

Projection of Total Fertility Rate (TFR) in Guinea Bissau

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Abstract - In this research article, the ANN approach was applied to analyze TFR in Guinea Bissau. 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 Guinea Bissau. The results of the study indicate that annual total fertility rates in Guinea Bissau are likely to remain around 5.0 births per woman throughout the out-of-sample period. Therefore, the government of Guinea Bissau is encouraged to focus on addressing barriers to accessing sexual and reproductive health (SRH) services among adolescents and young adults, and scale up women empowerment program activities.

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

I. INTRODUCTION

Total fertility rate dropped over the years in Guinea Bissau from 6.7 births per woman in 1985 to 4.5 births per woman in 2020. Infant mortality dropped from 162.52 infant deaths per 1000 live births in 1950 to 50.34 infant deaths in 2020 (Worldometer, 2020). In 2020 the country recorded 27 000 unintended pregnancies, the unmet need for family for married women stood at 48% and the modern contraceptive prevalence rate for married women or in union was 40.6% (Guinea Bissau FP 2020, 2020). The figures indicate that there is still a huge challenge of unintended pregnancies and the need to create more demand for family planning services especially for adolescent girls and young women. These young women are at risk of getting adverse SRH outcomes. There are limited published papers that have focused on examining fertility trends and related issues. In this paper we shall mention papers relevant to this study. Apanga et al (2020) assessed the prevalence and factors associated with modern contraceptive (CP) use among women of the reproductive age. The cross-sectional study used data from the Multiple Indicator Cluster Surveys (MICSs) from 20 African countries collected between 2013 and 2018. Data on 1 177 459 women aged 15–49 years old was used. The study indicated that the overall prevalence of modern CP use was 26% and ranged from 6% in Guinea to 62% in Zimbabwe. Women were more likely to use a modern CP if they: had a primary or secondary/higher education compared with women with no formal education; had no delivery in the last 2 years compared with women who delivered in the last 2 years. Barrow (2020) employed a community-based descriptive cross-sectional study to determine the women's proportion of contraceptive uptake and knowledge of FP methods for 643 women of reproductive age (15–49 years) from the selected clusters in rural Gambia through a multistage sampling technique. A pretested structured interview questionnaire was used to collect data. The study revealed a moderately low contraceptive uptake. Mac-Seing et al (2019) examined the relationships between equity-focused legislation and policy and the utilization of SRH services by vulnerable populations in sub-Saharan Africa. We searched nine bibliographic databases for relevant articles published between 1994 and 2019. Thirty-two studies, conducted in 14 sub-Saharan African countries, met the inclusion criteria. They focused on maternal health service utilization, either through specific fee reduction/removal policies, or through healthcare reforms and insurance schemes to increase SRH service utilization. Findings across most of the studies revealed that health-related legislation and policy promoted an increase in service utilization, over time, especially for antenatal care, skilled birth attendance and facility-based delivery.

The aim of this paper is to project total fertility rate in Guinea Bissau using the multilayer perceptron neural network. The findings are envisioned to reveal the likely fertility trends in the out of sample period. This will guide policy and trigger a scientific based response to the future health, education and employment needs of the people in Guinea Bissau.

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 Guinea Bissau.

Data Issues

This study is based on annual total fertility rate (births per woman) in Guinea Bissau 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	0.092063
MSE	0.012661
MAE	0.097662

