Forecasting Kandaga Library Visitors Using Autoregressive Integrated Moving Average (ARIMA) Model

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ABSTRACT

College libraries must provide optimal library services, which requires careful planning. The fluctuating number of visitors means that libraries must make preventive efforts to provide excellent service in the future, one of which is forecasting the number of visitors. Forecasting the number of visitors can help libraries prepare for surges in the number of visitors. This research aims to forecast the number of visitors at the Kandaga Library using the ARIMA model as a preventive effort for the Kandaga Library to provide better library services and

improve service quality and user satisfaction. This research uses descriptive quantitative methods through the ARIMA forecasting model assisted by SPSS Version 26 software. The best ARIMA model used is the ARIMA model (4,0,12), with a MAPE value of 26.89%. Based on the results of the ARIMA forecasting model (4,0,12), the predicted total number of visitors at the Kandaga Library from October 2024 to October 2025 is 105,742 visitors. Compared with Exper Modeler, which has a MAPE value of 13.10%, the ARIMA model (4,0,12) is no more accurate for forecasting the number of visitors. Therefore, it is essential for further research to compare various forecasting models to obtain the most appropriate and precise model for predicting the number of visitors.

Keyword: ARIMA model; number of visitors; forecasting; college library

A. INTRODUCTION

Higher education is a center that produces quality and professional human resources, which can be called a center of excellence for a country (Siregar, 2016). A university has various Technical Implementation Units (UPT), including the library. A library is an information system that includes multiple activities, such as collecting, processing, preserving, preserving, presenting, and disseminating information (Fatimah, 2018). Based on Article 20 of Law Number 43 of 2007 concerning Libraries (Peraturan Pemerintah RI, 2007), it is explained that there are several types of libraries, including a. National Library, b. Public Library, c. School/Madrasah Library, d. College Library, and e. Special Library. A college library is located at a college, a subordinate body, or an organization affiliated with a college (Kurniawan, 2016). College libraries play a role in meeting the information needs

of the academic community at a college (Fadilla, 2020). Apart from that, the library as a UPT in a university also has the main task of managing scientific information to support the implementation of the Tri Dharma of Higher Education effectively and efficiently (Inajati & Utomo, 2019). Rahayu (2017) believes that university libraries have several functions, such as an educational function, which is carried out by providing reading sources for the academic community, an information function through fulfilling the need for information for users, a research function through providing research reference sources in order to support the Tri Dharma of Higher Education, as well as a recreational function through the presentation of humorous, novel or skilled reading materials. Besides that, libraries are also at the forefront of assisting the teaching and learning process, research in higher education, and carrying out social, cultural, scientific, and technological changes (Dinata & Krismayani, 2018).

The Kandaga Library, as the central library UPT at Padjadjaran University, certainly has a vital role considering its role as a university library. The Kandaga Library has several services to carry out its duties and functions as a college library. Reporting from the Kandaga Library page https://kandaga.unpad.ac.id/ (UNPAD, 2024), the Kandaga Library consists of several types, namely Kandaga online services, Kandaga offline services, administration and submission services, as well as Kandaga research support services. Kandaga's online services include campus information, the latest news, e-library, online registration, and contacts and assistance. Kandaga's offline services include rare collections, membership, student reading room, e-learning, statistics corner, research, information services, museum, lockers, archives, discussion room, toilet, study room, classroom, prayer room, and standard room. Administrative and submission services at the

Kandaga Library include free library submissions and independent upload of Electronic Theses/Dissertation (ETD). The last type of service available at the Kandaga Library is the Kandaga research support service, which includes providing access to integrated information sources, research data management services, assistance in using research software, consultation and guidance on scientific writing, research cooperation and collaboration, as well as disseminating knowledge through the institutional repository. Apart from that, the Kandaga Library also provides services for increasing the capacity quality and developing human resources, technology, and innovation for knowledge accessibility, as well as contributing to the institution's ranking and reputation.

