the most important way to make planning more efficient and effective (Setiawan, 2021). Forecasting is also an important part of the planning process. Because working with forecasting will be much better than working without forecasting. Therefore, choosing the right method can be used to minimize forecast errors.

In this study, the forecasting method used is the Single Exponential Smoothing Method. The Single Exponential Smoothing Method is a type of Exponential Smoothing method that focuses on finding stability values by using historical data that is given an exponential function, and then produces easy to use options. Therefore, the smoothing method is often the best choice (Hariyono et al., 2017). The main advantage of the Single Exponential Smoothing method is that it is easy to operate and is able to adjust data based on its consistency based on the alpha value (Mahajan et al., 2018).

Several previous studies that discuss the Single Exponential Smoothing method include research conducted by Nugroho Arif Sudibyo et al (2020), where this study predicts the inflation rate in Indonesia by applying three methods, namely Moving Average, Single Exponential Smoothing, and Double Exponential Smoothing and using three error parameters, namely MAD, MSD, and MAPE. The results of this study indicate that the more accurate method is the Single Exponential Smoothing method with a forecast error result of 1,41746% at an alpha value of 1,32 seen from the results of MAD, MSD, and MAPE. Another study was conducted by Yudanto & Hartanto (2022) on the application of the Single Exponential Smoothing method to calculate inventory in snack shops using an information system. In this study, the MSE results were 11,0065, with the best forecasting results being 80,9 at alpha 0,1. Furthermore, research by Prapcoyo & As'ad (2022) discussed monthly inflation forecasting in the city of Yogyakarta using the Exponential Smoothing method. The results obtained were good enough to be used in the next period with an MAPE value of 12,71662, which is in the range of 10%. Then, Fauziah & Fauziah (2022) also conducted a forecast on the implementation of the Moving Average and Single Exponential Smoothing methods to forecast the availability of web-based products. The study found that the Single Exponential Smoothing method at alpha 0.5 with MAD = 0,50, MSE = 3,02, and MAPE = 11,38 was better than the Moving Average method.

The investigation into customer forecasting was carried out by Yadi (2024), and it focused on predicting banking clients for KUR through the C4.5 algorithm. The study revealed an entropy value of 0,97 and a gain value of 0,69, leading to the creation of a decision tree using various key data. Building on these findings, the current research aims to estimate customer numbers at the BMT NU Lenteng Branch by employing the Single Exponential Smoothing Method. The forecasting process covers the year 2024, utilizing data from 2014 to 2023, serving as a reference for organizations to boost customer numbers at the BMT NU Lenteng Branch.

2. RESEARCH METHOD

The following is a flow diagram of the research method, which can be seen in Figure 1.

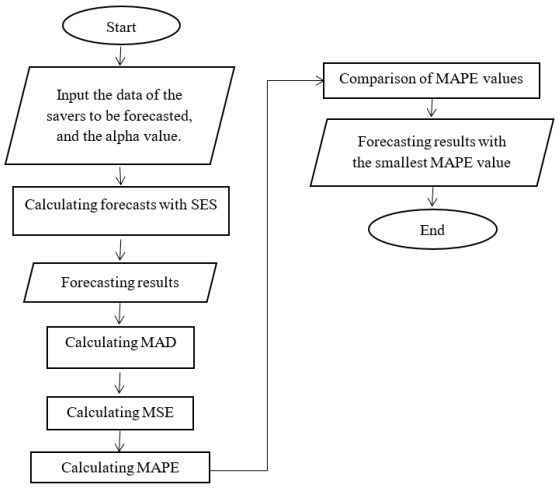

Figure 1. The flow of Research Design

The stages in Figure 1 can be explained as follows:

1. Enter customer data and alpha value. Customer data is taken from BMT NU Lenteng Branch starting from 2014 to 2023.
2. Calculate the forecast using the method used, namely Single Exponential Smoothing, which can be seen in the equation (1) (Fauziah & Fauziah, 2022) .

