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Modeling and Forecasting Tourists Arrival at Bagamoyo Catholic Museum, 2011-2021

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Abstract

Tourism can be described as the activities of visitors who visit the main destination outside their usual environment for less than a year for any purpose. The tourism industry has become one of the influential sectors in global economic growth. Thus, tourism forecasting plays an important role in the public and private sectors concerning future tourism flows. This study is an attempt to determine the best model for forecasting the combined international and domestic tourists arrival at Bagamoyo Catholic Museum based on the Autoregressive Integrated Moving Average (ARIMA) model. The comparison of the accuracy of the fitted different (ARIMA) models was done based on the value of Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC). The secondary time series data were obtained from the Bagamoyo Catholic Museum tourist records, which consist of many tourist arrivals from inside and outside of Tanzania from the year 2011 until the year 2021. The findings of this study suggest that the ARIMA (2, 1, 2) model was selected as suitable to be used in forecasting tourist arrivals in Bagamoyo Catholic Museum from the year 2022 to 2023. Therefore, this study will be beneficial to the government as well as other tourism stakeholders in Tanzania.

1.0 Introduction

Tourism is one of the most essential sectors which have a direct impact on the financial and economic development of Tanzania. The tourism sector is growing and emerging fast as it has become one of the forceful sectors of the global economy (Khairudin, Ahmad, Razali, Japeri, &Azmil, 2018). It is a surprisingly strong and resilient sector of economic activities and a fundamental

contributor to economic recovery by generating foreign currency and creating a large numbers of job opportunity. The tourism sector can contribute directly and indirectly to all of the sustainable development goals (UNWTO, 2015). Tourism contributes highly to gross domestic product (GDP), increasing the employment rate, a source of revenue for local people, the private sector as well as government sector (Upadhayaya, 2021).

In the year 2020, the tourism sector suffered the greatest crisis following unprecedented health, social, and economic emergencies during the outbreak of the Covid-19 pandemic diseases. Worldwide tourism arrivals decreased by 74% in 2020 than the previous year due to widespread travel restrictions and a massive drop in demand with losses of USD1.3 trillion in export revenues. Asia and the Pacific saw an 84% decrease in international arrivals in 2020, about 300 million less than in the previous year (Upadhayaya, 2021). The Middle East and Africa both recorded a 75% drop in arrivals. In Europe arrivals declined by 70%, representing over 500 million fewer international tourists, while the Americas saw a drop of 69 percent (UNWTO, 2021).

Tanzania was not isolated from the global impact of COVID-19 which affected the development of the tourism industry. Tourism is Tanzania's primary foreign exchange earner. The sector was severely hit in 2020 after the outbreak of the COVID-19 pandemic. The available sources further argued that after a record of 1.5 million international tourist arrivals in 2019 and USD 2,604.5 million in tourism revenue, in 2020 arrivals fell to 616,491, and travel receipts declined by 59.2% to USD 1,061.6 million (Tanzania Tourism, 2021).

In the year 2021, the government of Tanzania continued to promote various tourist attractions both within and outside the country by improving a special channel called the **"Tanzania Safari Channel",** using celebrities, voluntary ambassadors, and Tanzania Embassy offices. Furthermore, the Tanzania Tourism Board (TTB) continued to provide tourism education through festivals, sports events, and various exhibitions, including the Saba Saba Exhibition, Serengeti Cultural Festival, Bagamoyo Festival, and Sauti za Busara (NBS, 2021). Moreover, in April 2022 Tanzania's President Samia Suluhu Hassan unveiled the "The Royal Tour" documentary while promoting foreign direct investments FDIs during her official visit to the US (Tanzania Tourism, 2021). Tourism is a changing industry that is easily affected by weather and has many problems that can slow down its growth. To deal with these problems, people who plan and make rules for tourism, along with the tourism companies themselves, use something called "forecasting". This means they gather information beforehand to help them make good decisions before any bad things happen.

Tourism's importance has motivated researchers to investigate the number of both domestic and international tourist arrivals and develop accurate forecasting methods for future planning. However, no published research has examined the development of a tourist arrival forecasting model for the Bagamoyo Catholic Museum. Therefore, this study aims to fill this gap by proposing a model for forecasting monthly international and domestic (combined) tourist arrivals at the Bagamoyo Catholic Museum. It is anticipated that the findings of this study will assist local authorities in resource allocation and decision-making while providing industry players with a tool to predict their future market.

