Sales Forecasting Analysis Using Time Series Method: A Study on Chocolate Banana Snack Business

Sheila Mitha[1*], Lilia Pasca Riani[2]

[1, 2] Yogyakarta State University, Jl. Colombo No. 1 Karangmalang, Caturtunggal, Depok, Sleman, DIY, 55271

sheilamitha.2022@student.uny.ac.id

*corresponding author

Article Information	**Abstract**

Research aim : The purpose of this research is to analyze the sales trend of the Chocolate Banana snack business in the next period and analyze the accuracy level of chocolate banana snack sales forecasting.

Design/Methode/Approach : This research is descriptive research with a quantitative approach. There are two stages of data analysis, namely calculating sales forecasting for the next period using time series methods (Moving Average, Weighted Moving Average, and Exponential Smoothing methods. There are 3 types of Exponential Smoothing methods, namely Single Exponential Smoothing (SES) with constant α 0.1 and constant α 0.4, and Linear Exponential Smoothing (LES) with constant α 0.1 / β 0.2). While the second stage is to evaluate the results of the accuracy level of the sales forecasting method with the MAPE technique.

Research Finding : The result of this study is that the most effective method is the single exponential smoothing method (α 0.4) with the sales forecasting results for the next period of 594, with an accuracy level with MAPE of 5.67%.

Theoretical contribution/Originality : This research contributes to the application of time series forecasting methods in small-scale food businesses, especially in improving the accuracy of sales predictions.

Practitionel/Policy implication : The results of this study provide insights for small business owners in the food sector, emphasizing the importance of applying sales forecasting methods to improve decision-making.

Research limitation : This research is limited to 10 weeks of sales data, making it less accurate for the long term. Further studies are recommended using longer data and more complex methods.

Keywords : Sales Forecasting, Time Series, Single Exponential Smoothing, Mean Absolute Precentage Error, Small Business.

1. Introduction

Forecasting is a science or method used as a tool in estimating future events based on historical data and current data that are relevant and interrelated [1][2][3]. Forecasting methods have been widely applied in various fields, such as education, health, and sales [4]. One of the forecasting methods that is often used is the *time series* method. There are several scientifically recognized methods in demand forecasting. Namely the Moving Average, Weighted Moving Average, and Exponential Smoothing methods. There are 3 types of

Exponential Smoothing methods, namely Single Exponential Smoothing (SES), Linear Exponential Smoothing (LES), and Triple Exponential Smoothing (TES) [5]. This forecasting method in the business world has the aim of increasing the effectiveness of business planning, namely by helping businesspeople to plan production and inventory management in the future, so that the budget or financial sales of the business can be controlled properly [6][7].

There are still many small-scale food businesses that have not utilized this forecasting method optimally, including the Chocolate Banana food business. Many businesses do not understand that sales forecasting is needed as a tool in increasing the value of a new product and the amount of production to adjust product availability to market needs [8]. As a result, small-scale food businesses often experience problems in dealing with the uncertainty of products that will be sold and result in the accumulation of raw materials in the future. Therefore, it is necessary to make the right decisions, one of which is by predicting products that will be sold in the future using *forecasting* methods to support the operation of small businesses efficiently and sustainably [9] [10].

KThe effectiveness of *forecasting* methods is proven by several studies that have been conducted previously, but the results of effective methods depend on the research data being analyzed, such as: in research by N. I. Dewi and L. P. Riani (2024) [11] [11] which proves that the Single Exponential Smoothing method with alpha 0.1 has the best effectiveness in anticipating market demand at Smart Bakery. Meanwhile, research by A. Anastasya and W. Wahyudin (2023) [12] [12] states that the *Three Month Moving Average* forecasting method has the lowest error rate and is more effectively used by PT Artria Widya. However, although there are many studies that discuss sales forecasting, there are still shortcomings in the application of this method to small-scale food businesses, especially in the context of snacks based on local raw materials. This suggests a research gap that needs to be filled, especially in adapting existing forecasting methods to meet the specific needs of small businesses.

This research offers novelty in the use of sales time series forecasting in the microenterprise sector, specifically the Chocolate Banana snack business which has not received much attention in similar studies. Unlike other studies that tend to focus on large companies or the manufacturing sector, this study uses a simple and practical, yet accurate, forecasting method that is easy to use by SMEs. In addition, this study illustrates the application of time series forecasting methods tailored to the characteristics of small-scale food businesses, such as seasonal cycles and limited resources, with the aim of improving operational efficiency and data-driven decision-making.

