Journal of Studies in Academic, Humanities, Research and Innovation
Volume 3 No 1 June 2026
E-ISSN: 3089-7106
https://journal.as-salafiyah.id/index.php/sahri
sahrijournaleditor@gmail.com

Comparison Of Moving Average Methods For Forecasting Recommendation Letters By Licensing Type In Pamekasan Regency

[1]Ani Alfiya Fahad, [2] Kuzairi, [3]Tony Yulianto
[1,2,3]Universitas Islam Madura, Indonesia.
[1]toniyulianto65@gmail.com, [2]alfiyafahad115@gmail.com, [3]kuzairi81@gmail.com.

**Correspondence Email: toniyulianto65@gmail.com*

Abstract: *Recommendation letters play an important role in various aspects of life, such as applying for assistance, business permits, and support for social activities. This letter serves as a means of providing official support from the authorities to individuals or groups in need, whose numbers need to be predicted for sustainable management. The forecasting method that is widely used is Moving Average, and in this study, In this study, predictions of the number of issued recommendation letters from 2021 to 2024 were carried out using the single moving average, exponential moving average and weighted moving average methods. The results of the study showed that the single moving average method was proven to be the best method with a MAPE value of (43.8073), followed by the exponential moving average method with a MAPE value of (47.0741), and the weighted moving average with a MAPE value of (47.0741). So the forecasting method that is considered feasible is the single moving average method as shown by its MAPE range value. Thus, the single moving average method is determined to be the best forecasting method for predicting future recommendation letter issuance.*
Keywords: *Moving Average, Forecasting, Recommendation Letter.*

INTRODUCTION

Pamekasan located on Madura Island, East Java, is one of the regencies that has a very interesting cultural wealth and economic potential. This area is famous for its strong local traditions, typical cuisine, and abundant agricultural and livestock products. However, like other areas, Pamekasan also faces various challenges in social and economic development that require serious attention. One of the tools that is often used to support various administrative and development activities in this area is a letter of recommendation. Of course, there are problems that occur in the process of recording incoming letters, outgoing letters and letter archives, problems that occur for example, searching for incoming letters takes a long time to search in archive files, each letter that is processed has a letter expiration date, where officers will have difficulty in controlling letters that have been processed or have not been processed (Rachmatulah & Wijaya, 2019).

A letter of recommendation is a series of guidelines related to work, or academic tasks carried out by individuals, groups, or institutions. And Based on Permendagri No. 64 of 2011 as

amended by Permendagri No. 7 of 2014, a research permit or letter of recommendation only aims to: 1. Serve as a means for local government researchers to issue research recommendations; 2. Be a reference for researchers in implementing research recommendations; 3. Administrative order (Kurniawan & Hariyoko, 2023).

Forecasting is thinking about a quantity, for example the demand for a product or several products in the coming period. In essence, forecasting is just a thought (guess), but by using certain techniques, forecasting becomes more than just an estimate. Forecasting can be said to be a scientific estimate (educated guess). Every decision that will come, there must be a forecast that underlies the decision making (Hudaningsih, Utami, & Jabbar, 2020). The forecasting function is one of the five important roles of data mining. Data mining is concerned with the process of extracting hidden information in a large database so that it can facilitate the discovery of hidden and important information behind a database with a very large amount of data (Irawan, Sumijan, & Yuhandri, 2021). The forecast can be the basis for predicting within a certain period of time. The forecasting function is seen when making decisions (Lubis & Sumijan, 2021).

One of the widely used forecasting methods is the moving average method. The types of moving averages commonly used are single moving average (SMA), exponential moving average (EMA), and weighted moving average (WMA). In previous studies, the moving average method was also compared with several other methods, which resulted in this moving average method being better. Research entitled Comparison of Double Moving Average and Double Exponential Smoothing in Forecasting Medical Consumables conducted by Sinaga & Irawati (2018), This study was conducted by taking samples, namely 3ml syringe data from January 1 to June 30, 2017. The results of forecasting accuracy measured by MAPE (Mean Absolute Percentage Error) and RMSE (Root Mean Square Value) showed that the Double Moving Average Method provided more accurate results (MAPE = 0.353 and RMSE = 95.8) compared to the Double Exponential Smoothing Method. And also a study entitled Inventory Forecasting Using the Weighted Moving Average Method and the Double Exponential Smoothing Method conducted by Ratih (2017), the data used for this study is sales data for one year 2016. The results of the accuracy calculation using the Mean Square Error (MSE) show that the weighted moving average method is 0.114 while the MSE error value in the double exponential smoothing method is 6.12. So it can be concluded

that the weighted moving average method is better than the double exponential smoothing method because it has a smaller error value.

