

## THE IMPACT OF BIRTH AND DEATH RATES ON NIGERIA'S POPULATION GROWTH: A STATISTICAL PERSPECTIVE.

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### ABSTRACT

This study examined the impact of birth and death rates on population growth in Nigeria from 2010 to 2024, the data obtained were mainly secondary data sourced from World Bank's World Development Indicators (WDI). In this paper, the independent variables are: Birth rate and Death rate where the response variable is Population Growth. The research employed descriptive statistics and Multiple Regression analysis to explore the dynamics between fertility, mortality, and demographic expansion. From the regression model formed through Multiple regression Analysis, ( $Y = 1.724 + 0.115 X_1 - 0.294 X_2$ ): The model revealed that Nigeria's population has grown steadily over the past fifteen years, driven primarily by persistently high birth rates (0.115) and declining death rates (0.294). The regression findings indicated that birth rate exerts a strong and significant positive effect on population growth, while death rate has a weak and negative effect on population growth. The model explained approximately 93.9% of variations in population growth, suggesting that these demographic factors are critical determinants of Nigeria's population trends. Also, the test of multicollinearity, heteroskedasticity, and autocorrelation revealed that the data obtained were free of multicollinearity, heteroskedasticity, and autocorrelation. Likewise, the adequacy of the model was confirmed and it was also confirmed that the parameters of the model formed were significant at a 0.05 level of significance. Based on these findings, the study recommends strengthening family planning programs, investing in healthcare, and promoting female education to achieve sustainable population management and balanced economic development.

**Keywords:** Birth Rate, Death Rate, Population Growth, Fertility, Mortality.

### INTRODUCTION

Several studies have shown that demographic variables can significantly influence economic outcomes. Fasina et. al. (2020) examined how mothers' socio-demographic characteristics and antenatal clinic attendance influence neonatal mortality in Nigeria. The study utilized data from the 2013 Nigeria Demographic and Health Survey (NDHS), analyzing a nationally representative sample of 26,826 women aged 15–49 years who had experienced live or stillbirths in the five years preceding the survey. Employing binary logistic regression analysis appropriate given the dichotomous nature of the dependent variable (neonatal death: yes or no) the study identified significant associations between neonatal mortality and several maternal background variables, including age, education, region, wealth status, and place of residence. The findings indicated that higher maternal education, improved economic status, and urban residence correlated with lower

neonatal mortality rates. Moreover, regular antenatal clinic (ANC) attendance was found to substantially reduce the likelihood of neonatal deaths, reinforcing the importance of prenatal healthcare utilization. These results underscore the need for public health strategies that not only improve ANC coverage but also address socio-economic inequities among women to reduce preventable neonatal deaths in Nigeria.

Akinola (2021) conducted an in-depth empirical study to explore the controversial impact of population growth on Nigeria's economic performance. The study acknowledged the ongoing divide among economists some view population growth as a catalyst for sustainable development, while others argue it places undue pressure on limited economic resources. The findings from the trend analysis confirmed that Nigeria's population has steadily increased over the period under review. The study concluded that population growth can act as a stimulus to economic development, reinforcing the idea that a growing population when properly managed can be an asset rather than a burden.

During the COVID-19 period, Alhassan et al. (2021) studied how life expectancy, death rate, and government health spending affected Nigeria's economy. They found that when people live longer, the economy improves because healthy people work better. But when death rates rise, the economy suffers because it loses workers. Surprisingly, they also found that just spending money on healthcare didn't help much during COVID-19. This showed that poor management and planning can weaken the impact of government spending.

Adeosun and Popogbe (2021) highlight the strain rapid population growth places on human resource utilization and employment in Nigeria. Using VECM, they demonstrate that high population growth negatively affects economic resource efficiency, emphasizing the need for policies that align population trends with human capital development.

