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Forecasting New Student Admissions at Muhammadiyah Elementary School Metro Using the Weighted Moving Average Method

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Abstract: SD Muhammadiyah Metro Lampung was established in 1968 with the Decree of the Muhammadiyah Education, Teaching, and Culture Council Number 664/I-057/LP-68/1977. Since then, this institution has emphasized the importance of providing quality education and creating an environment that supports the development of students. The purpose of this study is to predict the acceptance of new students in the coming period, so that it can be the basis for compiling a more appropriate educational planning strategy that is in accordance with real needs. To realize all of this, the main analysis tool is the Weighted Moving Average (WMA). This method is different from other modeling methods such as exponential smoothing and ARIMA because this method provides greater weight based on current data, so that estimates are more sensitive to current trends and more credible as a decision-making tool. The results of the WMA forecast provide schools with the opportunity to estimate the need for resources needed (including teaching staff, supporting facilities, and classroom allocation) to ensure that the education process is running well and correctly. In addition, this technique is a way to assess developing or abolishing admission policies. However, forecasts are only as good as historical data and cannot predict the presence of external factors that affect outcomes.

Keywords: SD Muhammadiyah Metro; Forecasting; Weighted Moving Average; Educational Strategy; Resource Allocation.

1. Introduction

SD Muhammadiyah Metro Lampung began operating in 1968 based on the Decree of PP Muhammadiyah from the Education, Teaching, and Culture Assembly with number: 664/I-057/LP-68/1977. This school was established to address the pressing need for a specialized educational institution dedicated to training teachers, namely PGA Muhammadiyah Metro. Initially, the education program at PGA Muhammadiyah spanned 4 years, which was later extended to 6 years. This was to provide more comprehensive training for aspiring educators. As a teacher training school, PGA required a laboratory school or "Labschool" to serve as a practical training ground for its students. Under the visionary leadership of Amir Hamzah as head of PGA Muhammadiyah, and with the unwavering support of M. Yusuf from the Muhammadiyah Education section, SD Muhammadiyah Metro was finally established, marking a significant milestone in the region's educational landscape. Marsidie was appointed as the first principal, laying the foundation for the school's growth and development. The principals who have led SD Muhammadiyah Metro from its inception until 2019 include Marsidie (1968-1970), R. Hadiwiyoto (1970-1973), Daud Sidiq, BA. (1980-1982), Drs. Zainal Abidin (1982-1997), Kustono, S.Ag. (1997-2007), Busro, S.Ag. (2007-2011), Zainal Abidin, M.Pd.I. (2011-2014), and Ihwan (2014-present), each contributed to the school's legacy through their unique leadership styles and educational reforms. To realize quality learning, SD Muhammadiyah Metro remains steadfast in its commitment to implementing effective education by fostering an environment conducive to academic excellence and personal growth. It also provides competent, friendly, and polite educators who serve as role models for students. The school's vision is to nurture outstanding students with noble character. This is supported by state-of-the-art facilities, robust infrastructure, and a curriculum that places a strong emphasis on character development, ensuring that graduates are not only academically proficient but also morally grounded. This research aims to project the number of upcoming students accepted in the future at Muhammadiyah educational institutions. It provides a strategic guide for developing a more targeted and sustainable plan to accommodate growth and maintain academic standards. However, predicting student numbers is a complex task and often influenced by uncertainties stemming from external factors. These factors include fluctuating educational policies, varying economic conditions that impact family decisions, and demographic trends that alter population dynamics in the region.

Therefore, selecting an appropriate forecasting method becomes critical to ensure accurate and actionable predictions that guide institutional decision-making. The Weighted Moving Average (WMA) method was selected for this study due to its distinct advantages over other forecasting techniques, such as Exponential Smoothing and ARIMA, primarily because it assigns greater weight to recent data, making it more responsive to current trends and changes in enrollment patterns [1]. While the Exponential Smoothing method often requires the determination of complex smoothing parameters that can be challenging to optimize, WMA offers simplicity in its application and delivers reliable prediction results within a short time frame, which is particularly beneficial for educational institutions needing timely insights [2]. Additionally, WMA has been successfully applied in various educational forecasting studies, including the prediction of student enrollment numbers across different schools and universities, demonstrating its versatility and effectiveness in handling time-series data specific to academic contexts [3]. Furthermore, WMA's adaptability to prioritize recent data aligns well with the dynamic nature of student admissions, where recent years' trends often provide more relevant indicators of future enrollment than older data [6]. This method's proven track record in producing accurate short-term forecasts also makes it a suitable choice for planning resources such as classroom allocations, teacher recruitment, and infrastructure development [7]. This study builds on previous research by focusing specifically on the prediction analysis of new student admissions at SD Muhammadiyah Metro. This is a context that requires tailored approaches due to its unique demographic and institutional characteristics. By utilizing WMA, this research is expected to generate more relevant and precise predictions that will enable the school to effectively strategize learning programs, optimize resource planning, and anticipate future needs in a proactive manner, ultimately contributing to the long-term sustainability and success of the institution in fulfilling its educational mission.

