ILKOM Jurnal Ilmiah Vol. 15, No. 2, August 2023, pp. 222-228
Accredited 2nd by RISTEKBRIN No. 200/M/KPT/2020; E-ISSN 2548-7779 | P-ISSN 2087-1716

Building The Prediction of Sales Evaluation on Exponential Smoothing using The OutSystems Platform

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Article history: Received November 19, 2022; Revised December 01, 2022; Accepted March 25, 2023; Available online August 16, 2023

Abstract

To get a large profit in a company or business is to determine sales predictions for the next period. Prediction or forecasting is one of the keys to the success of sales because the predicted value of sales can be used as a reference to determine the order of goods, so there is no loss. Exponential smoothing method is a fairly superior forecasting method in long-term, medium-term and short-term forecasting. The data to be processed is sales data for the 2020-2022 period. The single exponential smoothing method was chosen because it can determine sales predictions for the next period with the smallest error value. The evaluation method used is MAPE, ME, MAD and MSE where this forecasting method is used to find the smallest error value. Based on the calculation results, the smallest error value obtained is ME at 62.8, MAD at 179.9, MSE at 55564.5, and MAPE at 9.20%. The value is at alpha 0.3. The next stage is to design a prediction system using the out-systems platform version 11.14.1 as a place to design the system. The test results of the system that has been designed to assist business owners in making decisions on product inventory estimates.

Keywords: Evaluation; Exponential Smoothing; Forecasting; Prediction; Sales.

Introduction

In conducting an economic analysis or analysis of the company's business activities, it must be estimated what will happen. This is either in the economic field or in the business world in the future. The company not only focuses on infrastructure [1] but also considers the movement of data. Efforts to see situations and conditions in the future is an attempt to estimate the effect that applies to future developments which is called forecasting [2]. Forecasting is an important tool in effective planning [3] and is widely used in various fields [4][5][6]. Evaluation of the use of the system implemented by the company is important [7], but forecasting is also needed to increase the quality of business strategy. There are two general approaches to forecasting, and there are only two ways to address all decision modeling, namely quantitative analysis and qualitative analysis [8]. In the qualitative analysis method, there is less emphasis on the use of calculations using formulas. This method can also be through opinions from various parties based on judgments and opinions. While the quantitative analysis method is a forecasting method that relies heavily on historical data patterns. Quantitative methods are grouped into two types, namely cause-effect analysis and time series analysis. Cause-and-effect analysis is based on the user analyzing the pattern of the relationship between the variables that will be estimated and the other variables that influence them. Meanwhile, time series analysis is always based on the use of pattern analysis of the relationship between the variables to be estimated and the time variable. The method estimates consumer demand and sales transactions for the coming period using previously available data. Basically, there are three techniques for calculating time series which consist of the moving average method, the weighted moving average, and the exponential smoothing.

Exponential smoothing is a statistical method of forecasting to detect changes in data [9] where the moving average is weighted exponentially decreasing to the value of the earlier observation. The given weight is characterized by an exponential decrease from the last data point to the earliest data point. If in forecasting calculations it is assumed that the mean value is constant over time, then each observation will be given the same

weight. Therefore, more weight is given to the new observation value and less weight is given to the older observation. This research is very important which can determine decisions as a company's business strategy. One method of exponential smoothing that is good and stable is Single Exponential Smoothing (SES) [10][11][12]. However, this needs evaluation so that the results of the method are truly acceptable. One method of looking at prediction errors is the Mean Absolute Percentage Error (MAPE) [13]. After evaluation, an application is built using the OutSystems Platform. The results obtained after an evaluation were carried out where the value of MAPE was 9.20%. This shows that the forecasting results are excellent with a value below 10%.

Method

Research data is needed as material for measurement. **Table 1** is sales transaction data from a company that is used for forecasting.