In providing its services, the Kandaga Library needs to pay attention to the quality of the library services provided. This aligns with the opinion of (Dinata & Krismayani, 2018), who state that university libraries must implement their functions optimally. The optimal quality of library services will satisfy users (Alfajar et al., 2021). Service quality can be interpreted by comparing the expected service with the service received by the user. If the quality of the service received is good, it can increase public satisfaction and create user loyalty. Community satisfaction can be created if the community assesses that the services or products provided have met community expectations and can encourage people to return to receive the service (Daeli et al., 2021).

The optimal quality of library services certainly requires careful library planning. Library planning is a thought process that determines the efforts that will be implemented in the future to support good library management (Hidayat, 2022). Library planning is significant for libraries as institutions that are constantly developing, which

includes planning library materials, human resources, budgeting, and facilities and infrastructure because goals will only be achieved if they have good planning (Yulinar, 2020). Harianja et al., (2021) argue that the availability of library facilities and infrastructure that support activities can influence the number of visits to the library. Feeling comfortable and wanting to visit the library is also influenced by several elements: comfort, adequate physical environmental conditions, supportive social and environmental conditions, and the services provided (Fajarina & Wasisto, 2023). Therefore, libraries are obliged to provide excellent services to users to meet users' expectations and increase the number of visits to the service.

Allen in Aziz et al., (2017) states that planning consists of several activities, including predicting, setting goals, programming, scheduling, budgeting, developing, and establishing and interpreting policies. The Kandaga Library also needs to prepare itself to realize its function as a Cultural Heritage Gallery, Library, Archives, and Museum (GLAM). Currently, the Kandaga Library can carry out developments related to its function as GLAM in the context of increasing the accessibility of knowledge. With insight into the number of visitors, the Kandaga Library can find solutions to the problem of lack of facilities and infrastructure, human resources, library materials, cultural heritage materials, and other primary sources for the benefit of the public and researchers.Based on this opinion, the prediction process is fundamental for an organization, including the Kandaga Library. One of the things that the Kandaga Library can predict is the number of visitors who use library services. The aim of predicting the number of visitors is so that the Kandaga Library can provide optimal library services by paying attention to the level of number of visitors. This is important because improving service elements such as collections, librarians,

and facilities that are felt lacking can affect visiting users' interest (Kamil et al., 2024). The following statistical data on the number of visits to the Kandaga Library from 2023 to September 2024 can be seen in Figure 1. Number of Visitors at Kandaga Library 2023-2024.

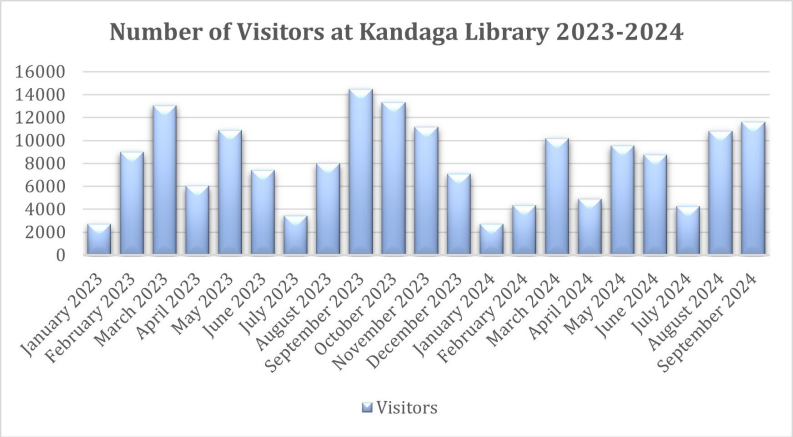

Figure 1. Number of Visitors at Kandaga Library 2023-2024

Source: Kandaga Library, 2024 (Processed by the author, 2024)

Based on Figure 1. Number of Visitors at Kandaga Library 2023-2024: The number of visitors at the Kandaga Library from January 2023 to September 2024 looks to fluctuate. This is because the number of visitors fluctuates every month. The lowest number of visitors was in January 2023, amounting to 2,705, while the highest number was in September 2023, amounting to 14,460. Based on this data, the average number of visitors to the Kandaga Library is 8,268.33. Seeing the fluctuating number of visitors, the Kandaga Library can make preparations related to improving service quality so that it can provide services that meet the academic community's expectations. This is because visitor behavior can be influenced by the library's readiness to meet the needs of library service recipients (Hendrawardani & Kurniasih, 2022).

