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Forecasting Information System with Single Exponential Smoothing Method in Pharmaceutical Companies PT. Priest Nirmala/Fahrenheit

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ABSTRACT

Forecasting systems play an important role in business and economics. In the planning of drug production at PT. Pratapa Nirmala is still semi-computerized, which is limited to recording using the Microsoft Excel program and has not used definite methods or tools, thus allowing for human errors and significant differences between forecasting and actual sales which will affect stock out and over-stock drug supplies. Forecasting is a calculation analysis technique that is carried out with qualitative and quantitative approaches to predict future events using data from the past. The method used is observation, interview, and research, and the type of research used is quantitative and qualitative with descriptive analysis. This system uses an object-oriented design method with UML (Unified Modeling Language). The programming language used is the PHP programming language with MySQL database and the forecasting method used is Single Exponential Smoothing by considering the Mean Absolute Percentage Error (MAPE) value. After the calculation, obtained with an alpha value of 0.9, where the value of the Mean Absolute Percentage Error generated is 16%. and the form of the forecasting equation model is Ft = Ft-1 + a (At-1 – Ft-1). So this forecast is feasible and can be applied.

1. Introduction

The rapid development of information technology and communication, making the flow of globalization feel more and more swift flowing to all corners of the world. Need for information quality, fast, accurate, relevant is very necessary for the community and for companies to obtain information [1]. Quality information requires timely data, where data at the right time is needed to be used for certain needs, thus requiring processing speed. Appropriate needs will be formed if the information produced is correct, so that it can assist in decision making. In addition, if the information is given to the right people and really need it, then the use of the information can only be felt, so the information must also be relevant to its users.

Information technology can be used to help solve problems that occur in a business activity. One of the information technologies that can be used is a management information system. The management information system can provide information from data that has been previously processed, so that the existence of an information system is expected to help improve business performance. In addition, the benefits of information systems can also allow entrepreneurs to make forecasts/predictions on the products they sell, so as to maximize sales results [2].

Pratapa Nirmala/Fahrenheit is a company engaged in the pharmaceutical manufacture or one of the pharmaceutical production manufacturers that carries out the production, research, development, and distribution of medicinal products to distributors for sale to outlets (drug stores, hospitals, etc.) public health and welfare. At this time the drug production planning system at PT Pratapa Nirmala is still semi-computerized, which is limited to recording using the Microsoft Excel program and in planning it has not used definite methods or tools in determining sales planning, thus allowing human error and differences to occur. There is a significant relationship between forecasting and actual sales, which will affect stockout and overstock drug supplies.

In this context, the drug supply system stock out can be interpreted as an impact that occurs in the inventory system if the forecasting results of consumer demand are smaller than the actual demand that occurs, on the contrary, over stock occurs when the estimated results of consumer demand are greater

than consumer demand that occurs. Stock out will result in a decrease in customer satisfaction and trust which will cause lost opportunities to sell products for the drug sales business (opportunity cost) and over stock will result in increased inventory costs. In terms of drug availability, stock out of medicinal products is defined as the physical unavailability of the drug where the drug is needed by the patient and shortage of drugs (shortages) is defined as a situation where the availability of the drug is less than what is needed by the patient [3].

Therefore, to minimize this from happening, the company must be able to determine and predict the optimum amount of inventory for smooth activities and the profit from selling drugs obtained by the company can increase. Seeing the importance of the forecasting/forecasting system in determining sales forecasts and the right decision support, according to the reviews discussed, the authors are interested in conducting research with the title "Forecasting Information Systems that Affect Sales System Excellence" at the Pharmaceutical Company PT. Pratapa Nirmala/Fahrenheit.

1.1 Information System

Information System can be interpreted as a collection of several components that work together that are used to process data, record data, and present information for decision makers in order to make the right decisions [4].

1.2 Forecasting

Forecasting can be interpreted as an activity / activity to predict an event / event in the future by involving data in the past and forecasting does not provide a definite answer about what will happen, but tries to find an approach about what will happen later, so that can contribute to making the right decisions [5].

