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Autoregressive integrated moving average (ARIMA) implementation in number of visitors forecasting at the Balai Layanan Perpustakaan DPAD DIY

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Abstract
Government organizations must provide excellent services to their citizens. The Balai Layanan Perpustakaan DPAD DIY, one of the government organizations for library affairs, must also provide the best library services. One way is to forecast the number of visitors to prepare better services for the future. This research aims to predict the number of visitors in 2024. This research used historical data in the form of the number of visitors at the Balai Layanan Perpustakaan DPAD DIY in 2023. This data was analyzed using the ARIMA Model (2,0,6) with the results that this model had a MAPE value of 25.35%, so it was accurate enough to be used in forecasting. Based on forecasting results, it is known that the total number of visitors to the Balai Layanan Perpustakaan DPAD DIY in 2024 will be 115,213. The fewest visitors were in January 2024, as many as 5,198 visitors, while the most were in June 2024, as many as 13,605 visitors.

Keywords: ARIMA model, Forecasting, Number of visitors

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Introduction

Libraries have an essential role in the progress of the Indonesian nation. Libraries, as knowledge collectors, are able to provide significant benefits through the development of superior, active, creative, and innovative human resources (Wijayanti, 2017). According to (Endarti, 2022), currently, libraries are reforming to become centers for accessing knowledge and information, conducting research and recreation, preserving the nation's cultural treasures, and providing other related services. Apart from that, libraries also have a function as a means of renewal in the fields of development and culture as time goes by through human desires and needs (Endarti, 2022). On a global scale, libraries are essential in achieving Sustainable Development Goals (SDGs). Libraries provide access to information, support the increase in literacy and technology, and create accessible community spaces (Suhernik & Cahyani, 2020). Apart from that, libraries also act as providers of information services in various formats and delivery services to meet the dynamic and complex needs of

society (Shafack, 2016). Libraries provide library materials and are centers of community activities that provide equal and inclusive services to reduce social, economic, and cultural disparities (Haryanto et al., 2024) Seeing libraries' significant contribution to society's progress, libraries need to provide excellent service.

The Balai Layanan Perpustakaan DPAD DIY is one of the public libraries in the Special Region of Yogyakarta, which carries out government affairs in the library sector. The library must serve the community competently (Rahayuningsih, 2016). If the library can provide excellent service, the community as users will feel cared for, so they will use library services again (Novianti et al., 2007). According to (Risparyanto, 2022), excellent library services influence user satisfaction. Users have high satisfaction if the library can provide quality services and can meet users' needs (Muliana et al., 2016). Based on Article 14 of Law Number 43 of 2007 concerning Libraries explained that library services are carried out in an excellent and oriented towards the interests of the user.Therefore, the Balai Layanan Perpustakaan DPAD DIY must pay attention to the services provided to achieve high public satisfaction.

The Balai Layanan Perpustakaan DPAD DIY can provide good library services to the community. This is proven by the Community Satisfaction Index Survey results from 2019 to 2024, which continues to increase.

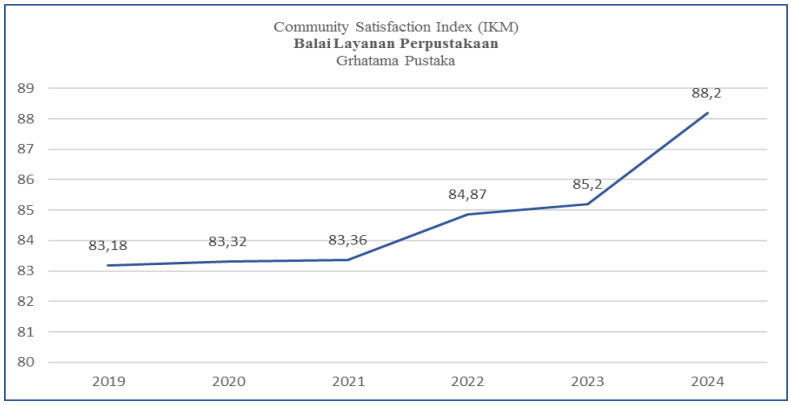

Figure 1. Community Satisfaction Index at Balai Layanan Perpustakaan DPAD DIY 2019-2024 (Source: Balai Layanan Perpustakaan DPAD DIY Community Satisfaction Index Survey 2019-2024 (DIY, 2024))