2.0 Literature Review

This paper reviews a few recent studies which applied different time series models in forecasting tourist arrivals. For example, a study carried out in Nepal applied an autoregressive integrated moving average (ARIMA) model in projecting tourist arrival in Nepal based on historical data (Upadhayaya, 2021). The study conclusively, the model ARIMA (1, 1, 1) has been selected to be the best model for forecasting international tourist arrival in Nepal. A similar study carried out in India applied Holt-Winters Exponential Smoothing and ARIMA models in forecasting foreign tourist arrivals (Sood & Jain, 2017).

Tourist arrival in Cambodia using different time series models (Chhorn & Chaiboonsri, 2018). Their study finally, based on Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) proposed that ARIMA (3, 1, 4) and the hybrid of ARIMA (3, 1, 4)-GARCH (1, 1) are the best model to predict the future value of tourist arrivals in Cambodia. Additionally, the study by Priyangika and Pallawala (2017) Used of SARIMA and GARCH models to forecast the tourist arrival in Sri- Lanka. Msofe and Mbago (2019) applied the SARIMA model to forecast international tourist arrivals in Zanzibar using secondary monthly data from January 1995 to December 2017. From their study the SARIMA (1, 1, 1) x $(1, 1, 2)_{12}$ model was found to be the best fitted model on the basis of Akaike's Information Criterion (AIC). Similarly, a study by Nurhasarah et al. (2022) used the Box-Jenkins (1971) methodology to forecasting international tourist arrival in Indonesia using the SARIMA model. The best model selected according to their study, was SARIMA (0, 1, 0) x $(1, 1, 0)_{12}$ because it took into account the seasonality of international tourists' arrivals. The prediction findings reveal a rise in incoming foreign tourists. The researchers suggested using the methodology; therefore, it will be used in this study to forecast international tourist arrivals. Also, a similar study by Lip et al., (2020) used SARIMA and Holt-Winters model to forecast international tourist arrivals in Malaysia. The findings of their study suggested that the SARIMA and Holt-Winters model are suitable to be used in forecasting tourist arrivals. The findings of their research found that the Holt-Winters model is the appropriate model to forecast tourist arrivals from the United Kingdom and Korea while SARIMA(1, 1, 1) x $(1, 1, 1)_{12}$ is the appropriate model for forecasting tourist arrivals from Singapore.

3.0 Methodology of the Study

This part describes different techniques and methods which were used in this study along with the reasons for using such methods and materials. This section also includes other important issues like data collection and different time series methodologies approaches which were used for forecasting the tourist arrival at Bagamoyo Catholic Museum.

3.1 Data Collection

This study used secondary data collected from Bagamoyo Catholic Museum that were collected from the visitors' museum records. Monthly tourist arrival data from January 2011 to December 2021 were collected and used in this study to forecast the tourist arrival at the Bagamoyo Catholic Museum from the year 2022 to 2023. However, it should be noted that the data collected was those of local and international tourist arrivals. The data for those who went there for pilgrimage and other church activities were not collected. It is also important to ask ourselves what makes Bagamoyo so special and attractive to tourists (Mapunda, 2007) answer that question by saying "its history" is what attracts many tourists to visit Bagamoyo. To be objective, Bagamoyo is a historical town that constitutes the heritage resources of different historical landmarks that existed there for a long time. Bagamoyo hosts the tangible remains of past human experiences of interaction among the people of East Africa and the external world through trade in the Indian Ocean, slave trade, missionary activities in East Africa, colonialism, and the post-colonial history of Bagamoyo and Tanzania in particular.

In addition to that historical attractions or centers that host many tourists in Bagamoyo are Kaole Ruins, Caravan Serai, German Boma, Old Town, and Old Catholic Church. Other factors that contribute to the tourist arrivals at Bagamoyo are its proximity to Dar es Salaam the busiest and most populated city, the breezy and quietness of town, and privacy for those who aim for serious business, social tranquility or intellectual meetings and workshops which previously were conducted in more distant places like Morogoro (Mapunda, 2007). Therefore, Bagamoyo Catholic Museum preserved the bulk of historical documents and tangible cultural artifacts that illuminate the diversity of human history across time.