Table 1. Sales Transaction

Period	Actual	Period	Actual
June 2020	1567	June 2021	1799
July 2020	1478	July 2021	1885
August 2020	1725	August 2021	1684
September 2020	1864	September 2021	1773
October 2020	1897	October 2021	1765
November 2020	1479	November 2021	1871
December 2020	1764	December 2021	2092
January 2021	2135	January 2022	2244
February 2021	2362	February 2022	2435
March 2021	1981	March 2022	2147
April 2021	1785	April 2022	1788
May 2021	1847	May 2022	1989

The proposed problem solving is carried out by designing a decision support system that can assist in predicting sales. This can help business owners in estimating the stock of products in the warehouse, by using the SES method. This method is often used by several researchers in their research [14][15][16]. The new forecast is calculated using Equation 1.

$$F_t = \alpha \times \text{DPPS} + (1 - \alpha) \times \text{DRPS} \quad (1)$$

Where Ft is the new forecast which has the forecast value for the current period. DPSS is sales data for the previous period, while for DRPS is forecast data for the previous period. In this case the data being analysed is an example of calculating the forecast value for data for April 2022. DPSS is the sales data figure for March 2022, and DRPS is the forecast value for March 2022. After calculating the forecast value, the next step is to calculate the accuracy of the forecasting error value. There are several criteria for identifying the error rate in forecasting such as Mean Error (ME), Mean Absolute Deviation (MAD), Mean Square Error (MSE), and MAPE. The calculation of the ME uses the following Equation 2.

$$\text{ME} = \frac{\Sigma(\text{JDP} - \text{HR})}{n} \quad (2)$$

Where ME is the mean error value. JDP is Total Sales Data in one period. HR is the forecast result that has been calculated previously, and n is the amount of data to be processed. An example is the author calculating the mean error in March 2022, then the total sales data for March 2022 is called the JDP while the forecasting results that have been calculated previously are called HR. The next step is to calculate the mean absolute deviation using the following Equation 3.

$$\text{MAD} = \frac{\Sigma|\text{JDP} - \text{HR}|}{n} \quad (3)$$

MAD is a calculation used to calculate the average absolute or absolute error. It is always used in forecasting methods to calculate tracking signals. The distribution of data on the tracking signal is used to determine whether the forecasting method can be used or not. The Equation 4 for calculating the MSE.

$$\text{MSE} = \frac{\Sigma(\text{JDP} - \text{HR})^2}{n} \quad (4)$$

In general, the MSE method is used to review how to estimate the error value in forecasting. MSE is the average error squared between the actual value and the forecast value. MSE values that are low or close to zero are stated that the forecasting results are good and almost in accordance with the actual data. Therefore, the forecast can be used for forecasting calculations in other data. The Equation 5 for calculating the MAPE.

$$\text{MAPE} = \frac{\Sigma((\,|\,\text{JDP} - \text{HR}\,|\,\times\,100\,)\,/\,\text{JDP})}{n} \quad (5)$$

MAPE is the absolute percentage error mean value which is used to calculate the forecasting error rate [17]. The MAPE method provides information on how much the forecasting error is compared to the actual value of the series. Definition of MAPE is a statistical calculation that is used to review how accurate the forecast is in forecasting methods. The MAPE method is usually used in matters related to forecasting because it is easy to use and effective. MAPE will state that forecasting is accurate if the error presentation value is getting smaller.

Low Code Application Concept

Low code is a software development approach that allows building applications more quickly and easily with minimal coding. The low code platform is a collection of tools that can enable the visual development of applications through interfaces and modelling. Low code can speed up and make it easier for users or developers in the process of making applications without having to type program code. The technique used by low code also allows users to develop an application using the drag-and-drop feature. A technique where programmers without writing code first to create a button and so on. One of the platforms used by low code applications is the OutSystems Platform [18].

Results and Discussion

The first step to start data processing is the stage of extracting the data that has been stored. The following is data for a period of 2 years and 24 months on a distributor of goods.

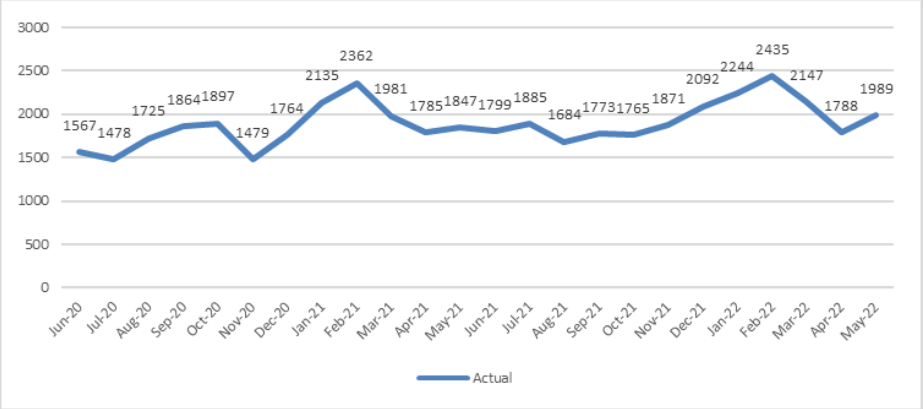

Figure 1. Data of Distributor

From the available data as shown in **Figure 1**, the next step is to process it using the single exponential smoothing method. The results exemplified here are the results of forecasting analysis with only one smoothing. Forecast calculation results are labelled with $alpha\ (\alpha) = 0.1$ and are applied to each data period to be studied. Alpha (α) is a parameter as a reference for the difference in exponential smoothing [19]. The following graph illustrates the forecast calculation results.