2. Related Work

Forecasting methods have garnered significant attention in academic research for their utility in predicting trends and facilitating strategic planning across diverse domains, including education. Statistical and mathematical techniques such as Weighted Moving Average (WMA), Exponential Smoothing, and Autoregressive Integrated Moving Average (ARIMA) have been extensively explored for their applicability to time-series analysis. This section synthesizes existing literature to provide a scholarly foundation for the adoption of WMA in predicting new student admissions at SD Muhammadiyah Metro, critically evaluating its merits relative to alternative methods through a rigorous review of prior studies.

2.1 Weighted Moving Average (WMA)

The Weighted Moving Average (WMA) method computes the average of historical data by assigning differential weights to each data point within a specified time frame. It places greater emphasis on more recent observations to better mirror current conditions. According to Silvya *et al.* (2020), WMA enhances predictions' responsiveness by prioritizing recent data, a feature that distinguishes it from simple moving averages [1]. Nasution (2019) elaborates that the subjective determination of weights in WMA allows analysts to tailor the method to specific contextual needs, often based on the perceived relevance of data points [2]. This flexibility is particularly advantageous in educational forecasting, as demonstrated by Kartika *et al.* (2023), who found that WMA achieved high accuracy in predicting student enrollment by aligning weights with data significance [3]. Similarly, Hidayanti *et al.* (2024) highlight WMA's efficacy in capturing dynamic trends in inventory forecasting, a principle transferable to educational contexts [6]. Further empirical support comes from Marita and Darwati (2022), who applied WMA to predict inventory needs with notable precision, underscoring its adaptability [7]. Additional studies by Rifadli and Sari (2024), Ramadania (2018), Rizaldi *et al.* (2023), Rizqi *et al.* (2021), Tarigan and Sagala (2021), and Ustadatin *et al.* (2023) affirm WMA's robustness across diverse applications such as sales predictions, commodity pricing, and healthcare visitor forecasting, illustrating its versatility in handling fluctuating time-series data [8][10][9][11][12][13][14]. Winarso (2017) also notes that WMA often outperforms linear regression in specific forecasting scenarios, including student number predictions, due to its weighted focus on recent trends [15]. Nevertheless, as Armstrong (2001) cautions, the method's effectiveness hinges on the accurate assignment of weights, a process that demands expertise to avoid biased outcomes [16].

2.2 Exponential Smoothing

Exponential smoothing represents an alternative forecasting technique that assigns exponentially decreasing weights to historical data, maintaining a balance between recent and older observations. Taylor (2003) emphasizes its utility in smoothing out noise in time-series data while still valuing historical trends [19]. However, Nasution (2019) argues that WMA surpasses Exponential Smoothing in educational forecasting due to its direct weight customization, bypassing the need for complex smoothing parameter adjustments that can complicate predictions [2]. This perspective is supported by Dewi and Evi (2018), who note that exponential smoothing is better suited to stable trends rather than rapidly shifting patterns often seen in student enrollment data [4]. Similarly, Ramadani *et al.* 2023) highlight that while Exponential Smoothing offers a systematic approach, its parameter sensitivity can hinder adaptability compared to WMA in dynamic [9]. Makridakis *et al.* (2018) further caution that improper parameter selection in Exponential Smoothing can lead to suboptimal forecasts, a challenge less pronounced in WMA's straightforward framework [17].

