*International Journal Of Mathematics And Statistics Invention (IJMSI)*
*E-ISSN: 2321 – 4767 P-ISSN: 2321 - 4759*
*www.Ijmsi.Org || Volume 2 Issue 12 || December. 2014 || PP-18-27*

# Model for the Prediction of the Reported Cases of Vesco Vaginal Fistula in Kebbi State

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***ABSTRACT :*** *The work examined the monthly reported cases of Vesco Vaginal Fistula (VVF) inKebbi State, Nigeria between the periods of 2004 and 2012 using Box and Jenkins approach. The result from the estimation of parameters of the model showed that SARIMA (2, 0, 0) X (1,1,4) is appropriate. More so, the forecast showed that the menace of VVF is still at higher side for the next 24 months if nothing is done to check the threat, all things being equal. It is recommended however, that the Child Rights Act 2003: Section 21 & 22 and Section 29(4) (b) of the Nigerian constitution should be enforced in order to check the threat.*

***KEY WORD:*** ***Vesco Vagi****nal Fistula, Box and Jenkins Approach, SARIMA (2, 0, 0) (1,1,4) and Forecast*

## I. INTRODUCTION

Vesico Vaginal Fistula (VVF) is one of the worst morbidities associated with delivery. It is an abnormal opening of the vaginal wall to the bladder or rectum or both at the same time, that results ion the leakage of urine (VVF) or faeces (Recto Vaginal Fistula, RVF) or both; VVF and RVF are serious health problems in the developing world, including Nigeria where it contributes greatly to the country's unacceptable high maternal mortality (Murphy; 1980; Harrison, 1989; Harrison, 1990;Kaburuk, 1990; Tanko, 1994; Chaurasia, 2006 ). VVF is as old as mankind and has a constant of misery to the women affected. It is believed that it was as a result of various factor that include deficiency of medical facilities leading to the lesser medical service among other indirect factor that are socio-cultural practices. The main course of VVF in over 85% of cases is in obstructed labour which is not relieved in time by a caesarean section. This may result from surgical damage to the bladder during a gynaecological operation (for example hysterectomy) or radiation damage following radiotherapy for pelvic malignancy. In third world countries it is open caused by necrosis associated with the prolonged obstructed labour; necrosis is the cutting through the wall of the mother's abdomen before she can deliver a child (Kaburuk, 1990; Disk and Armayau, 1993; WHO, 1994; 1997; 1999; 2000).

The Minister of Women Affairs and Social Development, Hajiya ZainabMaina, has disclosed that Nigeria has the highest incidences of VVF in the world with an estimated 400,000 to 800,000 cases with 20,000 new cases added each year. This is particularly disheartening given the high rate of maternal mortality in Nigeria, primarily due to the prevalence of VVF and RVF. The majority of the cases of VVF in Nigeria are as a result of early girl child marriage. Early marriage in many instances leads to the withdrawal of girls from schools and thrusts upon them marital and reproductive responsibilities for which they are neither physically nor mentally mature to carry out. Women's Human Rights (BAOBAB) strongly condemns the recent happenings with the Nigerian constitutional amendment process in the Senate to retain the provision of Section 29(4) (b) which says that "any woman who is married shall be deemed to be of full age", This provision would imply that a female child even at birth, if married, is deemed to be of full age. BAOBAB sees this clause as a clear violation of the rights of the girl child and various international treaties such as the Child Rights Act 2003: Section 21 & 22 which prohibits child marriage and betrothal.

The Health Minister, Prof OnyebuchiChukwu, said that within seven years of intervention, the Federal Ministry of Health in collaboration with USAID Fistula Care has seen to the repairs of over 8,000 women with fistula in the country. The Director, Family Health in the ministry, DrWapadaBalami, commended the USAID Fistula Care project, UNFPA and EngenderHealth who have supported the fistula intervention activities in Nigeria, leading to the expansion of fistula centres in Bauchi, Kwara, Oyo, Ebonyi and Cross River states. The USAID Nigeria Mission Director, Ms Dana Mansuri, without accurate information and knowledge of fistula, women will continue to be stigmatised and marginalised. They are also isolated as a result of the offensive smell or urine that they exude due to damaged urinary tract. Consequently, the victims are often prevented from socialising with other members of the family or society and as such, many of them become beggars and even destitutes.However, almost 10,000 women have received fistula surgeries free of charge, and most of these women have been rehabilitated and reintegrated into their communities.