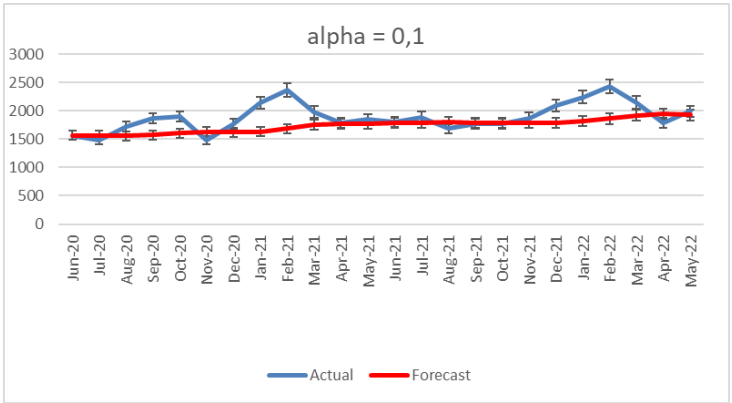

Figure 2. Forecast graph based on $\alpha = 0.1$

Figure 2 shows that there is a smoothing graph that illustrates the forecast calculation results for the value $\alpha = 0.1$. The blue line on the chart is actual data or sales data for each period. The highest actual value was in February 2022 with a score of 2435 and the lowest was in July 2020 with a score of 1478. Meanwhile, the red line is a smoothed forecasting value. The next step is to calculate the error value, namely ME. The following is a graph of the results of calculating the ME for the value $\alpha = 0.1$.

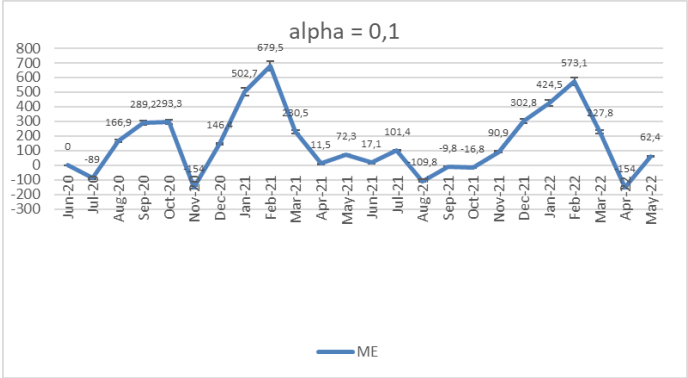

Figure 3. ME for $\alpha = 0.1$

ME is a calculation that is taken to produce a level of error testing. **Figure 3** shows that the highest ME value occurred in February 2021 at 679.5 and the lowest was in April 2022 at -154. Meanwhile, the ME of all periods is 152.4. The next step is to calculate the average absolute deviation of the research data, namely MAD. The following is a graph obtained based on the calculation of the MAD for the value α 0.1.

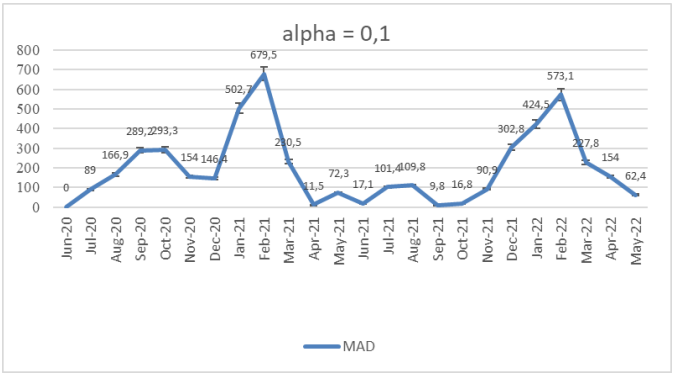

Figure 4. MAD for $\alpha = 0.1$

MAD describes how values are distributed in a data set so that the direction of the data is known. **Figure 4** shows that the highest MAD value occurred in February 2021 of 679.5 which is the same value as the highest value in the ME. Meanwhile, the lowest value in September 2021 was 9.8. The next step is to calculate the error value, namely MAPE. **Figure 5** is a graph obtained based on MAPE calculations for the value of $\alpha = 0.1$.