1.3 Single Exponential Smoothing

Single Exponential Smoothing is a moving average forecast that performs exponentially decreasing weighting of older observation values, this forecasting method is carried out by repeating calculations continuously using new data [6]. Each data is given a weight, where the weight used is symbolized by a (alpha). The smoothing constant ranges from 0-1, because the conditional value of a is 0< a<1.[7]

Formula: $F_t = F_{t-1} + \alpha (A_{t-1} - F_{t-1})$
Desc: F_t = *Forecast for period t*

F_{t-1} = Value of the previous estimate

α = Smoothing factor/constant ($0< \alpha<1$)

A_{t-1} = Actual value from previous period

1.4 Forecasting Accuracy

Forecasting Accuracy is a measure of forecasting error, where the level of difference between forecast results and actual demand occurs [8]. There are several sizes commonly used, which are as follows:

1.4.1 Mean Absolute Deviation (MAD)

MAD is an accuracy that can give equal weight to each value of the difference between forecasting and actual results. Appropriate to use if the error analysis is carried out in the same units as the actual request [9]. MAD is the average of the absolute values of deviation. The following is the formula for MAD, namely:

Formula: $MAD = \sum|A_t - F_t|/n$

Desc: A*t* = Actual demand in period-t

F*t* = Forecasting demand (forecast) in period-t

n = Number of forecasting periods

1.4.2 Mean Square Error (MSE)

MSE can be interpreted as the technique used in evaluating the results of forecasting calculations. This accuracy is used by squaring all the resulting errors divided by the number of forecasting calculation periods [10]. The following is the formula for MSE, namely:

Formula: $MSE = \sum(A_t - F_t)^2/n$

Desc: A*t*=Actual demand in period-t

F*t* =Forecasting demand (forecast) in period-t

n =Number of forecasting periods

1.4.3 Mean Absolute Percentage Error (MAPE)

MAPE is a measure of relative error, which is calculated using the absolute error in each period divided by the observed value [11] [12]. The following is the formula for MAPE, namely:

Formula: $MAPE = (100/n) \sum|A_t - F_t/A_t|$

Desc: A*t* = Actual data value in period-t

F*t* = Forecast on period-t

n = Number of forecasting periods

Table 1. Range MAPE [13]

No	Range *MAPE*	Criteria
1	<10%	Very good forecasting model
2	10% – 20%	Good forecasting model
3	20% – 50%	Forecasting model is feasible
4	>50%	Bad forecasting model

2. Methods

2.2 Data Collection Method

Data collection methods were used to obtain the required information and to achieve research objectives. The way the author uses the data collection method in this research is:

a. Observation

The observations made by the author are direct observation, direct observation, careful and direct observation in the field or research location. In this case, researchers based on their research design need to directly observe the running of the system that has been applied to the company PT. Pratapa Nirmala/Fahrenheit.

b. Interview

Interview or interview is a method of collecting data by researchers to obtain oral information by asking questions to the PPIC (Production Planning and Inventory Control) and Marketing division of PT. Pratapa Nirmala/Fahrenheit for questioning on matters related to research, so that the information obtained is more complete and clear.

c. Literature Study

Literature Study is a data collection method that is carried out by searching, collecting, reading and studying and understanding reference literature or reading material that is in accordance with the subject matter sourced from books, scientific journals, and other sources relevant to the problem being studied in order to obtain clarity of concepts and related with discussion.

d. Documentation

Documentation of various documents regarding data such as sales data and forecasting data.

2.1 Development Method/Analysis and Design Method

The method is a way, the stages to do something or an activity that will be done in solving the problem that will be researched and used to achieve the goal. The method used in this research is:

a. Analysis Method

The data analysis method used in this analysis is descriptive test. This descriptive test is a technique of analyzing data that is collected, compiled and interpreted and analyzed, so as to provide clear and complete information for problem solvers [14]. Descriptive test is a way of formulating and interpreting existing data, so that it can provide a clear picture through collecting, compiling and analyzing data, so that an overview of the company's sales forecasting/planning activities can be known. This research was conducted to determine and explain the characteristics of the variables studied in a situation. The sequence of data used includes data collection, data selection, data analysis, and then designing the proposed system to make a conclusion.

b. Design Method

The design method used in this analysis is the Object Oriented Design method, using UML (Unified Modeling Language), UML can clearly describe the flow of a system or program to be created. The design is carried out after the analysis stage, where in the design the software requirements are changed into a characteristic form that is easy to understand [15].

2.3 Object of Research

The author conducted research on the pharmaceutical company PT. Pratapa Nirmala/Fahrenheit which is located on Jl. Raya Industries II Block K, RT.006/RW.004, Pasir Jaya, Kec. Jatiuwung, Tangerang City, Banten 15135. PT. Pratapa Nirmala/Fahrenheit was officially established in 1988.

