Artificial Intelligence Forecasting Of Total Fertility Rate (TFR) In Ghana

[1]Dr. Smartson. P. NYONI, [2]Tatenda. A. CHIHOHO, [3]Thabani NYONI

[1]ZICHIRe Project, University of Zimbabwe, Harare, Zimbabwe
[2]Independent Health Economist, Zimbabwe
[3]SAGIT Innovation Center, Harare, Zimbabwe

Abstract - In this research article, the ANN approach was applied to analyze TFR in Ghana. The employed annual data covers the period 1960-2018 and the out-of-sample period ranges over the period 2019-2030. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is stable in forecasting TFR in Ghana. The results of the study indicate that annual total fertility rates in Ghana are likely to rise from approximately 4.0 births per woman in 2019 to nearly 6.2 births per woman by 2030. Therefore, the authorities in Ghana should concentrate on addressing adolescents and young adult challenges in accessing sexual and reproductive health (SRH) services, and channel more resources towards women empowerment.

Keywords: ANN, Forecasting, Total fertility rate (TFR).

I. INTRODUCTION

Sexual and reproductive health (SRH) is an essential component of universal health coverage and is included in the United Nations' sustainable development goal number 3 which speaks to healthy lives and well-being by paying particular attention to universal access to SRH services and rights (Docklalova, 2016). Family planning services are supposed to offer counselling, screening of STIs and treatment and appropriate contraception. There is need to address the SRH rights of adolescents girls and young women in order to improve maternal and child health outcomes (World Bank, 2016). Every couple or individual has a right to choose the time of giving birth, number of children, and birth spacing. Women must have equal opportunities for education and employment so that they participate in economic development. Many adolescents and young women in developing countries lack comprehensive knowledge on SRH and end up having unwanted pregnancies and unsafe abortions (Lema et al, 2002; Soderberg, 1997; Felice et al, 1999). Bwambale et al (2021) in their Ugandan study found out that SRH services utilization among migrant street children and young adults is low compared to their non-migrant counterparts and is independently associated with migration status, age, schooling status, knowledge of place of care and access to SRH information. Atuyambe et al (2015) revealed that in and out-of-school adolescents had sexuality problems such as unwanted pregnancies, sexually transmitted infections (STIs), defilement, rape, substance abuse. Unique to the females was the issue of sexual advances by older men and adolescents.

Ghana has witnessed a downward trend in fertility rates from 7.0 births per woman in 1950 to 3.9 births per woman in 2020. The country recorded similar trends for infant and under five mortality. Infant mortality rate decline from 147.44 infant deaths per 1000 live births in 1950 to 30.8 infant deaths per 1000 live births in 2020 (Worldometer, 2020). The aim of this study is to project TFR in Ghana using an artificial intelligence technique. The results of this paper are envisioned to highlight the likely fertility trends in the out of sample period. This will facilitate planning and allocation of resources for sectors such as health, education and employment.

II. METHODOLOGY

The Artificial Neural Network (ANN) approach, which is flexible and capable of nonlinear modeling; will be applied in this study. The ANN is a data processing system consisting of a large number of highly interconnected processing elements in architecture inspired by the way biological nervous systems of the brain appear like. Since no explicit guidelines exist for the determination of the ANN structure, the study applies the popular ANN (12, 12, 1) model based on the hyperbolic tangent activation function. This paper applies the Artificial Neural Network (ANN) approach in predicting annual total fertility rates in Ghana.

Data Issues

This study is based on annual total fertility rate (births per woman)in Ghana for the period 1960 – 2018.The out-of-sample forecast covers the period 2019 – 2030.All the data employed in this research paper was gathered from the World Bank online database.

III. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	G
Observations	47 (After Adjusting Endpoints)
Neural Network Architecture:	
Input Layer Neurons	12
Hidden Layer Neurons	12
Output Layer Neurons	1
Activation Function	Hyperbolic Tangent Function
Back Propagation Learning:	
Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	0.062972
MSE	0.011762
MAE	0.087347

