Time Series Analysis of Reported Cases of Birth Complications in Benue State (A Case Study of General Hospital, North Bank Makurdi)

Omale Joseph[1], Aideyan Donald Osaro[2], Ivande James Serumun[3]

Dept of Mathematics and Statistics, Taraba State University, Jalingo. Taraba State. Nigeria.

DOI: https://doi.org/10.51244/IJRSI.2026.13020044

Received: 05 December 2025; Accepted: 10 December 2025; Published: 26 February 2026

ABSTRACT

This study focused on analysing the reported cases of birth complications in Makurdi, Benue State. The data for this study is a secondary data obtained from the Medical Record Book of General Hospital North Bank, Makurdi, Benue State from January, 2020 to December, 2022. The statistical software such as Eviews and Minitab was used for the overall statistical analysis for this research work. From the research findings, the reported cases of birth complication for the period of 36 months (2020 – 2022) was found to be stationary. Also, it was found to have quadratic trend analysis model; hence the general movement can be predicted over time. In the research study ARMA (1, 0, 1) model was found to be the best fit for the time series data on reported cases of birth complications for the period of time covered. Based on the analysis carried out, the Cases of birth complications at time t-1 negatively affects the terms of birth rate at time t, hence a knowledge of the immediate past value of reported cases of birth complication in General Hospital North Bank Makurdi in Benue State can be useful in forecasting the future values. Due to the way the past values of reported cases of birth complications negatively affect the present values, it was recommended that policies should be made to improve the measures that can help in birth complications.

Keywords: Birth, Model, Time, Rate, Complications

INTRODUCTION

Pregnancy complications are health problems that occur during pregnancy. They can involve the mother's health, baby's health, or both. Such problems can arise at any point during pregnancy or soon after childbirth. Some women may also have health problems before they become pregnant but are worsened during pregnancy, especially if not managed as part of the woman's care. These could also lead to complications of pregnancy. The major complications that account for nearly 75% of all maternal deaths are severe bleeding, infections, high blood pressure during pregnancy (preeclampsia and eclampsia), complications from delivery, and unsafe abortion. The rest are caused by, or associated with infections such as malaria, or related to chronic conditions like cardiac diseases or diabetes (Say *et al*., 2014).

Some possible causes of pregnancy complications may include exposure to environmental contaminants, radiation, certain chemicals, drugs, or infections. Thus, antenatal care is essential for all pregnant women in order to detect any deviation from normal pregnancy conditions early, and treat such conditions before they cause maternal and/or child mortality. Maternal mortality has become a public health problem requiring urgent, concerted, and effective intervention at the various levels of the society (AbouZahr *et al*., 2015).

According to the WHO, about 287,000 women died worldwide during pregnancy and childbirth in 2020, with 94% of these deaths occurring in low-resource settings and most could have been prevented. Although maternal mortality figures vary widely by source and are highly controversial, the best estimates for Nigeria suggest that some 40,000 women and girls die each year due to pregnancy complications in 2022 (Wardlaw *et al.,* 2022).

In addition, approximately another 740,000 women and girls suffer from injuries or disabilities caused by complications during pregnancy and childbirth each year (United States Agency for International Development, 2016). Between 2005 and 2015, it was estimated that more than 600,000 maternal deaths and no less than 900,000 maternal near-miss cases occurred in Nigeria (Souza, 2019). In 2015, Nigeria's estimated maternal mortality ratio (MMR) was more than 800 maternal deaths per 100,000 live births, with 58,000 maternal deaths during that year. By comparison, the total number of maternal deaths in 2015 in the 46 most developed countries was 1700, resulting in an MMR of 12 maternal deaths per 100 000 live births. Thus, a Nigerian woman has a one in 22 lifetime risk of dying during pregnancy, childbirth, or postpartum/postabortion, whereas in the most developed countries, the lifetime risk is one in 4900 (Souza, 2019).

However, there has been reported cases of birth complications in Makurdi, Benue State, hence this seeks to investigate the trend and pattern of reported cases of birth complications in Makurdi, Benue State using the General Hospital, North Bank Makurdi, Benue State as a case study.