2.4 Current System Analysis

The system currently running in the company is a system that works by inputting sales data and prediction results into Microsoft Excel. Predictions made by marketing are calculations using Microsoft Excel by looking at sales history data and calculating average sales for three months (Average Method). The current forecasting system procedures can be explained as follows:

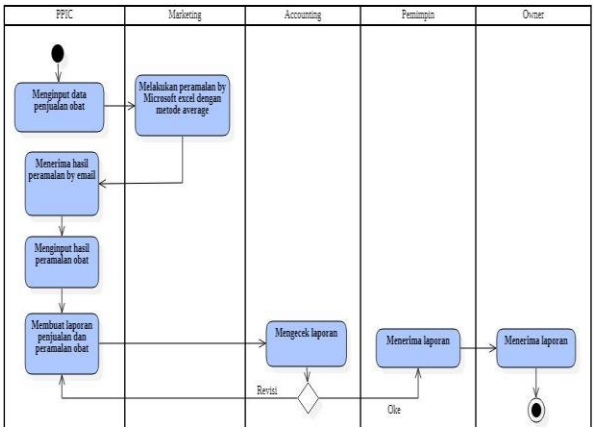


Figure 1. Activity Diagram Current System

2.5 Problems Encountered

Some of the problems faced at PT. The ascetic Nirmala is as follows:

1. The problem faced is the limited amount of stock (out of stock), resulting in unfulfilled demand, especially when market interest is high. However, excess drug stock (over stock) can also cause losses, namely the destruction of drugs because they have expired.
2. Inaccuracy in using forecasting methods (Moving Average).
3. There is a lot of storage of evidence of forecast results as archives which causes searching and updating data to take a long time.
4. There is a potential for data loss, due to data not being organized neatly or due to employee carelessness.

2.6 Alternative Troubleshooting

Based on the descriptions of the existing problems, the author will provide alternative solutions to the problem as follows:

1. A good way of predicting the number of sales in the following month is computerized by using a forecasting system and the Single Exponential Smoothing method, which is expected to have the potential for accuracy in forecasting that will support the planned plans, so as to maximize sales results.
2. A database system that is equipped with automatic calculations that aim to avoid or minimize errors in forecasting or predicting drug sales.
3. Provide access control to the database in the form of a security system to prevent users who do not have access rights from accessing the database.

2.7 User Requirement (Elicitation)

The Elicitation Final Draft can be seen in the following table:

Table 2. Elicitation Final Draft

Functional	
Needs Analysis	
No	**Description**
1	Displays the login and password form
2	Display the main page of Sales Forecasting Application
3	Displaying drug data form
4	There is a drug data search facility
5	There is a form to add new drug data
6	Display employee data
7	Show sales data
8	Show sales transaction form
9	Show sales forecasting form
10	Showing detailed forecasting results
11	Sales report and forecasting menu
12	There is a report printing facility
13	Logout process
Non Functional	
I want the system to be able to:	
1	Have an attractive appearance
2	The system is easy to understand and easy to use by the user

3. Results A\and Discussion

3.1 Proposed New Procedure

The need for data from this research is in the form of actual sales data. This data is obtained from the company PT. Pratapa Nirmala/Fahrenheit at the time of observation. The old data used is only the data for the last three years, from 2018 to 2020, and the current months are in Jan-Jul 2021. This data will be used to calculate sales forecasts for the following month. The examples of actual sales data for Renadinac-50 products from several products can be seen in Table 3 as follows:

Table 3. Sales Data for Renadinac-50 . Products

Year	Month	Actual Sales (Box)
2018	January	151.200
	February	153.720
	March	161.280
	April	168.000
	May	170.016
	June	108.023
	July	89.194
	August	96.703
	September	151.200
	October	151.200
	November	118.924
	December	82.115
2019	January	150.192
	February	140.524
	March	116.628
	April	150.192
	May	150.192

	June	112.758
	July	113.846
	August	126.000
	September	184.800
	October	201.600
	November	201.600
	December	151.200
2020	January	201.600
	February	220.080
	March	209.912
	April	151.200
	May	151.200
	June	151.200
	July	151.200
	August	151.200
	September	120.960
	October	151.200
	November	159.600
	December	168.000
2021	January	193.200
	February	210.000
	March	151.200
	April	151.200
	May	156.800
	June	207.200
	July	207.200

The results of the calculation of the forecast value using the Single Exponential Smoothing formula for the drug product Renadinac-50. The results of the forecasting obtained from January 2018 to July 2021 (using actual sales data) and alpha 0.9, the MAD (Mean Absolute Deviation) value is 21.96%. Forecasting results can be seen in Table 4.