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

where:
F_t = forecasting for period t
F_{t-1} = Previous forecast
α = Smoothing constant $0 < \alpha < 1$
A_{t-1} = Actual data of previous period

3. Obtain forecast calculation results.
4. Calculating the Mean Absolute Deviation (MAD) value, the Mean Absolute Deviation (MAD) is used to calculate the difference between actual data and estimated values (Ahmad, 2020), where to calculate it, you can see equation (2) (Sarifah et al., 2023).

$$\text{MAD} = \frac{\sum_{t=1}^{n} |Yt - Ft|}{n} \quad (2)$$

information:
Y_t = Actual data at period t
F_t = Forecast value at period t
n = Amount of data

5. Calculating the Mean Square Error (MSE) value. The way to calculate MSE is by calculating the difference between the actual data and the forecast value. After that, this result is doubled and divided by the total amount of data (Pratama et al., 2020). Equation (3) is the formula for calculating the value of MSE (Sarifah et al., 2023).

$$\text{MSE} = \frac{\sum_{t=1}^{n}(Yt-Ft)^2}{n} \quad (3)$$

where:
Y_t = Actual data at period t
F_t = Forecast value at period t
n = Amount of data

6. Calculating the Mean Percentage Error (MAPE) value. MAPE is the actual value minus the forecast result, divided by the actual data value and multiplied by 100%. The average value is found by dividing the data period (Hayuningtyas & Sari, 2021). Because it can be used on very small or huge variables, MAPE is very useful for seeing the accuracy of the forecast. In addition, it can show the level of error in the forecast that refers to the actual value. To calculate the percentage error (MAPE), it can be seen in equation (4) (Sarifah et al., 2023).

$$\text{MAPE} = \left(\frac{1}{n}\right)\sum_{t=1}^{n}\frac{|Yt-Ft|}{Yt}x\ 100\% \quad (4)$$

where:
Y_t = Actual data at period t
F_t = Forecast value at period t
n = Amount of data

7. Compare the MAD, MSE, and MAPE values. Then look at the smallest MAPE value.
8. Forecasting results and the smallest MAPE value.

3. RESULTS AND DISCUSSION

3.1 Data Set

The data used in predicting the number of customers is the data on savings customers at BMT NU Lenteng Branch obtained from the BMT NU Lenteng Branch Office, which can be seen in Table 1.

Table 1. Customer Data of BMT NU Lenteng Branch 2014-2023.

No	Year	Number of Customers
1	2014	615
2	2015	1.042
3	2016	1.302
4	2017	1.848
5	2018	2.260
6	2019	3.695
7	2020	5.296
8	2021	6.812
9	2022	8.389
10	2023	10.271

3.2 Forecasting with the Single Exponential Smoothing Method

In this study, $\alpha = 0{,}1$ to $\alpha = 0{,}9$ was used, namely as follows:

1) Calculation results for the last 10 years of data.
The overall calculation results for $\alpha = 0{,}1$ to $\alpha = 0{,}9$ can be seen in Tables 2 and 3.

Table 2. Forecasting results for $\alpha = 0{,}1$ to $\alpha = 0{,}5$

No	Year	Actual Data	Forecast				
			$\alpha = 0{,}1$	$\alpha = 0{,}2$	$\alpha = 0{,}3$	$\alpha = 0{,}4$	$\alpha = 0{,}5$
1	2014	615	615	615	615	615	615
2	2015	1.042	615	615	615	615	615
3	2016	1.302	657,7	700,4	743,1	785,8	828,5
4	2017	1.848	722,13	820,72	910,77	992,28	1.065,25
5	2018	2.260	834,717	1.026,176	1.191,939	1.334,568	1.456,625
6	2019	3.695	977,2453	1.272,941	1.512,357	1.704,741	1.858,3125

7	2020	5.296	1.249,02077	1.757,353	2.167,15	2.500,844	2.776,65625
8	2021	6.812	1.653,718693	2.465,082	3.105,805	3.618,907	4.036,328125
9	2022	8.389	2.169,546824	3.334,466	4.217,664	4.896,144	5.424,164063
10	2023	10.271	2.791,492141	4.345,373	5.469,064	6.293,286	6.906,582031
11	2024		3.539,442927	5.530,498	6.909,645	7.884,372	8.588,791016