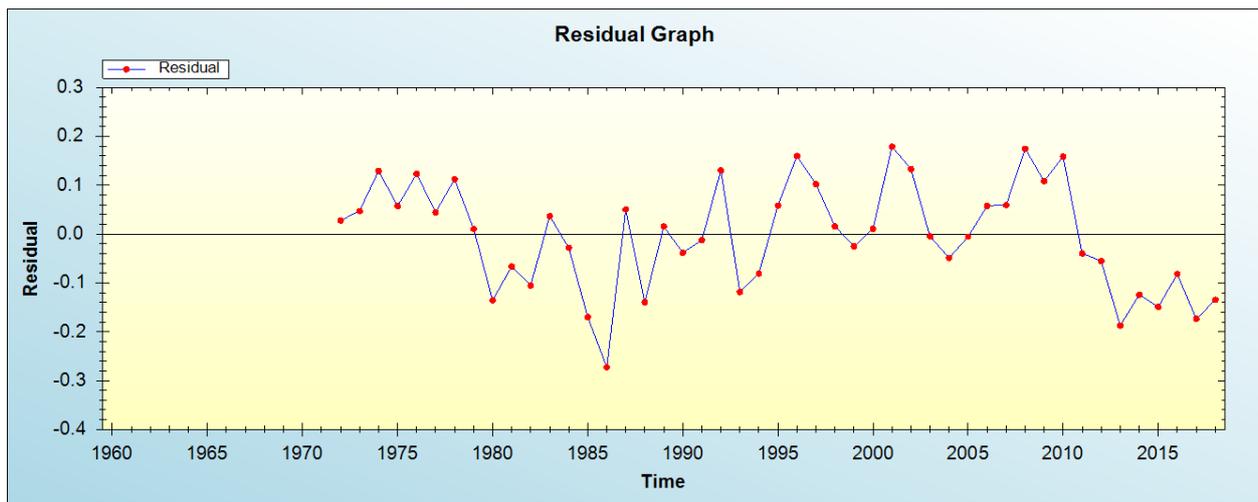*Residual Analysis for the Applied Model*

Figure 1: Residual analysis
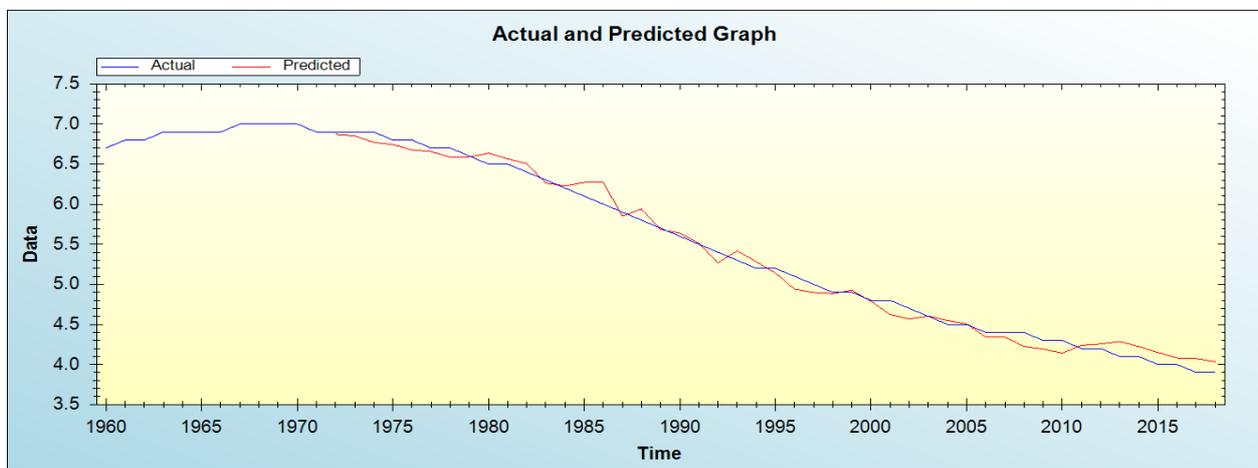
In-sample Forecast for G