Table 4. Forecasting Results as of January 2018-July 2021

Year	Month	Actual	Forecasting	*MAD*
2021	Jan	193.200	167.049	26.151
	Feb	210.000	190.585	19.415
	Mar	151.200	208.058	56.858
	Apr	151.200	156.886	5.686
	May	156.800	151.769	5.031
	Jun	207.200	156.297	50.903
	Jul	207.200	202.110	5.090

Average : **21.961**

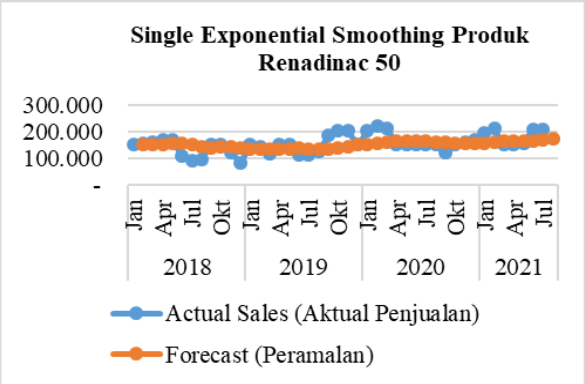
Based on the results of forecasting using actual sales data in the period January 2018 to July 2021, the results are shown in table 5. The forecasting results can be used as an illustration for companies in making decisions to support sales results in August 2021 and so on by minimizing MAPE (Mean Absolute Percentage) results. Error).

Forecasting results on the drug product Renadinac-50, the forecasting results are 206.691 and the MAPE value is 15.35% using an alpha value of 0.9. An example of the calculation in August 2021 is 202.110 + 0.9 (207.200 – 202.110) = 206.691 forecasting results for the period August 2021.

Table 5. Forecasting Results as of January 2018-July 2021

Year	Month	Actual	Forecasting	*MAPE*
2021	Jan	193.200	167.049	14
	Feb	210.000	190.585	9
	Mar	151.200	208.058	38
	Apr	151.200	156.886	4
	May	156.800	151.769	3
	Jun	207.200	156.297	25
	Jul	207.200	202.110	2
	Aug		**206.691**	-

Average : **15,35**



Graph of Single Exponential Smoothing forecast

Figure 2. Graph of Actual Sales and Forecasting

Based on the comparison of the approximate test of the alpha value, it can be seen that with a value of 0.9, the MAPE result is 15.35% and the accuracy is 100% - 15.35% = 84.65%, indicating that this method is feasible to be implemented in PT. Pratapa Nirmala/Fahrenheit. The comparison can be seen in table 6 as follows:

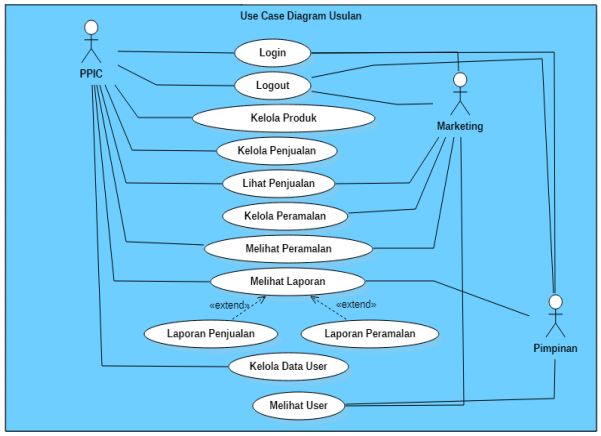
Table 6. Comparison of Estimated Tests Based on Alpha Values

Alpha values	MAPE
0,9	15,35%
0,8	15,82%
0,7	16,39%
0,6	16,99%
0,5	17,52%
0,4	17,89%
0,3	18,03%
0,2	17,97%
0,1	17,44%

3.2 System Design Diagram

The design of the system that is trying to be proposed is designed using UML (Unified Modeling Language), while the software is built using the PHP programming language and as data storage using the Mysql database.

Use Case Diagrams describe the structure, behavior and interaction of the system running on the sales forecasting information system and the expected functionality of a system, which emphasizes "what" the system does not "how" a system works. A Use



Case represents an interaction between the actor and the system.

