

## Forecasting the Number of Visitors to the UIN Walisongo Semarang Library with the Decomposition Method

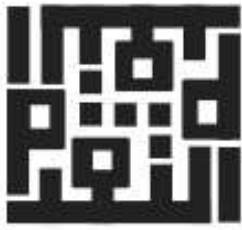
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### ABSTRACT

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The library is an important part of a university. Especially for UIN Walisongo Semarang which states to be a research Islamic university based on the vision that has been announced. The library is a vital unit contributing to the realization of the vision of the institution because it is a storage place for various research results both from inside and outside UIN Walisongo Semarang. In addition, several problems occur in the library, so it is necessary to forecast the number of visitors to ascertain the number of librarians who serve it. Decomposition becomes a statistical method in predicting the number of visitors because this method breaks the components of a periodic series separately which can improve the accuracy of forecasting. This prediction resulted in an increase in the number of visitors to the library of UIN Walisongo Semarang in 2020 compared to previous years. Based on the results of forecasting the number of visitors, the number of librarians that must be provided is 42 librarians.

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### Introduction

Libraries are an important part of an educational institution, including universities. In the Higher Education Library Guidelines book it is stated that the higher education library is a supporting element of the tertiary institution in education, research and community service activities (Team of Drafting of the Republic of Indonesia National Library Standards in the Field of School Libraries and Higher Education Libraries, 2011) . In order to

support these tridharma activities, the library is given several functions which are summarized in the Law of the Republic of Indonesia No. 43 of 2007 concerning Libraries (2007) concerning Libraries, namely as a vehicle for education, research, preservation, information and recreation to increase intelligence and national empowerment. These various functions will of course work well if the quality of the library is good. User satisfaction surveys need to be carried out in order to improve quality (Partap, 2019) .

The existence of libraries in educational institutions is very important in determining the quality of education. Azhari & Ramadan (2022) examined the intensity and purpose of students visiting the school library. From the results of this study, information was obtained that 2-4 times students visited the library. It turns out that not only is the purpose of reading books, but students take advantage of visiting the library to spend their school breaks. Another research has been conducted by Caudillo et al. (2022) who examined qualitatively regarding library quality based on learning outcomes from experience visiting the library. As a result, the experience of visiting libraries in Southern California contributes to improving library quality. The library of UIN Walisongo Semarang will play a role in supporting the achievement of the vision of UIN Walisongo Semarang as a research Islamic university (LPM, 2015) if the quality of the library is good. However, based on the results of interviews with the Head of the UIN Walisongo Library, it turned out that there were several problems.

According to the Head of the UIN Walisongo Semarang Library (2019), the main problem the library is currently facing is the disproportionate number of librarians and visitors. This resulted in acts of vandalism (scribbled on) books, destroying and even removing inventory books. Thus, it is necessary to know the number of visitors for the next period so that the procurement of the number of librarians is exactly proportional to the number of visitors. The increase in the number of visitors is also one of the parameters for the success of library services (Rafikasari & Rohman, 2018) so forecasting the number of visitors needs to be carried out.

Forecasting is an activity to predict or estimate the magnitude of something in the future based on past data that has been analyzed scientifically, especially using statistical methods (Sudjana, 1986) . Forecasting can be regarded as the beginning of a decision-making process. As stated by Yударuddin (2019) that the purpose of business forecasting for companies is to combine statistical analysis and the company's main knowledge to build and develop estimates as a basis for decision making. According to him, forecasting supports businesses in guiding production strategy and inventory control. Navratil & Kolkova (2019) did forecasting to find out business conditions in e-commerce. According to them, forecasting can be qualitative and quantitative. However, for the accuracy of the results, quantitative forecasting with statistics is preferred.

Many methods can be used in statistical forecasting. Decomposition is a good forecasting method because it divides data into three components, namely cyclical, seasonal, and trend (Ulya et al., 2020) . Projections from each component can then be combined to produce forecasts of future values from time series data (Subagyo, 1986) . The division of these components often helps improve forecasting accuracy and helps problems with time series behavior well. The number of library visitors is a time series data with a very large seasonal influence. Data on the number of visitors in the previous period greatly influences the results of forecasting the number of visitors in the coming period. In addition, the purpose of the decomposition method is to estimate the effect of seasonality on the data, which is the majority of time series data, so this method

can be said to be better than other methods. Therefore, the decomposition method is appropriate to use in predicting the number of library visitors at UIN Walisongo Semarang.

Several previous relevant studies, forecasting is more widely applied in the economic field. Rodrigues et al. (2020) predicted mutual fund investment by decomposing time series data. Nisa (2022) predicts Islamic stock prices in Indonesia using the ARIMA forecasting approach. This research will focus on the application of forecasting in the field of education, namely the number of visitors to the UIN Walisongo Semarang library using the .. decomposition method.