3.2 Time Series Models

The time series models have also been commonly used models forecasting non-stationary time series data along with the trend (Chandra & Kumari, 2018). The time series models look through things that have happened over a period of time and use a series of past data to make a forecast (Khairudin et al., 2018). Hence, this study uses the past data on the number of tourist arrivals at Bagamoyo Catholic Museum from January 2011 to December 2021 to forecast the arrivals for the next two years, 2022 to 2023. The time series model that is being used in this current study is the Box – Jenkins time series model. So, to apply the Box – Jenkins model we have to follow four step processes before forecasting that is identification, estimation of parameters of the model, diagnostic checking, and model selection criteria.

3.2.1 Identification

This is a step in determining the necessity of differencing, to produce stationarity and defining the order of seasonal and non-seasonal Autoregressive (AR) and Moving average (MA) operators for the series (Singye and Unhapipat,2018). Normally, in this step appropriate structure Autoregressive Integrated Moving Average (ARIMA) and the order of the model are specified (Singye and Unhapipat, 2018). The identification is done by observing both the Autocorrelation function (ACF) and Partial autocorrelation function (PACF) of the interested series.

3.2.2 Estimation of Parameter of the Model

Estimation of parameters is the second step in the Box –Jenkins model procedure to estimate the coefficients of the model. Box- Jenkins methodology required that the Autoregressive integrated moving average (ARIMA) model must satisfy the condition of stationary and invertible. Using R statistical software usually the estimation parameters were estimated by the least square method.

3.2.3 Diagnostic Checking

This is the third step in Box – Jenkins procedure process to check the model.In this step two important things in diagnostic checking are to ensure that the residuals are white noise and estimated parameters are strictly significant.In this step of diagnostic checking, the Autocorrelation function (ACF) behavior of the residuals produced by the estimation process is examined. For a good model, the residual time series should be close to independent and identically distributed (Chandra & Kumari, 2018).

3.2.4 Stationarity of the Data

A stationary process has a mean and variance that do not change over time and the process does not have trends (Rahman &Hasan, 2017). The time series value is affected by the trends and seasonality whose impact was removed by differencing the time series values to make them stationary. So, to proceed with the estimation of an ARIMA model the time series data must be stationary. There are different types of tests used to test the stationary of time series data such as the Augmented Dickey –Fuller (ADF) test and the Kwiatkowski, Philips, Schmidt, and Shin (KPSS) test. In this study the Augmented Dickey–Fuller (ADF) test was used to test the stationarity of the Bagamoyo Catholic tourist arrivals for the year 2011 to 2021.

3.2.5 Model Selection Criteria

Information criteria tools such as Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) are used in the selection of best fit model out of suggested Autoregressive integrated moving average (ARIMA) models (Chandra & Kumari, 2018). The model with the minimum value of both Akaike Information Criteria (AIC) and the Bayesian Information Criteria (BIC) is selected the best fit. Akaike Information Criteria (AIC) uses the maximum likelihood method. In the implementation of approach, a range of autoregressive moving average (ARMA) models

is estimated by maximum likelihood methods (Chandra & Kumari, 2018) and for each; the AIC value is computed as given by:

$$AIC(p,q) = \ln(\delta_e^2) + r(2/n) + constant \quad \ldots\ldots (1)$$

Where, n is the number of observations in the historical time series data, δ_e^2 is the maximum likelihood estimate of δ_e^2 , and r denotes the number of parameters estimated in the model that is (r = p+q+1). Likewise,Bayesian Information Criteria (BIC) also uses the maximum likelihood method. The Bayesian Information Criteria (BIC) imposes a greater penalty for the number of estimated model parameters than does the Akaike Information Criteria (Abdou, Musabanganji & Musahara, 2021). Bayesian Information Criteria (BIC) it is given by:

$$BIC(p,q) = \ln(\delta_e^2) + r\left(\ln(n)/n\right) \quad \ldots\ldots (2)$$

3.2.6 Autoregressive Integrated Moving Average (ARIMA) Model

Autoregressive integrated moving average (ARIMA) is the most widely time series forecasting model. This model has also been widely applied to tourism forecasting and performed well (Chandra & Kumari, 2018). This autoregressive integrated moving average (ARIMA) model is very adaptable in modeling and forecasting tourism arrivals because it takes into account both current and lagged values that is autoregressive components and lagged random shocks that is moving components (Abdou, Musabanganji & Musahara, 2021). The models developed by this method are usually called ARIMA models because they use a combination of autoregressive (AR), integration (I) - referring to the reverse process of differencing to produce the forecast and moving average (MA) operations (Upadhayaya, 2021). Thus, the general autoregressive integrated moving average (ARIMA) (p, d, q) model written as: $\varphi_p(B)(1-B)^d = \theta_o + \theta_q(B)a_t$ (Choden and Unhapipat, 2018). Where $\varphi_p(B) = 1 - \varphi_1 B - \varphi_2 B^2 - \cdots - \varphi_p B^p$ is the stationary Autoregressive (AR) operator, $\varphi_q(B) = 1 - \theta_1 B - \theta_2 B^2 - \cdots - \theta_q B^q$ is the invertible Moving Average (MA) operator and $\theta_o = \mu(1 - \varphi_1 - \varphi_2 \cdots \varphi_p)$ is deterministic trend term.

3.2.7 Forecasting

Forecasting is the process of prediction the future based on past and present data and commonly by analyzing their trends. The use of time series data for forecasting it needs statistical techniques. One forecasting statistical technique that can be used is integrated moving average (ARIMA) (p, d, q) model (Rahkmawati, Sumertajaya, & Aidi, 2019). The integrated moving average (ARIMA) (p, d, q) model uses the past and present values of the variables to produce accurate short-term forecasting (Rahkmawati et al., 2019). Hence, in this study the forecasting refers to computation of future values of a number of tourist arrivals at Bagamoyo Catholic Museum from January, 2011 to December 2021.

4.0 Results and Discussion

This section discusses the data analysis results of applying integrated moving average (ARIMA) modeling procedures. The monthly combined both domestic and international tourist arrivals data for Bagamoyo Catholic Museum for the period January 2011 to December 2021 obtained from the Museum visitor's book records are used in this study through testing of data stationary, identification, model parameter estimation, model selection, diagnostic checking and lastly forecasting using R software statistical package.

The study began with the crucial step of visualizing the data. Visualizing data is necessary for us because it helps to identify some usual behaviors and stationary in the data. The time series plot of the combined domestic and international tourist's arrival to Bagamoyo Catholic Museum for the period January 2011 to December 2021 is shown in Figure 1.0 below in the section on the result of this study. The time series plot in Figure 1.0 below revealed that there

was an increasing and decrease number of combined tourist arrivals steadily throughout the years, 2011 to 2019. However, there was a sharp decline in the combined number of tourist arrivals at Bagamoyo Catholic Museum from the year 2020 to 2021. The study correctly attributes this decline to the global outbreak of the COVID-19 pandemic. Travel restrictions, lockdowns, and concerns about the virus led to a sharp decline in international travel, affecting tourism worldwide.

The time series plot in Figure 1.0 below in the section of results shows evidence of changing variance in the data implies that the variability in tourist arrivals was not constant over time. This variability could be influenced by various factors, such as seasonality or external events like the pandemic. To make the data more suitable for modeling and analysis, the study plans to apply a logarithm transformation. This transformation aims to stabilize the variance, which is essential for certain statistical techniques. The combined tourist arrival data was identified as non-stationary, as evidenced by the series wandering up and down for extended periods. Non-stationarity can make it challenging to apply traditional time series models effectively. To address this issue, the study intends to take differences of the data until stationarity is achieved.

The time series plot in Figure 2.0 below in results section shows that now the series looks like a white noise series. The logarithm transformation and differencing have made the series appear relatively stationary. To further confirm this, we can perform an Augmented Dickey-Fuller (ADF) test. The Table 1.0 below in the section of results of this study shows the Augmented Dickey-Fuller (ADF) test result which we have performed after taking logarithm transformation and difference of lag 1. From the Table 1.0 below in the study results clearly shows that at the 5% level of significance, the null hypothesis is being rejected and it can be concluded that the combined number of tourist arrivals data at Bagamoyo Catholic Museum is now stationary since the p-vale = 0.01 which is less than the level of significance at, $\sim = 0.05$.

In order to identify the tentative time series model, the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) of the differenced combined tourist arrivals data at Bagamoyo Catholic Museum are plotted and shown in figure 3.0 below in the section of results of this study. Take a look at Figure 3.0 below shows decaying spikes on the Autocorrelation Function (ACF) the first spike that cutting off at lag 2 indicating that there are AR (2) and MA (2) orders in the autoregressive integrated moving average (ARIMA) model. The possible time series model being suggested is the ARIMA (2,1,2).