The purpose of this research is to analyze the sales trend of the Chocolate Banana snack business and implement time series forecasting techniques such as Moving Average, Weighted Moving Average, and Exponential Smoothing (Single Exponential Smoothing and Linear Exponential Smoothing), which will be tested with the MAPE method to get a more accurate prediction of future sales seen from the smallest value it produces [13]. Accurate forecasts allow MSME players to better plan production, minimize losses, and increase business profitability.

1.1 Statement of Problem

Based on the introduction described earlier, the problem statement in this study is as follows:

1. The uncertainty of the number of sales causes small-scale food businesses to have difficulty in managing production and raw material inventory.
2. The lack of utilization of sales forecasting methods by chocolate banana businesses.

1.2 Research Objectives

The purpose of this study is to:

1. Apply a time series forecasting method to predict the future sales of Chocolate Bananas.
2. Calculate the results of forecasting the number of sales using the selected method.
3. Analyze the level of forecasting accuracy to determine the reliability of the method used.

2. Method

The type of research used in this study is descriptive research with a quantitative approach, which focuses on collecting numerical data to analyze the relationship between the variables involved in the study with the implementation of the Time Series Forecasting method. The type of data to be analyzed in this study is primary data taken directly through interview sessions with business owners. In this study, the data used by the author to conduct the analysis is the sales data of the chocolate banana business for the last 10 weeks from January 5 to March 15, 2025. Then the sales data is analyzed using Microsoft Excel. The data analysis stages carried out in this study are as follows:
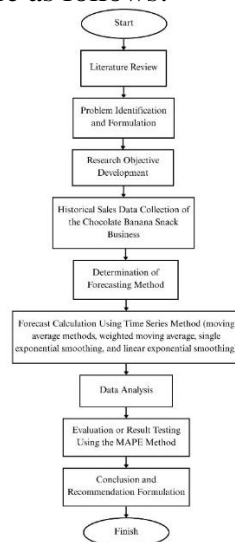

Figure 1. Research Flowchart

The Time Series Method is a method that can be used to analyze data collected periodically over a certain period. The time series method consists of several methods including: Moving Average Approach or often called Moving Average, is a method of forecasting the next period by calculating the average of the last period. The formula for the moving average method is as follows [14]:

$$F_t = \frac{\sum Previous\ period\ n\ demand}{n}$$

Description:

F_t : Current period forecasting   n   : Number of periods used

The second time series method is the weighted moving average method, which is a method of forecasting the next period using the average of the last period of data. The data will be given the greatest weight if the data is closest to the period to be forecast. The formula for the weighted moving average method is as follows:

$$F_t = \frac{\sum (weight\ of\ period\ n)(demand\ of\ period\ n)}{\sum weight}$$

The third method is the Exponential Smoothing method, which is a smoothing method when the last activity data is more likely to repeat than the previous activity data, the calculation of this method is using the alpha and beta constants. In addition, the Exponential Smoothing method consists of 2 methods namely Single Exponential Smoothing, Linear Exponential Smoothing. Single Exponential Smoothing has the following formula [14]:

$$F_{t+1} = \alpha \cdot X_t + (1-\alpha) \cdot F_t$$

Description:
X_t = data in the current period $\qquad$ F_{t+1} = forecast for the next period
α = smoothing factor/constant $\qquad$ F_t = forecast for period t or now
While the Linear Exponential Smoothing formula, as follows [8]:

$$S_t = \alpha \cdot X_t + (1-\alpha) \cdot (S_{t-1} + \frac{(X_2 - X_1) + (X_3 - X_2) + (X_4 - X_3)}{3})$$

Description:

S_t $\quad$: Experience the elements of data fluctuation $\qquad$ X_t $\quad$: current period data

The last step is the evaluation technique used to determine which method is the most effective to use. In this study, the evaluation technique used is the MAPE technique with the following formula [14]:

$$MAPE = \frac{\sum_{t=1}^{n} \frac{|Y_t - Y_t|}{Y_t} \times 100}{n}$$

The criteria for the accurate value of the MAPE method, if [15]:
1) MAPE value < 10%, then the forecasting accuracy is very good.
2) MAPE value of 10% - 20%, then the forecasting accuracy is good.
3) MAPE value of 20% - 50%, then the forecasting accuracy is sufficient.
4) MAPE value > 50%, then the forecasting accuracy is not accurate.