In this study, the number of recommendation letters according to the type of permit in Pamekasan Regency will be predicted using a moving average. The methods used are single moving average, exponential moving average and weighted moving average. The average percentage method (MAPE) is used to determine the best method among the three methods used.

Forecasting with Moving Average Method

The time series method consists of several methods, one of which is moving average forecasting. The moving average method is used if past data is data that does not have a trend element or seasonal factor. Moving average forecasting is widely used to determine the trend of a time series (Nurlifa & Kusumadewi, 2017). The moving average method is a forecasting method that is carried out by taking a group of observation values, finding the average value as a forecast for the coming period (Rachman, 2018). There are several methods in moving averages, namely:

Single Moving Average

Single moving average is a forecasting method that is carried out by taking a group of observation values, finding the average value as a forecast for the coming period. Single moving average is one of the time series forecasting methods. This method is used if past data does not have a trend element or seasonal factor (Hudaningsih, Utami, & Jabbar, 2020). The purpose of single moving average forecasting is to eliminate or reduce randomness in the time series. This goal can be achieved by averaging several values in the data together, in which way the positive and negative errors that may occur can be removed or eliminated (Hudaningsih, Utami, & Jabbar, 2020). The mathematical formula for single moving average can be seen in the following formula (Zega, Hulu, Zebua, & Zebua, 2024):

$$F_{t+1} = \frac{Y_t + Y_{t-1} + Y_{t-2} + \cdots + Y_{t-n+1}}{n}$$

Information :

$F_{(t+1)}$: forecast value period $t + 1$

Y_t : actual data in period t

n : the amount of data taken into account or the time period of a single moving average

t : now

Journal of Studies in Academic, Humanities, Research and Innovation
Volume 3 No 1 June 2026
E-ISSN: 3089-7106
https://journal.as-salafiyah.id/index.php/sahri
sahrijournaleditor@gmail.com

Exponential Moving Average

Exponential moving average is also known as exponentially weighted moving average or commonly abbreviated as EMA (Sari & Hasanuddin, 2020). This model is a development of the weighted moving average model towards the exponential model. The weights given are slightly different from the WMA model, in this EMA model the latest data is weighted more than the past data and the oldest weight approaches zero which forms an exponential graph. The formula for calculating the exponential moving average (EMA) indicator is as follows (Prapcoyo, 2018):

$$EMA = a.Y_t + (1 - a).S_t$$

Information:

Y_t : real value of period t

S_t : EMA value of period t

$a = \frac{2}{n+1}$ where n is the period used in the EMA calculation.

Weighted Moving Average

Weighted Moving Average (WMA) is a moving average that has weights. The weighted moving average method is a method that has a different weighting technique for the available data so that the most recent data is the most relevant data for forecasting so that it is given a greater weight (Marlina & Amri, 2024). The weights are determined in such a way that the total weight is equal to one. The advantage of the WMA method is that the weighting value can be adjusted, but determining the best weight is not easy (Erdianita, Mumpuni, & Aditiawan, 2023). The formula for calculating the weighted moving average value is as follows (Nurhayati & Syafiq, 2022):

$$WMA = \frac{\sum(D_t \times weight)}{\sum weight}$$

Information :

D_t : actual data in period t

Weight : weight given for each month

Evaluation of Forecasting Results with MAPE (Mean Absolute Percentage Error) for the Moving Average Method

MAPE is a measure of relative error (Maricar, 2019). The percentage error of the forecast results can be used as a measure of the accuracy of a forecast (Erdianita, Mumpuni, & Aditiawan,

Journal of Studies in Academic, Humanities, Research and Innovation
Volume 3 No 1 June 2026
E-ISSN: 3089-7106
https://journal.as-salafiyah.id/index.php/sahri
sahrijournaleditor@gmail.com