Table 3. Forecasting results for α = 0,6 to α = 0,9

No	Year	Actual Data	Forecast			
			α = 0,6	α = 0,7	α = 0,8	α =0,9
1	2014	615	615	615	615	615
2	2015	1.042	615	615	615	615
3	2016	1.302	871,2	913,9	956,6	999,3
4	2017	1.848	1.129,68	1.185,57	1.232,92	1.271,73
5	2018	2.260	1.560,672	1.649,271	1.724,984	1.790,373
6	2019	3.695	1.980,2688	2.076,781	2.152,997	2.213,0373
7	2020	5.296	3.009,10752	3.209,534	3.386,599	3.546,80373
8	2021	6.812	4.381,24301	4.670,06	4.914,12	5.121,080373
9	2022	8.389	5.839,6972	6.169,418	6.432,424	6.642,908037
10	2023	10.271	7.369,27888	7.723,125	7.997,685	8.214,390804
11	2024		9.110,31155	9.506,638	9.816,337	10.065,33908

From Table 2, it is obtained that the results of the forecasting calculations for $\alpha = 0{,}1$ to $\alpha = 0{,}5$ have a significant difference from the actual data, while Table 3 shows that the alpha value that is closest to the actual data is $\alpha = 0{,}9$. The calculations of MAD, MSE, and MAPE for $\alpha = 0{,}9$ can be seen in Table 4.

Table 4. Prediction accuracy value for α = 0,9

No	MAD	MSE	MAPE
2	427	18.2329	40,97888676
3	302,7	91.627,29	23,24884793
4	576,27	332.087,1129	31,18344156
5	469,627	220.549,5191	20,77995575
6	1.481,9627	2.196.213,444	40,10724493
7	1.749,19627	3.059.687,591	33,02863048
8	1.690,919627	2.859.209,185	24,82266041
9	1.746,091963	3.048.837,142	20,81406559
10	2.056,609196	4.229.641,386	20,0234563
	1.050,037676	1.622.018,167	25,49871897

From Table 4, the MAD value is obtained = 1.050,037676, MSE = 1.622.018,167, and MAPE = 25%. These values are included in the normal category.

2) Calculation results for the last 5 years of data

The calculation results when $\alpha = 0{,}1$ to $\alpha = 0{,}9$ can be seen in Tables 5 and 6 below.

Table 5. Forecasting results for $\alpha = 0{,}1$ to $\alpha = 0{,}5$

No	Year	Actual Data	Forecats				
			α = 0,1	α = 0,2	α = 0,3	α = 0,4	α = 0,5
1	2019	3.695	3.695	3.695	3.695	3.695	3.695
2	2020	5.296	3.695	3.695	3.695	3.695	3.695

3	2021	6.812	3.855,1	4.015,2	4.175,3	4.335,4	4.495,5
4	2022	8.389	4.150,79	4.574,56	4.966,31	5.326,04	5.653,75
5	2023	10.271	4.574,611	5.337,448	5.993,117	6.551,224	7.021,375
6	2024		5.144,2499	6.324,158	7.276,482	8.039,1344	8.646,1875

Table 6. Forecasting results for α = 0,6 to α = 0,9

No	Year	Actual Data	Forecast			
			α = 0,6	α = 0,7	α = 0,8	α = 0,9
1	2019	3.695	3.695	3.695	3.695	3.695
2	2020	5.296	3.695	3.695	3.695	3.695
3	2021	6.812	4.655,6	4.815,7	4.975,8	5.135,9
4	2022	8.389	5.949,44	6.213,11	6.444,76	6.644,39
5	2023	10.271	7.413,176	7.736,233	8.000,152	8.214,539
6	2024		9.127,8704	9.510,57	9.816,83	10.065,35

From Table 5, it is obtained that the results of the forecasting calculations for $\alpha = 0{,}1$ to $\alpha = 0{,}5$ have a significant difference from the actual data, while Table 6 shows that the alpha value that is closest to the actual data is $\alpha = 0{,}9$. The calculations of MAD, MSE, and MAPE for $\alpha = 0{,}9$ can be seen in Table 7.

Table 7. Forecasting results for α = 0,9

No	MAD	MSE	MAPE
2	1.601	2.563.201	30,23036254
3	1.676,1	2.809.311,21	24,60510863
4	1.744,61	3.043.664,052	20,79640005
5	2.056,461	4.229.031,845	20,02201344
	1.415,6342	2.529.041,621	19,13077693

From Table 7, the MAD value is obtained = 1.415,6342, MSE = 2.529.041,621, and MAPE = 19%. These values are included in the good category.

The program implementation uses Minitab to find out the best alpha value for the last 10 years of data and the last 5 years of data, which can be seen in Figure 2 and Figure 3.