One preventive effort that the Kandaga Library can carry out to improve the quality of library services in the future is to forecast the number of visitors. In (Ahmad, 2020) opinion, forecasting is an approach to predicting future events quantitatively based on relevant historical data. Forecasting is vital in deciding because it is carried out based on historical data and analyzed using specific methods (Mulyani et al., 2021). The relationship between forecasting the number of visitors and fluctuations in the number of visitors at the Kandaga Library is that predicting the number of visitors can help the library anticipate a spike in the number of visitors in the future. This is very important for the Kandaga Library so that it can evaluate the performance that has been provided so far, carry out plans to overcome future problems and realize these plans.

Many methods, including the ARIMA model, can be used to carry out forecasting. The ARIMA model is suitable for predicting the number of visitors at the Kandaga Library. It can predict quickly, simply, and efficiently because it only requires historical data and is accurate (Hartati, 2017). The ARIMA model is considered to have a high level of accuracy, so it is suitable for forecasting the number of visitors at the Kandaga Library. The implementation of the ARIMA model for forecasting has been carried out in several previous studies. Buchori & Sukmono (2018) use the ARIMA model to predict production at PT. XYZ, R. A. Wulandari & Gernowo (2019) use a combination of the ARIMA model and the ANFIS method to estimate rainfall, Yuliyanti & Arliani (2022) in research that examines population forecasting also uses ARIMA model for analysis, and Indayani & Darsyah (2018) also used ARIMA and Winters models to choose the best forecasting model to predict the LQ45 Index. Based on the literature study, researchers have not found research that discusses using the ARIMA model to

predict the number of visitors at the Kandaga Library. Therefore, this research aims to forecast the number of visitors at the Kandaga Library using the ARIMA model as a preventive effort for the Kandaga Library to provide better library services and improve service quality and user satisfaction.

B. LITERATURE REVIEW

Forecasting Concept

Forecasting is an effort to predict the future by utilizing information or data from the past to make decisions in the future (Zulhamidi & Hardianto, 2017). This opinion is in line with the opinion of Hartati (2017), who states that forecasting is a statistical method used to make future estimates based on historical data to assist in decision-making. Nasution in Buchori & Sukmono (2018) state that estimating future needs, which includes quantity, quality, time, and location to fulfill demand for goods or services, can be called forecasting. So, forecasting is a statistical method used to estimate the future using historical data.

Many studies discuss forecasting the number of visitors to libraries. Yuni et al., (2015) forecasted the number of visitors at the Pattimura Ambon University Library using the decomposition method with the result that in May and November 2015, the library experienced an increase in the number of visitors. Kendek et al., (2014) using the same method that Yuni et al., (2015) used, namely the decomposition method, also conducted a study regarding forecasting the number of visitors at the Sam Ratulangi University Library Manado with the result that there was an increase in the number of visitors at the Sam Ratulangi University Library Manado from February to March and September to October 2013. Apart from the decompo-

sition method, the ARIMA method is also used in forecasting the number of visitors as was done by Aziz et al., (2017) at the UIN Suska Riau Library with the results that up to the 190th day of forecasting the number of visitors, it was discovered that as many as 24 students came to the library every day. The Fuzzy Time Series was also used by Perangin-angin et al., (2024) to forecast the number of visitors to the Karo Regency Regional Library with the result that 91 people visited the library on March 7, 2023.