2.3 Autoregressive Integrated Moving Average (ARIMA)

The Autoregressive Integrated Moving Average (ARIMA) model is a sophisticated statistical tool that integrates autoregressive, differencing, and moving average components to address complex time-series patterns. Wang and Chen (2019) underscore ARIMA's strength in modeling long-term trends, provided sufficient historical data and meticulous parameter tuning are available [20]. Hyndman and Athanasopoulos (2018) note its robustness in comprehensive forecasting scenarios, yet acknowledge its complexity as a barrier in resource-constrained settings [18]. In educational contexts, where short-term adaptability is often prioritized, ARIMA's extensive data requirements and analytical demands render it less practical than WMA, as discussed by Goodwin and Wright (2014) [21]. Additionally, forecasting (2005) suggests that simpler models like WMA may yield comparable or superior results in scenarios with limited data or rapid trend changes. This is relevant to institutional planning at schools like SD Muhammadiyah Metro [5].

2.4 Comparative Analysis and Justification for WMA Selection

In comparing WMA with Exponential Smoothing and ARIMA, its simplicity and adaptability emerge as critical advantages. This is particularly in educational settings where enrollment trends are influenced by volatile socio-economic and policy factors, as noted by Cuaresma (2017) [22]. WMA's ability to directly adjust weights based on data relevance offers a practical edge over Exponential Smoothing's parameter-dependent structure and ARIMA's computational intensity, a point reinforced by Makridakis *et al.* (2018) [17]. The extensive body of literature supporting WMA's application—spanning education, inventory, sales, and other sectors—provides a strong empirical basis for its selection in this study [1][3][6][7][8][9][10][11][12][13][14][15]. Consequently, WMA was chosen for forecasting upcoming student admissions at SD Muhammadiyah Metro due to its proven accuracy in short-term predictions, ease of implementation, and alignment with the institution's need for actionable, data-driven planning strategies.

3. Research Method

This study adopted a mixed-method approach, combining qualitative and quantitative techniques to create a robust framework for forecasting new student admissions at SD Muhammadiyah Metro using the Weighted Moving Average (WMA) method. The research process is designed systematically to ensure data accuracy and predictive reliability. This begins with the collection of historical admission records from the school's archives. This is followed by validating the data through qualitative interviews with key administrative personnel who possess in-depth knowledge of enrollment trends and influencing factors. Subsequently, weights for the WMA method are determined based on data recency and insights gathered from these interviews. These weights prioritize recent years as more reflective of current patterns. The validated data is then used to perform WMA calculations to predict future student numbers. The results are analyzed to support strategic planning. This sequential process integrates numerical precision and contextual understanding to enhance forecasting outcomes.

The qualitative component of this study focuses on conducting semi-structured interviews to complement the quantitative data used in the WMA analysis, providing critical context for historical records. Interviews target key personnel at SD Muhammadiyah Metro, specifically the Head of Administration, who oversees student data and school operations. In addition, there is an Administrative Staff Member responsible for recording and maintaining student numbers and maintaining data archives. These interviews, conducted face-to-face over two one-hour sessions, utilize guiding questions to maintain focus while allowing flexibility for emerging insights. Key questions explore the admission process over the past five years. They also explore factors influencing annual enrollment, the impact of policy changes, and the availability and archive of historical data. The insights gained serve to validate historical records' accuracy, identify external factors such as promotional activities or competition that may affect predictions, and inform whether WMA weights need adjustment to account for significant trends or policy shifts.

On the quantitative side, historical data on student admissions is meticulously verified against interview findings to ensure consistency and mitigate errors that could distort forecasts. Weights for the WMA method are then assigned, with an emphasis placed on the most recent three years of data, as these are deemed more indicative of current enrollment trends. A decision informed by both interview insights and established forecasting principles. The validated data is inputted into the WMA formula. This calculates a weighted average of past data points to generate predictions for future admissions, prioritizing recent patterns for greater responsiveness. This structured quantitative process ensures that the forecasting model is grounded in accurate, relevant data, tailored to the specific dynamics of SD Muhammadiyah Metro.