Ayano (2022) investigated the study on how population dynamics influence health outcomes in Nigeria, focusing specifically on life expectancy. Using secondary time-series data covering the period from 1980 to 2018, the researchers applied the Augmented Dickey-Fuller (ADF) test to assess the stationarity of the variables. The findings indicated that life expectancy at birth (LOGLEXB), population size (LOGPOP), gross savings rate (GSR), and birth rate (BR) were stationary at their levels, whereas access to basic sanitation and total labour force participation rate (TLFPR) achieved stationarity only after second differencing. The Ordinary Least Squares (OLS) regression model was then employed for estimation. Results demonstrated a significant and positive association between access to basic sanitation and life expectancy, as well as between the gross savings rate and life expectancy.

Population dynamics particularly birth and death rates remain vital factors shaping economic growth in developing nations like Nigeria. The country's persistently high birth rate, coupled with a steady decline in death rates, has led to rapid population expansion. This growth continues to exert considerable pressure on Nigeria's resources, infrastructure, and labor market (Qosim et. al., 2022). Therefore, examining the statistical relationship between these demographic factors and key economic indicators is essential for developing effective and evidence-based policy interventions.

Awoyemi et al. (2023) carried out a time-series investigation to assess how government health expenditure influences health outcomes in Nigeria. Using the Autoregressive Distributed Lag (ARDL) model, the study analyzed both the short-run and long-run dynamics between public health spending and two key indicators life expectancy at birth and mortality rate. The results indicated a negative relationship between government health expenditure and mortality rate, suggesting that higher levels of public investment in healthcare contribute to lower death rates.

Abdulazeez (2024) highlights that both birth and death rates have strong correlations with Nigeria's economic performance over the past two decades. Demographic factors, especially birth and death rates, have a strong influence on the economic direction of any country. In Nigeria, with a population of over 220 million people and one of the highest fertility rates globally, the relationship between these demographic factors and the nation's economic growth has continued to draw the attention of researchers and policymakers alike.

The crude birth rate, defined as the number of live births per 1,000 people in a given year, remains persistently high in Nigeria. Cultural norms, limited access to family planning, and low female education levels contribute to this demographic trend (Ufomadu & Ettah, 2024). At the same time, the crude death rate has been on a gradual decline, thanks to modest improvements in healthcare, nutrition, and sanitation. This combination of high fertility and declining mortality has resulted in rapid population growth, increasing pressure on national resources, infrastructure, employment, and health systems (Adesola et al., 2024).

In this paper the model was formulated to know the the impact of birth and death rates on population growth in Nigeria

## METHODOLOGY

The data for this work are mainly secondary data and were extracted from World Bank's World Development Indicator (WDI). The research strategy adopted was to conduct statistical analysis on birth and death rates and their effects on Nigeria's population growth. Multiple Regression Method and Descriptive Research Design were adopted. The data was gathered over a span of fifteen years, from 2010 to 2024, and the analysis was conducted using the Statistical Software Package for Social Sciences (SPSS).

## MULTIPLE REGRESSION MODEL

The general form of the model can be expressed as:

$$Y = f(X^1, X^2, \dots, X_n; \beta) + \varepsilon \dots (i)$$

Representing the above equation econometrically, it becomes

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \dots (ii)$$

Y = population growth,

Where: Y is the dependent variable, (Population growth.),  $X_1, X_2, \dots, X_n$  are the independent variables, also known as regressors, and  $f(\cdot)$  represents the functional form or relationship specified between the dependent and independent variables,  $\beta_0$  = Intercept,  $\beta_1$  to  $\beta_2$  = Slope coefficients

$X_1$  = Birth rate (BR),  $X_2$  = Death rate (DR),  $\varepsilon$  = Error term.

**ANALYSIS OF VARIANCE IN MULTIPLE REGRESSION.**

Recall the model again

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon_t$$

**ANOVA TABLE**

Source of variation	SS	Df	MS	F-statistic
Regression	$SSR = Y'(H - J/n)Y$	P	$MSR = \frac{SSR}{p}$	$\frac{MSR}{MSE}$
Error	$SSE = Y'(I - H)Y$	n-p-1	$MSE = \frac{SSE}{n-p-1}$	
Total	$SST = Y'(I - J/n)Y$	n-1		