ARIMA Model

The Autoregressive Integrated Moving Average (ARIMA) model is a time series analysis method commonly known as BoxJenkins, which originates from the integration of the Autoregressive (AR) and Moving Average (MA) models (R. A. Wulandari & Gernowo, 2019). The ARIMA model is also a forecasting model that utilizes historical data for short-term forecasting (Buchori & Sukmono, 2018). The following is the formula used to forecast the number of visitors using the ARIMA model (Zulhamidi & Hardianto, 2017):

$$Yt = \gamma\, 0 + \partial 1 Yt - 1 + \partial 2 Yt - 2 + \ldots + \partial n Yt - p - \lambda 1 et - 1 - \lambda 2\, et - 2 - \lambda n\, et - q$$

Information:

B : Regression coefficient

Yt : Dependent variable at time t

$Yt - 1 \ldots Yt - p$: Lag variable

et : Residual term

$W1 \ldots W q$: Weight

$et - 1 \ldots et - p$: Previous or residual value

Several methods or models can be used to forecast the number of visitors. In the opinion of (Gunaryati & Suhendra, 2015), the decomposition method can be used to predict by breaking down a periodic series into its main components. This method can also obtain data related to periodic series components from trend, cycle, seasonality, and randomness factors. The exponential smoothing method is often used in forecasting because its principle focuses on decreasing exponential priorities for research objects. This is because this method continuously repeats forecasting using the latest data so that the latest observations have more priority than old observations (Fahmuddin et al., 2023). Tafalas (2019) states that an expert modeler is an automatic way to identify and estimate the most suitable forecast in a time series data. Apart from that, Pattirajawane et al., (2016) also argue that the expert modeler provided by SPSS software is used to automatically obtain choices regarding the best or optimal model provided by SPSS software. Thus, expert modelers are considered capable of choosing a model with minimum errors.

C. RESEARCH METHODS

Data Collection Technique

The data used in this research is secondary data in the form of historical data regarding the number of visitors to the Kandaga Library from January 2023 to September 2024. This data was obtained from the Visit Report at the Kandaga Library, published on the Instagram social media account @kandagaunpad. This data is official because the official social media account of the Kandaga Library publishes it. The following report on visits to the Kandaga Library from January 2023 to September 2024 can be seen in Figure 1. Number of Visitors at Kandaga Library 2023-2024.

Data Analysis Technique

The data analysis technique in this research can be seen in Figure 2. Research Flows below.

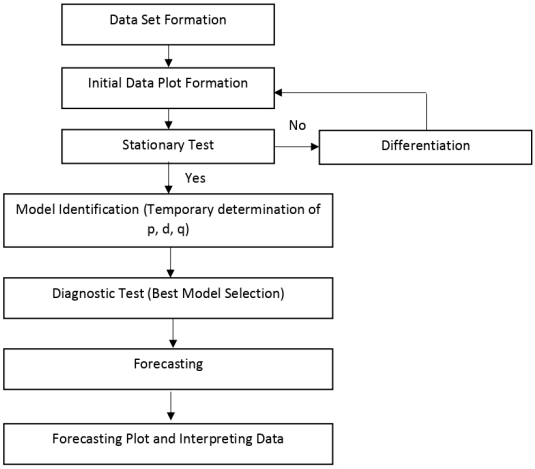

Figure 2. Research Flows (Processed by the author, 2024)

Data analysis in this research used SPSS Version 26 software. Based on Figure 2. Research Flows: This research began by creating a data set related to the number of visitors at the Kandaga Library from January 2023 to September 2024, then continued by creating initial data plots from the historical data held. After the initial plot data is formed, whether the data is stationary can be seen, so a stationary test is carried out. If the data still needs to be stationary, differencing is carried out. In contrast, if the data is stationary, then it is continued by identifying the temporary model from the ARIMA model (p, d, q). In determining a temporary model, it is possible to create several models, so a diagnostic test must be carried out to determine the best model for forecasting. The forecasting stage is carried out when

the best model has been obtained. This research ends by making a forecasting plot, interpreting data, and drawing conclusions.