3. Results and Discussion
3.1. Sales Data of Chocolate Banana Business

Table 1. Sales Data of Chocolate Banana

Weekly	Actual Sales	Weekly	Actual Sales
1	560	6	490
2	610	7	570
3	670	8	610
4	740	9	600
5	660	10	590

Source: Chocolate Banana Business Primary Data, 2025

Based on Table 1, the sales of chocolate bananas business during the period January 5 to March 15, 2025, have a random pattern with an unstable increase in numbers. This causes prediction of sales in the next period to be difficult without proper quantitative or statistical calculation techniques.
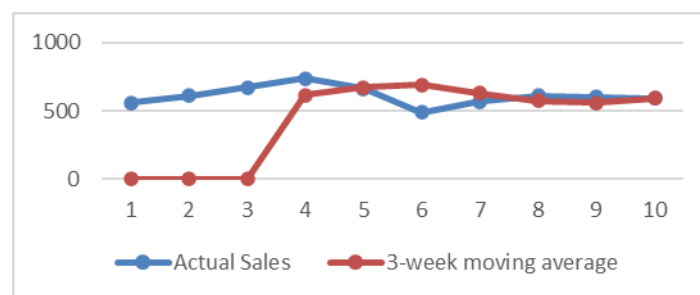
3.2. Time Series Model Forecasting
3.2.1. Moving Average Method
Table 2. Calculation of Brown Banana forecasting with the Moving Average method

Weekly	Actual Sales	Moving Average Method (3-week)
1	560	-
2	610	-
3	670	-
4	740	613,33
5	660	673,33
6	490	690,00
7	570	630,00
8	610	573,33
9	600	556,67
10	590	593,33
11	?	600,00

Source: Output Microsoft Excel Data, 2025

Source: Output Microsoft Excel Data, 2025
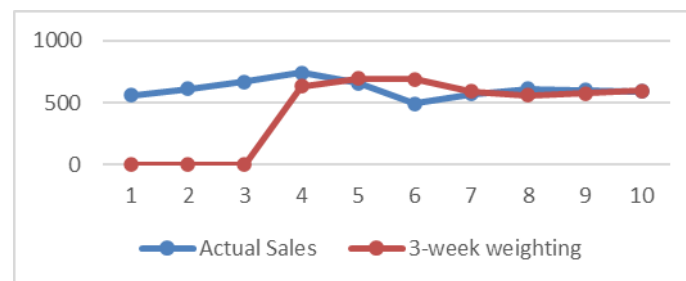**Figure 2. Graph of Forecasting Results Moving Average Method**

Based on table 2, the moving average method is carried out in the 4th period to get the forecasting results for the 11th week with a value of 600 units. From Figure 3, there are significant fluctuations in some sales weeks. However, based on the moving average method can provide fairly good results in predicting sales in the next period, in weeks 5, 7, 8, 9, and 10 forecasting results, but there is less accurate forecasting, for example in week 6 with a significant deviation. And this approach method, cannot be used for the early weeks because there is no previous sales data to calculate the moving average approach forecasting.

3.2.2. Weighting Moving Average Method
Table 3. Calculation of Chocolate Banana Forecasting with Moving Weighting Method

Weekly	Actual Sales	Weighting Moving Average (3 weeks)
1	560	-
2	610	-
3	670	-
4	740	631,67
5	660	695,00
6	490	688,33
7	570	588,33
8	610	558,33
9	600	576,67
10	590	598,33
11	?	596.67

Source: Output Microsoft Excel Data, 2025

Source: Output Microsoft Excel Data, 2025
Figure 3. Graph of Forecasting Results of The Weighting Moving Method

The moving average weighting method is used by giving a forecasting value based on the average sales of the previous three weeks. Based on table 3, the first forecasting result appears in week 4 because weeks 1, 2, and 3 are used to calculate the forecast. This forecasting result is quite stable which can help in identifying sales trends in the short term.