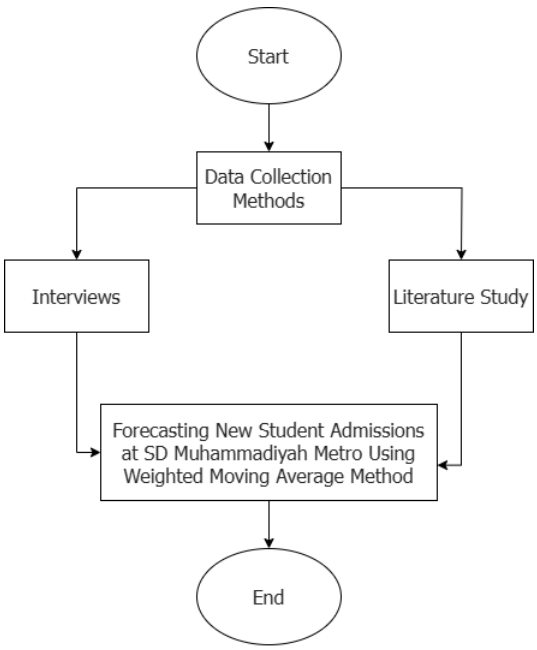

Figure 1. Flowchart for Forecasting New Student Admissions

To illustrate the integration of these qualitative and quantitative components, the methodology flow includes several key stages: initial collection of historical enrollment data, validation of this data through stakeholder interviews, determination of WMA weights based on current and contextual insights, and finally, application of WMA calculations to predict new student numbers (Figure 1). This flow, which will be represented as a flowchart in the final documentation, underlines the systematic nature of the research design.

It ensures that each step builds on the previous to produce reliable and actionable predictions. By combining detailed qualitative input with rigorous quantitative analysis, the methodology aims to provide SD Muhammadiyah Metro with precise predictions to optimize resource allocation, infrastructure planning, and education programs.

4. Result and Discussion

4.1 Results

4.1.1 Historical data on the number of students

The following table shows data on the number of students of SD Muhammadiyah Metro from 2017 to 2023:

Table 2. Historical data on the number of students

No	Year	Number of Students
1	2017	230
2	2018	211
3	2019	241
4	2020	225
5	2021	206
6	2022	211
7	2023	220

The data shows fluctuations in the number of students over the past seven years. In general, the number of students experienced a downward trend from 2017 to 2021, with the sharpest declines occurring in 2018 and 2021. However, 2022 and 2023 saw a slight increase in student numbers, indicating a recovery in trend after a period of decline.

4.1.2 Calculation of Weighted Moving Average (WMA)

Based on historical data, the weights for each year were determined by assigning higher values to the most recent data to reflect their greater relevance in the forecasting process. Specifically, the weights and corresponding student numbers are as follows: for 2023, a weight of 7 was assigned with 220 students; for 2022, a weight of 6 with 211 students; for 2021, a weight of 5 with 206 students; for 2020, a weight of 4 with 225 students; for 2019, a weight of 3 with 241 students; for 2018, a weight of 2 with 211 students; and for 2017, a weight of 1 with 230 students. These weighted values are used to calculate the forecast for the upcoming year using the Weighted Moving Average method. Weighted Moving Average (WMA) formula:

$$WMA = \frac{\sum(D_i \, x \, W_i)}{\sum W_i}$$

The WMA calculation for forecasting the number of students in 2024 is performed using the following formula:

$$\frac{(220 * 7) + (211 * 6) + (206 * 5) + (225 * 4) + (241 * 3) + (211 * 2) + (230 * 1)}{28} = 218.25$$

Based on the results of this calculation, the forecasted number of new students for 2024 using the WMA method is approximately 218.25, which can be rounded to 219 students.

4.1.3 Analysis of Results and Data Trends

The forecasted number of new students for 2024, which stands at approximately 218 students, aligns well with the historical data trend. This indicates a moderate upward trajectory over the past two years. This positive shift suggests that SD Muhammadiyah Metro has effectively addressed and overcome the notable decline in student enrollment observed between 2018 and 2021. Several key factors have contributed to this recovery, while certain external elements pose challenges to the prediction precision. Regarding the supporting factors behind this upward trend, the school's revised admission policies have played a significant role. Over the last two years, a more flexible and accommodating approach to the enrollment process has likely encouraged more parents to choose SD Muhammadiyah Metro for their children's education. This has helped boost student numbers. Additionally, the school's proactive promotional efforts have increased visibility and attracting qualified students. By leveraging social media platforms and engaging in local community events, the school has successfully raised awareness and interest among prospective families. Furthermore, the recovery from the COVID-19 pandemic has contributed to this positive trend. The years 2020 and 2021 saw a

marked decline in enrollment due to the widespread impact of the pandemic, including economic hardships and restrictions on in-person learning. However, as conditions improved in 2022 and 2023, the school witnessed a gradual return to pre-pandemic enrollment levels, reflecting a broader post-pandemic recovery in the education sector.