D. RESULTS AND DISCUSSIONS

Initial Data Plot

Historical data, in the form of statistics on the number of visitors at the Kandaga Library from January 2023 to September 2024, was then made into an initial data plot using SPSS Version 26 software. The following Figure 3. The Initial Data Plot of the Number of Visitors at Kandaga Library 2023-2024 results from data visualization using SPSS Version 26 software.

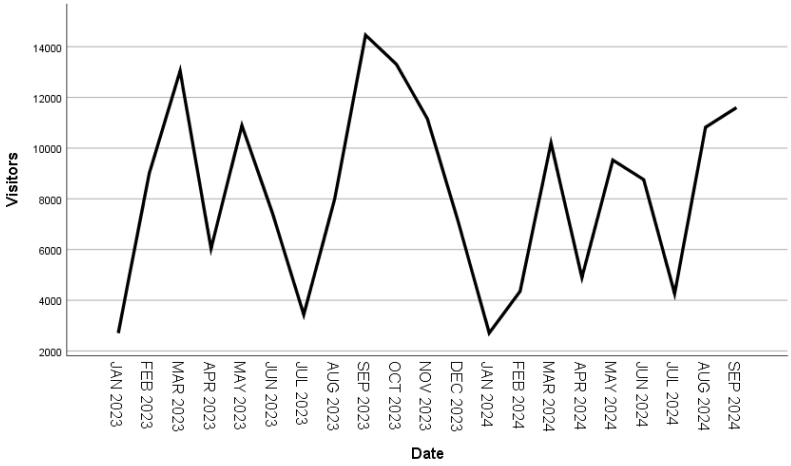

Figure 3. The Initial Data Plot of the Number of Visitors at Kandaga Library 2023-2024

(Processed by the author, 2024)

Based on Figure 3. The Initial Data Plot of the Number of Visitors at Kandaga Library 2023-2024: It can be seen that the number of visitors at Kandaga Library from January 2023 to September 2024

was 173,635 visitors. The most visitors were in September 2023, with 14,460 visitors, while the fewest were in January 2024, with 2705 visitors. The average number of visitors to the Kandaga Library from January 2023 to September 2024 is 8,268.33. Researchers believe that the number of visitors in September, October, and November have a more significant number of visitors than other months because, in those months, there are new student orientation activities. This allows new students' enthusiasm for visiting the library to be higher.

Data Stationary Test

Correlgram analysis of the autocorrelation function consisting of Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots can be a test of data stationarity (Sagala & Tarigan, 2023). The results of the autocorrelation function analysis using SPSS Version 26 software are shown in Figure 4. ACF Plot and Figure 5. PACF Plot.

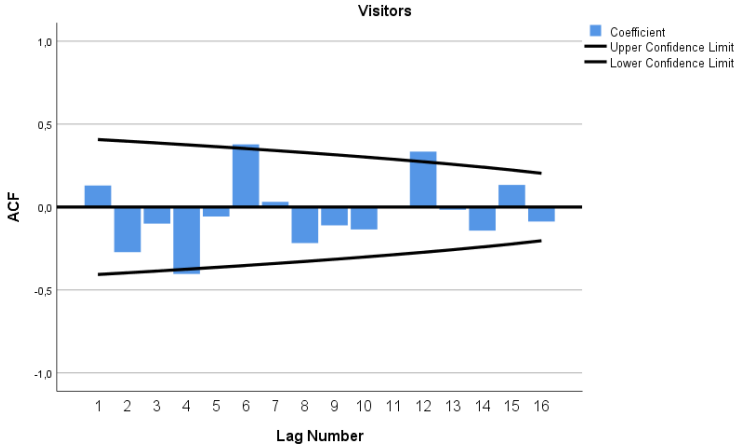

Figure 4. ACF Plot (Processed by the author, 2024)

Based on Figure 4. ACF Plot, the q value from the ARIMA model

(p, d, q) can be seen in the Moving Average (MA) process (S. Wulandari et al., 2021). The MA value is known based on the lag that exceeds the significance limit. Based on the ACF Plot, it is known that lag 4, lag 6, and lag 12 are lags that exceed the significance limit. So the possible q values are q=4, q=6, and q=12.