**F test for regression relation**

$$H_0 : \beta_1 = \beta_2 = \dots = \beta_p = 0$$

$H_1$ : not all  $\beta_k$  ( $k = 1, \dots, p$ ) equal zero

$$SST = \sum_{i=1}^n (\hat{Y}_i - \bar{Y})^2$$

Degrees of freedom =  $n - 1$

$$\text{Model: } Y_i = \beta_0 + \beta_1 X_{i1} + \dots + \beta_p X_{ip} + \epsilon_i$$

$$SSE = e'e = (Y - Xb)'(Y - Xb)$$

Degrees of freedom =  $n - p - 1$

F test statistic (also called F-test for the model)

$$F^* = \frac{(SSE(R) - SSE(f)) / (df(R) - df(f))}{SSE(f) / df(f)} = \frac{SSR/p}{SSE/(n-p-1)} \dots \text{(iii)}$$

If  $F^* \leq F(1 - \alpha; p, n - p - 1)$ , conclude (accept  $H_0$ )

If  $F^* > F(1 - \alpha; p, n - p - 1)$ , conclude  $H_a$  (reject  $H_0$ )

**$R^2$  and the adjusted  $R^2$**

- $SSR = SST - SSE$  is the part of variation explained by regression model
- Thus, define coefficient of multiple determination

$$R^2 = \frac{SSR}{SST} = 1 - \frac{SSE}{SST} \dots \text{(iv)}$$

Which is the proportion of variation in the response that can be explained by the regression model (or that can be explained by the predictors  $X_1, \dots, X_p$  Linearly)

$$0 \leq R^2 \leq 1$$

With more predictor variables, SSE is smaller and  $R^2$  is larger. To evaluate the contribution of the predictors fair, we define the adjusted  $R^2$

$$R_a^2 = 1 - \frac{SSE}{SST} = 1 - \left(\frac{n-1}{n-p-1}\right) \frac{SSE}{SST} \dots \text{(v)}$$

**RESULTS OF ANALYSIS**

**Table1: Data Presentation**

Year	Population Growth (%)	Birth Rate (per 1000)	Death Rate (per 1000)
2010	2.8	42.14	13.0
2011	2.8	41.79	13.0
2012	2.51	41.12	13.0
2013	2.47	40.44	13.0
2014	2.6	39.89	13.0
2015	2.5	38.95	12.8
2016	2.32	37.77	12.6
2017	2.27	36.69	12.4
2018	2.19	35.69	12.3
2019	2.12	34.69	12.2
2020	2.13	33.73	12.0
2021	2.09	33.55	12.0
2022	2.09	33.19	11.7
2023	2.1	32.95	11.7
2024	2.1	32.7	11.5

**Source:** World Bank’s World Development Indicators (WDI) database, 2025.

**Table 2: Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
Population Growth	15	2.09	2.80	2.3393	0.25672
Birth Rate	15	32.70	42.14	37.0193	3.48534
Death Rate	15	11.50	13.00	12.4133	0.54493

Table 2 above shows that population growth in Nigeria varied between 2.09 and 2.80, with a mean of 2.34 and a standard deviation of 0.26. Birth rates ranged from 32.70 to 42.14 per 1,000 individuals, averaging 37.02 with a standard deviation of 3.49. Death rates varied between 11.50 and 13.00 per 1,000 peoples, with a mean of 12.41 and a standard deviation of 0.54.

**MODEL FORMATION AND TEST OF SIGNIFICANCE OF COEFFICIENTS**

$H_o : \beta_i = 0$  There is no statistical significance between the parameters

$H_o : \beta_i \neq 0$  There is a statistical significance between the parameters

**Table 3: Regression analysis**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.724	0.966		1.784	0.100
	birth rate (X <sub>1</sub> )	0.115	0.022	1.563	5.285	0.000
	death rate (X <sub>2</sub> )	-.294	0.139	-.623	-2.108	0.057

a. Dependent Variable: population growth (Y)

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon_i$$

$$Y = 1.724 + 0.115(X_1) - 0.294(X_2)$$

**ASSUMPTION TEST**

**Table 4: Tests for linearity of the Model**

Model		ANOVA				Sig.
		Sum of Squares	df	Mean Square	F	
1	Regression	0.867	2	0.433	93.083	0.000
	Residual	0.056	12	0.005		
	Total	0.923	14			

a. Dependent Variable: population growth (Y)

b. Predictors: (Constant), death rate (X<sub>1</sub>), birth rate (X<sub>2</sub>)

Table 4 above shows that the p-value is 0.000, which is less than 0.05 then we reject the null hypothesis, thus the model  $Y = 1.724 + 0.115(X_1) - 0.294(X_2)$  are statistically significant.