To confirm the suggested time series model and to select an appropriate model, the Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC) were used to test different autoregressive integrated moving average (ARIMA) models. The transformed and differenced combined both domestic and international tourist arrivals data has been generated using R statistical package. Several different autoregressive integrated moving average (ARIMA) models with Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC) values were computed using R software are tested as shown in Table 2.0 below in order to select an appropriate ARIMA model for forecasting the combined both domestic and international tourist arrivals time series data. From Table 2.0 below the results shows that the ARIMA (2, 1, 2) model has the lowest both AIC and BIC values. In this model, it is likely that tourist arrivals at Bagamoyo Catholic Museum are subject to autoregressive of order 2, moving average of order 2, and difference of order 1. So, from the Table 2.0 below, we conclude that the ARIMA (2, 1, 2) model is the best for the Bagamoyo Catholic Museum tourist arrivals data because of the lowest both AIC and BIC values. Therefore, we will rely on this selected ARIMA (2, 1, 2) model to estimate the forecasts of the next two years of 2022-2023.

After we had already identified the best ARIMA model, the process was followed by the step of estimation of the parameters of the model selected. The method of maximum likelihood estimation was used in the estimation of the ARIMA (2,1,2) model parameters. The parameters estimate along with corresponding standard errors of fitted ARIMA (2,1,2) model of combined both domestic and international tourist arrivals at Bagamoyo Catholic Museum are presented in Table 3.0 below in the section of results of this study. The results from Table 3.0 below indicate the estimated parameters for ARIMA (2,1,2) selected as the best fit model for the forecasting process for tourist arrival time series data. The fitted ARIMA (2,1,2) model is given as:

$$Y_t = 0.192 + 0.9834Y_{t-1} - 0.9638Y_{t-2} - 1.0771\varphi_{t-1} + 0.9128\varphi_{t-2} \ldots . (3)$$

To verify the accuracy of the selected time series model, the residual analysis of the ARIMA (2,1,2) model was performed. Figure 3.0 below in the section on the results of this study shows the Autocorrelation function (ACF) time series plot of the combined domestic and international tourist arrival at Bagamoyo Catholic Museum. Take observation at the ACF plot shown in Figure 3.0 below we can see that the ACF plot of the residuals from the ARIMA (2,1,2) model shows all correlations within the threshold limits indicating that the residuals are behaving like white noise. So, we can conclude that there is no autocorrelation of the residuals and the model is correct to forecast tourist arrival.

Finally, we used the selected ARIMA (2,1,2) model to forecast twenty-four (24) months for the year 2022 to 2023 of the combined both domestic and international tourists arrival at Bagamoyo Catholic Museum as presented in Table 4.0 below in the section of results of this study. The result from Table 4.0 below shows that the tourist forecasts there will be a big increase number of tourist arrivals in January 2022 at Bagamoyo Catholic Museum. Consequently, the tourist forecasts indicate that after February 2022 there will be an upward and downward trend of the combined domestic and international tourists' arrival, pointing to have seasonal fluctuations.

4.2 Results of the study

Table 1.0 ADF test results of combined tourist arrivals at Bagamoyo Catholic Museum.

Unit root test/ Combined tourist arrivals data		
	Test value	**P-value**
ADF test	**-7.0574**	**0.01**

Table 2.0 Model selection criteria for combined tourist arrivals at Bagamoyo Catholic Museum (2011-2021)

Fitted different ARIMA models	AIC - value	BIC – value
ARIMA(1,1,2)	190.3131	201.463
ARIMA(1,1,3)	186.7541	200.6915
ARIMA(1,1,4)	188.2899	205.0149
ARIMA(2,1,0)	201.7862	210.1486
ARIMA(2,1,1)	189.2231	200.3731
ARIMA(2,1,2)	**176.765**	**190.7024**
ARIMA(3,1,0)	185.409	196.5589
ARIMA(3,1,1)	182.8517	196.5589
ARIMA(4,1,0)	181.5269	196.7892
ARIMA(4,1,1)	183.5169	200.2419
ARIMA(5,1,0)	183.5126	200.2375

