Forecasting The Number of Visitors in Borobudur Temple
As The Single Largest Buddhist Temple In The World Using
Seasonal Autoregressive Integrated Moving Average
(SARIMA) Model

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Abstract. Borobudur Temple, the biggest Buddhist temple since the 9th century, one of the 7 Wonders of the world heritage site historic with total relief of 1460 and 504 Buddha effigies amount. One of the parameters that can be used as benchmarks level of popularity of Borobudur Temple is the number of its visitors. This study want to know the form and time series models appropriate to describe and explain both behavior and patterns of the number of visitors in Borobudur Temple. Also, to find out the forecasting of the number of visitors to Borobudur Temple in the future. Methods used in this study are modeling and forecasting with data exploration by using the application of Seasonal Autoregressive Model Integrated Moving Average (SARIMA) especially in seasonal school holiday. Processing data is analyzed by using R software. The result of this study is to forecast the number of Borobudur temple visitors, so it can be prepared a program to anticipate the circumstances in the future so that the risk of failure can be minimized. In addition, forecasting is the basis for preparing the business plan, so it can increase the effectiveness of a business plan, especially in the field of tourism business to boost the country's foreign exchange, as it can potential to be the single largest Buddhist temple in the world.

Keywords: SARIMA, Borobudur Temple, Modelling and Forecasting, Visitors

INTRODUCTION

Borobudur Temple, the biggest Buddhist temple since the 9th century, even the building is one of the 7 Wonders of the world heritage site historic when it with total relief of 1460 and 504 Buddha effigies amount, thereby making many tourists both in the land even abroad who come to see for yourself how the beauty and splendor of the building of Borobudur Temple (Sofia, 2007).

In recent years many reported the quality of the management of the temple has decreased. This is due to inconvenience travelers against less specifically regulations enforced party temple to tourists. Borobudur Temple is considered as the cultural heritage and monument to the dead, so the tourists ignore again the conditions of hygiene of the temple where the tourists bring food and drinks and dispose of garbage scattered everywhere, coupled with a few strokes of the hand on the stone temples. In addition, the nature of a very forced traders to buy their wares to tourists also makes some tourists fret (Survey Sonjaya, 2015).

On the other hand, the effects of several natural disasters like earthquakes in 2006 resulted in the destruction of stone temples of Borobudur Temple and tourist travelers decline about 20 percent (Wahyuningsih, 2011). Next, on the Merapi eruption in 2010 resulted in tourists decreased 10 percent (Zakaria, 2010) and at the time of the occurrence of eruption of Kelud which made the temple the temple resulted in volcanic ash closed in a very long period of time so as to make some tourists mainly foreign tourists disappointed by the closure of the Temple of Borobudur (Setyawan, 2014).
international sphere. This led to the popularity of the Borobudur temple as the single largest Buddhist temple in the world started to decline.

One of the parameters that can be used as benchmarks the level of popularity of Borobudur is the number of its visitors. The pattern of number of tourists Borobudur Temple from time to time can be described and analyzed using one of the methods of statistical analysis, i.e. the time besides time series pattern number of tourists a tour place tend to have seasonality (seasonal). This is because the number of tourists attractions tend to be high when holidays. One of the public holidays in Indonesia is public school holiday. So there will be a month where the visitors of Borobudur temple is higher even it can be the highest than the other months during that year. Because of that, so it can be used a Seasonal Autoregressive Integrated Moving Average (SARIMA) method to forecast the number of Borobudur temple visitors.

**METHOD**

The model used in this study is a model of SARIMA. It is a model that used to explain patterns of data which have the effect of seasonal. SARIMA model can be written as below:

\[(1 - \phi_1 B - \ldots - \phi_p B^p)(1 - \Phi_1 B^s - \Phi_p B^{ps})(1 - B)^d (1 - B^s)^D y_t = (1 - \theta_1 B - \ldots - \theta_q B^q)(1 - \Theta_1 B^s - \ldots - \Theta_q B^{qs}) \epsilon_t\]

**Description:**
- P = order of the seasonal autoregressive
- D = number of seasonal difference
- Q = order of the seasonal moving average
- p = order of the non seasonal autoregressive
- d = number of non seasonal difference
- q = order of the non seasonal moving average
- s = seasonal period
- B = backshift operator
- \(\epsilon_t\) = rows of white noise with a mean of zero and a constant variance

Implementation of the method in this research consists of several stages. The first stage, researchers conduct studies of literature in order to add insight and knowledge of the author in the process of analyzing the way read books, journals and related resources. Then, researchers collect data of the visitors of Borobudur temple. Secondary data in the form of the number of visitors Borobudur temple in January 2012 to December 2016 obtained directly from the official of PT. Taman Wisata Candi Borobudur which is located around Borobudur temple, Magelang, Central Java.