**Table 5: Predictive Power of The Model**

Model	Model Summary			
	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.969	0.939	0.929	0.06824

a. Predictors: (Constant), Birth rate(X<sub>1</sub>), Death rate (X<sub>2</sub>)

b. Dependent Variable: Population growth (Y)

The model summary in table 5 shows a strong positive relationship (R = 0.969) between population growth, birth rate, and death rate. The R<sup>2</sup> value of 0.939 means that 93.9% of the variation in population growth is explained by the two predictors. The Adjusted R<sup>2</sup> (0.929) confirms the model’s reliability. The small standard error (0.06824) indicates accurate predictions.

**TEST OF MULTICOLLINEARITY, AUTOCORRELATION AND HETEROSCEDASTICITY.**

**Table 6: Test of multicollinearity through variance inflating factor**

Variables	Tolerance	VIF	Decision
<b>Birth Rate</b>	0.642	1.557	No multicollinearity
<b>Death Rate</b>	0.589	1.698	No multicollinearity
<b>Population Growth</b>	0.521	1.918	No multicollinearity

**Variance Inflating Factor (VIF):** If the VIF values lies between 1-10, there is no multicollinearity, if the VIF less than 1 or greater than 10 then there is multicollinearity. The VIF values for the model is between the acceptable ranges and we conclude that the independent variables are free of multicollinearity.

**GRAPHICAL METHOD OF DETECTING HETEROSCEDASTICITY.**

Rule of thumb: If there is a regular pattern in the scatter plot of graph of Standardized Residuals and the Predicted Values then there has been a problem of heteroscedasticity. Conversely, if there is no clear pattern, the indication is no heteroscedasticity problem.