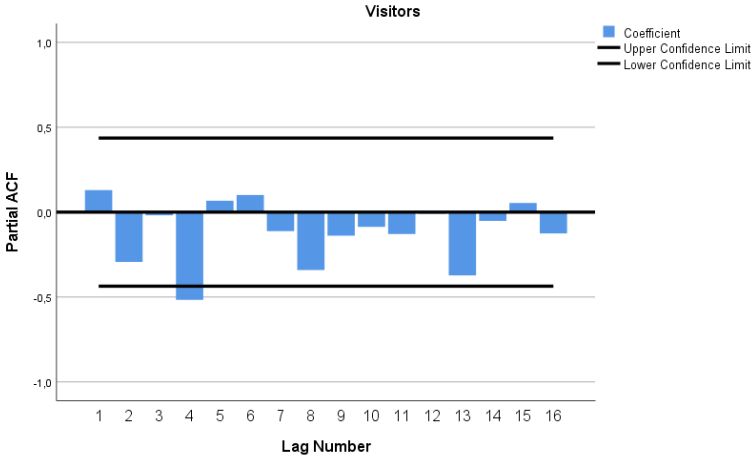

Figure 5. PACF Plot (Processed by the author, 2024)

The p value in the ARIMA model (p, d, q) can be found by analyzing the PACF Plot. The p value is known through the Autoregressive (AR) process (Sagala & Tarigan, 2023). In the opinion of S. Wulandari et al., (2021), in the same way as knowing the MA value, the AR value can also be known by analyzing the PACF Plot by paying attention to the lag that exceeds the significance line. Based on Figure 5. In the PACF plot, it is known that lag 4 exceeds the significance line, so it can be concluded that the p value = 4.

Temporary ARIMA Model Identification

Based on the analysis results of Figure 4. ACF Plot and Figure 5. PACF Plot, the ARIMA model values (p, d, q) can be seen. PACF Plot

Analysis produces a p value = 4. Historical data regarding the number of visitors at the Kandaga Library has been considered stationary since the beginning because it is close to the average, so the value of d=0. The values q=4, q=6, and q=12 were obtained based on the results of the ACF Plot analysis. So the temporary ARIMA (p, d, q) model that can be formulated is ARIMA (4,0,4), ARIMA (4,0,6), ARIMA (4,0,12), ARIMA (4,0,3), and ARIMA (1,0,3).

Best Model Selection

The temporary ARIMA models that have been successfully formulated are ARIMA (4,0,4), ARIMA (4,0,6), ARIMA (4,0,12), ARIMA (4,0,3), and ARIMA (1,0, 3). The entire model will then be conducted with a diagnostic test to find the best ARIMA model. Determining the best ARIMA model can be done by paying attention to the Mean Absolute Percentage Error (MAPE) value, where the smaller the MAPE value, the more accurate the model is for use in forecasting Wei in R. A. Wulandari & Gernowo, (2019). Based on the diagnostic test results of all ARIMA models while using SPSS Version 26 software, the MAPE value of each model can be seen in Table 2. The MAPE values are as follows.

Table 2. The MAPE Values

ARIMA Model	MAPE	Information
ARIMA (4,0,4)	33,90%	Forecasting is enough
ARIMA (4,0,6)	34,20%	Forecasting is enough
ARIMA (4,0,12)	26,89%	Forecasting is enough
ARIMA (4,0,3)	33,28%	Forecasting is enough
ARIMA (1,0,3)	45,17%	Forecasting is enough

Source: Processed by the author (2024)

Based on Table 2. The MAPE Values, the temporary ARIMA model with the smallest MAPE value, is the ARIMA model (4,0,12). The MAPE values of the ARIMA (4,0,4), ARIMA (4,0,6), ARIMA (4,0,3), and ARIMA (1,0,3) models are 33.90%, 34.20%, 33.28%, and 45.17%, respectively. Therefore, the ARIMA model (4,0,12) was chosen as the best model for forecasting the number of visitors at the Kandaga Library.