Based on the results of the Community Satisfaction Index survey, it can be seen that the Community Satisfaction Index at the Balai Layanan Perpustakaan DPAD DIY has increased every year. In 2019, the Balai Layanan Perpustakaan DPAD DIY had an Community Satisfaction Index value 83.18. Meanwhile, the Community Satisfaction Index values in 2020, 2021, 2022, and 2023 are 83.32, 83.36, 84.87, and 85.2, respectively. Until 2024, the Community Satisfaction Index at the Balai Layanan Perpustakaan DPAD DIY experienced a significant increase until it reached a score of 88.2 in the excellent category. Seeing the value of Community Satisfaction Index, which continues to increase, the Balai Layanan Perpustakaan DPAD DIY can still provide better library services to achieve service excellence.

Service excellence can be interpreted as the quality of library services that meet or even exceed the expectations of users (Fathmi, 2017) According to (Evalina, 2018), technical

quality in the form of machines and computerization, technical solutions and functional quality in the form of attitudes, behavior, and ease of obtaining services, can influence service quality. The excellent quality of library services attracts users to visit again (Kamil et al., 2024). User visits are one factor determining a library's success (Sumiati, 2019). Dahlan in (Rahayu & Christiani, 2019) states that the level of user visits can be seen through user interest in the library, the intensity of user visits, and the behavior of users. Apart from that, the increase in the number of visitors must be balanced with adequate facilities and infrastructure to ensure that library services and quality remain guaranteed, so careful planning is needed (Aziz & Sayuti, 2023). (Rafikasari & Rohman, 2018) argue that the level of visits and the number of borrowings is an indicator of the success of library services because if the library has good services, the level of visits and the number of borrowings will also increase. So, the Balai Layanan Perpustakaan DPAD DIY can forecast the number of visitors to be able to provide better quality library services in the future.

Forecasting is an effort to predict future needs in quantity, quality, and time to fulfill the demand for goods and services Nasution & Prasetyawan in (Zahara et al., 2023) In forecasting, there are several methods such as ARIMA, Holt Winters method, Double Exponential Smoothing method, linear regression, and others. (Yulistia & Fryonanda, 2021). Forecasting can be done by taking historical data and then projecting it into the future through mathematical models (Sagala & Tarigan, 2023). The time series analysis method, better known as time series analysis, is a mathematical model used in forecasting (Wulandari et al., 2021). According to (Arya et al., 2019), one of the time series analysis methods that can be used in forecasting is the Autoregressive Integrated Moving Average (ARIMA) Model through regression models and historical data correlation. The ARIMA model is suitable for forecasting because it is flexible in following data patterns, has high accuracy values, and only requires historical data (Muhammad et al., 2017) Compared with other forecasting methods, the ARIMA model is more suitable for this research. This is because the data in this research contains seasonal patterns; the ARIMA model is appropriate for predicting the number of visitors at the Balai Layanan Perpustakaan DPAD DIY. If the data to be analyzed does not contain seasonal patterns, then using the Moving Average Method is more suitable. At the same time, the Brown method is considered too excessive in reacting to random changes because a change is considered a quadratic trend Makridakis in (Frasandy et al., 2022).

Several previous studies used the ARIMA model to carry out forecasting. (Wulandari R.A & Gernowo R, 2019) used the ARIMA model and the Adaptive Neuro Fuzzy Inference System (ANFIS) method to analyze rainfall. The ARIMA model is also used by (Jamila et al., 2021) to forecast the number of new students at XYZ University. (Sinaga, 2023) also uses the ARIMA model to predict car showroom sales. This proves that the ARIMA model has been widely used in various research related to forecasting. Based on previous research literature studies related to the ARIMA Model, there has yet to be research using the ARIMA Model for forecasting the number of visitors at the Balai Layanan Perpustakaan DPAD DIY. Therefore, researchers are interested in further studying the implementation of the Autoregressive Integrated Moving Average (ARIMA) Model in forecasting the number of visitors at the Balai Layanan Perpustakaan DPAD DIY.