Emaikwu (2012) maintained that, "the review of literature helps to eliminate the duplication of what has been done and provide useful hypotheses and helpful suggestions for significant investigation". The review of literature aids in sharpening a researcher's focus

Antenatal Care (ANC) provides an opportunity for the detection and identification of pregnancy complications as well as prevention and management of pregnancy-related complication or concurrent diseases, health education and health promotion (Geltore and Anore, 2021). It also provides an opportunity to identify women and girls at increased risk of developing complications during labour and delivery, thus ensuring referral for appropriate care (Anore *et al*., 2021). Identification and treatment of pregnancy-related complications reduces the maternal mortality ratio, thus contributing to the thirteen targets for Sustainable Development Goal (SDG) 3 which aims to ensure healthy lives and promote well-being for all at all ages (United Nation, 2015). SDG 3 targets a reduction in global maternal mortality ratio to 70 per 100,000 live births, neonatal mortality to 12 per 1,000 live births, and under-5 mortality to 25 per 1,000 live births (United Nation, 2015).

In order to end preventable maternal deaths, in 2016, the World Health Organization (WHO) developed guidelines on ANC for a positive pregnancy experience, with the aim of streamlining the management of specific pregnancy complications (World Health Organization**,** 2016). These guidelines recommend an early ultrasound scan (before 24 weeks of gestation) for pregnant women to estimate gestational age, improve detection of fetal anomalies and multiple pregnancies, and to reduce induction of labour for post-term pregnancy (World Health Organization**,** 2016). WHO guidelines on ANC for a positive pregnancy experience also recommend antibiotics for asymptomatic bacteriuria for the prevention of persistent bacteriuria, preterm birth and low birth weight, antibiotic prophylaxis for the prevention of recurrent urinary tract infections (UTIs), tetanus toxoid vaccination for the prevention of neonatal mortality from tetanus, and intermittent preventive treatment for malaria to reduce the risk of anemia (Wylie *et al*., 2021).

In Federal Medical Center, Makurdi, the goal oriented antenatal care protocol recommends a minimum of 8 ANC visits in an uncomplicated pregnancy (Ministry of Health**,** 2021). The first contact happens in first trimester (0 – 12 weeks), second and third contact occurs during the second trimester (>13 – 28 weeks), while the 4th to 8th contacts occurs in the third trimester (29-40 weeks). These visits are used to identify multiple pregnancy and fetal abnormalities, danger signs of pregnancy induced hypertension and any other danger signs, and to provide appropriate preventive and treatment interventions (UNICEF**,** 2022). The WHO guidelines on ANC for a positive pregnancy experience, and the goal oriented antenatal care protocol provide an opportunity for the identification of pregnancy complications.

Aim and Objectives of the Study

The aim of this study is the time series analysis of reported cases of birth complications in Makurdi, Benue State.

The specific objectives are to;

(i) evaluate the trend of reported cases of birth complications in Makurdi.

(ii) determine if the case of birth complications depends on past cases.

(iii) determine if the case of birth complications depends on random shocks.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue IX September 2025

Significance of the study

The findings of this research work will provide early warning signals to healthcare professional and policy makers to take preventive measures before the occurrence of potential crises. This study will facilitate evidencebased decision–making and resource allocation for healthcare facilities and providers in managing these complications. It will also be of great help to sensitize mothers on the dangers of late antenatal care and dangers of giving birth to too many children. Also, it will help policy makers and researchers to design some specific strategies to improve the utilization of antenatal Care service, prevention and treatment of complications.

RESEARCH METHODOLOGY

The Data

The data for this study is a secondary data obtained from the Medical Record Book of General Hospital North Bank, Makurdi, Benue State. Data was obtained on Reported Cases of Total Birth Complications recorded in the Hospital from January, 2020 to December, 2022.

Time series

Time series was employed as the method of analysis as it deals with the record of outcomes of a variable according to time. The outcomes may be recorded daily, weekly, monthly, quarterly, yearly or at any other specified interval of time. A time series model can be either multiplicative or additive. The multiplicative model is given as;

$$Y = T \times S \times C \times I \qquad (1)$$

While the additive model is given as;

$$Y = T + S + C + I \qquad (2)$$

Trend Accuracy Measure

The trend accuracy measure such as MAPE, MAD, and MSD are used as a statistic to compare the fits of different forecasting and smoothing methods. These statistics are not very informative by themselves, but can used to compare the fits obtained by using different methods. For all three measures, smaller values usually indicate a better fitting model.