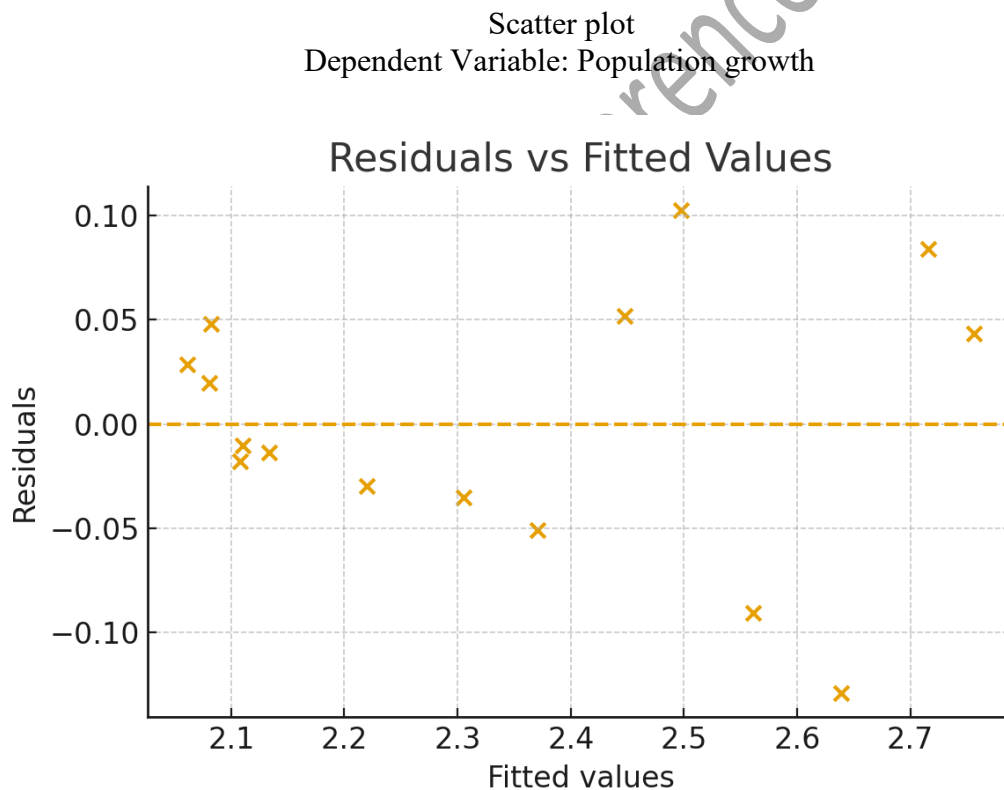


Figure 1: Plot of Standardized Residuals versus Predicted Values

**Interpretation:** Since there is no regular pattern in the scatter plot of graph of standardized residual and the fitted values then there is no heteroscedasticity in the error variance. i.e. the disturbance terms are homoscedastic.

**TEST FOR AUTOCORRELATION**

**Table 7: Detection of autocorrelation**

<i>Model Summary<sup>b</sup></i>						
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson	
1	0.969	0.939	0.929	0.06824	1.935	

a. Predictors: (Constant), Birth rate( $X_1$ ), Death rate( $X_2$ )

b. Dependent Variable: Population growth (Y)

**Decision rule:**

- $\rho = 0, d = 2$ , no autocorrelation
- $\rho = 1, d = 0$ , perfect +ve autocorrelation
- $\rho = -1, d = 4$ , perfect -ve autocorrelation
- $0 \leq d \leq 2$ , presence of +ve autocorrelation

From the model above, Durbin-Watson ( $d$ ) =  $\frac{\sum(u_t - u_{t-1})^2}{\sum u_t^2} = 1.935 \approx 2$ .

Since  $d \approx 2$ , independent variables are free of autocorrelation.

**SUMMARY OF THE FINDINGS**

This study examines the relationship between birth rate, death rate, and population growth in Nigeria from 2010 to 2024. To assess how changes in birth and death rates influence population growth over time, the study employed descriptive statistics and multiple regression analysis.

The multiple regression analysis conducted on the original data produced the following model:

$$Y = 1.724 + 0.115X_1 - 0.294X_2$$

where  $Y$  represents population growth,  $X_1$  denotes birth rate, and  $X_2$  denotes death rate. The constant term (1.724) indicates the expected level of population growth when both birth rate and death rate are held at zero. The coefficient of birth rate is positive (0.115) and statistically significant ( $p = 0.000 < 0.05$ ), implying that increases in birth rate significantly contribute to population growth. Conversely, the death rate carries a negative coefficient (-0.294) with a p-value of 0.057 ( $> 0.05$ ), suggesting that although higher death rates tend to reduce population growth, this effect is not statistically significant.

Overall, the findings indicate that birth rate exerts a strong positive influence on population growth, while death rate has a weak and statistically insignificant negative effect. The model summary shows a strong positive association among population growth, birth rate, and death rate, with a correlation coefficient (R) of 0.969. The coefficient of determination ( $R^2$ ) is 0.939, indicating that 93.9% of the variation in population growth is explained by the combined effects of birth rate and death rate.

Specifically, higher birth rates are associated with increased population growth, whereas higher death rates are associated with a reduction in population growth. Holding other factors constant, a

one-unit increase in birth rate leads to a 0.115-unit increase in population growth, while a one-unit increase in death rate results in a 0.294-unit decrease in population growth.

The result also revealed that there is no presence of multicollinearity, autocorrelation and heteroscedasticity in the collected data.

## CONCLUSION

The findings reveal an increasing trend in population growth driven by rising birth rates across the years, indicating a significant relationship between birth rate and population growth. In contrast, both death rate and population growth exhibit a declining pattern, suggesting a negative but statistically insignificant effect.

Diagnostic tests show that the regression assumptions were adequately satisfied. Multicollinearity was not a concern, as indicated by the Variance Inflation Factor (VIF) values, while the Durbin–Watson test confirmed the absence of autocorrelation. In addition, residual plot analysis showed no evidence of heteroscedasticity.

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