And in Figure 3, the forecasting graph rises in week 4 and the forecasting graph pattern has weeks with high deviations, and some are close together such as in week 6 where the forecasting is higher, but the actual sales are lower. And in week 10 the forecasting and actual points are close together. This proves that this method can show variations in sales that are not fully reflected in the three-week average.
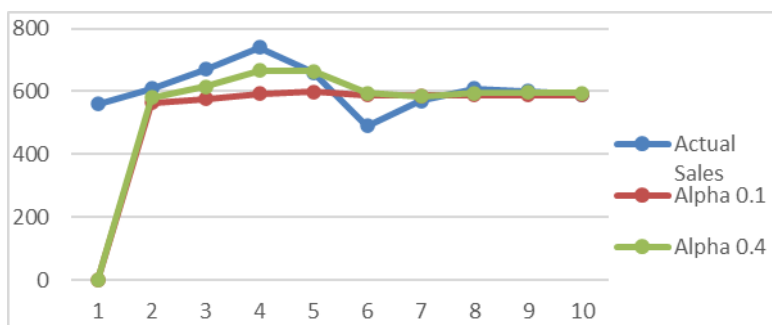
3.2.3. Single Exponential Smoothing Method
Table 4. Chocolate Banana Forecasting Calculation with Single Exponential Smoothing Method

Weekly	Actual Sales	Alpha 0,1	Alpha 0,4
1	560	-	-
2	610	565	580

3	670	575,50	616
4	740	591,95	665,60
5	660	598,76	663,36
6	490	587,88	594,02
7	570	586,09	584,41
8	610	588,48	594,65
9	600	589,63	596,79
10	590	589,67	594,07

Source: Output Microsoft Excel Data, 2025

Source: Output Microsoft Excel Data, 2025

Figure 4. Graph of Forecasting Results of Single Exponential Smoothing Method

In calculating the Single Exponential Smoothing forecast, researchers used two values of the smoothing parameter (alpha), namely 0.1 and 0.4. Based on the calculation of table 4, it is found that forecasting using alpha 0.1 tends to be more stable because the change in value is smaller. Meanwhile, forecasting results with alpha 0.4 tend to be more responsive to changes in actual sales but show greater fluctuations. This can be seen in the alpha 0.1 (orange) graph pattern whose lines are smoother than the alpha 0.4 (green) graph pattern, but the orange graph has a slower responsiveness in adjusting actual sales changes. And the alpha 0.4 (green) graph pattern shows a line that tends to approach the actual change pattern, but the value is more fluctuating. Overall, the selection of alpha values shows the impact on the sensitivity of forecasting to changes in actual sales.
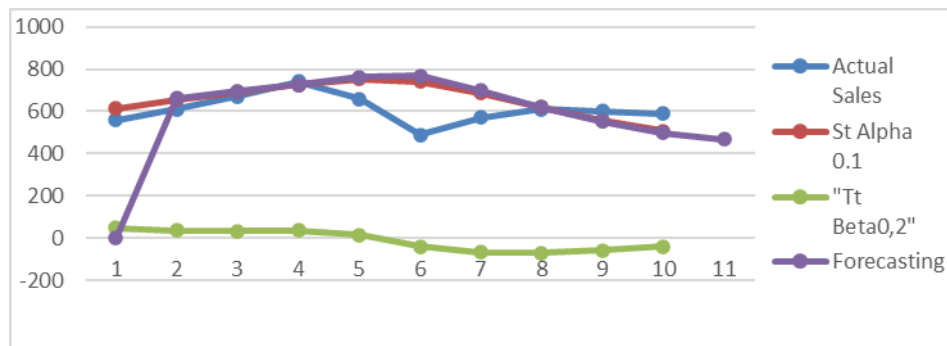
3.2.4. Linear Exponential Smoothing Method
Table 5. Chocolate Banana Forecasting Calculation with Linear Exponential Smoothing Method

Weekly	Actual Sales	St Alpha 0,1	Tt Beta 0,2	Forecasting
1	560	614,00	48,00	-
2	610	656,80	37,60	662,00
3	670	691,96	32,72	694,40
4	740	726,21	35,78	724,68
5	660	751,80	15,38	762,00
6	490	739,46	-40,05	767,18
7	570	686,47	-65,93	699,41

8	610	619,48	-68,04	620,54
9	600	556,30	-58,33	551,44
10	590	507,17	-39,92	497,97
11				467,25

Source: Output Microsoft Excel Data, 2025

Source: Output Microsoft Excel Data, 2025
Figure 5. Linear Exponential Smoothing Forecasting Results Chart