Mean Absolute Percentage Error (MAPE)

Mean Absolute Percentage Error (MAPE) expresses accuracy as a percentage of the error. Because this number is a percentage, it can be easier to understand than the other statistics. For example, if the MAPE is 5, on average, the forecast is off by 5%. The equation is given as;

$$\frac{\sum |(y_t - \hat{y}_t / y_t)|}{n} \times 100, (y_t \neq 0) \qquad (3)$$

where y = the actual value

$\hat{y}$ = the fitted value

n = the number of observations.

Mean Absolute Deviation (MAD)

Mean Absolute Deviation (MAD) expresses accuracy in the same units as the data, which helps conceptualize the amount of error. Outliers have less of an effect on MAD than on MSD. The equation is given as;

$$MAD = \frac{\sum_{t=1}^{n} |y_t - \hat{y}_t|}{n} \quad (4)$$

where $y =$ the actual value, $\hat{y}$ = the fitted value

$n =$ the number of observations.

Mean Squared Deviation (MSD)

Mean Squared Deviation (MSD) is a commonly used measure of accuracy of fitted time series values. Outliers have a greater effect on MSD than on MAD. The equation is given as;

$$MSD = \frac{\sum_{t=1}^{n} |y_t - \hat{y}_t|^2}{n} \quad (5)$$

where $y =$ the actual value,

$\hat{y} =$ the forecast value

$n =$ the number of forecasts.

Unit Root Test (Stationarity Test)

A time series model is fitted with stationary series that is, all components of the series must be stationary at level before fitting the model. If the series is not stationary, we difference the data to obtain stationarity. Consider the following random walk model without drift and trend;

$$Y_t = \rho Y_{t-1} + u_t \;; \quad -1 \leq \rho \leq 1 \quad (6)$$

where u_t is a white noise error term.

$Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + u_t$ By subtracting Y_{t-1} from both sides

$$\Delta Y_t = \delta Y_{t-1} + u_t \quad (7)$$

where $\delta = (\rho - 1)$ and Δ is the first difference operator.

Thus we test the hypotheses;

$H_0: \delta = 0$ vs $H_1: \delta < 0$

If the null hypothesis is accepted, $\delta = 0$, then $\rho = 1$, that is we have a unit root, meaning the time series under consideration is non-stationary. The Dickey-Fuller (DF) and the augmented Dickey-Fuller (ADF) tests can be used as test statistic for testing the above hypotheses. If the computed absolute value of the tau statistic ($|\tau|$) exceeds the DF critical tau value, we reject the hypothesis that $\delta = 0$.

Box-Jenkins Methodology

This is the technique for determining the most appropriate ARMA or ARIMA model for a given variable. It comprises of four stages in all;

(i) **Identification of the Model:** This involves selecting the most appropriate lags for the AR and MA parts, as well as determining if the variable requires first-differencing to induce stationary. The ACF and PACF are used to identify the best model.

(ii) **Estimation of Parameters:** This usually involves the use of a least squares estimation method.

(iii) **Diagnostic Testing:** This is the test for autocorrelation. If this part fails then the process returns to the identification section and begins again, usually by the addition of extra variables.

(iv) **Forecasting:** This is the stage where the fitted ARMA models are used to project the future values of the variable under study.

The Box-Jenkins methodology is often referred to as more of an art than a science. The lack of theory behind the models is one criticism of the method; however they are used as an effective model for forecasting.

Autoregressive Moving Average (ARMA) Models

A stochastic process resulting from the combination of autoregressive and moving average models is called an Autoregressive Moving Average (ARMA) model. An ARMA model of order p, q, ARMA (p, q) is specified as:

$$r_t = \phi_1 r_{t-1} + \phi_2 r_{t-2} + \cdots + \phi_p r_{t-p} + \varepsilon_t + \beta_1 \varepsilon_{t-1} + \beta_2 \varepsilon_{t-2} + \ldots + \beta_q \varepsilon_{t-q} \quad (8)$$

To obtain stationarity for this model the equation $\Phi[L] = 0$ has its roots outside the unit circle and the root of $\beta[L] = 0$ must lie outside the unit circle for the process to be invertible.