This research will make a real contribution to the Balai Layanan Perpustakaan DPAD DIY in managing libraries to improve the quality of library services by forecasting the number of visitors. Apart from being a reference material for academics to conduct research related to the use of the ARIMA model in forecasting, this research can also be an evaluation material for the Balai Layanan Perpustakaan DPAD DIY so that they can prepare themselves to face an increase or decrease in the number of visitors by planning good library management.

Methods

Data collecting method

The data used in this research is secondary data in the form of historical data related to the number of visitors to the Balai Layanan Perpustakaan DPAD DIY service from January 2023 to December 2023. This data comes from the 2023 Balai Layanan Perpustakaan DPAD DIY Visit Statistics Report by asking directly to the Balai Layanan Perpustakaan DPAD DIY staff. The authenticity and validity of this statistical report on the number of visits are guaranteed because the Balai Layanan Perpustakaan DPAD DIY has verified this data and signed it by the Head of the Balai Layanan Perpustakaan DPAD DIY, so the data can be trusted to be used as research material. The following is historical data on the number of visitors to the Balai Layanan Perpustakaan DPAD DIY during 2023.

Table 1. The Number of Visitors at the Balai Layanan Perpustakaan DPAD DIY 2023

Month	Number of Visitors
January 2023	6,827
February 2023	9,289
March 2023	11,308
April 2023	4,672
May 2023	4,014
June 2023	12,918
July 2023	14,106
August 2023	8,202
September 2023	11,164
October 2023	15,977
November 2023	14,648
December 2023	4,958
Total	**118,083**

Source: Balai Layanan Perpustakaan DPAD DIY Visit Statistics Report 2023
(Processed by the author, 2024)

Data analysis method

This research used the ARIMA model with tools in the form of SPSS Version 26 software to analyze historical data that had previously been collected. As seen in Figure 2, there are several stages of data analysis in this research. The following research flow follows.

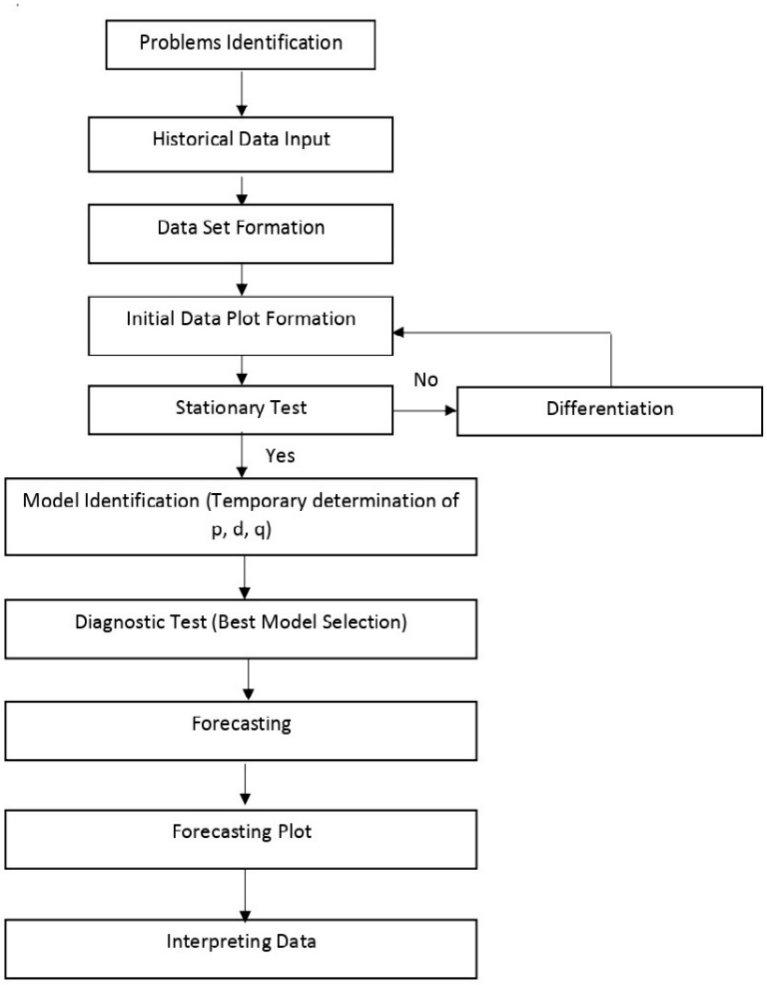

Figure 2. Research Flows (Processed by the author, 2024)