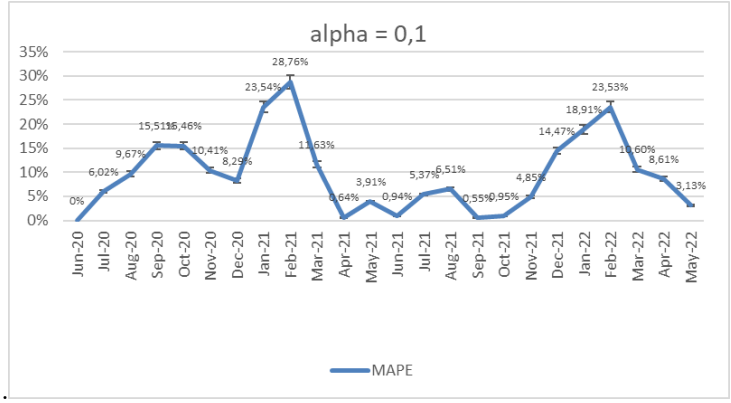

Figure 5. MAPE for $\alpha = 0.1$

Figure 5 shows that the highest MAPE value occurred in February 2021 at 28.76% and the lowest in September 2021 at 0.55%. Forecasting is declared accurate when the MAPE value is getting smaller. The absolute symbol in the MAPE equation indicates that the negative value of the calculation results will still be positive. The next step is to calculate the error value, namely MSE. The following is a graph obtained based on the calculation of MSE for the value of 0.1.

Figure 6 describes that the highest MSE value occurred in February 2022 at 328392.8 and the lowest was in September 2021 at 95.8. Forecasting calculations are carried out by minimizing the difference in error based on available data.

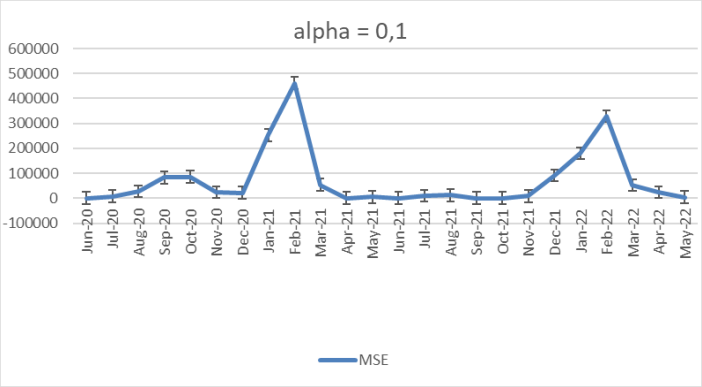

Figure 6. MSE for $\alpha = 0.1$

Minimization is carried out using the manual method, namely by selecting a value of α equal to 0.1 to 0.9. The intended error value is the calculated value of ME, MAD, MAPE, MSE. The following is the result of the calculation for the value α equal to 0.1, while the values 0.2 to 0.9 are not shown.

Table 2. Calculation results of MSE ($\alpha = 0.1$)

Mean Squared Error α = 0.1						
Period	***Actual***	***Forecast***	***ME***	***MAD***	***MAPE***	***MSE***
Jun-20	1567	1567	0	0	0%	0
Jul-20	1478	1567	-89	89	6.02%	7921
Aug-20	1725	1558.1	166.9	166.9	9.67%	27855.6
Sep-20	1864	1574.8	289.2	289.2	15.51%	83642.4
Oct-20	1897	1603.7	293.3	293.3	15.46%	86018.4
Nov-20	1479	1633	-154	154	10.41%	23728.3
Dec-20	1764	1617.6	146.4	146.4	8.29%	21422.4
Jan-21	2135	1632.3	502.7	502.7	23.54%	252735.1
Feb-21	2362	1682.5	679.5	679.5	28.76%	461659
Mar-21	1981	1750.5	230.5	230.5	11.63%	53134.6
Apr-21	1785	1773.5	11.5	11.5	0.64%	131.3
May-21	1847	1774.7	72.3	72.3	3.91%	5229.1
Jun-21	1799	1781.9	17.1	17.1	0.94%	291.8
Jul-21	1885	1783.6	101.4	101.4	5.37%	10276.5
Aug-21	1684	1793.8	-109.8	109.8	6.51%	12048.2
Sep-21	1773	1782.8	-9.8	9.8	0.55%	95.8
Oct-21	1765	1781.8	-16.8	16.8	0.95%	282.5
Nov-21	1871	1780.1	90.9	90.9	4.85%	8257.7
Dec-21	2092	1789.2	302.8	302.8	14.47%	91678.6
Jan-22	2244	1819.5	424.5	424.5	18.91%	180205.6
Feb-22	2435	1861.9	573.1	573.1	23.53%	328392.8
Mar-22	2147	1919.2	227.8	227.8	10.60%	51870.1
Apr-22	1788	1942	-154	154	8.61%	23723.7
May-22	1989	1926.6	62.4	62.4	3.13%	3891
Jun-20		1932.9				
		Average	152.4	196.9	9.68%	72270.5