Autoregressive (AR) Models

In these models, the current value of the series, can be explained as a function of p past values, $X_{t-1}, \cdots, X_{t-p}$ where p determines the number of steps into the past needed to forecast the current value. An X_{t-1} autoregressive model of order p, AR (p) could be explicitly written as,

$$X_t = \phi_1 X_{t-1} + \phi_2 X_{t-2} + \cdots + \phi_p X_{t-p} + w_t \quad (9)$$

where, X_t is stationary series,

$\phi_1, \cdots, \phi_p$ are the parameters of the AR(p) w_t is a Gaussian white noise series with mean zero and variance $\sigma < \infty$, unless stated otherwise.

The highest order p is referred to as the order of the model.

Moving Average MA (q) Model

A time series (Y_t) is said to follow a Moving Average process if its current values depend on its past shocks. This implies that, the forecast values of the series depend on the past errors. Thus, a Moving Average process of order q, MA(q) is given as,

$$Y_t = e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} - \ldots - \theta_q e_{t-q} \quad (10)$$

Integrated Autoregressive Moving Average Process ARIMA (1, 1, 1)

A time series $\{Y_t\}$ is said to follow an integrated autoregressive moving average model if the d^{th} difference $W_t = \nabla^d Y_t$ is a stationary ARMA process. If $\{W_t\}$ follows an ARMA (p, q) model, we say that $\{Y_t\}$ is an ARIMA (p, d, q) process. Consider then an ARIMA(p, 1, q) process, with

$$W_t = Y_t - Y_{t-1}, \quad (11)$$

we have;

$W_t = \phi_1 W_{t-1} + \phi_2 W_{t-2} + \ldots + \phi_p W_{t-p} + e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} - \ldots - \theta_q e_{t-q}$ (12) or
in terms of the observed series;

$$Y_t - Y_{t-1} = \phi_1(Y_{t-1} - Y_{t-2}) + \phi_2(Y_{t-2} - Y_{t-3}) + \ldots + \phi_p(Y_{t-p} - Y_{t-p-1}) + e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} - \ldots - \theta_q e_{t-q} \quad (13)$$

Parameter Estimation

Throughout this section, we assume we have n observations, $x_1, \ldots, x_n$, from a causal and invertible Gaussian ARMA(p, q) process in which, initially, the order parameters, p and q, are known the goal is to estimate the parameters, $\varphi_1, \ldots, \varphi_p, \theta_1, \ldots, \theta_q$, and $\sigma\ 2_w$.

Beginning with the method of moments estimators. The idea behind these estimators is that of equating population moments to sample moments and then solving for the parameters in terms of the sample moments. We immediately see that, if $E(x_t) = \mu$, then the method of moments estimator of μ is the sample average, $\bar{X}$. Thus, while discussing method of moments, we will assume $\mu = 0$. Although the method of moments can produce good estimators, they can sometimes lead to suboptimal estimators. We first consider the case in which the method leads to optimal (efficient) estimators, that is, AR(p) models.

When the process is AR(p), $X_t = \varphi_1 X_{t-1} + \cdots + \varphi_p X_{t-p} + w_t$, the first $p + 1$ equation.

This equation lead to

The Yule–Walker equations are given by

$$\gamma(h) = \varphi_1\gamma(h-1) + \cdots + \varphi_p\,\gamma(h-p),\ h = 1, 2, \ldots, p, \quad (14)$$

$$\sigma^2 w = \gamma(0) - \varphi_1\gamma(1) - \cdots - \varphi_p\,\gamma(pk) \quad (15)$$

Diagnostic Check

After tentative model has been fitted to the data, it is important to perform diagnostic checks to test the adequacy of the model and, if need be, to analysis of potential improvements. One way to accomplish this is through the analysis correlogram.

Plot of Correlogram

A correlogram gives a summary of correlation at different periods of time. The plot shows the correlation coefficient for the series lagged (in distance) by one delay at a time. For example, at x=1 you might be comparing

January to February or February to March. The horizontal scale is the time lag and the vertical axis is the autocorrelation coefficient (ACF). The plot is often combined with a measure of autocorrelation like Moran's I; Moran's values close to +1 indicate clustering while values close to -1 indicate dispersion.