Forecasting Using ARIMA Model

The ARIMA model (4,0,12), which has been chosen as the best forecasting model, is then forecasted using SPSS Version 26 software. Researchers try to predict the number of visitors to the Kandaga Library from October 2024 to October 2025. Below is Figure 6. Forecasting Using ARIMA Model at Kandaga Library.

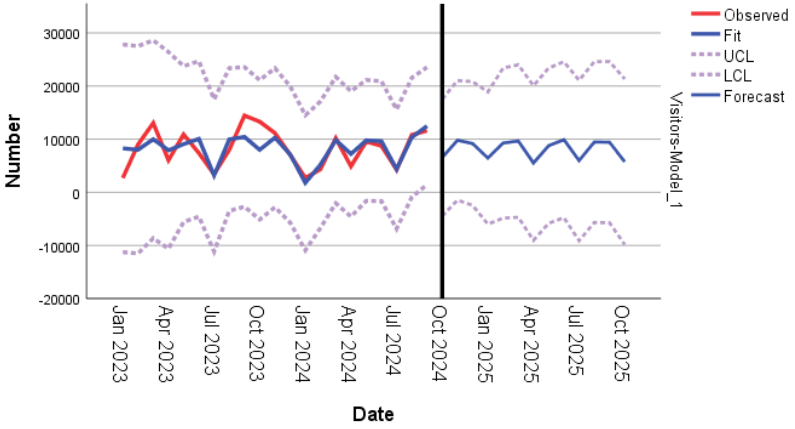

Figure 6. Forecasting Using ARIMA Model at Kandaga Library
(Processed by the author, 2024)

Figure 6. Forecasting Using ARIMA Model at Kandaga Library results from forecasting using the ARIMA model (4,0,12). For detailed information regarding the estimated number of visitors at the Kandaga Library from October 2024 to October 2025, see Table 3. Forecasting at Kandaga Library Using ARIMA (4,0,12) below.

Table 3. Forecasting at Kandaga Library Using ARIMA (4,0,12)

Month	Number of Visitors
October 2024	6528
November 2024	9793
December 2024	9183
January 2025	6456
February 2025	9262
March 2025	9663
April 2025	5522
May 2025	8790
June 2025	9911
July 2025	5985
August 2025	9460
September 2025	9440
Oktober 2025	5749

Source: Processed by the author (2024)

Table 3. Forecasting at Kandaga Library Using ARIMA (4,0,12) is the result of analysis using SPSS Version 26 software. Based on this table, June 2025 is predicted to have the highest number of visitors, namely 9,911 visitors, while April 2025 is predicted to have the lowest number of visitors, namely 5,522 visitors. The predicted total number of visitors at the Kandaga Library from October 2024 to October 2025 is 105,742 visitors, with an average of 8,134.

Forecasting Using Expert Modeler

To compare the forecasting results for the number of visitors at the Kandaga Library, the researcher tried to compare forecasting using another model, Expert Modeler, which was analyzed using SPSS Version 26. Expert modelers have the advantage of forecasting

because they are able to identify the best model by going through a trial-and-error process without carrying out standard procedures manually (Tafalas, 2019). The following is Figure 7. Forecasting Using Expert Modeler at Kandaga Library.