Table 2 is the result of calculations from the single exponential smoothing method using an α value equal to 0.1 to 0.9. Information obtained from the table shows that the smallest error value is ME of 62.8, MAD of 179.9, MSE of 55564.5, and MAPE of 9.20%, namely the value of $\alpha = 0.3$. With a MAPE value below 10%, this indicates that the forecasting results are very accurate and can be used to estimate demand data in the next period. The following **Table 3** below is the result of calculating ME, MAD, MSE, and MAPE with a value of α equal to 0.1 to 0.9.

Table 3. Calculation results of ME, MAD, MAPE, MSE with varying alpha values.

Alpha	**ME**	**MAD**	**MAPE**	**MSE**
0.1	152.4	196.9	9.68%	72270.5
0.2	91.4	184.1	9.26%	59239.8
0.3	62.8	179.9	9.20%	55564.5
0.4	46.2	182.9	9.43%	53693.9
0.5	35.5	182.7	9.47%	52365.6
0.6	28.5	183.6	9.57%	51276.4

Alpha	ME	MAD	MAPE	MSE
0.7	23.8	183.8	9.63%	50318.3
0.8	20.7	183.5	9.66%	49445.6
0.9	18.8	183.7	9.71%	48655.9

Conclusion

The decision support system designed using the single exponential smoothing method uses OutSystems version 11.14.1. It has passed the calculation results manually and the results are in accordance with the results displayed by the system. This application can be used easily and quickly to make forecasting. Thus, it can be concluded that this system has been successfully built-in solving problems that can help predict sales. The results obtained after the evaluation were that the smallest error value was at alpha equal to 0.3 which obtained ME of 62.8, MAD of 179.9, MSE of 55564.5, and MAPE of 9.20%. The highest forecasting was in February with an increase of 124.98%.

For further research, it is recommended to be able to develop even more by adding several forecasting models in the system such as the weighted moving averages model and the moving averages model. The weighted moving averages model is more responsive to changes, while the moving averages model is more responsive to new demand data.

Acknowledgement

There are thousands of thanks to Putera Batam University and the STIE Nagoya Campus for supporting the research process. We also thank the research team for their hard work in collecting data as research material.

References

[1] S. A. Arnomo and Y. Yulia, "Clustering the potential bandwidth upgrade of FTTH broadband subscribers," *Ilk. J. Ilm.*, vol. 13, no. 1, pp. 51–57, 2021.

[2] A. W. Saputra, A. P. Wibawa, U. Pujianto, and ..., "LSTM-based Multivariate Time-Series Analysis: A Case of Journal Visitors Forecasting," *Ilk. J. ...*, vol. 14, no. 1, pp. 57–62, 2022.

[3] S. Panggabean, P. R. Sihombing, and ..., "Simulasi Exponential Moving Avarage dan Single Exponential Smoothing: Sebuah Perbandingan Akurasi Metode Peramalan," *J. Pemikir. dan Penelit. Pendidik. Mat.*, vol. 4, no. 1, pp. 1–10, 2021.

[4] A. Picu and T. Spyropoulos, "DTN-Meteo: Forecasting the performance of DTN protocols under heterogeneous mobility," *IEEE/ACM Trans. Netw.*, vol. 23, no. 2, pp. 587–602, 2015.

[5] A. Werth, N. Kitamura, and K. Tanaka, "Conceptual Study for Open Energy Systems: Distributed Energy Network Using Interconnected DC Nanogrids," *IEEE Trans. Smart Grid*, vol. 6, no. 4, pp. 1621–1630, 2015.