Today, there are three federally-run regional fistula centres in Ebonyi, Katsina and Bauchi states with plans to open two additional centres in Oyo and Kwara states. Fistula does not just affect women; it affects families, communities, societies and countries. She said since 2007, the US government has been committed to partnering Nigeria to reduce the number of fistula cases and provide care for victims of fistula. Also, Our efforts have focused on treating and rehabilitating fistula in 10 Nigerian states. We have also concentrated on sensitizing and mobilizing communities to change attitudes and behaviours that lead to fistula.Today, millions of Nigerians now recognize fistula as a National problem that requires a holistic approach and sustained commitment. According to her, the Fistula Care partnership also helped the federal government to develop and allocate funding for fistula care, which previously did not exist, to a total budget allocation of close to $7 million in 2013. Thanks to USAID Fistula Care Project, many women have been given a new lease of life.

## II. AIM AND OBJECTIVES

The research work aim at fitting a time series model for the monthly reported cases of VVF in Kebbi State with a view to obtain the following objectives:.

[1] The time plot and identification of the model through autocorrelation and partial autocorrelation function for the data.
[2] To estimate the parameter for the data and diagnose the resultant model
[3] To forecast the future occurrence of VVF cases in Kebbi State

**Scope and limitation :** This project work, examines the reported cases of VVF in Kebbi State between the Periods of 2004-2012, using time series methodology. The data used in this research work are collected as secondary data from vesico vaginal fistula centreBirninKebbi. The data describe the number of VVF patients recorded with the centre for the period of 9years.

## III. METHOLOGY

**MODEL BUILDING :** A time series model building is a selection of the appropriate model for the data in achieving and itrativeproceedure based on the three paundamental steps of Box and Jenkins (1976). This proceedures are:-

[1] Model identification
[2] Model estimation
[3] Diagonostic checking.

**MODEL IDENTIFICATION :** In model Identification, Frances, P.H (1980), wrote that model identification involves the use of the data on available information to suggest a suitable model to describe how the has been generated. If the data appears to be stationary no difference is called for,and we identify d = 0 where d is the order of difference of the series until its time plot appear to be stationary. As mentioned earlier the input series of SARIMA model need to be stationary, that it is should have a constant mean, variance and autocorrelation through time. There fore, usually the series first needs to be differeced until it is statinaryi.ehowevwr one should keep in mind that, some time series may require little or no differencing and that over differenced series produce less stable estimate.

The first step in the identification of SARIMA process is to examine the time plot to indicate and identify the presence of trend and seasonal variation however the three (3) commonly use tools for grafical methods in identification in are:- (i) The time plot of the series, (ii) the time plot of auto currelation at various lags ACF and (iii) the time plot of

partialautocurrelation function PACF.

- Time plot of a series:-

  This is a graphical representation of time series of observed values $X_1$, $X_2$,$X_3$,…..$X_k$ plotted agains time observations. It is a useful tool for interpreting a set of autocorrelation co-efficient.
- Time plot of autocorrelation function:-This is a graphical representation of the sample autocorrelation $r_h$versus h (the time lags).it is also said to be plot that describes the currelation between values of the process at different point in time,as the fuction of the two or of the different time.

- Time plot for partialautocurrelationfuntion:-

This is a graphical representation of the autocorrelation between $X_t$ and $X_{t-l}$ that is not accounted for by ‘lag 1 through K-1.The partial autocorrelation function is a use full device for determining the order of a stationary process i.e. it identifies the order of an autoregressive model.

**MODEL ESTIMATION :** Dickey, D.A (1979) in this estimation stage said here parameters are been estimated for adequate model. The parameters of a SARIMA $(P,d,q)(P,D,Q)^s$, model selected can be estimated consistently by least square or maximum likelihood estimation (M.L.E). The estimation of the parameter used in the forecasting stage is to calculate new values of the series and the confidence intervals for those predicted values. The estimation process can be performed on the transformed data before the forecast of the data is generated. Estimation coefficients are nearly always correlated with one another.

Estimates of the correlated parameters provide useful diagnosis. If estimates are highly correlated , the estimate are heavily dependent in each other and tend to be unstable(i.esligh changes in the data can cause large changes in estimates).if one or more of the currelation among the parameters are close to one another, it may be an indication that the model contain too many parameters.