## Literature Review

### Forecasting

Forecasting is a data mining technique combined with machine learning that is used to analyze and calculate future events using past data (Moghadam et al., 2018). Forecasting can be approached quantitatively and qualitatively. The quantitative approach means predicting events with the help of statistics while the qualitative approach is more *judgmental* in predicting something (Thoplan, 2014). Suppose there is a Delphi forecasting method. This method of predicting for the future uses a consensus of experts in the field.

The challenge in *forecasting* is data management in the long term (Wu et al., 2021). Thus, it is necessary to pay close attention to data patterns and periods, both used in the data and future forecasts. There have been many forecasting methods applied in order to predict future events. But a good forecasting method is one that

adjusts the data pattern (Nisa, 2022). In general, forecasting data patterns are divided into *trend*, cyclical and seasonal data patterns

### Decomposition

Decomposition can be said as a standard method in *time series analysis* (Wu et al., 2021). Decomposition is always used as *pre-processing* in predicting the future (Asadi & Regan, 2020). The decomposition method is based on the assumption that the existing data is a combination of pattern and error components.

$Y' = pola + error$

$= f(trend, cyclical, seasonal) + irregular$

Thus, the general equation of the decomposition model is as follows.

$$Y' = T, C, S, I$$

with

$Y'$  = periodic data

$T$  = variation *trend*

$C$  = cyclic variation

$S$  = seasonal variations

$I$  = variation *errors / irregularities*

There are two models of the decomposition method, namely the additive and multiplicative models. The additive decomposition model is effective when the peak values of the seasonal data do not vary too much, while the multiplicative model is effective when the seasonal values are excessive (Prema & Rao, 2015). In selecting the best model to predict the number of visitors in this study using the Mean Absolute Percentage Error (MAPE) because it is easy to interpret (Kim & Kim, 2016). MAPE is a measure of selecting the best model commonly used in previous studies (Chen & Bloomfield, 2003).

MAPE is formulated as follows.

$$MAPE = \frac{\sum_{t=1}^n \left| \frac{a-b}{a} \right|}{n} \times 100\%$$

with a : actual data

b : forecast data

n : amount of data

The best model is the model with the smallest MAPE, which means that the model has high accuracy in predicting the number of library visitors.

### Research Method

This research was conducted with a quantitative approach. For the analysis used descriptive and inferential statistics. Analysis with descriptive statistics was used to analyze the results of data exploration, in this case visitor data at UIN Walisongo Semarang library. The mean, median, and standard deviation of the data on the number of visitors to the UIN Walisongo Semarang library will be calculated and interpreted to provide more information in analyzing the research results.

Inferential statistics used in this study is forecasting with decomposition. The stages of research with the decomposition method are as follows: 1). Determine the pattern of time series data using the autocorrelation function graph (FAK) and the partial autocorrelation function (FAKP). 2). Form additive and multiplicative decomposition models. 3). Determine the best decomposition model based on the smallest MAPE value. 4). Starting the process of forecasting the number of visitors to the UIN Walisongo Semarang library with the best decomposition model. 5). Determine the trend value. 6). Define seasonal values.

7). Specifies the cyclic value. 8). Determine the forecasting of the number of visitors to the UIN Walisongo Semarang library. 9). Determine the number of librarians needed based on the results of forecasting the number of visitors to the UIN Walisongo Semarang library. 10). Measure the accuracy of the forecasting method used. 11). Analyzing the results of forecasting based on a comparison of the number of visitors with the needs of librarians in order to maintain the quality of central library services.

The type of data used is secondary data by taking data from the UIN Walisongo Semarang Library. The data in question is data on the number of visitors to the UIN Walisongo Semarang library from 2015 to 2022.

### Result and Discussion

We can analyze the data obtained descriptively. The following is the result of calculating descriptive statistics on the number of visitors to the UIN Walisongo Semarang library in 2019, 2020 and 2021.

**Table 1.**  
*Descriptive Statistics of the Number of Visitors to the UIN Walisongo Semarang Library*

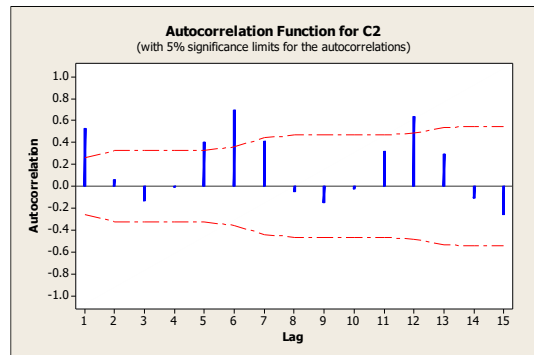
Size	2019	2020	2021
Average	6,530	6,580	6,805
Median	7.020	7,025	7.145
Standard deviation	1646,2	17021.7	18211,2

Based on Table 1, information is obtained that the average number of library visitors from year to year is increasing. Thus, we can say that the trust of students and academics both within the UIN Walisongo environment and not towards the UIN Walisongo Semarang library is still good. A median value that is greater than the average means that the data on the number of library visitors is greater than the average. Furthermore, the diversity of data on the number of visitors to the UIN Walisongo Semarang library from 2019 to 2020 is getting bigger. The standard deviation of the number of visitors is large, meaning that the difference in the number of visitors to the library each month is large. The value fluctuates.