In the linear exponential method, researchers use level (St) and trend (Tt) components calculated using smoothing parameters, namely alpha 0.1 and beta 0.2. In table 5, the level (St) value changes following the actual sales pattern, while the trend (Tt) value shows positive and negative value movements according to changes in sales trends. And the sales forecasting result is the sum of the level value (St) and trend value (Tt) shown in the light blue graph. In the graph, the forecasting pattern with this method shows a pattern that tends to follow the actual sales graph pattern, but starting from the 4th week the graph pattern experiences a delay in responding to changes in actual sales. Overall, the linear exponential method is able to identify downward trends in sales, but with a slight delay in responding to drastic changes in actual sales data.

3.3. Sales Forecasting Evaluation

The following is an error test calculation or evaluation on time series forecasting methods (moving average approach, moving average weighting, single exponential smoothing, and linear exponential smoothing) using MAPE evaluation, which can be seen in table 6:

Table 6. MAPE Forecasting Evaluation Calculation

Forecasting Method	MAPE
Moving Average	12,04
Weighting Moving Average	11,06
Single Exponential Smoothing (a = 0,1)	8,76
Single Exponential Smoothing (a = 0,4)	5,67
Linier Exponential Smoothing	14,93

Source: Output Microsoft Excel Data, 2025

Based on the table above, the evaluation results using MAPE show that all methods used are quite accurate, as the average MAPE value is below 30%. The Moving Average method produces an average MAPE value of 12.04%, while the Weighted Moving Average method shows an average MAPE value of 11.06%. Both are also quite accurate. Meanwhile, the Single Exponential method at alpha 0.1 produced an average MAPE value of 8.76%, and at alpha 0.4 it was even lower at 5.67%. This shows that the method has a good level of accuracy. Finally, the Linear Exponential method recorded an average MAPE value of 14.93%, which is also still in the accurate category as it is below 30%.

4. Conclusion

From the results of the research completed, all the forecasting methods tested are accurate and effective in evaluating the sales prediction of Chocolate Banana for the upcoming period, using sales data from the last 10 weeks. This can be proven through the evaluation results of the forecasts, where the average MAPE value is below 30%. Of the various methods tested, the most effective and efficient by far is the single exponential smoothing with alpha 0.4, which yields a MAPE of 5.67 percent. This means that this method has the highest accuracy in anticipating market demand.

This study provides practical relevance for microenterprises such as Mrs. Tia's Chocolate Banana, particularly for sales data management and production planning. The application of Single Exponential Smoothing with alpha 0.4 is not only simple to implement but also has a good response to actual sales data. This method is also appropriate for sales data that has a fluctuating and non-constant pattern and is more accurate for short-term forecasting. In terms of novelty, this study highlights the importance of choosing the right forecasting method in terms of small business data characteristics so that the analysis can be applied for immediate business decision-making.

This study is limited by the scope of the sales data analyzed, which only covers the last ten weeks, therefore the forecasts made are unlikely to be accurate in the long term. In addition, this study only tested simple forecasting techniques without complex ones such as ARIMA or machine learning algorithms. It is recommended for future research to approach the study problem with longer time series datasets and other forecasting methods to achieve more comprehensive findings. On a practical level, Chocolate Banana business owners are also expected to allow some family members, such as the owner's children, to assist in conducting forecasting analysis using single exponential smoothing with alpha 0.5, which should help improve the efficiency of production planning and stock management.

References

[1]   F. Ahmad, "PENENTUAN METODE PERAMALAN PADA PRODUKSI PART NEW GRANADA BOWL ST Di PT.X," *JISI: Jurnal Integrasi Sistem Industri*, vol. 7, no. 1, p. 31, May 2020, doi: 10.24853/jisi.7.1.31-39.

[2]   F. Petropoulos *et al.*, "Forecasting: theory and practice," Jul. 01, 2022, *Elsevier B.V.* doi: 10.1016/j.ijforecast.2021.11.001.

[3]   L. Wiranda and M. Sadikin, "PENERAPAN LONG SHORT TERM MEMORY PADA DATA TIME SERIES UNTUK MEMPREDIKSI PENJUALAN PRODUK

PT. METISKA FARMA," *Jurnal Nasional Pendidikan Teknik Informatika (JANAPATI)*, vol. 8, 2019, doi: https://doi.org/10.23887/janapati.v8i3.19139.