**THE DIAGNOSTIC CHECKING STAGE**

Once an appropriate model had been entertained and its parameters

Estimated, the Box-Jenkins methodology required examining the residuals of the actual values minus those estimated through the model. If such residuals are random, it is assumed that the model is appropriate. If not, another model is entertained, its parameters estimated, and its

Residuals checked for randomness. In practically all instances a model could be found to result in random residuals. Several tests (e.g., the Box-Pierce Statistic, Box and Pierce, 1970) have been suggested to help users determine if overall the residuals are indeed random.

Although it is a standard statistical procedure not to use models whose residuals are not random, it might be interesting to test the consequences of lack of residual randomness on post-sample forecasting accuracy. In theory, the three-stage iterative process of model identification, estimation, and diagnostic checking is repeated until an adequate model yielding white noise residuals is arrived at. In practice, however, the analyst may have to settle for the model which has the "whitest" residuals, i.e., the model which least seriously violates any of the Box-Jenkins criteria

## IV. STATISTICAL TEST IN THE SERIES

**KPSS TEST:-** Kwiatkowski, Philips, Schmidt, P. and Shin (1992) proposed a test of the null hypothesis that an observable series is trend stationary (stationary around a deterministic trend). The integration properties of $a$ series $y_t$ may also be investigated by testing the null hypothesis that the series is stationary against a unit root. Assuming no linear trend term, the data generating process is given as:-

$y_t = x_t + z_t$ Where $x_t$ a random is walk, $x_t = x_{t-1} + v_t, v_t : iid\left(0, \sigma_v{}^2\right)$ and $z_t$ is a stationary process. Kwiatkowski *et al.*, (1992) proposed the following test statistic

KPSS $= \frac{1}{T^2}\sum_{t=1}^{r}\frac{S_t{}^2}{\sigma^2{}_\infty}$ where $S_t = \sum_{j=1}^{t}\hat{w}j$ with $w_j = y_t - \overline{y}$ and $\hat{\sigma}_\infty{}^2$ an estimator of the long run variance of $Z_t, \hat{\sigma}_\infty^2 = \lim_{T\to\infty} T^{-1} Var\left(\sum_{t=1}^{T} Z_t\right)$

The null hypothesis of the test is $H_0 : \hat{\sigma}_v^2 = 0$ against the alternative hypothesis $H_0 : \hat{\sigma}_v^2 \neq 0$ Reject the null hypothesis if the test statics is greater than the asymptotic critical values.

**AUGEMENTED DICKEY FULLER** (ADF) TEST:- The ADF regression equation due to Dickey and Fuller (1979) and said Dickey (1984) is given by:

$$\Delta y_t = \mu_0 + \mu_1 t + \phi y_{t-1} + \sum_{j-1}^{p} \alpha_j \Delta y_{t-j} + \varepsilon_t$$ Where $t = p+1, p+2....., T.$

Where $\mu_0$ the intercept is $\mu_1 t$ presents the trend in case it is present, $\phi$ is the coefficient of the legged depended variable. $y_{tj}$ And p lags of $\Delta y_{t-j}$ with coefficients $o_j$ are added to account for serial correction in the residuals. The null hypothesis $H_0 : \emptyset = 0$ is that the series has unit while root while the alternative hypothesis $H_t : \phi \neq 0$ is that series is stationary. The ADF test statics is given by:-

$$ADF = \frac{\emptyset}{SE\left(\hat{\emptyset}\right)}$$ Where $SE\left(\hat{\emptyset}\right)$ is the standard error for $\hat{\emptyset}$ and ^ denotes estimate. The null hypothesis of unit root is accepted if the test statics is greater than the critical values.

**JARQUE-BERA TEST:-**Jarque and Bera (1987) have proposed test for normality based on skewness and kurtosis of a distribution. The Jarque-Bera test is a two- sided goodness-of-fit test suitable when a fully-specified null distribution is unknown and its parameters must be estimated. The test statistic is:-

$$JB = \frac{n}{6}\left( s^2 + \frac{(k-3)^2}{4} \right)$$ Where $n$ is the sample size, $S$ is the sample skewness, and $k$ is the sample kurtosis. The test checks the pairs of hypothesis;

$$H_0 : E\left(U^x{}_t\right)^3 = 0\left(Skewness\right)$$ and $$H_0 : E\left(U^x{}_t\right)^4 = 3\left(Kurtosis\right)$$

That is distribution is symmetry and hence normal.

$$H1 : E\left(U^x{}_t\right)^3 \neq 0\left(Skewness\right) \quad H1 : E\left(U^x{}_t\right)^4 \neq 3\left(Kurtosis\right)$$

and

and for the alternative hypothesis it implies that the distribution is asymmetry and hence non-normal.