**Forecasting the Number of Visitors to the UIN Walisongo Semarang Library**

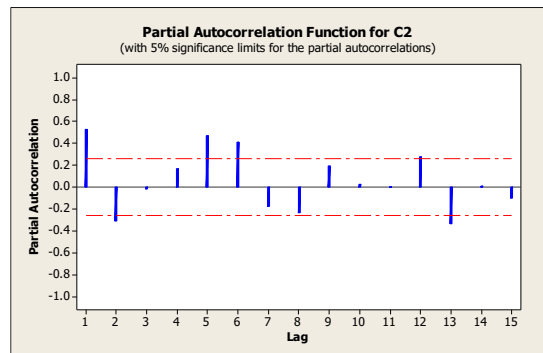
The first thing to do in forecasting is to determine the pattern of time series data using the graph of the autocorrelation function (FAK) and the partial autocorrelation function (FAKP). The following is a picture of the two graphs referred to in the data on the number of library visitors.

**Figure 1.**  
*FAK Graph Number of Visitors to the UIN Walisongo Semarang Library*



From the FAK diagram above, it can be seen that the data forms a trend because from the FAK chart it appears to be rising slowly.

**Figure 2.**  
*Graph of FAKP Number of Library Visitors UIN Walisongo Semarang*



Likewise in Figure 2. shows a trend. This is based on the graph, there is a value indicated by a blue line whose value is close to one, which is 0.5 and another blue line is below the value of 0.5. After knowing the data pattern, then choosing the best decomposition model to predict the number of library visitors. The criterion used to select the best decomposition model is MAPE. The following is the MAPE value of each decomposition model.

**Table 2.**

MAPE Value in Each Decomposition Model

Dekompo Model-side	N	MAPE
Additives	60 months	49
Multiplicativ e	60 months	45

From Table 2. Information is obtained that the best decomposition model for predicting the number of library visitors at UIN Walisongo Semarang is the multiplicative decomposition model because the MAPE value is smaller than the additive decomposition model. The forecasting process with multiplicative decomposition begins with determining the trend equation function using the least squares method.

Figure 3. Trend Analysis Plots

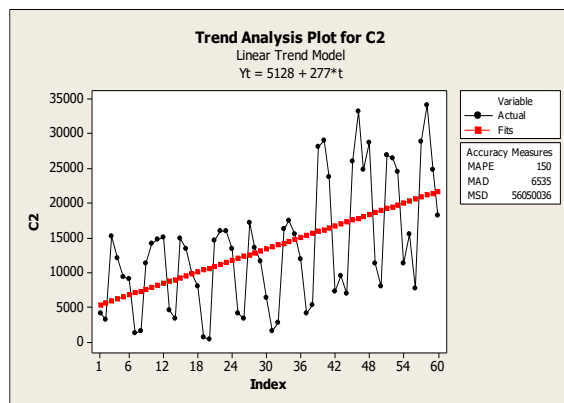


Figure 3. shows a linear equation for the trend function obtained, namely  $Y_t = 5128 + 277t$  where  $t$  is time. The trend of the number of visitors to the UIN Walisongo Semarang library seems to be increasing, although in recent years there has been a decline. After the trend value, the component that needs to be looked for

again is the seasonal index. The following are the seasonal values obtained for a year.

Table 3. Seasonal Index in Forecasting the Number of Visitors to the UIN Walisongo Semarang Library

Month	Average	Seasonal Index
Jan	5667.6	41.75
Feb. 10,	4667.8	34.39
Mar	20524.8	151.20
Apr. 10,	18927.2	139.43
Mei	15832	116.63
june	8444.4	62.21
Jul	5722	42.15
Agu	3908	28.79
Sep. 10th	19473.2	143.46
Oct	22998.2	169.43
Nov. 19,	19199.4	141.44
Dec	17525,6	129,11
<b>Amount</b>	<b>162890,2</b>	<b>1200</b>

The seasonal index in forecasting has an expected value of 100%. Based on Table 3, we can see that the seasonal index for the number of library visitors in January was only 41.75 %, which is lower than expected. Likewise, what happened in February was only 34.39 %. Furthermore, the seasonal index in March was above the expected value of 151.20 % or 51.20% higher than the expected value. Likewise in April and May above the expected value. Then in June, July and August it fell again and rose again beyond expectations from September to December. The highest seasonal index occurred in October and the lowest in August. Cyclical values are difficult to obtain because the cyclical pattern is not fixed, it always waves around the trend. Therefore, the value of forecasting the

number of visitors to the UIN Walisongo Semarang library immediately determined. The following is the forecast value for the number of visitors to the UIN Walisongo Semarang library in 2022.