Based on Figure 2. Research Flows: This research begins by identifying problems at the Balai Layanan Perpustakaan DPAD DIY, namely that the Balai Layanan Perpustakaan DPAD DIY needs to provide excellent quality library services to the community to meet community expectations. One effort that can be made is to forecast the number of visitors. After knowing the problem, the researcher collected historical data in the form of statistical data on the number of visitors at the Balai Layanan Perpustakaan DPAD DIY during 2023 and made an initial data plot. Based on the initial data plot, it can be seen whether the data is stationary, and if the data is not stationary in the mean, then differencing must be carried out (Buchori & Sukmono, 2018).

If the initial data plot is successfully formed, proceed with the stationary test. According to (Sagala & Tarigan, 2023) stationary tests can be carried out by creating a correlgram of autocorrelation functions consisting of Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) in identifying time patterns. After the data is declared stationary, it is continued by placing the temporary model (p, d, q). p is the order of the Autoregressive (AR) process, d is the level of differencing, and q is the order of the Moving Average (MA) process (Sagala & Tarigan, 2023). (Wulandari et al., 2021) state that, based on the Partial Autocorrelation Function (PACF) plot, if there is a lag that is more than the significance limit, then it describes the order of the Autoregressive (AR) process. In

contrast, based on the Autocorrelation Function (ACF) plot describes the order of the Moving Average (MA) process if a lag is more from the significance limit.

The best model is selected after obtaining the temporary model (p, d, q). According to Wei in (Wulandari et al., 2021), the best model selection can be made if there are several model choices by looking at the Mean Absolute Percentage Error (MAPE), the smallest of all the temporary models. As seen in Table 2. MAPE Value, there are the MAPE value criteria according to Chang et al in (Wulandari et al., 2021) which can be used in selecting the best model.

Table 2. MAPE Value

MAPE (x)	Explanation
X < 10%	Forecasting is excellent
10% ≤ x < 20%	Good forecasting
20% ≤ x < 50%	Forecasting is enough
X ≥ 50%	Bad forecasting

Source: Chang et al in (Wulandari et al., 2021)

If the best model has been determined, the next step is to continue forecasting using the ARIMA model via SPSS Version 26 software. After successful forecasting, the research continues by plotting and interpreting the forecasting data.

Result

The Plot of Initial Data on Number of Visitors

The increase in visitors at the Balai Layanan Perpustakaan DPAD DIY is essential to understand because the rise in visitors needs to be balanced with the quality of service and adequate facilities and infrastructure in planning. Louis A. Allen in (Aziz & Sayuti, 2023) also believes that planning involves several activities, such as predicting, setting goals, programming, scheduling, budgeting, developing procedures, and establishing and interpreting policies. In Figure 3. The Initial Data Plot for the Number of Visitors shows the number of visitors at the Balai Layanan Perpustakaan DPAD DIY from January 2023 to December 9, 2023.

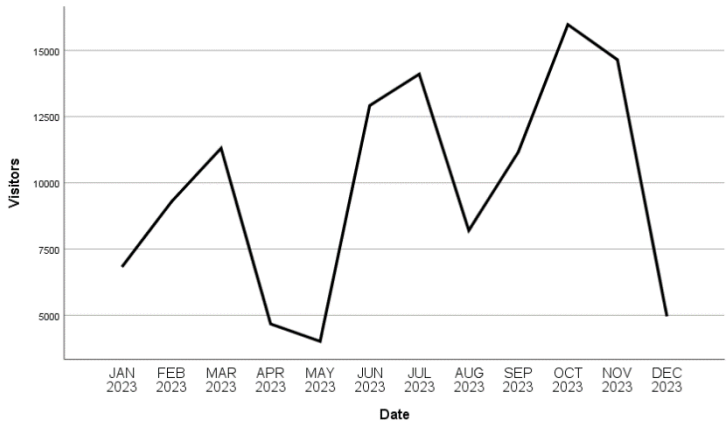

Figure 3. The Initial Data Plot for the Number of Visitors (Processed by the author, 2024)

Based on Figure 3. In the plot of initial data on the number of visitors, it is known that the number of visitors at the Balai Layanan Perpustakaan DPAD DIY has fluctuated. The highest number of visits occurred in October 2023, with a total of 15,977 visitors, while the lowest number occurred in May 2023, with 4,014 visitors. It is also known that the total number of visits to the Balai Layanan Perpustakaan DPAD DIY from January 2023 to December 9, 2023, was 118,083 visitors.