Where $\hat{\pi}$ are obtained by substitution the estimated parameters in place of the theoretical one.

Forecasting

One of the most important tests of any model is how well it forecasts. This can involve either in-sample or outof-sample forecasts, usually the out-of-sample forecasts are viewed as the most informative, as the data used for the forecast is not included in the estimation of the model used for the forecast. When assessing how well a model forecasts, we need to compare it to the actual data, this then produces a forecast value, an actual value and a forecast error (difference between forecast and actual values) for each individual observation used for the forecast. Then the accuracy of the forecast needs to be measured, this can be done by:

1) Plot of forecast values against actual values
2) Use of a statistic such as the Mean Square Error (MSE) or RMSE (R stands for Root).

3) Use of Theil's U coefficient, which in effect compares the forecast to a benchmark forecast.

4) The use of financial loss functions, where the % of correct sign predictions or direction change predictions are calculated. This is particularly important in finance, as if you can forecast the sign correctly; it usually means a profit can be made.

When forecasting future values of a variable, it is often important to have a benchmark model, such as the random walk to compare the forecasts of the model with, if it cannot beat the random walk it can be argued to be a relatively poor forecast, the random walk often wins.

RESULTS AND DISCUSSIONS

In this chapter we intend to present the results and discussion of the data analysis for this study. The statistical software used in this research work includes Eviews, MS Excel and Minitab. The software were used to plot graph, autocorrelation functions and transform the original series and it was used for the overall statistical analysis for this research work.

Results

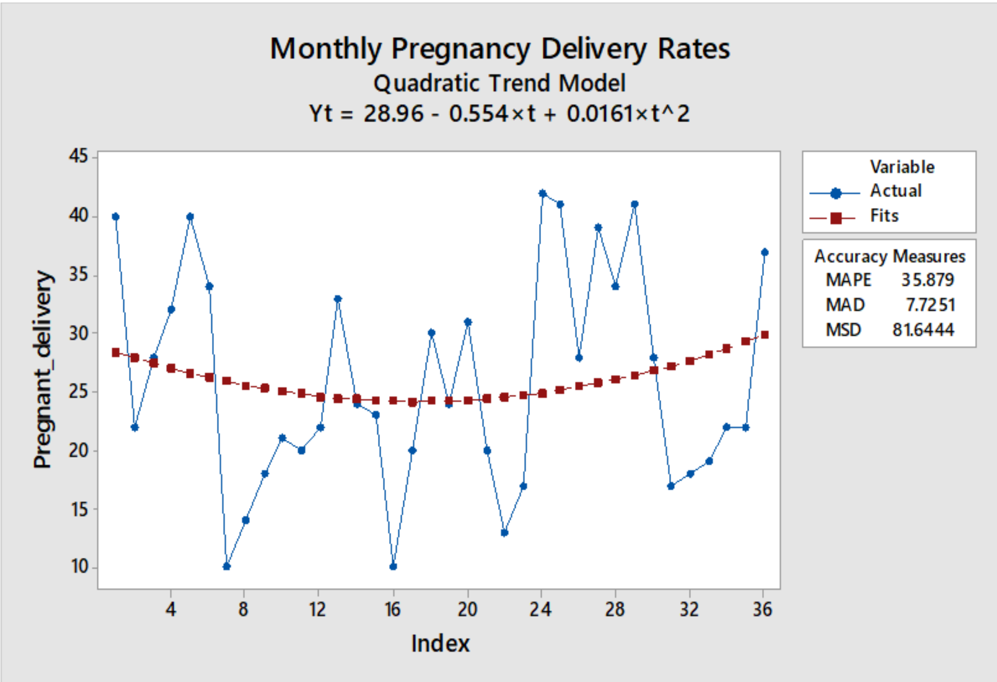


Figure 1: Trend plot of reported cases of birth complications.