Table 3.0 Estimated parameters of ARIMA (2,1,2) model for tourist arrival data

	AR (1)	AR (2)	MA (1)	MA (2)
Coefficients	0.9834	-0.9638	-1.0771	0.9128
Standard errors (s.e)	0.0291	0.0420	0.0614	0.0595
Sigma square	0.2389			
Log likelihood	-83.38			

Table 4.0 Forecast of combined tourist arrivals to Bagamoyo Catholic Museum for next 24 months from January 2022 to December 2023

Months	Tourist arrivals Forecast values
Jan -2022	1274
Feb -2022	1136
Mar- 2022	967
Apr -2022	962
May- 2022	868
June- 2022	899
July- 2022	827
Aug -2022	867
Sept- 2022	804
Oct -2022	844
Nov -2022	785
Dec- 2022	824
Jan -2023	767
Feb -2023	805
Mar -2023	750
Apr -2023	786
May- 2023	733
June -2023	767
July -2023	716
Aug -2023	748
Sept -2023	698
Oct -2023	729
Nov- 2023	681
Dec- 2023	710

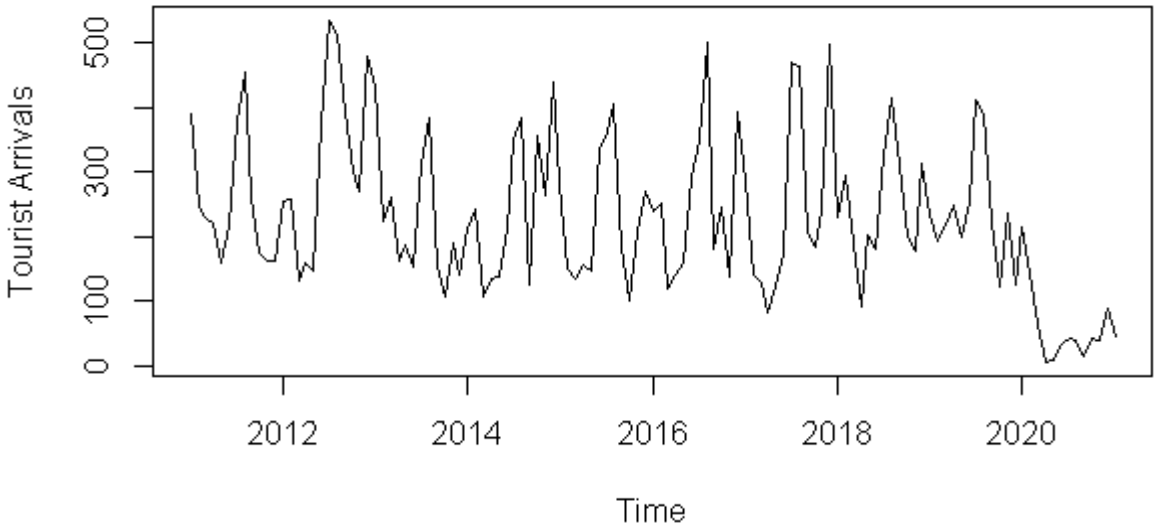

Figure 1: The time series plot of the tourist original data.