Data Stationary Test

To determine the stationarity of historical data regarding the number of visitors at the Balai Layanan Perpustakaan DPAD DIY in 2023, a data stationary test was carried out by creating a correlgram of the ACF and PACF autocorrelation functions. Based on the correlgram, it is known that the data is stationary because the graph does not show a trend and circulates around the average value. The following is Figure 4. ACF plot and Figure 5. PACF plot.

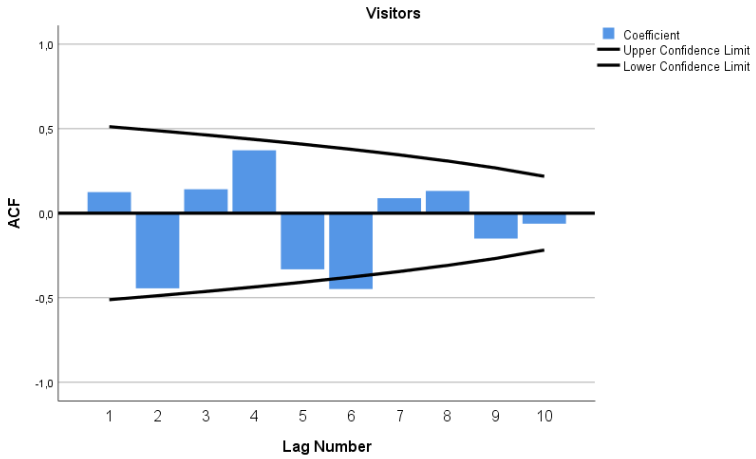

Figure 4. ACF Plot (Processed by the author, 2024)

Based on Figure 4. The ACF plot shows the MA (q) value because it shows that lag 6 soared past the significance line, and there was a decrease in the subsequent lag, namely lag 7. So, it can be seen that based on the ACF plot, the value is q=6.

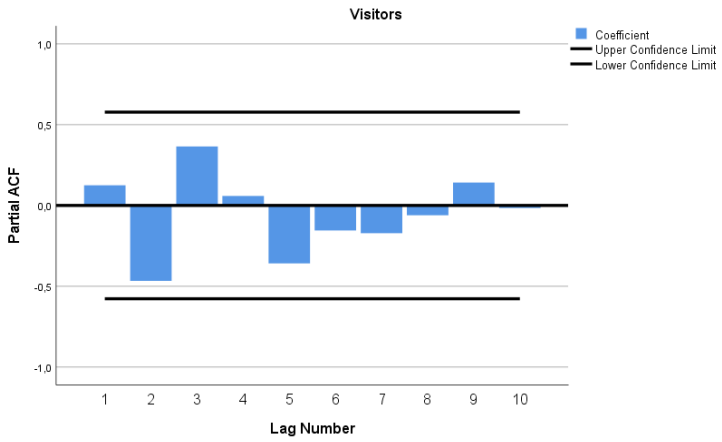

Figure 5. PACF Plot (Processed by the author, 2024)

Based on Figure 5. The PACF plot shows the AR value p=0 because it shows no lag that soars above the significance line. So, it can be seen that based on the PACF plot, the p=0.

Identify Temporary ARIMA Models

Based on the analysis results of Figure 4. ACF plot and Figure 5. PACF plot, it is known that the values q=6, d=0, and p=0. The q value is obtained from the ACF plot, which has a lag at the 6th lag. The d value is 0 because the data in this study do not require differencing, while the p value is obtained from the PACF plot, which does not show any lag. So, a temporary ARIMA model (p, d, q) can be formulated, namely an ARIMA model with order (0,0,6). According to (Zulhamidi & Hardianto, 2017), the initial ARIMA model can give rise to guesses from other ARIMA models through trial and error for suspected numbers close to the initial ARIMA model. Other possible ARIMA models are the ARIMA Model (0,0,1), ARIMA Model (0,0,0), ARIMA Model (2,0,6), and ARIMA Model (2,0,1).