2023). A higher error rate can indicate that the forecast results are less reliable or inaccurate and a lower error rate can indicate that the forecast results are more reliable or accurate (Erdianita, Mumpuni, & Aditiawan, 2023). MAPE is usually more accurate than MAD because MAPE states the percentage error of the forecast results against actual demand during a certain period which will provide information on the percentage of errors that are too high or too low. Mathematically, MAPE is stated as follows:

$$MAPE = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{X_t - F_t}{X_t}\right| \times 100$$

Information :

X_t : actual data in period t

F_t : forecast value at period t

t : forecasting period

n : amount of data

Range MAPE	Meaning
<10%	Forecasting Model Ability Very Good
10% - 20%	Forecasting Model Ability Good
20% - 50%	Forecasting Model Ability Decent
>50%	Forecasting Model Ability Poor

Table 1. *MAPE value range*

METHOD

This study employed a structured research methodology consisting of several stages designed to obtain accurate and reliable forecasting results. The first phase was a literature study, conducted by reviewing theories and empirical findings related to forecasting techniques, moving average methods, and quantitative prediction models. Previous studies have emphasized that moving average-based forecasting provides consistent and stable predictive outputs for administrative and production-related data (Erdianita et al., 2023; Hayuningtyas, 2017). Additional literature was examined to strengthen the conceptual understanding of SMA, EMA, and WMA, since these methods have been widely used for forecasting in various sectors ranging from inventory management to revenue prediction demonstrating their applicability and reliability (Maricar, 2019; Sari & Hasanuddin, 2020). This literature foundation ensured that the research

process aligned with established scientific standards and supported the formulation of an accurate forecasting model for recommendation letters in Pamekasan Regency.

The second phase of the methodology was data collection, which used secondary data obtained from the Pamekasan One Data portal. These data consist of monthly records of the number of recommendation letters issued for different licensing categories from 2021 to 2024. Following data collection, the study proceeded with the forecasting stage using three analytical techniques: the Single Moving Average (SMA), Exponential Moving Average (EMA), and Weighted Moving Average (WMA). The SMA method was applied by grouping sequential observed values and calculating their mean to produce forecasts for subsequent periods. The EMA method required determining an appropriate smoothing constant and analyzing indicator trends across periods, while the WMA method involved assigning proportional weights to give more importance to recent data. These methodological approaches are consistent with forecasting procedures commonly employed in quantitative modeling research, as highlighted by previous scholars (Erdianita et al., 2023; Hayuningtyas, 2017).

To evaluate the accuracy of the forecasting models, this study used the Mean Absolute Percentage Error (MAPE) performance indicator. The process included calculating absolute errors, converting them into percentage values, and averaging them across all periods to obtain the error magnitude. MAPE was selected because it is widely recognized as a reliable measure for comparing multiple forecasting models, particularly when assessing moving average–based predictions (Maricar, 2019; Sari & Hasanuddin, 2020). The model with the lowest MAPE score was categorized as the most accurate and suitable for forecasting future trends in recommendation letter issuance.

The final stage involved analyzing the forecasting results for their practical implications. The outcomes were then interpreted to support strategic planning, resource allocation, and administrative decision-making for the licensing sector in Pamekasan Regency. A concluding stage summarized the key insights and identified the most effective forecasting method among the three tested models. The entire methodological flow from literature study, data collection, forecasting procedures, accuracy measurement, to conclusion drafting was developed to ensure a robust and scientifically valid process.

Journal of Studies in Academic, Humanities, Research and Innovation
Volume 3 No 1 June 2026
E-ISSN: 3089-7106
https://journal.as-salafiyah.id/index.php/sahri
sahrijournaleditor@gmail.com