Residual Analysis for the Applied Model

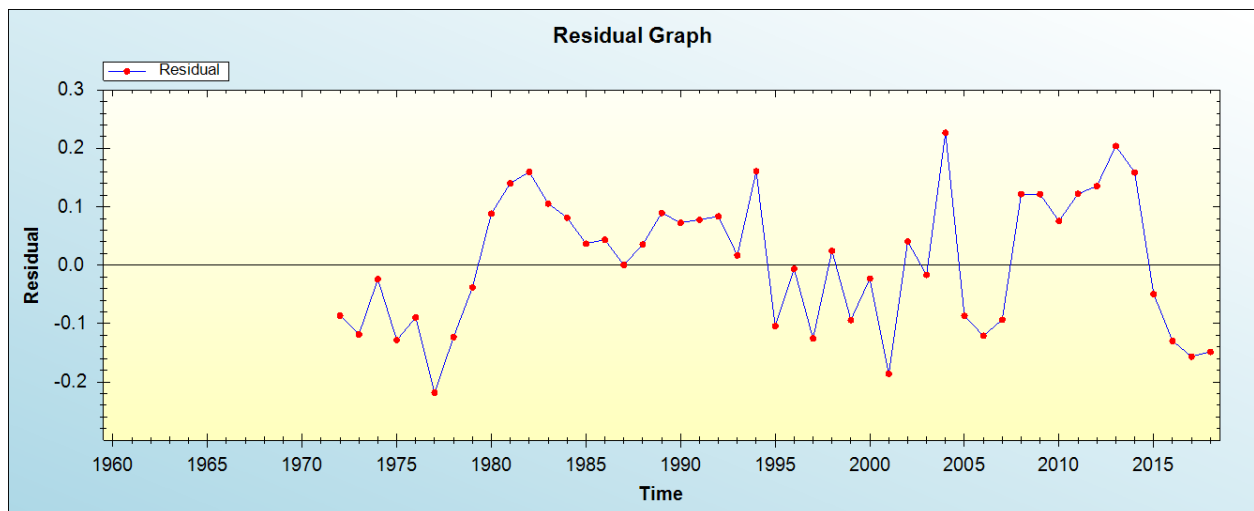


Figure 1: Residual analysis

In-sample Forecast for G

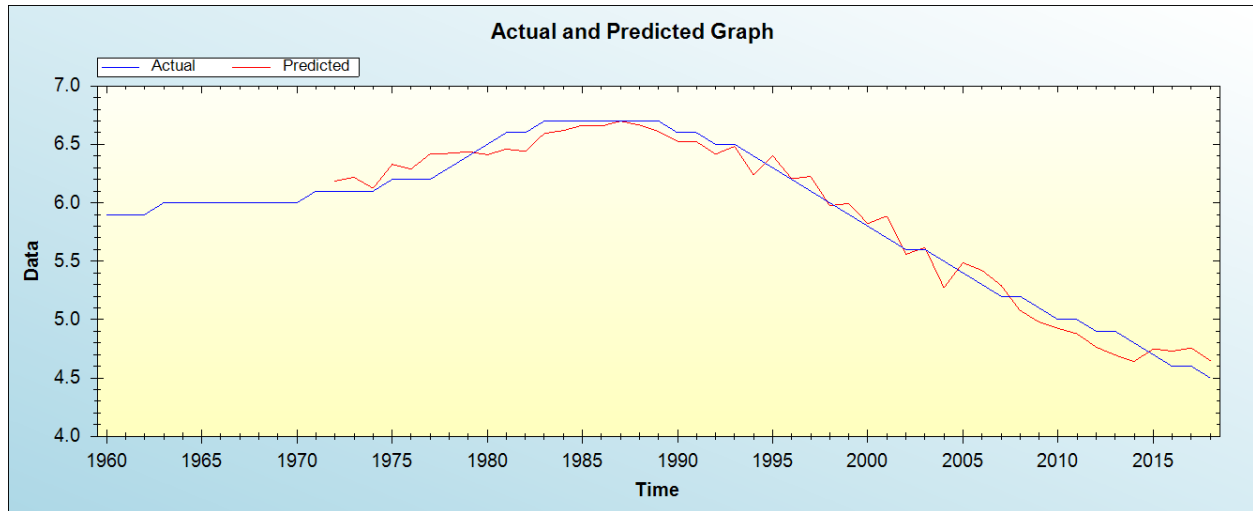


Figure 2: In-sample forecast for the G series

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

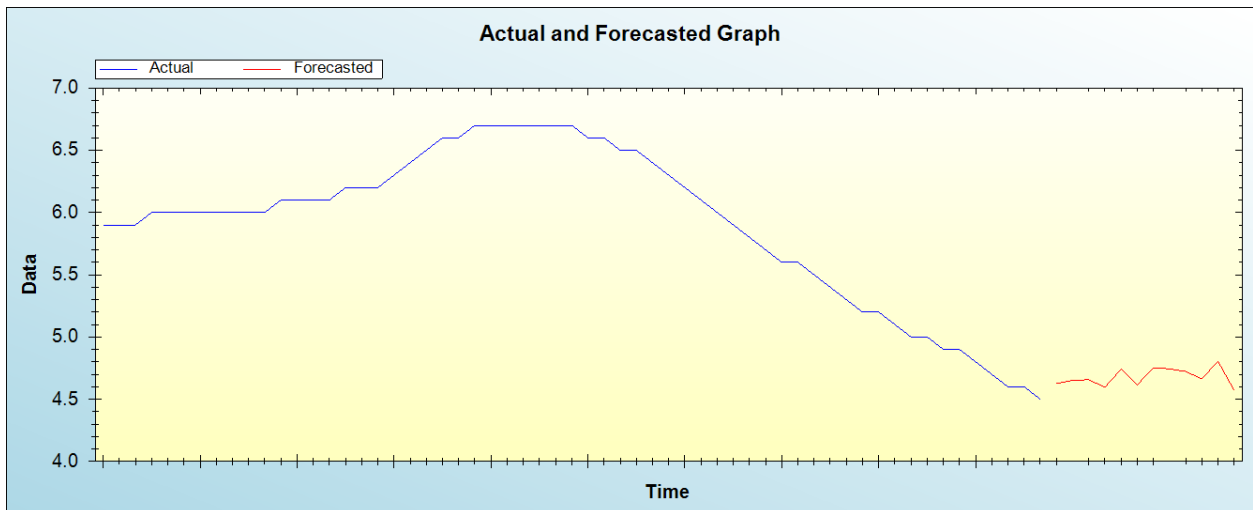


Figure 3: Out-of-sample forecast for G: actual and forecasted graph

Out-of-Sample Forecast for G: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	4.6252
2020	4.6530
2021	4.6566
2022	4.5964
2023	4.7406
2024	4.6152
2025	4.7528
2026	4.7440
2027	4.7228
2028	4.6634
2029	4.8064
2030	4.5727

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 Guinea Bissau are likely to remain around 5.0 births per woman throughout the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

The low contraceptive prevalence rate and high unmet need for family planning in Guinea Bissau high contributed to high teenage pregnancies. In this paper we applied a machine learning technique to project total fertility rate in Guinea Bissau. The results of the study indicated that annual total fertility rates in Guinea Bissau are likely to remain around 5.0 births per woman throughout the out-of-sample period. Therefore, the government is encouraged to focus on addressing barriers to accessing sexual and reproductive health (SRH) services among adolescents and young adults, and scale up women empowerment program activities.

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Citation of this Article:

Dr. Smartson. P. NYONI, Tatenda. A. CHIHOHO, Thabani NYONI, "Projection of Total Fertility Rate (TFR) in Guinea Bissau" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 8, pp 260-263, August 2021. Article DOI <https://doi.org/10.47001/IRJIET/2021.508056>
