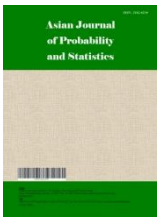

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On the Revenue Generation of the Internally Generated Funds across Twifo Hemang Lower Denkyira District Assembly

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

Balancing the budget is one of the most important concerns of financial policy. Improving the quality of revenue and expenditure projections has become essential for policymakers. However, The most crucial component in sustaining success in terms of revenue generation and other grounds is time. Keeping up with the speed of time is difficult. A time series model is one such method for dealing with time-based data. The time series model is an adequate model when there are serially correlated data. Autoregressive Moving Averages (ARMA) is the appropriate approach when the error(s) of the data has the same variance regardless of the value taken by the independent variable(s). For this reason, an internally generated fund data were collected from the Twifo Hemang Lower Denkyira District assembly from 2013 to 2019 which was subjected to descriptives and time series analysis. From the time series analysis, ARMA (1, 1) was selected as the best model using the AIC value and fit the observed monthly internally generated fund pattern. The study revealed among others that January 2020 will record the highest revenue generation of 21465.96 cedis over the two years forecast followed by March 2020, 19023.17 cedis and May 2021 of 18122.05 cedis. The study also recommended among others that the authorities of Twifo Hemang Lower Denkyira District assembly should embark on educating the citizens on the need to pay their taxes for developmental progress of their assembly.

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Keywords: Revenue; internally generated funds; homoscedasticity; ARMA; time series.

1 Introduction

Governments across the globe rely mainly on taxation revenue for developmental projects and resources [1]. Revenue mobilization is the backbone of every governmental development and survival [2]. Until 2010, where the decentralization policy framework was developed, Ghana was operating within the overall guiding programming document, the National Decentralization Action Plan (NDAP), which was endorsed by the Cabinet in 2004 [3]. The Metropolitan/Municipal/District Assemblies (MMDAs) are given revenue mobilization instruments and other legal frameworks which empower them to generate revenue to enhance their development. Boampong & Dwumfour, [4] elucidated that the provision of social amenities such as good roads, electricity, potable water, hospitals etc. are all funded by government through tax revenue generated [5]. It is in this light that the Local Government Act of Ghana (Act 462) of 1993 authorizes and empowers the MMDAs to mobilize revenue internally generated fund in the form of rates, fees, fines, licenses, rents among others [6]. This is to help finance projects and programs in their various areas of operation [6].

Nearly all management decisions are established on past and present condition to predict future results. Sabaj & Kahveci, [7] explained that budgetary process involves two building blocks; forecasting the revenues and allocating the revenues to expenditures. The prediction of tax revenues therefore remains a major issue in many developing countries. Related research on GDP forecasts exists, but the impact on the economy is significant in the developing countries [7]. Ghana, being part of the developing countries, its various Metropolitan/Municipal/District Assemblies (MMDAs) set revenue target for each specific fiscal year upon which budget is prepared. However, most often than not, these revenue targets for the internally generated fund are not achieved due to some of the challenges of which the Twifo Hemang Lower Denkyira District Assembly is not an exception. One of the most significant difficulties facing Ghana's District Assemblies is how to efficiently gather income from within the country to assist local development initiatives [8]. Akudugu & Oppong-Peprah, [8] in their research revealed the growing gap between estimated revenue and actual revenue collected as well as budgeted expenditure and actual expenditure. It is in this light that this research seeks to ascertain the pattern of revenue generated by the internally generated funds of Twifo Hemang Lower Denkyira District Assembly from 2013 to 2019 for growth.

2 Objectives

Homoscedastic is when the variation of the random term is uniform, in other words the error remains the same over the range of observations and regardless of the functional form. Homoscedasticity is the process when the error(s) has the same variance regardless of the value taken by the independent variable(s) that is the homogeneity of variance. The Box Jenkins models do work with this type of data because those models require the stability of the time series [9]. The research problem is that the time series is stationary invariance.

3 Research Aim

This research aims to select the best model for the ARMA of the time series of the revenue generated by the internally generated funds of Twifo Hemang Lower Denkyira District Assembly.