The next stage is identify the data by making a plot of time series to see if there are any indication of seasonal data or to see the data and not already stationary or not. The plot will give a result is it stationary or not. If the data is not stationary yet, so it should be difference step which will make the data become stationary. Then, after the data already stationary, it can be proceed to the next step which is forecast using R software. The value of ACF (Autocorrelation Function) and PACF (Partial Autocorrelation Function) of the data had been checked before to make sure if the data has been stationary. Then it can be formed ARIMA (Autoregressive Integrated Moving Average) temporary model. Because to find the result of SARIMA, it should be obtain the result of ARIMA first.

In this research, researchers use R to calculate the result also to forecast the number of Borobudur temple visitors. The reason of using R is because R is free, so it is easy to get. R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and Mac Operating System. R is an open source programming language and software environment for statistical computing and graphics that is supported by the R Foundation for Statistical Computing. The R language is widely used among statisticians and data miners for developing statistical software and data analysis. To process especially ARIMA and SARIMA, it should be installed T3A (Time Series Analysis), ggplot2 and forecast packages to support the calculation especially for data in time series and forecasting calculation.
FIGURE 1. Flowchart of Research Methods

RESULT

The first thing to do is checking the data obtained to see what kind of the model of the data. Checking can be done by making plot of the data. The plot of the data of Borobudur temple visitors from January 2012 to December 2016 using time series plot is shown in the following figure:

FIGURE 2. Plot of Data of Borobudur Temple Visitors from January 2012 until December 2016
From the figure above, it appears that the number visitors of Borobudur temple is higher than the other when it reaches from 6th to 7th month. By that plot actually it can be said that the data is seasonal type. So, it will be processed in seasonal steps. Because the data is not stationary, so it should be stationary first by using syntax in R program.

In the calculation in R program, it is input the number of each year is 12 period, so the value of s is 12. Then, in R program it is automatically to find the best result order of ARIMA and SARIMA model. So, by applying syntax in R program, it shows that the order of ARIMA is (1, 0, 0) and for the SARIMA is (4, 0, 0), the result of AIC is 1551.25 and BIC is 1557.54. It is caused by the syntax in R can be automatically detected the best value which has smallest minimum error value.

After inputting the syntax of R, it is obtained the result of the forecasting stage based on data of Borobudur visitors from January 2012 until December 2016. Table below shows the result of forecasting the visitors of Borobudur temple in 2017.

<table>
<thead>
<tr>
<th>Time</th>
<th>Visitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2017</td>
<td>317243.9</td>
</tr>
<tr>
<td>February 2017</td>
<td>255530.6</td>
</tr>
<tr>
<td>March 2017</td>
<td>252884.5</td>
</tr>
<tr>
<td>April 2017</td>
<td>266190</td>
</tr>
<tr>
<td>May 2017</td>
<td>373632.3</td>
</tr>
<tr>
<td>June 2017</td>
<td>256462.4</td>
</tr>
<tr>
<td>July 2017</td>
<td>419842.2</td>
</tr>
<tr>
<td>August 2017</td>
<td>237571.5</td>
</tr>
<tr>
<td>September 2017</td>
<td>214237</td>
</tr>
<tr>
<td>October 2017</td>
<td>266047.4</td>
</tr>
<tr>
<td>November 2017</td>
<td>245871.3</td>
</tr>
<tr>
<td>December 2017</td>
<td>134697.6</td>
</tr>
</tbody>
</table>

Then the forecasting result for 12 stages ahead of Borobudur temple visitors is 317243.9 ; 255530.6 ; 252884.5 ; 266190 ; 373632.3 ; 256462.4 ; 419842.2 ; 237571.5 ; 214237 ; 266047.4 ; 245871.3, and 134697.6 which sorted appropriate by month.

From the results of forecasting pattern, then the number of visitors is indeed fit for every new year's holidays, school holidays and Idul Fitri the number of Borobudur temple visitors is increasing. If the forecasting data is in plot, it will appear like the following figure:
FIGURE 3. Plot of Data Forecasting of Borobudur Temple Visitors in 2017

CONCLUSION

The conclusion that can be derived from this research is the number forecasting of Borobudur temple visitors in 2017 unaccounted from January to December 2017 is 317243.9 ; 255530.6 ; 252884.5 ; 266190 ; 373632.3 ; 256462.4 ; 419842.2 ; 237571.5 ; 214237 ; 266047.4 ; 245871.3, and 134697.6 which sorted appropriate by month.

SUGGESTION

This paper will be analyzed more with the effect of calendar variations using ARIMAX (Autoregressive Integrated Moving Average with Exogenous) model.

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