Diagnostic Test (Best Model Selection)

The temporary ARIMA models are known: ARIMA Model (0,0,6), ARIMA Model (0,0,1), ARIMA Model (0,0,0), ARIMA Model (2,0,6), and ARIMA Model (2,0,1). All temporary ARIMA models will undergo a diagnostic test to select the best model by paying attention to the smallest MAPE value. The following are the diagnostic test results of the temporary model.

Table 3. Diagnostic Test Results

ARIMA Model	MAPE (x)	Explanation
ARIMA Model (0,0,6)	34.42%	Forecasting is enough
ARIMA Model (0,0,1)	33.37%	Forecasting is enough
ARIMA Model (0,0,0)	45.71%	Forecasting is enough
ARIMA Model (2,0,6)	25.35%	Forecasting is enough
ARIMA Model (2,0,1)	27.14%	Forecasting is enough

Source: Processed by the author (2024)

Based on Table 3, Diagnostic Test Result, the ARIMA model (2,0,6) has the smallest MAPE value, namely 25.35%, so it can be called the best model. It can predict well because it is considered to have better forecasting accuracy than other temporary models.

Forecasting

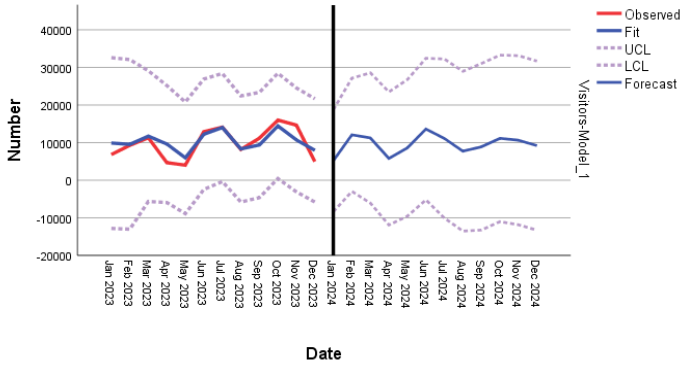

Figure 6. The Forecasting Plot (Processed by the author, 2024)

The forecasting in this research aims to estimate the number of visitors at the Balai Layanan Perpustakaan DPAD DIY from January 2024 to December 2024. Figure 6. The Forecasting Plot shows the result of forecasting the number of visitors at the Balai Layanan Perpustakaan DPAD DIY during 2024 using the ARIMA Model (2,0,6). In more detail, Table 4. Results of Forecasting the Number of Visitors in 2024 Using the ARIMA Model (2,0,6).

Table 4. Results of Forecasting the Number of Visitors in 2024 Using the ARIMA Model (2,0,6)

Month	Number of Visitors
January 2024	5,198
February 2024	12,080
March 2024	11,248
April 2024	5,796
May 2024	8,601
June 2024	13,605
July 2024	11,101
August 2024	7,715
September 2024	8,894
October 2024	11,129
November 2024	10,644
December 2024	9,202
TOTAL	**115,213**

Source: Processed by the author (2024)

Based on Table 4. Results of Forecasting the Number of Visitors in 2024 Using the ARIMA Model (2,0,6), it is known that the estimated number of visitors at the Balai Layanan Perpustakaan DPAD DIY in 2024 will experience ups and downs. The most visitors are estimated to occur in June 2024, with 13,605 visitors. The lowest number of visitors is estimated to occur in January 2024, with 5,198 visitors. The estimated total number of visitors at the Balai Layanan Perpustakaan DPAD DIY in 2024 is 115,213 visitors.