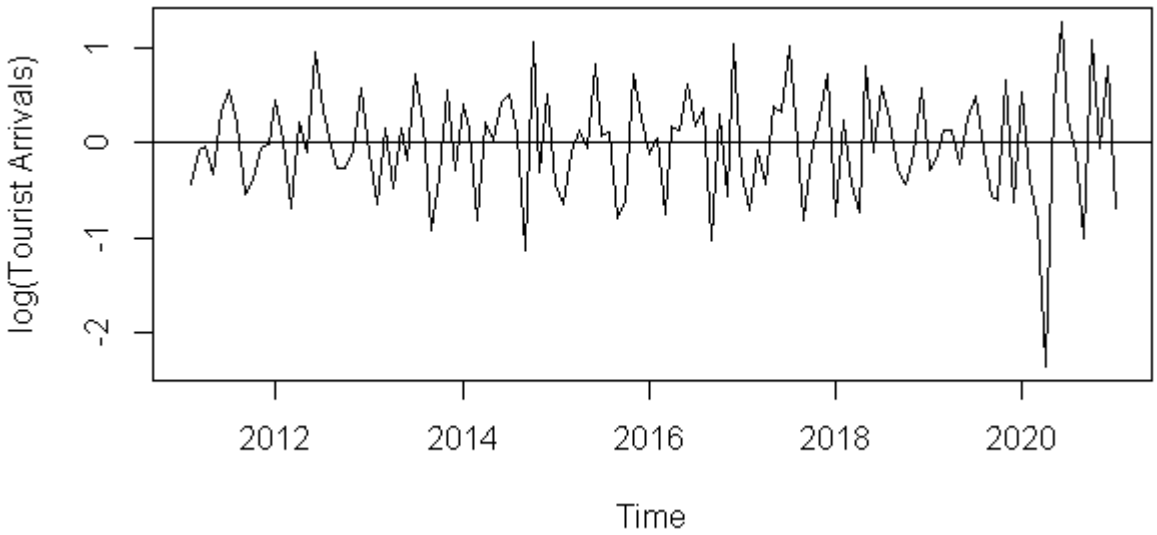

Figure 2: The time series plot of the differenced tourist arrivals data.

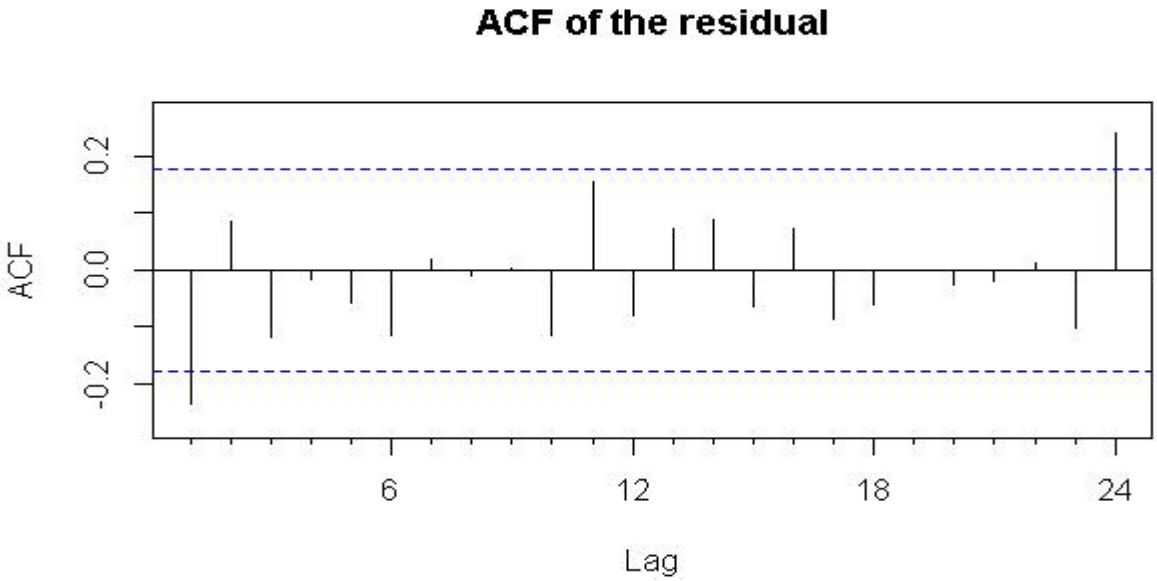

Figure 3: ACF of the Residual of ARIMA (2, 1, 2).

4.3 Conclusion of the Study

This study was conducted to forecast the combined domestic and international tourist arrival at Bagamoyo Catholic Museum using the autoregressive integrated moving average (ARIMA) model. The study used monthly tourists' arrival data from January 2011 to December 2021 to forecast monthly tourists' arrival for the next two-year period from January 2022 to December 2023. We used tourist raw data in plotting a time series plot that exhibited the behavior of combined both domestic and international tourist arrivals. From the plotted time series plot an increasing variance with time and non-stationary series was observed. The logarithm transformation and differencing have made the series appear relatively stationary also ADF test confirmed the stationarity of tourist arrival as shown in the Table 1.0 above. The time series plots such ACF and PACF was used to suggest the ARIMA (2,1,2) model. Consequently, the model selection criteria such as AIC and the BIC were used to decide the best fitting ARIMA model as shown in Table 3.0 above in the section of discussion of results of this study. The forecast results from the Table 4.0 above showed that incoming tourist arrival would increase and decrease in future years at Bagamoyo Catholic Museum. The findings of this study will be beneficial to the government as well as other tourism stakeholders in Tanzania.

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