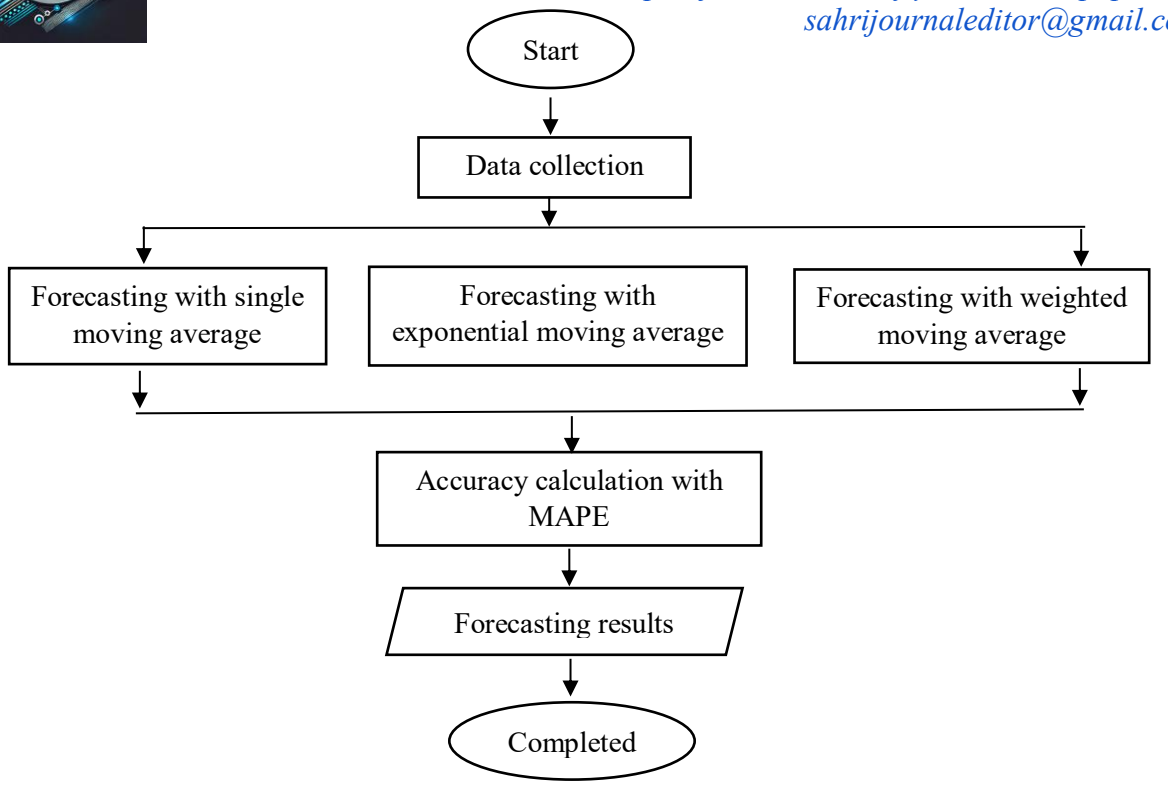

***Figure 1**. Solution steps*

RESULTS AND DISCUSSION

RESULT

The following are the forecasting results using the single moving average, exponential moving average and weighted moving average methods, which can be seen in Table 2 below:

Month	Data	SMA	EMA	WMA
01/01/2021	28			
01/02/2021	34	28	28	28
01/03/2021	44	31	32	32
01/04/2021	31	35,33333	38	38
⋮	⋮	⋮	⋮	⋮
01/12/2024	54	43,38298	46,3227	46,3227
01/01/2025		43,60416	46,6360	46,6360

***Table 2**. SMA, EMA and WMA forecasting results*

From Table 2, the results of the calculation of the prediction of the number of recommendation letters according to the type of permit in Pamekasan using 3 methods, namely

the single moving average method of 43.60416, the exponential moving average of 46.6360 and the weighted moving average of 46.6360, each method used is able to predict the next period from the calculation results of each method tested for the magnitude of the error so as to obtain the MAPE value and the best method can be determined to predict the number of recommendation letters according to the type of permit in Pamekasan in the next period.

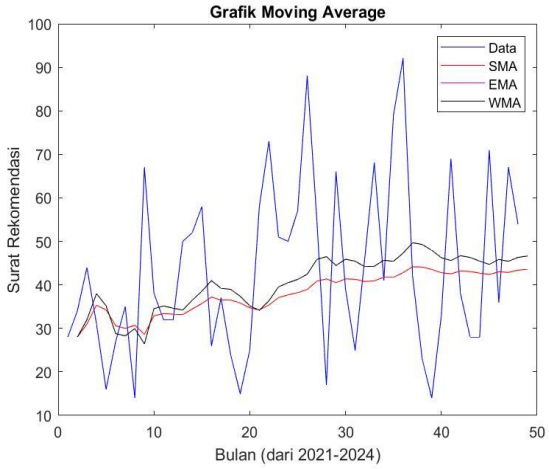

Figure 2. *Moving average forecasting results*

The overall comparison of SMA, EMA and WMA models in Figure 2 shows that the SMA model is closer to the actual data of the number of recommendation letters. It is not enough and it is impossible to conclude that it is not objective if it is only compared graphically rather than numerically, for that it will be compared numerically using the Mean Absolute Percentage Error (MAPE) forecast accuracy. The forecast results will be presented in Table 3 below:

	SMA	EMA	WMA
MAPE	43.8073	47.0741	47.0741

Table 3. *Comparison of MAPE values in the three models*

From Table 3, the results of SMA MAPEL are 43.8073. MAPE EMA is 47.0741. MAPE WMA is 47.0741. From the results of the accuracy values used to compare the three SMA models, EMA and WMA, it can be seen that the SMA model has the smallest accuracy value, this means that the SMA model is the best model for forecasting the number of recommendation letters for the next period.

Journal of Studies in Academic, Humanities, Research and Innovation
Volume 3 No 1 June 2026
E-ISSN: 3089-7106
https://journal.as-salafiyah.id/index.php/sahri
sahrijournaleditor@gmail.com

DISCUSSION

The results of this study demonstrate that the Single Moving Average (SMA), Exponential Moving Average (EMA), and Weighted Moving Average (WMA) methods each provide viable forecasting outputs for predicting the number of recommendation letters by licensing type in Pamekasan Regency. However, their performance levels differ substantially, particularly when evaluated using Mean Absolute Percentage Error (MAPE). The SMA method produced the smallest MAPE value (43.8073), indicating higher accuracy compared to EMA and WMA, which both resulted in identical MAPE values of 47.0741. These findings suggest that the dynamic characteristics of the data characterized by moderate fluctuations without strong trends are best captured using the simpler averaging mechanism employed in SMA. This aligns with existing studies that argue SMA tends to perform optimally when data variation is stable and historical patterns are consistent (Makridakis et al., 2019).

The superior performance of SMA in this study can be attributed to the absence of abrupt changes or significant seasonality in the dataset. SMA assumes equal weighting for all data points in the selected window, which reduces the influence of random short-term fluctuations. Previous research has shown that when datasets exhibit moderate variability, the smoothing effect of SMA leads to more stable forecasts (Hyndman & Athanasopoulos, 2021). In contrast, EMA and WMA apply greater emphasis on recent data points, which can distort predictions when recent fluctuations are not indicative of long-term patterns. This condition appears evident in the recommendation letter dataset, where short-term variations do not reflect structural changes in licensing demand.

The identical forecasting values generated by EMA and WMA indicate that the weighting coefficients used in WMA closely resemble the exponential decay factor applied in EMA. This similarity has been noted in studies where WMA and EMA outputs converge when recent data receive substantially higher weights (Cryer & Chan, 2008). Nonetheless, both methods yielded higher MAPE values compared to SMA, reinforcing the argument that weighted approaches do not always guarantee improved accuracy, especially when the data pattern is relatively stable.

From another perspective, moving average methods inherently assume that future values can be approximated from past behaviors, an assumption that aligns with short-term administrative

processes such as licensing activities (Chatfield, 2016). In Pamekasan Regency, the number of recommendation letters tends to follow administrative cycles rather than economic cycles, which may explain the absence of strong trends. This aligns with findings from similar studies analyzing short-term forecasting in bureaucratic contexts, where SMA often outperforms more complex smoothing techniques (Wei, 2019). Administrative data are rarely influenced by extreme outliers or sudden trends, making SMA an efficient tool for forecasting such datasets.

Despite the practical benefits of SMA, EMA and WMA offer theoretical advantages in contexts where recent developments significantly influence future outcomes. EMA, for example, is widely applied in financial forecasting due to its responsiveness to market volatility (Tsay, 2010). Likewise, WMA is beneficial when analysts can assign weights based on domain expertise, particularly when certain months are known to influence future values more heavily (Montgomery et al., 2015). However, the licensing data in this study do not exhibit such characteristics, limiting the relative advantage of weighted methods. Therefore, SMA emerges as the most suitable model for short-term forecasting in this administrative context.