The null hypothesis is accepted if the test statics is less than the critical values, and rejected if the test statics is greater than the critical values.

**PORTMANTEAU TEST:-** in statistics, a portmanteau test, test whether any group of autocorrelation of a time series are different from zero that is, it is a test used for investigating the presence of autocorrelation in time series. Among portmanteau test are both the Ljung-Box test and the (now absolute) Box-Pierce test. The portmanteau test is used to test the stationary of time series. The Ljung-Box test statistics is calculated as:-

$$Q = T\left(T+2\right)\sum_{K=1}^{\infty} r_k{}^2 / \left(T-K\right)$$ Where

$T =$ Number of observations, $S =$ number of coefficients to test autocorrelation $r_k =$ autocorrelation coefficient (for lag k) and $Q =$ portmanteau test statistics. If the sample value of $Q$ exceeds the critical value of a Chi-Square distribution with $S$ degrees of freedom, then at least one value of $r$ is statistically different from zero at the specified significance level. The null hypothesis is:-

## V. DATA ANALYSIS

**Visual Representation**

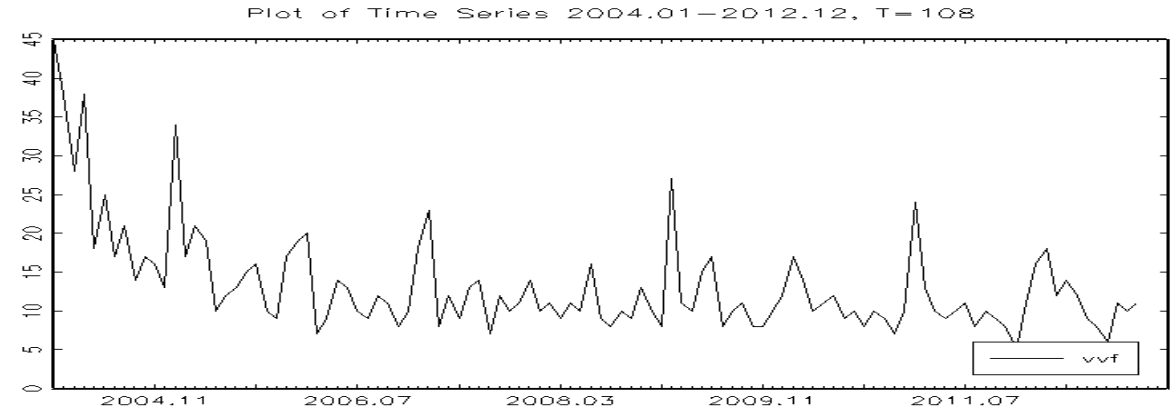



Figure 3.1 Time Plot of the Monthly Reported Cases of VVF in Kebbi State2004-20012

A critical visual inspection of the plot shows that the sign of seasonality, the plot has a wave- like pattern, with Speak levels occurring around may - June of each year. Also, the observed time plot showed that the data is not stationary. i.e. the mean and variance are not constant but in order to apply certain techniques for identifying the model for the data, we must determine the form of stationarity of the original time series by transformation of the data. We now proceed to examine the correlogram i.e. the Autocorrelation function (ACF) and partial Autocorrelation function(PACF) of the series.