Figure 3. Proposed Use Case Diagram

Figure 3. is a proposed Use Case diagram consisting of 3 actors, namely PPIC, Marketing and Leaders. Each actor has different access rights. PPIC has access rights which consist of logging in; manage product data; manage sales data; view sales results; can see forecasting results; view reports; manage user data. Marketing has access rights which consist of logging in; view sales results; manage forecasting; see

fortune telling; see users. Leaders also have access rights, namely to login; view reports and view users.

3.3 Implementation of Application Results

1. Login Page Display

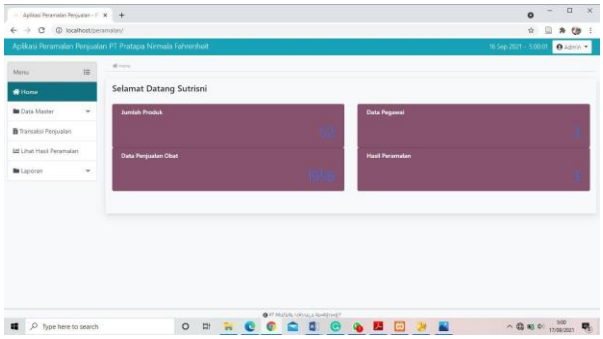


Figure 4. Login Page Display

Figure 4. The page to access the system by logging in first and the user must input the username and password before entering the main menu page.

2. Main Menu Page Display

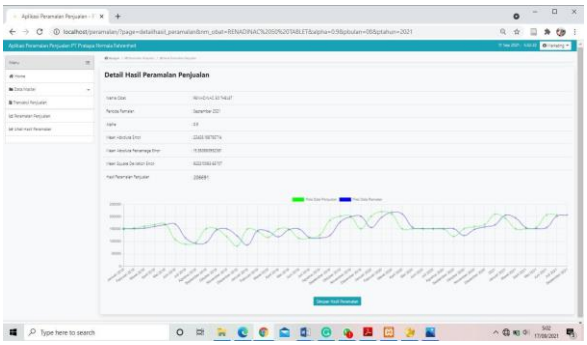


Figure 5. Main Menu Display

Figure 5. PPIC admin main menu page if you have successfully logged in. The three actors have the same appearance, only differ in their access rights. An explanation of access rights is in Figure 3.

3. Forecasting Results Detail Display

Figure 6. Forecasting Details page

Figure 6. This page is a detail of the forecasting results carried out by marketing. If the forecast results with the specified alpha value and get the smallest error value, the marketing division will click save the forecasting result to be used as a reference by the PPIC admin in scheduling the amount of production for the following month.

4. Conclusions and Suggestions

4.1 Conclusions

Based on the results of research and discussion, the authors draw the following conclusions:

1. The current forecasting system is still done manually and is prone to errors because it is only done by forecasting.
2. Information system forecasting / forecasting PT. Pratapa Nirmala was designed by using UML (Unified Modeling Language) and forecasting calculation method using Single Exponential Smoothing (SES). By designing a forecasting system using a web-based SES method, it is expected to minimize forecast errors and to reduce problems that often occur.
3. Based on the results of the research that has been done, it can be seen that the forecasting role of the SES model with the specified alpha value produces more accurate forecasting results and small error results compared to the conventionally determined value. This is an innovation in increasing accuracy in forecasting. Forecasting system using Single Exponential Smoothing calculation by considering the value of Mean Absolute Percentage Error (MAPE). After the calculation, it is obtained with an alpha value of 0.9, where the resulting Mean Absolute Percentage Error (MAPE) value is 16% and the form of the forecasting equation model is Ft = Ft-1 + (At-1 - Ft-1). So this forecast is feasible and can be applied.

4.2 Suggestions

So that the application of this system design can be realized properly, the authors provide suggestions, among others:

1. Forecasting calculation methods can be added with other methods in order to compare the accuracy of the methods.
2. The system that has been created needs to be integrated with other systems, for example with ordering system facilities from distributors. So, no need to order via email anymore.
3. Further development, so that the system can be connected with the existing stock in the warehouse, thus making forecasting easier.

References

[1] A. A. Sofyan, L. F. Gustomi, and S. Fitrianto, "Perancangan Sistem Informasi Perencanaan dan Pengendalian Bahan Baku Pada PT. Hema Medhajaya," *J. Sisfotek Glob.*, vol. 6, no. 1, pp. 87–95, 2016.