Figure 2: In-sample forecast for the G series

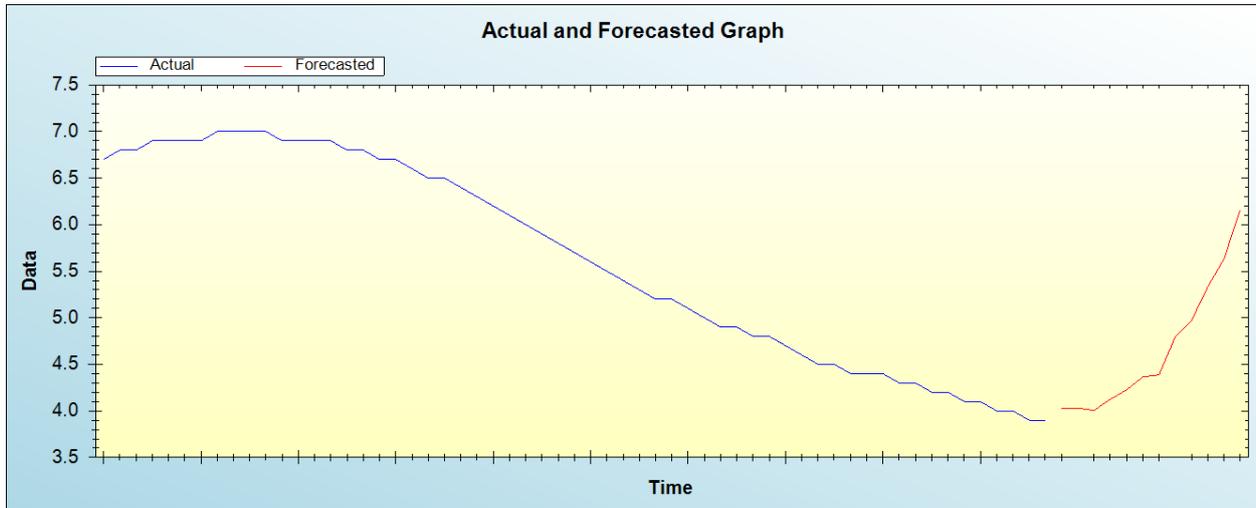*Out-of-Sample Forecast for G: Actual and Forecasted Graph*

Figure 3: Out-of-sample forecast for G: actual and forecasted graph

Out-of-Sample Forecast for G: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	4.0306
2020	4.0307
2021	4.0055
2022	4.1251
2023	4.2240
2024	4.3648
2025	4.3872
2026	4.7956
2027	4.9683
2028	5.3309
2029	5.6320
2030	6.1571

The main results of the study are shown in table 1. It is clear that the model is stable as confirmed by evaluation criterion as well as the residual plot of the model shown in figure 1. It is projected that annual total fertility rates in Ghana are likely to rise from approximately 4 births per woman in 2019 to nearly 6.2 births per woman by 2030.

IV. CONCLUSION & RECOMMENDATIONS

Family planning services should be affordable and accessible to adolescents and youths in order to prevent unwanted pregnancies. In this paper we applied the artificial neural network approach to forecast total fertility rate in Ghana. The ANN model projections reveal that annual total fertility rates in Ghana are likely to rise from approximately 4 births per woman in 2019 to nearly 6.2 births per woman by 2030. Therefore, the government should concentrate on addressing adolescents and young adult challenges in accessing sexual and reproductive health (SRH) services, and channel more resources towards women empowerment.

REFERENCES

[1] Worldometer (2020). Ghana demographics. https://www.worldometers.info

[2] Dockalova B., Lau K., Barclay H., & Marshall A (2016). Sustainable Development Goals and Family Planning 2020. International Planned Parenthood Federation. London.

[3] The World Bank (2016). Disease control priorities, third edition (volume 2): reproductive, maternal, newborn, and child health. In: Disease control priorities, third edition (volume 2): reproductive, maternal, newborn, and child health; 2016. p. 95–108. Available from: https://www.ncbi.nlm.nih.gov/ books/NBK361907/pdf/Bookshelf_NBK361907.pdf

[4] Lema V M., Mpanga V., & Makanani BS (2002). Socio-demographic characteristics of adolescent post-abortion patients in Blantyre. Malawi East Afr Med J, 79(6):306–10.

[5] Soderberg H., Andersson C., Janzon L & Sjoberg NO (1997). Continued pregnancy among abortion applications. A study of women having a change of mind. Acta Obstet Gynecol Stand, 76(10):942–7.

[6] Felice ME., Feinstein RA., Fisher MM ., Kaplan DW., Olmedo LF., & Rome ES (1999). Adolescent pregnancy–current trends and issues: 1998 American Academy of Pediatrics Committee on Adolescence, 1998–1999. Pediatrics. 1999; 103(2):516–20.

Citation of this Article:

Dr. Smartson. P. NYONI, Tatenda. A. CHIHOHO, Thabani NYONI, "Artificial Intelligence Forecasting Of Total Fertility Rate (TFR) In Ghana" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 8, pp 420-423, August 2021. Article DOI https://doi.org/10.47001/IRJIET/2021.508094

****