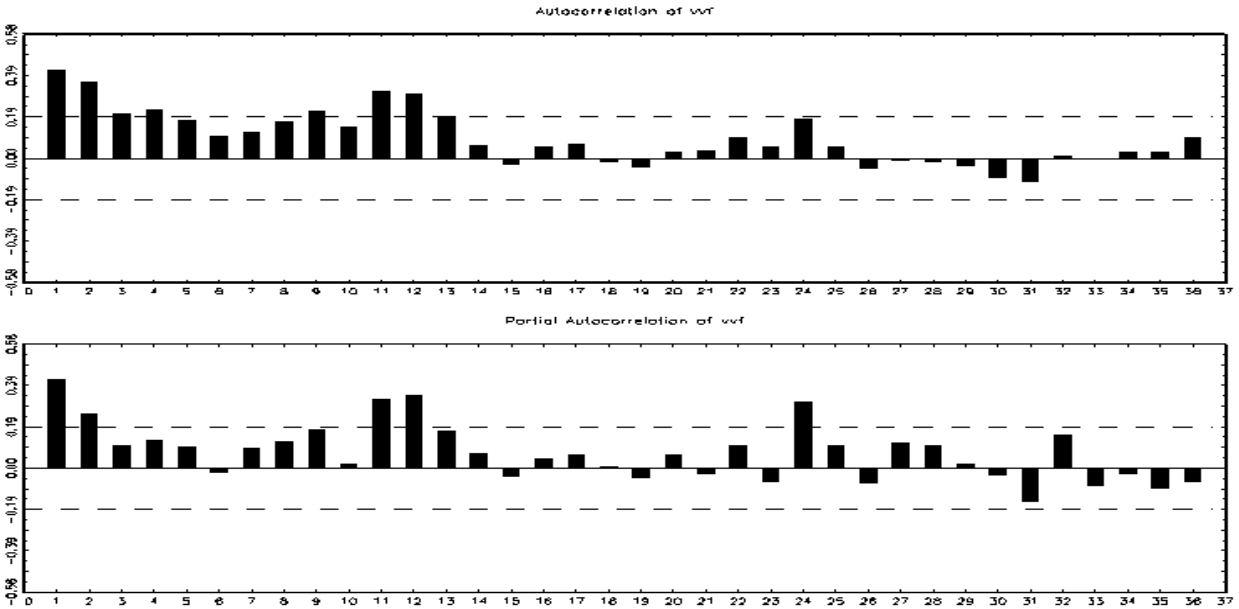



Figure 3.2 ACF and PACF of the VVF Series

Also, on visual inspection of the autocorrelation function, the time plot at 37 lags showed a sinusoidal wave-like pattern which was strongly periodic with period at lag interval of 12 and this clearly shows that the series has seasonal behaviour.

**Descriptive Statistics:**

| Variable | Mean | Min | Max | STD Dev. |
|---|---|---|---|---|
| VVF | 1.33241e+01 | 5.00000e+00 | 4.50000e+01 | 6.72176e+00 |

The mean average number of VVF cases is 13 and the minimum number of people affected with VVF in Kebbi state is 5.00 and maximum number of people affected with the disease is 45 which indicate that the disease was very rampant around January 2004 in Kebbi state

Jarque-Bera Test for "VV
Test Statistic: 289.6980
P-Value (Chi^2): 0.0000
Skewness: 2.3511
Kurtosis: 9.5015
Thus the null hypothesis "$H_0$" is rejected since the value of the test statistic exceeds the critical value of the Chi-square "$\chi^2$" i.e., (289.6980 > 0.0000) then alternative hypothesis "$H_1$" is accepted, and it is concluded that the series of the VVF data is from non-normal distribution.

**AUGMENTED DICKEY-FULLER (ADF) AND KPSS TEST FOR VVF**
**TEST OF HYPOTHESIS FOR KPSS TEST**

$H_O$: $\sigma = 0$ (The series is stationary.)
$H_1$: $\sigma > 0$ (series in not stationary.)
KPSS test based on y(t)=a+e(t) (level stationary)
asymptotic critical values:
10% 5% 1%
0.347 0.463 0.739
Value of test statistic: 1.1768
In this case the value of test statistic is 1.1768 and level of significance at 10%, 5% and 1% are 0.347, 0.463 and 0.739 respectively. Which show that the test statistic value is greater than all the critical values which indicated that there's no stationarity in the series i.e. the series is not stationary

## VI. TEST OF HYPOTHESIS FOR ADF

$H_O$: The series has unit root
$H_1$: The series is stationary
ADF TEST
1% 5% 10%
-2.56 -1.94 -1.62
value of test statistic: -2.058
1n the case of ADF the test statistics is -2.058 and the critical values at 1%, 5% and 10% are -2.56, -1.94 and -1.62 respectively which show that the test statistic is greater than all, which show that there is no evidence to reject the null hypothesis which shows that the series has unit root