Important implications emerge from the finding that SMA produced the most accurate predictions. Policymakers and administrative offices in Pamekasan Regency may adopt SMA to anticipate future workloads related to licensing processes. Accurate forecasting enables optimal allocation of human resources, improved service delivery, and timely preparation for periods with potentially higher administrative demands. Forecasting tools also strengthen data-driven governance, supporting decentralization reforms aimed at improving local service quality (Pollitt, 2013).

Forecasting accuracy in this study should be interpreted with caution. Although SMA achieved the lowest MAPE, its error level remains relatively high, suggesting that moving average methods alone may not fully capture the dynamics influencing recommendation letter issuance. External factors such as new government regulations, seasonal spikes in business licensing, or changes in population demographics may contribute to fluctuations. Researchers therefore recommend integrating moving average methods with more advanced forecasting models such as ARIMA, Holt-Winters exponential smoothing, or machine-learning approaches for higher accuracy (Box et al., 2016; Shumway & Stoffer, 2017).

This study contributes to the broader literature on forecasting administrative data, which remains underexplored compared to economic or financial time series. The findings reinforce previous research indicating that simpler models often perform well for short-term public administration forecasting, especially when data lack strong patterns (Armstrong, 2001). Thus, the use of SMA offers a practical and computationally efficient approach for government agencies seeking evidence-based decision-making tools.

CONCLUSION

The analysis of the three forecasting methods Single Moving Average (SMA), Exponential Moving Average (EMA), and Weighted Moving Average (WMA) demonstrates a clear difference in predictive accuracy based on the Mean Absolute Percentage Error (MAPE). The SMA method achieved the lowest MAPE value at 43.8073, while both the EMA and WMA methods produced higher and identical MAPE values of 47.0741. These results confirm that the Single Moving Average method offers the highest forecasting accuracy and is therefore the most appropriate and reliable model for predicting the number of recommendation letters in Pamekasan Regency. The acceptable MAPE range further validates the feasibility of the SMA method as a forecasting tool capable of capturing historical patterns and providing more precise estimates than its comparative methods.

This study provides essential insights for government agencies by offering evidence-based information that can support decision-making and future administrative planning. Accurate forecasting results can help anticipate service demands, enhance the efficiency of public administration, and optimize the management of recommendation letters. Furthermore, the study contributes to methodological development by identifying the most effective forecasting technique for this context, thereby serving as a valuable reference for practitioners and researchers. Overall, the Single Moving Average method stands out as the most effective, accurate, and practical forecasting model for future projections of recommendation letters in Pamekasan Regency.

REFERENCES

Armstrong, J. S. (2001). *Principles of forecasting: A handbook for researchers and practitioners*. Springer.

Box, G. E. P., Jenkins, G. M., Reinsel, G. C., & Ljung, G. M. (2016). *Time series analysis: Forecasting and control* (5th ed.). Wiley.

Chatfield, C. (2016). *The analysis of time series: An introduction* (7th ed.). CRC Press.

Cryer, J. D., & Chan, K.-S. (2008). *Time series analysis: With applications in R* (2nd ed.). Springer.

Erdianita, D., Mumpuni, R., & Aditiawan, F. P. (2023). Sales prediction system using weighted moving average and economic order methods. *Polinema Informatics Journal, 9*(4), 363–372.

Gardner, E. S. (2006). Exponential smoothing: The state of the art. *International Journal of Forecasting*, 22(4), 637–666.

Goodwin, P., & Wright, G. (2014). *Decision analysis for management judgment*. Wiley.

Hayuningtyas, R. Y. (2017). Inventory forecasting using weighted moving average and double exponential smoothing methods. *PILAR Nusa Mandiri Journal, 13*(2), 217–222.

Hayuningtyas, R. Y. (2017). Inventory forecasting using weighted moving average and double exponential smoothing methods. PILAR Nusa Mandiri Journal, 13(2), 217–222.

Hudaningsih, N., Utami, S. F., & Jabbar, W. A. (2020). Comparison of Aknil product sales forecasting at PT Sunthi Sepuri using single moving average and single exponential smoothing methods. *Journal of Informatics Technology and Science (JINTEKS), 2*(1), 15–22.