On the other hand, several factors could affect the accuracy of the WMA-based prediction for 2024. One significant concern is the increasing competition with other schools in the vicinity. As nearby institutions enhance their programs or facilities, they may attract potential students away from SD Muhammadiyah Metro, impacting enrollment figures. Another critical factor is the local economic condition of the surrounding community. Economic stability fluctuations, such as rising costs of living or unemployment rates, can directly influence parents' financial capacity to enroll their children in school or afford associated expenses like uniforms and materials. Additionally, variations in government policies related to education, such as zoning regulations or tuition subsidies, can unpredictably alter enrollment patterns by facilitating or hindering access to school for certain families. The prediction derived from the Weighted Moving Average method offers a reasonably accurate estimate that can serve as a valuable reference for planning school resources. This includes classroom allocations, teacher recruitment, and budget preparations for the upcoming year. Nevertheless, to enhance the reliability and precision of future forecasts, it is imperative to conduct a more comprehensive analysis that incorporates external variables. Factors such as evolving government education policies, shifts in local economic conditions, and the competitive landscape among schools should be systematically evaluated and integrated into the forecasting model. By adopting a more holistic approach to data analysis, SD Muhammadiyah Metro can better anticipate potential challenges and opportunities. This will ensure more effective strategic planning and sustained growth in student enrollment.

4.1.4 Student Number Trend Graph and WMA Forecasting

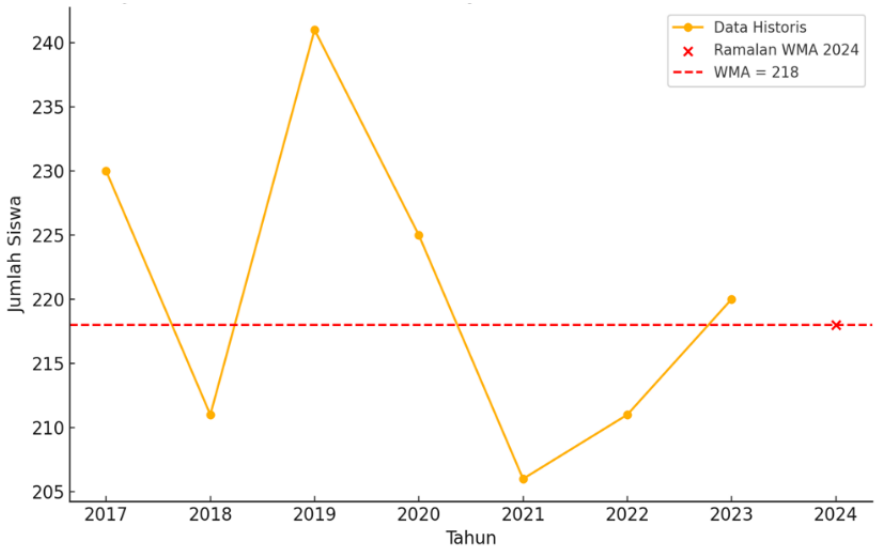

Figure 2. Student Count Trend Chart and WMA Forecasting

The trend graph presented below serves as a vital tool for visualizing the historical data on student enrollment at SD Muhammadiyah Metro spanning from 2017 to 2023. It also shows the forecasted number of students for 2024, calculated using the Weighted Moving Average (WMA) method. This graphical representation offers a clear and immediate insight into the enrollment patterns over the specified period. It highlights both annual fluctuations and the overarching trend in student numbers. By plotting the data points year by year, the graph not only illustrates the rise and fall in student counts—such as the decline observed between 2018 and 2021 and the subsequent recovery in 2022 and 2023—but also provides a visual benchmark to assess how the forecasted figure for 2024 aligns with past trends. This visualization is particularly useful for stakeholders, including school administrators and policymakers. It facilitates a better understanding of how external factors, such as economic conditions or policy changes, may have influenced past enrollment figures. Moreover, it serves as an intuitive method to compare the actual historical data with the predicted value. This aids in the evaluation of the WMA forecasting model's accuracy and reliability. Such a comparison is essential for validating the forecasting approach and ensuring that it adequately captures the underlying trends in the data. Additionally, the graph supports strategic planning for future academic years by providing a visual reference that can inform decisions related to resource allocation, infrastructure development, and staffing needs. For instance, anticipating an increase in student numbers might prompt the school to plan for additional

classrooms or hire more teachers. Overall, this trend chart is an indispensable component of the analysis. It transforms raw data into a comprehensible format that enhances decision-making and fosters a proactive approach to managing enrollment challenges and opportunities at SD Muhammadiyah Metro.