[2] A. Nurlifa and S. Kusumadewi, "Sistem Peramalan Jumlah Penjualan Menggunakan Metode Moving Average Pada Rumah Jilbab Zaky," *INOVTEK Polbeng - Seri Inform.*, vol. 2, no. 1, p. 18, 2017, doi: 10.35314/isi.v2i1.112.

[3] I. Kholidasari, L. Setiawati, and R. Ramanda, "Demand Categorization Dan Inventory Management Produk Obat: Studi Kasus Pada Suatu Toko Obat Di Kota Solok, Sumatera Barat," *Ind. J. Ilm. Tek. Ind.*, vol. 4, no. 2, pp. 72–77, 2020, doi: 10.37090/indstrk.v4i2.227.

[4] A. Stephano, S. Martha, and S. Rahmayuda, "Sistem informasi peramalan tren pelanggan dengan menggunakan metode double exponential smoothing di Mess GM," *J. Komput. dan Apl.*, vol. 8, no. 1, pp. 1–10, 2020.

[5] Hernadewita, Y. K. Hadi, M. J. Syaputra, and D. Setiawan, "Peramalan Penjualan Obat Generik Melalui Time Series Forecasting Model Pada Perusahaan Farmasi di Tangerang: Studi Kasus," *J. Ind. Eng. Manag. Res. (Jiemar)*, vol. 1, no. 2, pp. 35–49, 2020.

[6] 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, pp. 176–178, 2019, doi: 10.1088/1742-6596/1175/1/012036.

[7] N. P. L. Santiari and I. G. S. Rahayuda, “Penerapan Metode Exponential Smoothing Untuk Peramalan Penjualan Pada Toko Gitar,” *JOINTECS (Journal Inf. Technol. Comput. Sci.*, vol. 5, no. 3, p. 203, 2020, doi: 10.31328/jointecs.v5i3.1520.

[8] A. Putrasyah and S. Sukemi, “Perhitungan Peramalan Harga Emas Menggunakan Metode Single Exponential Smoothing Dan Single Moving Average,” *Annu. Res. Semin.*, vol. 5, no. 1, pp. 237–241, 2020.

[9] N. U. R. E. Sahra, H. Yozza, and Y. Asdi, “Pengendalian Mutu Berat Produksi Pt . Semen Padang Menggunakan Bagan Kendali Median Absolute Deviation (Mad) Pada Data Tidak Normal,” vol. 3, no. 1, pp. 123–131.

[10] R. Kurniati, Rini; Sugiarto, Sigit; Efendi, “Mean Square Error Terkecil dari Kombinasi Penaksi Rasio-Produk untuk Rata-Rata Populasi pada Sampling Acak Berstrata,” vol. 1, no. 1, pp. 15–17, 2014.

[11] H. S. Pakpahan, Y. Basani, and R. R. Hariani, “Prediksi Jumlah Penduduk Miskin Kalimantan Timur Menggunakan Single dan Double Exponential Smoothing,” *Inform. Mulawarman J. Ilm. Ilmu Komput.*, vol. 15, no. 1, pp. 47–51, 2020.

[12] A. Krisma, M. Azhari, and P. P. Widagdo, “Perbandingan Metode Double Exponential Smoothing Dan Triple Exponential Smoothing Dalam Parameter Tingkat Error Mean Absolute Percentage Error (MAPE) dan Means Absolute Deviation (MAD),” *Pros. Semin. Nas. Ilmu Komput. dan Teknol. Inf.*, vol. 4, no. 2, pp. 81–87, 2019.

[13] K. J. Atmaja, I. Bagus, G. Anandita, and S. Exponential, “Sales Forecasting System Using Single Exponential Smoothing,” *JurnalMantik*, vol. 4, no. 4, pp. 2552–2557, 2021.

[14] I. Kamlasi, “Descriptive Analyses on English Test Items based on the Application of Revised Bloom’s Taxonomy,” *Metathesis J. English Lang. Lit. Teach.*, vol. 2, no. 2, p. 203, 2018, doi: 10.31002/metathesis.v2i2.847.

[15] H. L. H. S. Warnars, “Pemodelan Elearning Perguruan Tinggi Dengan Menggunakan Framework Learning Technology System Architecture (Ltsa) Dan Unified Modeling Language (Uml),” *JUTI J. Ilm. Teknol. Inf.*, vol. 15, no. 1, p. 43, 2017, doi: 10.12962/j24068535.v15i1.a634.