Hyndman, R. J., & Athanasopoulos, G. (2021). *Forecasting: Principles and practice* (3rd ed.). OTexts.

Irawan, F., Sumijan, S., & Yuhandri, Y. (2021). Prediction of oil palm fruit production levels using the single moving average method. *Journal of Information and Technology*, 251–256.

Kurniawan, I. Y., & Hariyoko, Y. (2023). Analysis of the quality of research recommendation letter-making services at the National Unity and Politics Agency of East Java Province. *Proceedings of the National Symposium on Public Administration (SIAP), 1*(1), 260–265.

Lubis, M. H., & Sumijan, S. (2021). Predicting crime rate using the single moving average method. *Journal of Information Systems and Technology, 3*(4), 183–188.

Makridakis, S., Wheelwright, S. C., & Hyndman, R. (2019). *Forecasting: Methods and applications* (4th ed.). Wiley.

Maricar, M. A. (2019). Comparative analysis of accuracy values of moving average and exponential smoothing for revenue forecasting system at XYZ Company. *Journal of Systems and Informatics (JSI), 13*(2), 36–45.

Maricar, M. A. (2019). Comparative analysis of accuracy values of moving average and exponential smoothing for revenue forecasting system at XYZ company. Journal of Systems and Informatics, 13(2), 36–45.

Marlina, W. A., & Amri, A. O. (2024). Forecasting moving average and exponential smoothing at Erina Business, Payakumbuh. *Journal of Industrial Engineering Research*, 115–128.

Montgomery, D. C., Jennings, C. L., & Kulahci, M. (2015). *Introduction to time series analysis and forecasting* (2nd ed.). Wiley.

Nurhayati, S., & Syafiq, A. (2022). Prediction system for clothing production quantity using weighted moving average. *Journal of Informatics Management (JAMIKA), 12*(1), 14–24.

Nurlifa, A., & Kusumadewi, S. (2017). Sales quantity forecasting system using moving average method at Zaky Hijab House. *INOVTEK Polbeng – Informatics Series, 2*(1), 18–25.

Peng, J., & Lai, F. (2012). Forecasting administrative workload using statistical models. *Government Information Quarterly*, 29(2), 150–160.

Pollitt, C. (2013). *The essential public manager*. Open University Press.

Prapcoyo, H. (2018). Forecasting the number of students using moving average. *Telematika, 15*(1), 67–76.

Rachman, R. (2018). Application of moving average and exponential smoothing methods in forecasting garment industry production. *Jurnal Informatika, 5*(2), 211–220.

Rachmatulah, S., & Wijaya, A. P. (2019). Recommendations for letter disposition with the Naïve Bayes method in the letter archives at the Bakorwil Office of Pamekasan Regency. *Journal of Computer and Information Technology, 2*(2), 50–59.

Sari, N. L., & Hasanuddin, T. (2020). Comparative analysis of the performance of the simple moving average and exponential moving average methods for forecasting the number of COVID-19 patients. *Indonesian Journal of Data and Science, 1*(3), 87–95.

Sari, N. L., & Hasanuddin, T. (2020). Comparative analysis of the performance of the simple moving average and exponential moving average methods for forecasting the number of COVID-19 patients. Indonesian Journal of Data and Science, 1(3), 87–95.

Shumway, R. H., & Stoffer, D. S. (2017). *Time series analysis and its applications* (4th ed.). Springer.

Sinaga, H. E., & Irawati, N. (2018). Comparison of double moving average with double exponential smoothing in forecasting disposable medical materials. *JURTEKSI (Journal of Technology and Information Systems), 4*(2), 197–204.

Tsay, R. S. (2010). *Analysis of financial time series* (3rd ed.). Wiley.

Wei, W. W. S. (2019). *Time series analysis: Univariate and multivariate methods* (2nd ed.). Pearson.

Zega, F. K., Hulu, T. S., Zebua, S., & Zebua, E. (2024). Analysis of tofu sales forecasting using the single moving average method to optimize production at the Nias Tofu Factory. *Innovative: Journal of Social Science Research, 4*(1), 2931–2942.

Zhang, G. (2003). Time series forecasting using a hybrid ARIMA and neural network model. *Neurocomputing*, 50, 159–175.