Table 1: Model Trend Analysis Measure of Accuracy

MODEL TYPE	MAD	MAPE	MSD
LINEAR	7.9405	36.9530	84.0429
EXPONENTIAL	7.7519	33.7664	86.9680
QUADRATIC*	7.7251	35.8790	81.6444

* Indicate the selected model trend analysis

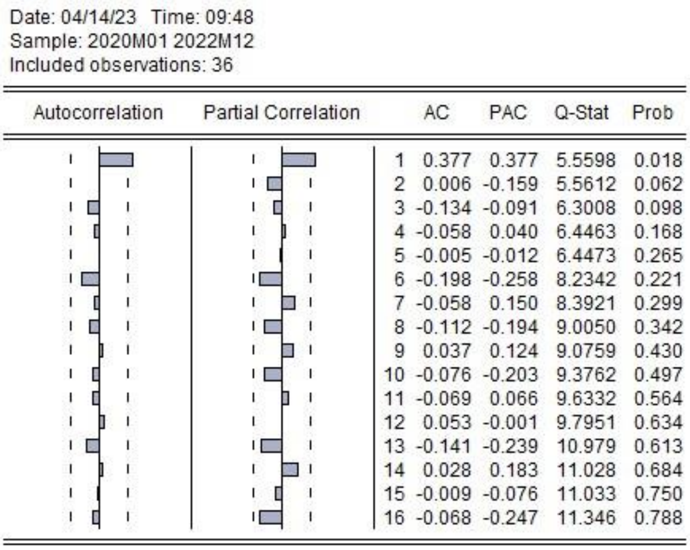
Stationarity Test

Table 2: A Unit Root Test for cases of birth complications in General North Bank Makurdi at level

Null Hypothesis: PREGNANT_DELIVERY has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.858054	0.0056
Test critical values:	1% level		-3.632900	
	5% level		-2.948404	
	10% level		-2.612874	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(PREGNANT_DELIVERY)				
Method: Least Squares				
Date: 04/14/23 Time: 09:42				
Sample (adjusted): 2020M02 2022M12				
Included observations: 35 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PREGNANT_DELIVERY(-1)	-0.608056	0.157607	-3.858054	0.0005
C	15.49789	4.286956	3.615126	0.0010
R-squared	0.310843	Mean dependent var		-0.085714
Adjusted R-squared	0.289959	S.D. dependent var		10.08310
S.E. of regression	8.496414	Akaike info criterion		7.172611
Sum squared resid	2382.239	Schwarz criterion		7.261488
Log likelihood	-123.5207	Hannan-Quinn criter.		7.203291

F-statistic	14.88458	Durbin-Watso	n stat	1.636762
Prob(F-statistic)	0.000502			

Model Identification



Date: 04/14/23 Time: 09:48
Sample: 2020M01 2022M12
Included observations: 36

	AC	PAC	Q-Stat	Prob
1	0.377	0.377	5.5598	0.018
2	0.006	-0.159	5.5612	0.062
3	-0.134	-0.091	6.3008	0.098
4	-0.058	0.040	6.4463	0.168
5	-0.005	-0.012	6.4473	0.265
6	-0.198	-0.258	8.2342	0.221
7	-0.058	0.150	8.3921	0.299
8	-0.112	-0.194	9.0050	0.342
9	0.037	0.124	9.0759	0.430
10	-0.076	-0.203	9.3762	0.497
11	-0.069	0.066	9.6332	0.564
12	0.053	-0.001	9.7951	0.634
13	-0.141	-0.239	10.979	0.613
14	0.028	0.183	11.028	0.684
15	-0.009	-0.076	11.033	0.750
16	-0.068	-0.247	11.346	0.788

Figure 2: Correlogram plot for reported cases of birth complications

Model selection

Table 3: Showing Model Selection Criteria

Model	Significance coefficients	Adjusted R^2	AIC	SBIC
(1,0,1)*	1	0.253	7.0489	7.182
(1,0,0)	1	0.231	7.0912	7.179
(0,0,1)	1	0.132	7.1726	7.261

* Indicate the selected mode; AIC = Akaike Information Criteria; SBIC = Schwarz Bayesian Information Criteria.