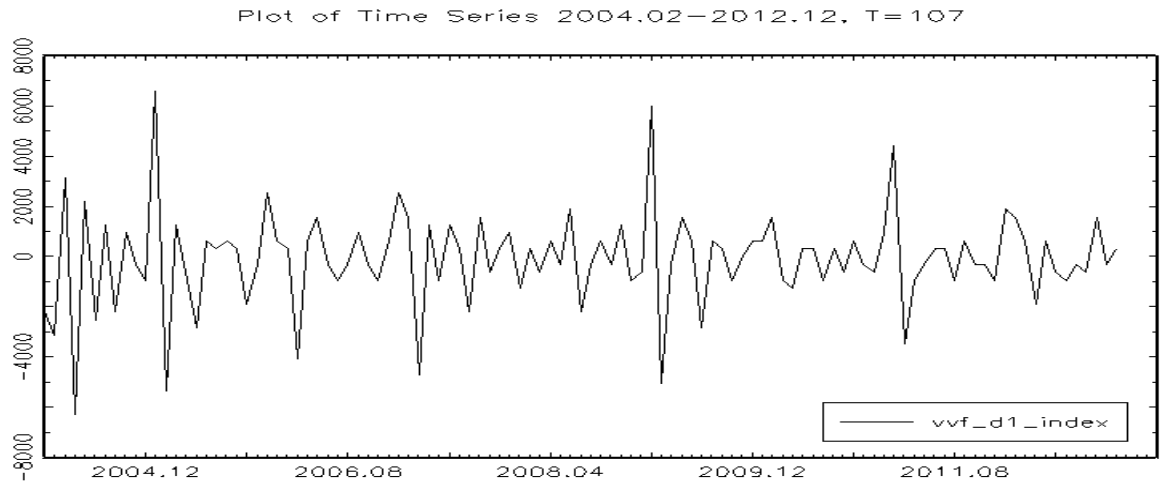
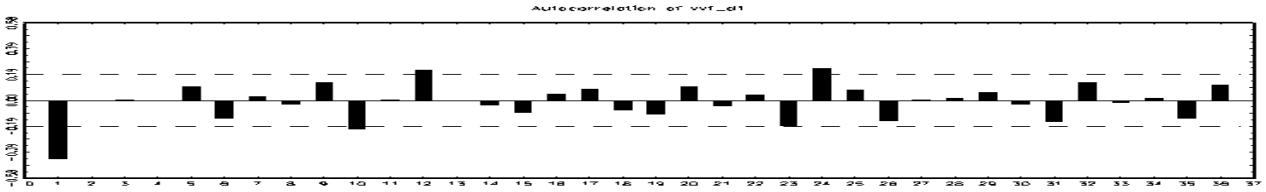



Figure 3.3 Plot of Differenced VVF Series

This plot clearly suggests that the differenced data is stationary; the mean and variance are constant; the variability of the series changes after the first differencing. To confirmed that we shall consider autocorrelation and partial autocorrelation function