4 Methods

4.1 Autoregressive Model (AR)

The Autoregressive model (AR) depicts the relationship between the time series' current and prior values. It can be used for the description of a particular phenomenon, either it is natural or economic [10]. Suppose $\{\varepsilon_t\}$ is a purely random process with mean zero and variance σ^2. Then a process X_t is said to be an autoregressive process of order m which is abbreviated as $AR(p)$ if

$$X_t = \alpha_1 X_{t-1} + \alpha_2 X_{t-2} \dots \dots \dots + \alpha_m X_{t-m} + \varepsilon_t \quad (1)$$

4.2 Moving Averages Model (MA)

The moving-average model (MA), also known as the moving-average process, is a standard method for modelling univariate time series [10]. MA models provide predictions of X_t based on a linear combination of past forecast errors. It is one of the smoothing techniques. The moving average model of order q, or $MA(q)$. is defined as:

$$X_t = e_t + \theta_1 e_{t-1} + \theta_2 e_{t-2} + \cdots + \theta_q e_{t-q} \quad (2)$$

where there are q lags in the moving average and $\theta_1, \theta_2, \dots, \theta_q$ $(\theta_q \neq 0)$ are parameters that should be estimated and $e_t = NID(0, \sigma^2)$.

4.3 Autoregressive Moving Averages (ARMA) model

Autoregressive Moving Averages models are well suited for describing the dynamics of stationary time series. $ARMA$ approach is a tool for forecasting future values of time series. An $ARMA(p, q)$ process includes both autoregressive and moving average terms [11]. It is assumed that the series is partly autoregressive and partly moving average, and then we obtain a quite general time series model. Just as an $AR(p)$ model regress against past values of the series, an $MA(q)$ model uses past errors as the explanatory variables. In general [11], if

$$X_t = \varphi_1 X_{t-} + \varphi_2 X_{t-2} + \cdots \varphi_p X_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \cdots \theta_q \varepsilon_{t-q} \quad (3)$$

Where φ and θ represent the parameters of AR and MA models $\varepsilon_t = NID(0, \sigma^2)$ is an identically and independent normal distribution.

We say that X_t is a mixed autoregressive moving average process of order p and q respectively. We abbreviate the name to $A(p, q)$.

4.4 Data description and tool of study

The sample of the research consist of monthly IGF data points over 7 years period revenue internally generated funds in Twifo Hemang Lower Denkyira District Assemblies since 2013 through to 2019. The data were analyzed using ARMA model, autocorrelation function (ACF) and partial autocorrelation function (PACF). Statistical test of the series was conducted using the {unit root test) Augmented Dickey Fuller (ADF) [12] , that is the series is stationary [13]. The analysis of the time series data was done by using RStudio software.

5 Results and Discussion

From Table 1, it can be seen that the value of the skewness coefficient was positive (2.673), which indicates that the error distribution is skewed to the right (positive skewed). Also, it can be seen that the kurtosis coefficient value is of 7.700 which differs from the value of "3" characteristic of the normal distribution, indicates that most of the time series is concentrated around the mean than those in the normal distribution.

To show the features of the time series in terms of the stability of the series in the original data, we draw the data using the fluctuation chart. Fig. 1 shows the stationary plot of the series in the revenue generated

Table 2 shows the results of the unit root test for the time series. The result indicates the series test, the p-value which is 0.01 is lower than the significance level alpha value of 0.05, we reject the null hypothesis H_o and accept the alternative hypothesis H_a , thus the series is stationary.

Table 1. Descriptive statistics on the IGF revenue

Sum	1476410.36
Observation	84
Mean	17576.3138
Range	99101.16
Maximum	102265.76
Minimum	3164.60
Standard Deviation	18682.99985
Skewness	2.673
Kurtosis	7.700