Model Estimation

Table 4: Model Estimation for reported cases of birth complications

Dependent Variable: PREGNANT_DELIVERY				
Method: Least Squares				
Date: 04/14/23 Time: 09:53				
Sample (adjusted): 2020M02 2022M12				
Included observations: 35 after adjustments				
Convergence achieved after 11 iterations				
MA Backcast: 2020M01				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	25.73176	1.968974	13.06861	0.0000

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue IX September 2025

AR(1)	-0.319972	0.182053	-1.757575	0.0884
MA(1)	0.948639	0.043824	21.64674	0.0000
R-squared	0.297184	Mean dependent var		25.54286
Adjusted R-squared	0.253258	S.D. dependent var		9.121219
S.E. of regression	7.882031	Akaike info criterion		7.048865
Sum squared resid	1988.045	Schwarz criterion		7.182180
Log likelihood	-120.3551	Hannan-Quinn criter.		7.094885
F-statistic	6.765566	Durbin-Watson stat		1.858779
Prob(F-statistic)	0.003544			
Inverted AR Roots	-.32			
Inverted MA Roots	-.95			

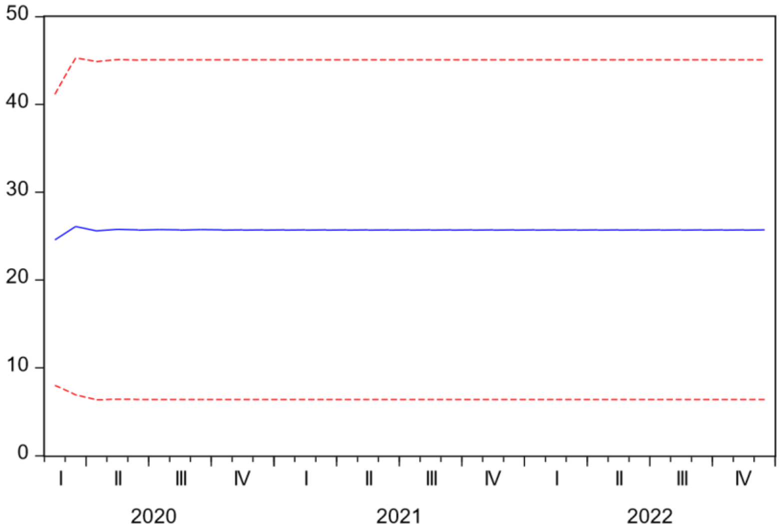
Diagnostic check

Date: 04/14/23 Time: 10:10
Sample: 2020M01 2022M12
Included observations: 35
Q-statistic probabilities adjusted for 2 ARMA terms

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.045	0.045	0.0775	
		2	0.115	0.113	0.5922	
		3	-0.177	-0.189	1.8585	0.173
		4	-0.126	-0.127	2.5240	0.283
		5	0.079	0.143	2.7914	0.425
		6	-0.280	-0.317	6.2809	0.179
		7	0.201	0.205	8.1586	0.148
		8	-0.217	-0.199	10.422	0.108
		9	0.178	0.126	11.993	0.101
		10	-0.065	-0.089	12.210	0.142
		11	-0.093	-0.091	12.681	0.178
		12	0.169	0.145	14.285	0.160
		13	-0.249	-0.210	17.944	0.083
		14	0.155	0.020	19.431	0.079
		15	-0.080	0.167	19.844	0.099
		16	0.066	-0.227	20.143	0.126