Autocorrelation function for VVF



Partial autocorrelation function for VVF

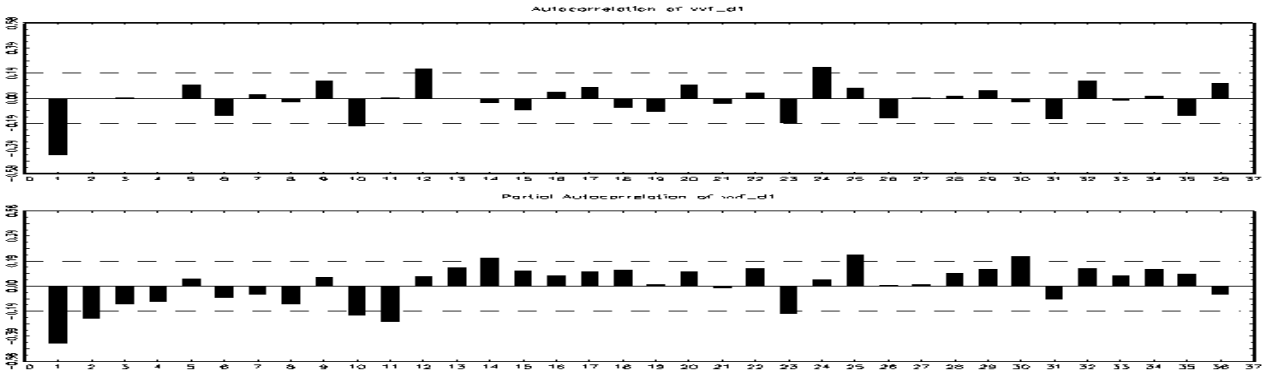


Fig 3.4 The ACF and PACF of First Difference of VVF Cases in Kebbi State

From the autocorrelation function lag 1, 10 lie below the confidence limit and lag 12, 24 lie above the confidence limit. From the partial autocorrelation function lag 1, 2, 10, 11 and 23 lies below the confidence limit and lag 14, 25 and 30 lie above the confidence limit. Both the ACF and PACF have a wave like movement on the series which suggest stationary

## MODEL IDENTIFICATION

To identified the best model, five (5) candidate model are chosen out of this model a parsimonious model is obtained which has the lowest AIC, SBC and log likelihood function. The values of AIC, SBC and log likelihood function of the five(5) candidates

SARIMA model are computed and reported in the table below:

## VII. ESTIMATION

**TABLE 3 ORDER OF ESTIMATION**

| MODEL | AIC | SBC | LOG |
|---|---|---|---|
| SARIMA(1,0,0)(1,1,1) | 610.930679 | 618.560564 | -302.465340 |
| SARIMA(1,1,0)(1,1,2) | 625.895169 | 636.068348 | -308.947584 |
| SARIMA(0,1,1)(1,1,3) | 595.724988 | 608.441461 | -292.862494 |
| SARIMA(2,0,2)(1,2,1) | 687.909222 | 695.507021 | -340.954611 |
| SARIMA(2,0,0)(1,1,4) | 584.304707 | 599.564476 | -286.152354 |

SARIMA (2, 0, 0) (1, 1, 4) was chosen as our best model for the series, because it

Has the lowest AIC and SBC.

$0.066_{12}(L^{12})(1-L)^{1}0.089_{12}(1-L^{12}) = a + 0.007(L^{12})0.023(L^{12})\varepsilon_t$

## VIII. PARAMETER ESTIMATES OF THE MODEL

After the best model has been chosen, the parameters of the model are next to be estimated. The result of the parameter estimates of the best model SARIMA (2,0,0)(1,1,4) are shows
sample range: [2005 M3, 2012 M12], T = 94

Model:**SARIMA(1,1,4)**

Final Results:

Log Likelihood: -286.152354 Number of Residuals: 94

AIC : 584.304707 Error Variance : 25.325725547

SBC : 599.564476 Standard Error : 5.032467143

DF: 88 Adj. SSE: 2425.433777579 SSE: 2228.663848161

Dependent Variable: vvf_d1_d

| Coefficients | Std. Errors | T-Ratio | Approx.Prob. |
|---|---|---|---|
| AR1 | -0.87770916 | 0.06609746 | -13.27902 | 0.00000 |
| MA1 | 0.91664932 | 0.70158525 | 1.2334545 | 0.00000 |
| MA | 0.81452385 | 0.80012324 | 1.122434 | 0.00000 |
| MA3 | -0.92804509 | -0.10243111 | -12.1123 | 0.00000 |
| MA4 | 0.7408038 | 0.04313506 | 0.11760 | 0.00000 |
| CONST | -0.01371779 | 0.00972596 | -1.41043 | 0.16194 |

**MODEL DIAGNOSIS**
Having chosen the best model, there is need to verify the strength of the model if it's a good model that best fit the data by applying the following test:

- Portmanteau test: This test is used to determine whether there is serial correlation in a time series. The model is good if there no serial correlation between the residual.

- ARCH LM test: This test for neglected conditional heteroskedasticity (ARCH) the null hypothesis is that there is no conditional heteroskedastic

- **ARCH-LM TEST (**with 2 lags)**:**

$H_0$: $\alpha_0 = \alpha_1 \ldots \alpha_p = 0$ (the series has no ARCH effect)

$H_1$: $\alpha_0 = \alpha_1 . \alpha_p \neq 0$ (one or more coefficient are non-zero and we say the series has ARCH effect)

**ARCH-LM TEST** with 4 lags:

test statistic: 0.6431
p-Value(Chi^2): 0.9582
F statistic: 0.1619
p-Value(F): 0.9570

**Decision rule**: The null hypothesis is accepted and concluded that the series has no ARCH effect. i.e the variance is constant and heteroskedastic.