4.2 Discussion

In forecasting the number of new students at SD Muhammadiyah Metro for 2024, the Weighted Moving Average (WMA) method has been used as a prediction tool that provides fairly accurate results, namely 218 students. The WMA method is a historical data-based forecasting approach that gives more weight to the latest data than older data, so that it is able to capture current trends better. According to Nasution (2019), the WMA method is effective in forecasting because of its ability to adjust weights based on data relevance, which is very suitable for predicting variables such as the number of students that tend to be influenced by short-term trends [2]. This is also supported by Kartika *et al.* (2023), who applied the WMA method to forecast the number of student enrollments at SMA IT IQRA' Bengkulu City and found that this method provides reliable results for school resource planning [3]. Thus, the use of WMA in this study is relevant and appropriate to support strategic decision making at SD Muhammadiyah Metro. The forecasting results show a moderate upward trend in the number of new students over the past two years (2022-2023), indicating a recovery after a significant decline in the 2018-2021 period due to the impact of the COVID-19 pandemic. This finding is in line with research by Silvya *et al.* (2020), which states that the WMA method can be used to identify historical data patterns and predict future values by considering fluctuations caused by external factors [1]. Factors such as more flexible student admission policies, active promotion through social media, and post-pandemic recovery have contributed to the increase in the number of students. However, the accuracy of predictions is still influenced by external variables such as competition with other schools, local economic conditions, and changes in government policies related to education. This is also recognized by Hidayanti *et al.* (2024), who emphasize the importance of considering external factors in forecasting to improve the accuracy of the results [6].

Ramadan *et al.* (2023) in their study compared the WMA method with Single Exponential Smoothing to predict the number of new students and found that WMA was superior in capturing fluctuating data trends, such as those in student enrollment data [9]. Therefore, although the WMA prediction results in this study are accurate enough to be used as a reference for school resource planning, further analysis by including external variables such as government policies, economic conditions, and the level of competition between schools is still needed to improve the reliability of future predictions. Makridakis et al support this approach. (2018), who suggested that statistical methods such as WMA need to be complemented with external factor analysis to produce more comprehensive forecasts [17]. The use of the WMA method in forecasting the number of new students at SD Muhammadiyah Metro provides an overview for strategic planning. However, as suggested by Hyndman and Athanasopoulos (2018), forecasting success depends not only on the method used, but also on the ability to integrate qualitative and quantitative data into the analysis [18]. Thus, the next step is to enrich the forecasting model with additional data and a more holistic approach. This is so that the results are closer to actual conditions.

5. Conclusion and Recommendations

Through the application of the Weighted Moving Average (WMA) method, this study successfully predicted the number of new students at SD Muhammadiyah Metro for 2024 to be 218 students. This forecast holds significant strategic importance for the school, particularly in facilitating both short-term and long-term planning related to new student admissions. Strategically, it guides resource allocation by determining the need for classrooms, teaching staff, and supporting facilities to ensure an optimal learning environment. It also aids in policy planning by enabling the school to design adaptive admission policies, such as targeted promotions or capacity adjustments based on demand trends. It provides a basis for monitoring and evaluating the effectiveness of current policies for future improvements. Practically, prediction supports infrastructure management by ensuring adequate and conducive classrooms. It assists in teacher recruitment to maintain an ideal teacher-student ratio, and helps develop effective promotional strategies to attract prospective students. For future research, integrating external variables like educational policies, local economic conditions, and competition levels with other schools is recommended to enhance prediction accuracy. Additionally, exploring hybrid models by combining WMA with methods like Exponential Smoothing or ARIMA, as well as leveraging advanced data technologies such as Neural Networks or Long Short-Term Memory (LSTM), could capture complex patterns in data for more precise forecasting. Ultimately, this prediction not only serves as a critical planning tool but also as a reflective resource for improving education quality at SD Muhammadiyah Metro. By consistently monitoring enrollment trends and adapting strategies based on evaluation outcomes,

the school can continue to evolve in alignment with the needs of the community. This will enable it to meet the challenges of the modern era.

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