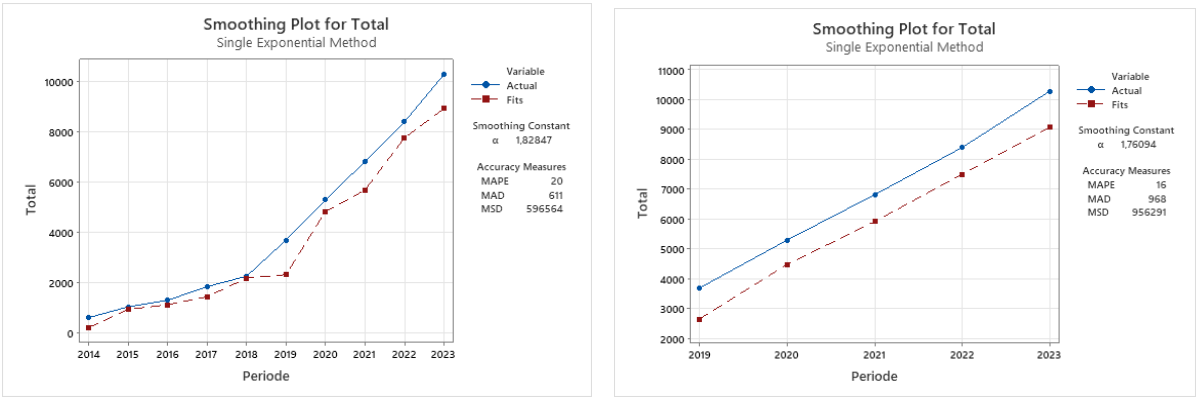

Figure 2. (a). Minitab graph results of last 10 years data, (b). Minitab graph results of last 5 years data

Based on Figure 2, which refers to research conducted by Nugroho Arif Sudibyo et al. (2020) with an alpha value = 1,32 and using Minitab software, the results obtained for the best alpha with the last 10 years of data are at a value of $\alpha = 1{,}82847$ with a MAPE error value of 20% and are included in the good category. While the results for forecasting with the last 5 years of data are at $\alpha = 1{,}76094$ and an MAPE error value of 16% are also included in the good category.

4. CONCLUSION

The conclusion of this research is as follows:

1. The results of the application of the single exponential smoothing method in forecasting the number of customers are influenced by the alpha value and the amount of data, so that the best alpha value for forecasting the number of BMT NU customers is at $\alpha = 0{,}9$. For calculations with data from the last 10 years and the last 5 years, the forecast results are 10.065,34 and 10.065,35. While in the minitab results, the best alpha is at $\alpha = 1{,}82847$ for data from the last 10 years and $\alpha = 1{,}76094$ for data from the last 5 years.
2. The accuracy results of the method obtained in the calculation process for the last 10 years of data are MAD = 1.050,037676, MSE = 1.622,018.167, and MAPE = 25%, while for the last 5 years of data obtained, MAD = 1.415,6342, MSE = 2.528.041,621, and MAPE = 19%. From the calculation results, the smallest MAPE error value is obtained when using the last 5 years of data, which is around 19% at $\alpha = 0{,}9$ and is included in the good category. Meanwhile, the Minitab results obtained the best alpha at $\alpha = 1{,}82847$ for the last 10 years of data with MAPE = 20% and MAD 611. For the last 5 years of data, it is at $\alpha = 1{,}76094$ with MAPE = 16% and MAD = 968.

REFERENCES

Ahmad, F. (2020). Penentuan Metode Peramalan Pada Produksi Part New Granada Bowl St di Pt.X. *JISI: Jurnal Integrasi Sistem Industri*, *7*(1), 31. https://doi.org/10.24853/jisi.7.1.31-39

Faisol, F. & Aisyah, S. (2016). Penerapan Metode Exponential Smoothing untuk Peramalan Jumlah Klaim di BPJS Kesehatan Pamekasan. Jurnal Matematika MANTIK, 2(1), 46-51. https://doi.org/10.15642/mantik.2016.2.1.46-51

Fauziah, L., & Fauziah, F. (2022). Penerapan Metode Single Exponential Smoothing dan Moving Average Pada Prediksi Stock Produk Retail Berbasis Web. *STRING (Satuan Tulisan Riset Dan Inovasi Teknologi)*, *7*(2), 159-168. https://doi.org/10.30998/string.v7i2.13932

Hariyono, Latipah, & Achmad Zakki Falani. (2017). Implementasi Metode Exponential Smoothing Sebagai Forecasting Permintaan Obat Pada Dinas Kesehatan Kota Surabaya. *Insand Comtech : Information Science and Computer Technology Journal*, *2*(2), 1–8.