**Portmanteau test** (with 12 lags)
$H_0$: $\rho_{\upsilon,1}^2 = \ldots \rho_{\upsilon,h}^2 = 0$ (there is serial correlation in the series)

$H_1$: $\rho_{\upsilon,1}^2 \neq \ldots \rho_{\upsilon,h}^2 \neq 0$

**PORTMANTEAU TEST** with 10 lags
Portmanteau: 2.7742
p-Value (Chi^2): 0.5963
Ljung& Box: 3.0185
p-Value (Chi^2): 0.5547
**Decision rule**: The null hypothesis is rejected for the portmanteau's test since the test statistics 2.7742 > the p value 0.5963 and the alternative hypothesis is accepted then the conclusion is that there is absence of serial correlation in the series.

**FORECASTING**
Forecast of future occurrence of VVF cases in Kebbi State from 2013-2014
VVF disease (in levels)

Forecast range: [2013 M1, 2014 M12], T = 24

| TIME | LOWER CI | FORECAST | UPPER CI |
|---|---|---|---|
| 2013 M1 | 5.4050 | 13.8986 | 25.7285 |
| 2013 M2 | 4 .2879 | 16.0194 | 25.2496 |
| 2013 M3 | 4.8652 | 15.4922 | 26.2698 |
| 2013 M4 | 4.5821 | 16.1458 | 25.9277 |
| 2013 M5 | 5.0036 | 15.7620 | 26.7771 |
| 2013 M6 | 4.7032 | 16.3390 | 26.5427 |
| 2013 M7 | 4.0213 | 16.5639 | 27.2686 |
| 2013 M8 | 4.7409 | 16.3682 | 27.1204 |
| 2013 M9 | 4.9840 | 16.8089 | 27.7514 |
| 2013 M10 | 4.7337 | 16.6766 | 27.6730 |
| 2013 M11 | 4.9198 | 17.0644 | 28.2286 |
| 2013 M12 | 5.6999 | 16.9829 | 28.2286 |
| 2014 M1 | 4.8414 | 17.2367 | 28.7024 |
| 2014 M2 | 4.6490 | 17.2863 | 28.7273 |
| 2014 M3 | 4.7547 | 17.5938 | 29.1736 |
| 2014 M4 | 4.5860 | 17.5863 | 29.2364 |
| 2014 M5 | 4.6629 | 17.8644 | 29.6429 |
| 2014 M6 | 4.5141 | 17.8864 | 29.7635 |
| 2014 M7 | 5.5672 | 18.1379 | 30.1105 |
| 2014 M8 | 4.4349 | 18.1803 | 30.229 |
| 2014 M9 | 4.4687 | 18.4134 | 30.5764 |

| | | | |
|---|---|---|---|
| 2014 M10 | 5.3499 | 18.4741 | 30.5157 |
| 2014 M11 | 4.367 | 18.6907 | 27.0413 |
| 2014 M12 | 4.250 | 18.5127 | 27.0986 |

The data above shows the rate at which the Vesico Vaginal cases will be in the next 24 months.

## IX. CONCLUSION

This project work examined the reported cases of VVF between the periods of 2004-2012 using time series methodology. The initial inspection of the time plot showed that the cases of VVF in Kebbi State exhibit seasonality pattern and this can be verified from initial ACF and PACF of the data, as they cut off in sinusoidal pattern at almost every interval of 12 months. This in turn, makes the series to be non stationary and there is need for attainment of stationarity. Hence the data was transformed and some statistical tests like ADF and KPSS are carried out to ascertain the stationary of the data. The initial test statistics value for ADF was -8.0628 which showed that the series has unit root, however, after transformation, the VVF series become stationary.The same case was observed for KPSS test. To confirm the stationarity in the residual analysis, ARCH LM and portmanteau test are used to test if the series has serial correlation in residual, the test statistics for ARCH LM was 0.6431and p-value(Chi^2) was 0.9582 which showed that the series has no ARCH LM effect. While, in the case of portmanteau test for testing the serial correlation the value of the test statistics was 2.7742 and p-value(Chi^2) was 0.5963 which showed that there's no serial correlation in the residuals. The SARIMA (2, 0, 0) (1, 1, 4) model is found to be appropriate model. The result of the forecast showed that the menace of VVF is still at higher level in the next two years, if nothing is done to put it under check.

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