**Table 4.**  
*Seasonal Index in Forecasting the Number of Visitors to the UIN Walisongo Semarang Library*

Month	Forecast results
January	9,530
February	7,715
March	34,263
April	26,548
May	14,068
June	14,068
July	9,530
August	6,580
September	32,447
October	38,347
November	31,994
December	29,271

Table 4. shows that the seasonal effect is clearly seen in the forecasting value of the number of visitors to the UIN Walisongo Semarang library. In January to February it decreased but in March it immediately rose drastically then fell again until August. Then immediately rose sharply from 6,580 visitors in August to 32,447 people in September. It rose again in October and continued to decrease until the end of the year. This seasonal pattern is of course influenced by the UIN Walisongo Semarang academic calendar. Visitor forecast in March rose sharply from the

previous month because the even semester lectures started in mid-February and ended at the end of June. Likewise in September the number of visitors skyrocketed even the number of visitors in October became the highest forecast value for one year. This is of course due to the odd semester lectures which start in mid-August to the end of December.

This forecasting value is of course in accordance with the factual data that has been given because this multiplicative decomposition model is feasible for predicting the number of visitors. This is because the MAPE value obtained is based on Table 5. as big 0.235 or 23.5%. This value is included in the interval  $20\% < \text{MAPE} \leq 50\%$  which means that it is feasible in forecasting (Chang et al., 2007) . The MAPE calculation is given below.

**Table 5.**  
*MAPE calculations*

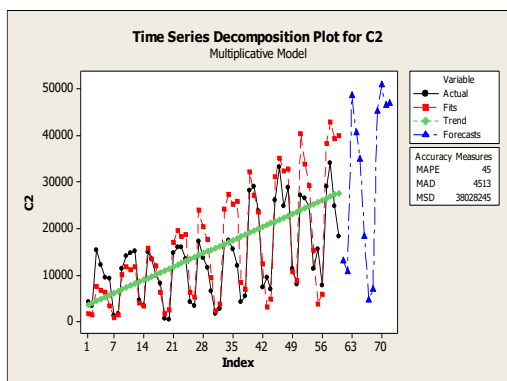
Month	Predictive Value	Actual Value-Predicted Value /Actual Value
Jan	9530	0.160500352
Feb. 10,	7715	0.033329157
Mar	34263	0.268765044
Apr. 10,	26548	0.000867107
Mei	14068	0.426801939
june	14068	0.243525148
Jul	9530	0.389220022
Agu	6580	0.150967742
Sep. 10th	32447	0.121336743
Oct	38347	0.124413559
Nov. 19,	31994	0.290080645

Month	Predictive Value	$\frac{ Actual Value - Predicted Value }{Actual Value}$
Dec	29271	0.605121737
	MAPE	0.234577433

The number of visitors to the UIN Walisongo Semarang library from year to year has increased as well as the forecasting results as illustrated in the plot below.

**Figure 4 .**

*Plot Forecasting the Number of Visitors to the UIN Walisongo Semarang Library*



It can be seen from Figure 4, every month the number of visitors to the UIN Walisongo Semarang library fluctuates, but every year it increases so that the number of librarians must also be proportional to the number of visitors. Based on the prediction results, the number of visitors in 2020 will be 254361 and the average monthly visitor will be 21197. Thus, the number of librarians that must be available in 2020 is 42 librarians considering the standard for the number of librarians based on the National Higher Education Library Standard is one in 500 visitors. By forecasting the number of visitors and in

the end it can be calculated the number of librarians needed is an effort to maintain the quality of academic services in a tertiary institution including the quality of the library.

**Conclusion**

The multiplicative decomposition model is a feasible model to use in predicting the number of library visitors at UIN Walisongo Semarang. From the forecasting results, it can be concluded that in 2023 the number of library visitors has increased compared to previous years with an average of 21197 visitors per month. Based on forecasting the number of visitors obtained, the number of librarians that must be as many as 42 librarians so that the quality of library service at UIN Walisongo Semarang is good. This research further enriches the application of forecasting in the social field. From the results of this study a comparison of the ideal number of visitors and librarians will be obtained according to accreditation standards, both university accreditation and private library accreditation. Furthermore, the quality of good academic services has implications for the good quality of education as well. This is one of the contributions in achieving the vision of UIN Walisongo Semarang to become a research Islamic university.

**Recommendations**

other forecasting methods so that they can compare forecast results and method accuracy to obtain the best method.

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