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue IX September 2025

Figure 3: Correlogram of residuals for reported cases of birth complications



Forecast

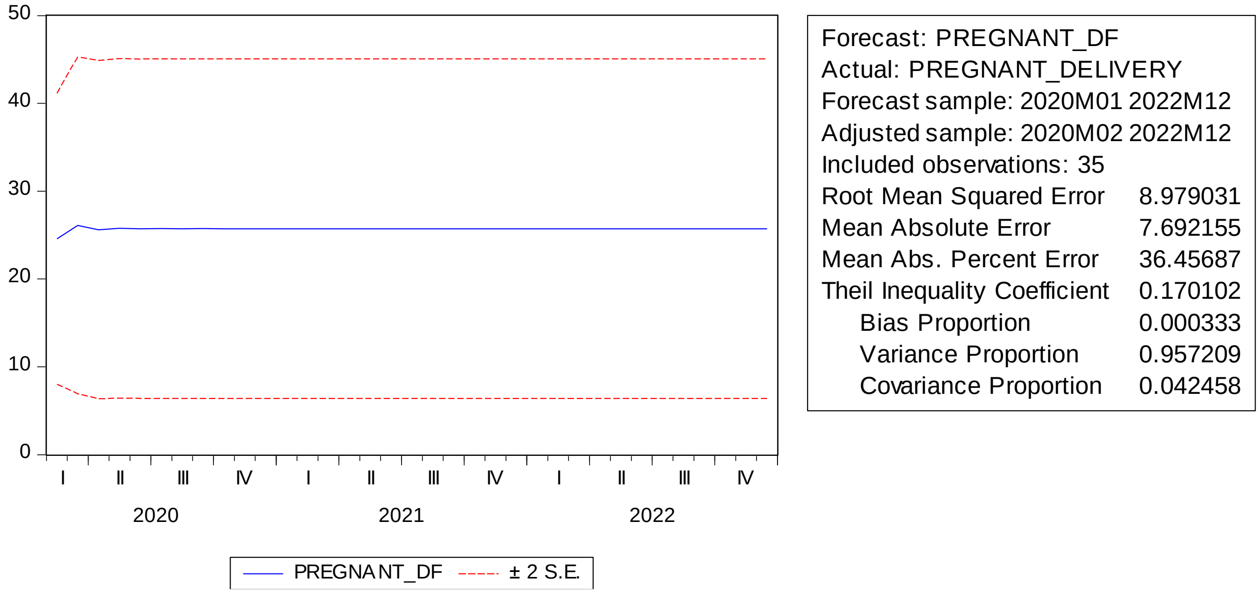


Figure 4: Forecast of the reported cases of birth complications

DISCUSSION

The data used for this research work are monthly data on reported cases of birth complications in General Hospital, North Bank Makurdi Benue State for the period of 36 months (2020 – 2022).

From the time series plot of reported cases of birth complications (Figure 1), it could virtually be seen that the data on the reported cases of birth complications appears to be non-stationary.

However, in Table 1, Measure of accuracy was performed to selected the best fitted model trend. To confirm if the time series data is non-stationary, a unit root test was carried out. Thus, from Table 2, the Augmented Dickey Fuller (ADF) test statistic of -3.858054 is less than the critical values at 1%, 5% and 10% respectively. This led to the rejection of the null hypothesis which states that the time series data is not stationary.

From the trend analysis of reported cases of birth complication (Figure 1), it was observed that quadratic trend analysis model was selected for these series. This was due to the fact that it has the lowest measures of accuracy when compared with accuracy measures of the linear trend model and exponential growth trend model respectively.

This shows that the reported cases of birth complication at a given time t is Negatively related to its immediate past value at time t-1.

From the diagnostic check, it was observed that the coefficient of determination R^2 of 29.7% from Table 4 satisfied the residual assumptions. That is both the assumption of normality of residuals and the absence of serial correlation in the residuals were satisfied. This is due to the fact the autocorrelation and partial autocorrelation function spikes are within the upper and the lower bound limits respectively. This is another prove that the model selected was best fitted.

From summary of the model order of selection criteria (Table 4), ARMA (1, 0, 1) was selected because among all the models that satisfied the residual assumption, it has the lowest Akaike Information Criteria (AIC) and Schwarz Bayesian Information Criteria (SBIC).

Furthermore, the model was used to forecast for reported cases of birth complications as shown in Figure 4.

CONCLUSION AND RECOMMENDATION

Conclusion

Based on this research work, the following findings were made:

1. The reported cases of birth complication for the period of 36 months (2020 – 2022) was found to be stationary. ii. It was found to have quadratic trend analysis model; hence the general movement can be predicted over time.

2. ARMA (1, 0, 1) model was found to be the best fit for the time series data on reported cases of birth complications for the period of time covered.

3. Cases of birth complications at time t-1 negatively affect the terms of birth rate at time t, hence a knowledge of the immediate past value of reported cases of birth complication in General Hospital North bank Makurdi in Benue state can be useful in forecasting the future values.

Recommendation

Due to the way the past values of reported cases of birth complications negatively affects the present values, it is therefore advised that policies should be made to improve the measures that can help in birth complications.

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