[4] Riaqiati, "Penerapan Metode Single Exponential Smoothing dalam Peramalan Penjualan Benang," *Smart Comp*, vol. 10, no. 3, 2021, doi: https://doi.org/10.30591/smartcomp.v10i3.2887.

[5] L. Pasca Riani and M. R. Afandi, "Forecasting Demand Produk Batik Di Tengah Pandemi Covid-19 Studi Pada Usaha Batik Fendy, Klaten," *JURNAL NUSANTARA APLIKASI MANAJEMEN BISNIS*, vol. 5, no. 2, pp. 122–132, Oct. 2020, doi: 10.29407/nusamba.v5i2.14441.

[6] S. N. Budiman, "Peramalan Stock Barang Dagangan Menggunakan Metode Single Exponential Smoothing," *Jurnal Teknologi dan Manajemen Informatika*, vol. 7, no. 2, pp. 113–121, 2021, doi: https://doi.org/10.26905/jtmi.v7i2.6727.

[7] N. Luh, W. Sri, R. Ginantra, I. Bagus, and G. Anandita, "Penerapan Metode Single Exponential Smoothing Dalam Peramalan Penjualan Barang," *Jurnal Sains Komputer & Informatika (J-SAKTI*, vol. 3, pp. 433–441, 2019, doi: http://dx.doi.org/10.30645/j-sakti.v3i2.162.

[8] D. R. Indah and E. Rahmadani, "Sistem Forecasting Perencanaan Produksi dengan Metode Single Eksponensial Smoothing pada Keripik Singkong Srikandi Di Kota Langsa," *JENSI*, vol. 2, no. 1, 2018, doi: https://doi.org/10.33059/jensi.v2i1.930.

[9] Jay. Heizer, Barry. Render, and Chuck. Munson, *Operations management : sustainability and supply chain management*. Pearson, 2020. Accessed: Mar. 23, 2025. [Online]. Available: https://sophora.id/wp-content/uploads/2023/08/operations-management-12ed-jay-heizer-pdfdrive-.pdf

[10] F. Rohman Hariri and C. Mashuri, "Sistem Informasi Peramalan Penjualan dengan Menerapkan Metode Double Exponential Smoothing Berbasis Web," *Generation Journal*, vol. 6, no. 1, pp. 2580–4952, doi: https://doi.org/10.29407/gj.v6i1.16204.

[11] N. I. Dewi and L. P. Riani, "ANALISIS FORECASTING DEMAND TERHADAP PENJUALAN ROTI TAWAR (STUDI KASUS DI TOKO ROTI SMART BAKERY)," *Prosiding Simposium Nasional Manajemen dan Bisnis*, vol. 3, pp. 1–14, 2024, doi: https://doi.org/10.29407/0q82ee55.

[12] A. Anastasya and W. Wahyudin, "Analisis Peramalan dengan Metode Naive, Linear Regression, Moving Average dan Exponential Smoothing (Studi Kasus: PT Artria Widya)," *Jurnal Serambi Engineering*, vol. 8, no. 3, 2023, doi: https://doi.org/10.32672/jse.v8i3.6602.

[13] J. Vimala and A. Nugroho, "FORECASTING PENJUALAN OBAT MENGGUNAKAN METODE SINGLE, DOUBLE, DAN TRIPLE EXPONENTIAL SMOOTHING (STUDI KASUS : APOTEK MANDIRI MEDIKA)," *Jurnal Penerapan Teknologi Informasi dan Komunikasi*, vol. 1, no. 2, 2022, doi: https://doi.org/10.24246/itexplore.v1i2.2022.pp90-99.

[14] A. Lusiana and P. Yuliarty, "PENERAPAN METODE PERAMALAN (FORECASTING) PADA PERMINTAAN ATAP di PT X," *Jurnal Teknik Industri ITN Malang*, vol. 10, p. 1, 2020, doi: https://doi.org/10.36040/industri.v10i1.2530.

[15] F. Aditya, D. Devianto, and Maiyastri, "PERAMALAN HARGA EMAS INDONESIA MENGGUNAKAN METODE FUZZY TIME SERIES KLASIK," *Jurnal Matematika UNAND*, vol. VIII, pp. 45–52, 2019, doi: https://doi.org/10.25077/jmu.8.2.45-52.2019.