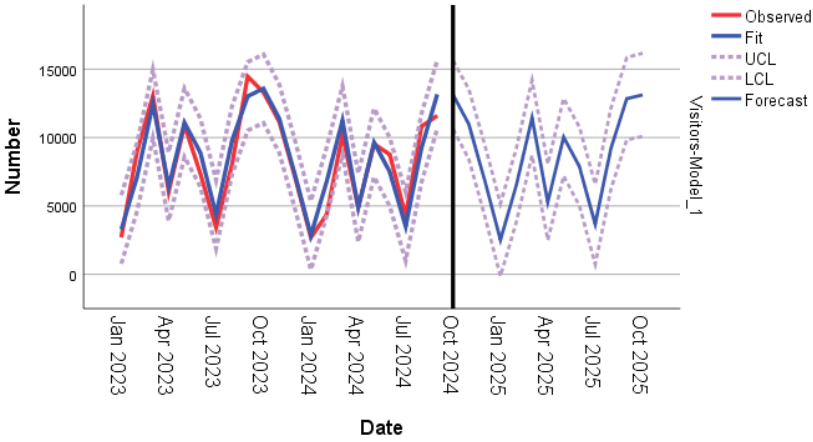

Figure 7. Forecasting Using Expert Modeler at Kandaga Library
(Processed by the author, 2024)

Figure 7. Forecasting Using Expert Modeler at Kandaga Library can be further detailed in Table 4. Forecasting at Kandaga Library Using Expert Modeler is below.

Table 4. Forecasting at Kandaga Library Using Expert Modeler

Month	Number of Visitors
October 2024	13120
November 2024	10976
December 2024	6905
January 2025	2522
February 2025	6496
March 2025	11440
April 2025	5283

May 2025	10029
June 2025	7892
July 2025	3665
August 2025	9225
September 2025	12847
Oktober 2025	13120

Source: Processed by the author (2024)

Forecasting using an Expert Modeler in this research has a MAPE value of 13.10%. Based on Table 4. Forecasting at Kandaga Library Using Expert Modeler, the number of visitors at the Kandaga Library from October 2024 to October 2025 is predicted to be at least 2,522 visitors in January 2025. The highest number of visitors is expected to be in October 2024 and October 2025, with the same number, namely 13,120 visitors. Based on this table, it is also known that the predicted total number of visitors to the Kandaga Library from October 2024 to October 2025 is 113,520, with an average number of visitors of 8,732.

E. CONCLUSIONS

Based on the results and analysis, this research uses the ARIMA model (4,0,12) because this model has the smallest MAPE value of 26.89% compared to other ARIMA models. The predicted results of forecasting the number of visitors at the Kandaga Library from October 2024 to October 2025 using the ARIMA model (4,0,12) show that the predicted total number of visitors reaches 105,742, with the fewest visitors in April 2025 being 5,522 and the most visitors in June 2025 as many as 9,911. Compared with other forecasting methods, namely Expert Modeler, with a MAPE value of 13.10%, the predicted total number of visitors at the Kandaga Library from October 2024

to October 2025 is 113,520. The most visitors in October 2024 and October 2025 were 13,120, and the fewest visitors in January 2025 were only 2,522. If look at the MAPE value, forecasting using the Expert Modeler is more accurate than the ARIMA model (4,0,12) because the Expert Modeler has a MAPE value of 13.10%. In comparison, the ARIMA model (4,0,12) is 26.89%.

The results of forecasting the number of visitors are very important for management at the Kandaga Library because, with forecasting data, the library can know when there will be a spike in the number of visitors and when the number of visitors will decrease. Based on these reasons, libraries can prepare themselves for the problem of a surge in the number of visitors by planning adequate human resources, procuring facilities and infrastructure, and allocating budgets to create library innovations that are able to attract more visitors.

Apart from being limited to the model used, future researchers can consider internal and external factors that can influence the number of library visitors, such as the new student admission period, new student orientation period, exam period, and the possibility of outbreaks such as COVID-19 and other infectious outbreaks. Other researchers can develop further by comparing this research using different forecasting methods to obtain the most accurate model for forecasting the number of visitors.

This study can have an impact on libraries through the preparation of preventive actions to overcome library management problems. Apart from that, this study can be a consideration for policy-makers to create the latest innovations to realize the Kandaga Library as GLAM. Library development based on the results of forecasting the

number of visitors can also encourage the creation of a productive educational environment and support the realization of the Tri Dharma of Higher Education.

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