[6] Muladi, S. A. Siregar, and A. P. Wibawa, "Double Exponential-Smoothing Neural Network for Foreign Exchange Rate Forecasting," *Proc. - 2nd East Indones. Conf. Comput. Inf. Technol. Internet Things Ind. EIConCIT 2018*, pp. 118–122, 2018.

[7] S. A. Arnomo, Nopriadi, R. Harman, and Yulia, "Model Importance Performance Analysis Dan Webqual Untuk Evaluasi Website," *J. Desain Dan Anal. Teknol.*, vol. 1, no. 1, pp. 36–44, 2022.

[8] S. Juriah, "Peramalan (Forecasting) Volume Penjualan Sepatu," *JUDICIOUS J. Manag.*, vol. 2, no. 2, pp. 134–137, 2021.

[9] E. Balouji, O. Salor, and M. Ermis, "Exponential Smoothing of Multiple Reference Frame Components with GPUs for Real-Time Detection of Time-Varying Harmonics and Interharmonics of EAF Currents," *IEEE Trans. Ind. Appl.*, vol. 54, no. 6, pp. 6566–6575, 2018.

[10] Nugroho Arif Sudibyo, Ardymulya Iswardani, Arif Wicaksono Septyanto, and Tyan Ganang Wicaksono, "Prediksi Inflasi Di Indonesia Menggunakan Metode Moving Average, Single Exponential Smoothing Dan Double Exponential Smoothing," *J. Lebesgue J. Ilm. Pendidik. Mat. Mat. dan Stat.*, vol. 1, no. 2, pp. 123–129, 2020.

[11] F. Sidqi and I. D. Sumitra, "Forecasting Product Selling Using Single Exponential Smoothing and Double Exponential Smoothing Methods," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 662, no. 3, 2019.

[12] R. Rachmat and S. Suhartono, "Comparative Analysis of Single Exponential Smoothing and Holt's Method for Quality of Hospital Services Forecasting in General Hospital," *Bull. Comput. Sci. Electr. Eng.*, vol. 1,

no. 2, pp. 80–86, 2020.

[13] R. P. Kristianto and A. Setyanto, "Golden section search-multi variable algorithm for optimization parameter of triple exponential smoothing algorithm to predict sufferers of lungs disease," *Proc. - 2018 3rd Int. Conf. Inf. Technol. Inf. Syst. Electr. Eng. ICITISEE 2018*, pp. 194–198, 2018.

[14] R. Gustriansyah, N. Suhandi, F. Antony, and A. Sanmorino, "Single exponential smoothing method to predict sales multiple products," *J. Phys. Conf. Ser.*, vol. 1175, no. 1, 2019.

[15] S. Fachrurrazi, "Peramalan Penjualan Obat Menggunakan Metode Single Exponential Smoothing Pada Toko Obat Bintang Geurugok," *Techsi*, vol. 6, no. 1, pp. 19–30, 2015.

[16] K. D. Hartomo, S. Yulianto, and J. Maruf, "Spatial model design of landslide vulnerability early detection with exponential smoothing method using google API," *Proc. - 2017 Int. Conf. Soft Comput. Intell. Syst. Inf. Technol. Build. Intell. Through IOT Big Data, ICSIIT 2017*, vol. 2018-Janua, pp. 102–106, 2017.

[17] Chusyairi Ahmad, Ramadar N.S. Pelsri, and Bagio, "The Use of Exponential Smoothing Method to Predict Missing Service E-Report 2017 2nd International conferences on Information Technology, Information Systems and Electrical Engineering (ICITISEE) : proceedings : 1-2 November 2017, Yogyakarta, Indonesia," in *International Conferences on Information Technology, Information Systems and Electrical Engineering (ICITISEE)*, 2017, pp. 39–44.

[18] R. Martins, F. Caldeira, F. Sa, M. Abbasi, and P. Martins, "An overview on how to develop a low-code application using OutSystems," *Proc. Int. Conf. Smart Technol. Comput. Electr. Electron. ICSTCEE 2020*, pp. 395–401, 2020.

[19] Harliana and Hartatik, "Optimizing Single Exponential Smoothing Method by Using Genetic Algorithm for Object Selling Prediction," in *International Conference on Information and Communications Technology (ICOIACT)*, 2020, pp. 77–82.