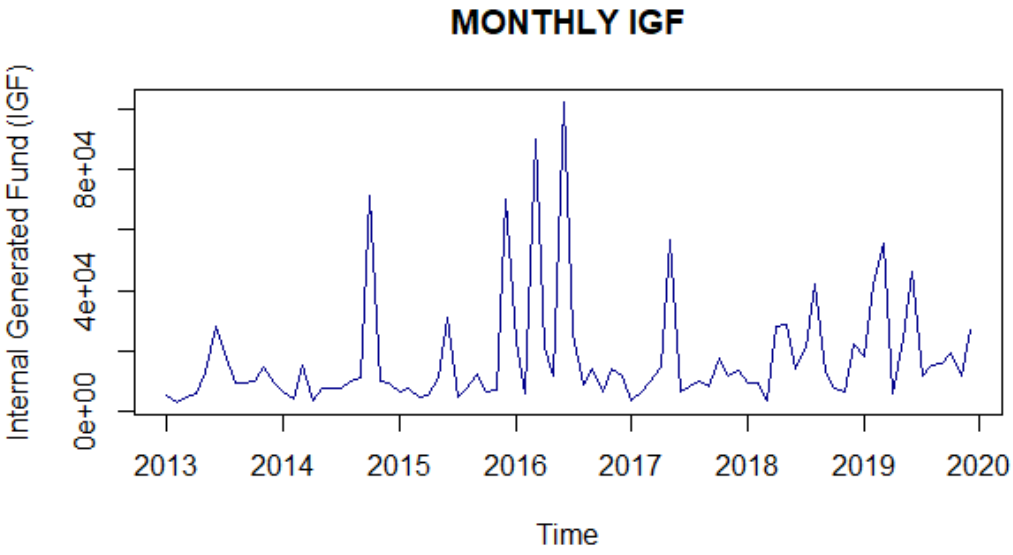

Fig. 1. The plot of the time series of monthly revenue generated of the IGF for the period (2013-2019)

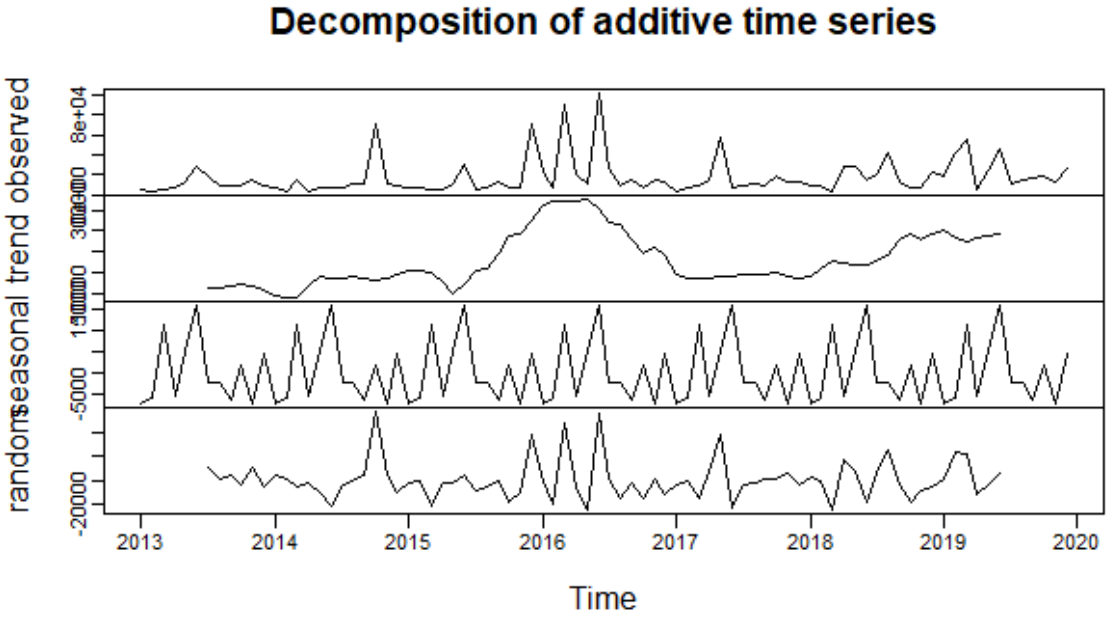

Fig. 2. Plot of the Decomposition of the additive time series

Table 2. Dicky Fuller Test Statistic on the IGF **revenue**

Variable	Value
Dickey-Fuller	-8.7823
p-value	0.01
Alpha	0.05

$$H_o = T\square ere\ is\ unit\ root\ for\ t\square e\ \ series$$
$$H_a = T\square ere\ is\ no\ unit\ for\ t\square e\ series$$