Discussion

Figure 3. The Initial Data Plot for the Number of Visitors noted that the number of visitors to the Balai Layanan Perpustakaan DPAD DIY fluctuates monthly. Researchers assume that the number of visitors at the Balai Layanan Perpustakaan DPAD DIY will fluctuate in 2023 due to many external factors. Considering the library's function as a recreation area, the number of visitors at the Balai Layanan Perpustakaan DPAD DIY will increase during school holidays because of the availability of storytelling services, children's play services, reading corner services, 3D cinema services, and audio-visual film screening services. Apart from that, the number of visitors will experience a drastic increase if there are visits from other organizations or agencies because the Balai Layanan Perpustakaan DPAD DIY also has a library visit or library tour service. The library as a center for information and library materials is also one of the reasons for the increase in the number of visitors at the Balai Layanan Perpustakaan DPAD DIY during school exams because students or students need reading materials or reference materials for studying. In 2024, the Balai Layanan Perpustakaan DPAD DIY will also have a new policy, namely operating hours on Saturdays, so that people are more enthusiastic about coming to the library even though only a few services are open on Saturdays. The quality of library services dramatically influences the

number of visits, as (Sumiati, 2019) opined. This opinion is also supported by (Sari et al., 2022), who state that the quality of library services influences visitors.

Based on the analysis results from Figure 4. The ACF plot and Figure 5. The PACF plot and the ARIMA values (p, d, q) are known so that a temporary ARIMA model can be formulated, including ARIMA (0,0.6), ARIMA (0,0,1), ARIMA Model (0,0,0), ARIMA Model (2,0,6), and ARIMA Model (2,0,1). The best model was selected from several temporary ARIMA models by looking at the smallest MAPE value. This is the opinion of Fahmuddin et al. (2023), who argue that the MAPE value can be used in choosing the best ARIMA model if the researcher has several ARIMA models. Table 3, Diagnostic Test Results, shows that the ARIMA model has the smallest MAPE value, ARIMA (2,0,6) of 25.35%, so this model was chosen as the best ARIMA model. Petrevska (2017) argues that forecasting can be a solution for planners and policymakers as an effort to provide information regarding possibilities that have not yet occurred based on past events. Based on Figure 6. The Forecasting Plot, it is known that from January 2024 to December 2024, the DIY DPAD Library Services Center experienced a fluctuating number of visitors, which is detailed in Table 4. Results of Forecasting the Number of Visitors in 2024 Using the ARIMA Model (2, 0.6).

Several studies use the ARIMA model to carry out forecasting. (Ramadhan et al., 2024) used the ARIMA model to forecast the number of visitors at the Kandaga Library. They compared the results of the ARIMA model forecast with forecasting using an Expert Modeler. (Bai et al., 2023) also used the ARIMA model to predict the number of outpatient visits in Kunshan City. The ARIMA model can also be implemented in the health sector to model and forecast emergency visits in departments at medical centers in Southern Taiwan (Juang et al., 2017) and daily visits in blood sampling rooms (Zhang et al., 2020).

This research also uses the ARIMA model to forecast the number of visitors at the Balai Layanan Perpustakaan DPAD DIY. This is because the ARIMA model can be implemented to predict based on past time series values to describe future values (Khatibi et al., 2022). The ARIMA model is a forecasting model that is very accurate and has high forecasting accuracy, so it can be implemented as a solution to solving problems related to forecasting (Yang et al., 2023). This aligns with the opinion of (Huang et al., 2020), who state that the ARIMA model is also used in several studies related to time series forecasting that require accuracy.

Conclusions

Based on the results of research and analysis carried out by researchers, it can be concluded that the implementation of the ARIMA Model with the order (2,0,6) to estimate the number of visitors at the Balai Layanan Perpustakaan DPAD DIY in 2024 has a MAPE value of 25.35% so that forecasting accuracy is enough. June 2024 had the highest number of visitors, namely 13,605, while January had the least number of visitors, namely 5,198 visitors. The total number of visitors at the Balai Layanan Perpustakaan DPAD DIY in 2024, based on the ARIMA forecasting model (2,0,6), is 115,213.

This study's limitation is that it only discusses forecasting the number of visitors at the Balai Layanan Perpustakaan DPAD DIY in 2024 using the ARIMA model. Therefore, future

research can study forecasting the number of visitors using other models and then compare the accuracy of forecasting between the several models used. This is because the ARIMA model is only based on historical data, which allows for other external factors such as visits, school exam times, and holidays, which influence the rise and fall of the number of visitors.

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Declarations

Author Contribution : NR: Conceptualization, Writing - Original Draft, Editing and Visualization, Methodology, Formal Analysis.
SC: Writing - Review & Editing, Methodology, and Supervision.
JQAFA: Writing - Review & Editing.
NA: Writing - Review & Editing.
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Conflict of Interest : The authors declare no conflict of interest.

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