Hayuningtyas, R. Y., & Sari, R. (2021). Aplikasi Peramalan Alat Kesehatan Menggunakan Single Moving Average. *Jurnal Infortech*, *3*(1), 40–45. https://doi.org/10.31294/infortech.v3i1.10397

Mahajan, S., Chen, L.-J., & Tsai, T.-C. (2018). Short-Term PM2.5 Forecasting Using Exponential Smoothing Method: A Comparative Analysis. Sensors, 18(10), 3223. https://doi.org/10.3390/s18103223

Meranti, I. D. I., & Yazid, A. A. (2021). Peran Baitul Mal Wat Tamwil dalam Mewujudkan Ekonomi Syariah yang Kompetitif. *Economic : Jurnal Ekonomi Dan Hukum Islam*, *12*(01), 31–38. https://doi.org/10.59943/economic.v12i01.64

Nugroho Arif Sudibyo, Ardymulya Iswardani, Arif Wicaksono Septyanto, & Tyan Ganang Wicaksono. (2020). Prediksi Inflasi Di Indonesia Menggunakan Metode Moving Average, Single Exponential Smoothing Dan Double Exponential Smoothing. *Jurnal Lebesgue : Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika*, *1*(2), 123–129. https://doi.org/10.46306/lb.v1i2.25

Prapcoyo, H., & As'ad, M. (2022). the Forecasting of Monthly Inflation in Yogyakarta City Uses an Exponential Smoothing-State Space Model. *International Journal of Economics, Business and Accounting Research (IJEBAR)*, *6*(2), 800. https://doi.org/10.29040/ijebar.v6i2.4853

Pratama, D. A., Hidayati, S., Suroso, E., & Sartika, D. (2020). Analisis Peramalan Permintaan dan Pengendalian Persediaan Bahan Baku Pembantu pada Industri Gula (Studi Kasus PT. XYZ Lampung Utara) Analysis Forecasting Dem & Control of Supply Raw Materialsi In The Sugar Industry (Case Study of PT. XYZ North Lampung). *Jurnal Penelitian Pertanian Terapan*, *20*(2), 148–160. http://www.jurnal.polinela.ac.id/JPPTeISSN2047-1781

Sarifah, L., Kamilah, S., & Khotijah, S. (2023). Penerapan Metode Single Moving Average Dalam Memprediksi Jumlah Penduduk Miskin Pada Perencanaan Pembangunan Daerah Kabupaten Pamekasan. *Zeta - Math Journal*, *8*(2), 47–54. https://doi.org/10.31102/zeta.2023.8.2.47-54

Setiawan, I. (2021). Rancang Bangun Aplikasi Peramalan Persediaan Stok Barang Menggunakan Metode Weighted Moving Average (WMA) Pada Toko Barang XYZ. Jurnal Teknik Informatika, 13(3), 1–9.

Yadi, Y. (2024). PREDIKSI NASABAH KREDIT USAHA RAKYAT MENGGUNAKAN ALGORITMA C4.5. Networking Engineering Research Operation, 9(1), 1–8. https://doi.org/10.21107/nero.v9i1.25348

Yudanto, B. W., & Hartanto, B. (2022). Implementasi Metode Single Exponential Smoothing dalam Melakukan Perkiraan Stok Barang di Toko Makanan Ringan Berbasis Sistem Informasi. *Journal of Economic, Management, Accounting and Technology*, *5*(2), 188–199. https://doi.org/10.32500/jematech.v5i2.2563

Zulhazmi, Z., & Auwalin, I. (2020). Peran Pembiayaan Terhadap Perkembangan Usaha Dan Peningkatan Kesejahteraan Anggota Baitul Maal Wat Tamwil. *Jurnal Ekonomi Syariah Teori Dan Terapan*, *7*(3), 602. https://doi.org/10.20473/vol7iss20203pp602-609