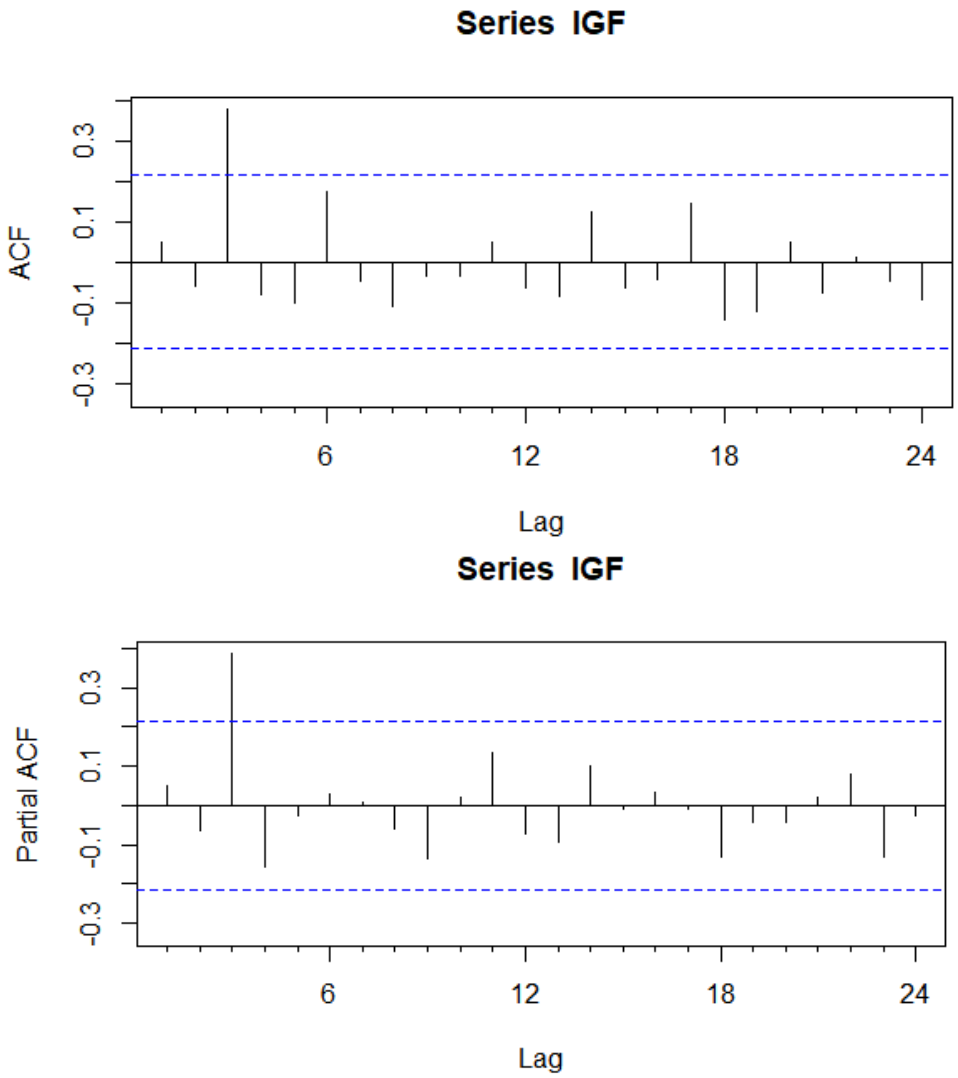

Fig. 3. Autocorrelation and partial Autocorrelation functions of the revenue

The autocorrelation function and partial autocorrelation function as shown in Fig. 3. The graph suggests an AR process in order 1. Candidate model is obtained using the minimum AIC criteria. To confirm the appropriate model, ARMA model was obtained as:

Table 3. ARMA model result

MODEL	AIC Value	S.E_ar1
ARMA(1,1)	1893.25	0.1616

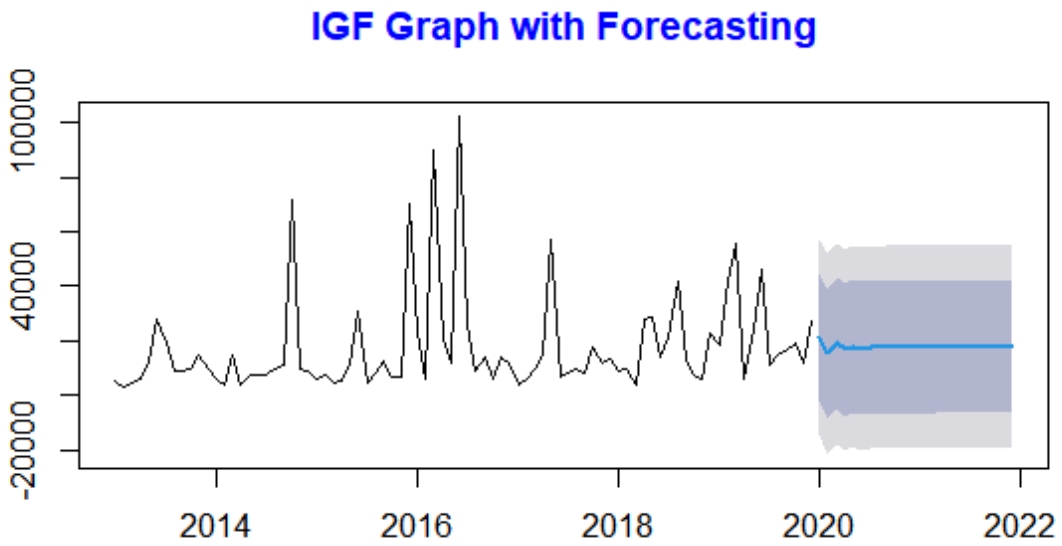

Fig. 4. Forecasts for two years revenue generation

From Fig. 4, the forecast for the two year period will be stable and will not experience any major increase in terms of revenue mobilization.

Table 4. Forecasted values for revenue of the internally generated funds

Month/Year	Forecasted Values
Jan 2020	21465.96
Feb 2020	15244.49
Mar 2020	19023.17
Apr 2020	16728.15
May 2020	18122.05
Jun 2020	17275.45
Jul 2020	17789.64
Aug 2020	17477.34
Sep 2020	17667.02
Oct 2020	17551.82
Nov 2020	17621.79
Dec 2020	17579.29
Jan 2021	17605.10
Feb 2021	17589.43
Mar 2021	17598.95
Apr 2021	17593.17
May 2021	17596.68
Jun 2021	17594.54
Jul 2021	17595.84
Aug 2021	17595.05
Sep 2021	17595.53
Oct 2021	17595.24
Nov 2021	17595.42
Dec 2021	17595.31

It can be seen from Table 4 that revenues for the IGF on the various months over the two year period has been generally stable. This shows how the revenue generated improvement will be almost the same amount across the years. It can be also seen that January 2020 recorded the highest revenue generated of 21465.96 cedis over the two years forecast followed by March 2020, 19023.17cedis and May 2021 of 18122.05 cedis. The lowest

amount of revenue generation was recorded in the same year of 2020 in the month of February with the amount of ₵15244.49 . Throughout the months of 2021, there was a general stability of revenue generation across. January 2021 recorded the highest amount of revenue generated of 17605.10 cedis.

6 Conclusions

The study employed ARMA methodology to determine Twifo Heman Lower Denkyira revenue generation for their internally generated funds and also provide a two-year forecast estimate for the seven (7) year period. The study formulated tentative model and the model with the least AIC value was selected as the Best model fit for the district. The study used the best model fit to forecast for 2020 and 2021. The results showed that revenue generation over the forecasted years will be stable and not increase much.

7 Recommendations

The study recommended that the Twifo Hemang Lower Denkyira District assembly should access avenues that will boost their revenue generation to avoid the steadiness of future IGF's. The study also recommended that the authorities of Twifo Hemang Lower Denkyira District assembly should collaborate with stakeholders to increase their revenue collection in other to reduce revenue in the years ahead. Education should be given to citizens on the need to pay their taxes for developmental progress of their community in the Twifo Hemang Lower Denkyira assembly. Future studies should be carried to apply other methods that will allow for forecasting for years.

Disclaimer

The products used for this research are common and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

Data Availability

The dataset used in this research is available from the corresponding author upon request.

Competing Interests

Authors have declared that no competing interests exist.

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