

Projection of Total Fertility Rate (TFR) in Equatorial Guinea

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Abstract - In this research paper, the ANN approach was applied to analyze TFR in Equatorial Guinea. The employed annual data covers the period 1960-2019 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 Equatorial Guinea. The results of the study indicate that annual total fertility rates in Equatorial Guinea are likely to rise first up to 5.2 births per woman in 2028 and then decline over the rest of the out-of-sample period. Therefore, the government of Equatorial Guinea is encouraged to focus on creating more demand for family planning services by targeting adolescents and young adults, and promote women empowerment.

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

I. INTRODUCTION

The 1994 international conference on population and development which was held in Cairo, Egypt made a landmark commitment to improve the quality of life for many people all over the world by recognizing their sexual and reproductive health rights (UN, 2020). The programme action called for all countries to provide universal access to health including sexual and reproductive health services to which are safe and reliable (UN, 1995). The 2030 agenda for sustainable development goals includes a target for family planning and fertility reduction under goal 3 (UN, 2020). Family planning involves counseling, education, contraception, obstetric and post abortal care, and STI screening and treatment. It is unfortunate that in some of the developing countries many women and adolescent girls continue to suffer from gender based violence and sexual abuse. Some of the cultural practices deprive women and adolescent girls of their right to determine age of marriage, desired number of children and birth spacing (UN, 2020).

Total fertility rate globally has fallen drastically from 3.2 births per woman in 1990 to 2.5 births per woman in 2019. In Sub-Saharan Africa total fertility has dropped from 6.3 births per woman in 1990 to 4.6 births per woman in 2019 (UN, 2020). In Equatorial Guinea TFR declined from 6.0 births per woman in 1990 to 4.6 births per woman in 2020 (Worldometer, 2020). The country has witnessed similar falling trends of infant and under five mortality rates. In 2020, infant mortality rate was 58.4 infant deaths per 1000 live births and 82.9 under five deaths per 1000 live births (Worldometer, 2020). There are limited studies in the country and region that have examined fertility trends therefore we shall mention the available relevant papers. Apanga et al (2020) assessed the prevalence and factors associated with modern contraceptive (CP) use among women of the reproductive age. Authors used data from the Multiple Indicator Cluster Surveys (MICSs) from 20 African countries collected between 2013 and 2018. The authors applied logistic regression and concluded that the overall prevalence of modern CP use was 26% and ranged from 6% in Guinea to 62% in Zimbabwe. Overall, injectable (32%) was the most preferred method of CP, followed by oral pill (27%) and implants (16%). 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. Mercer et al (2019) estimated the levels and trends of FP indicators at a subnational scale in Nigeria utilizing all available data and accounting for survey design and uncertainty by utilizing a cross-sectional study. The results indicated that the overall rates and trends of mCPR and unmet need have remained low in Nigeria. Based on a systematic review, Pretorius (2015) examined the scope and impact of interventions targeting YPLWH (Young people living with HIV) to improve SRH-related outcomes in SSA. The study concluded that there have been a limited number of evaluated interventions to strengthen SRH of YPLWH in SSA, and gaps exist in addressing the SRHR needs of YPLWH.

The aim of this paper is to project TFR in Equatorial Guinea using a machine learning approach. The results are expected to reveal the likely fertility trends in the out of sample period. This will assist in policy making and trigger an appropriate response to the future health, education and employment needs of the people in Equatorial Guinea.

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 Equatorial Guinea.

Data Issues

This study is based on annual total fertility rate (births per woman) in Equatorial Guinea 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	E
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	0.086880
MSE	0.004566
MAE	0.051908

Residual Analysis for the Applied Model

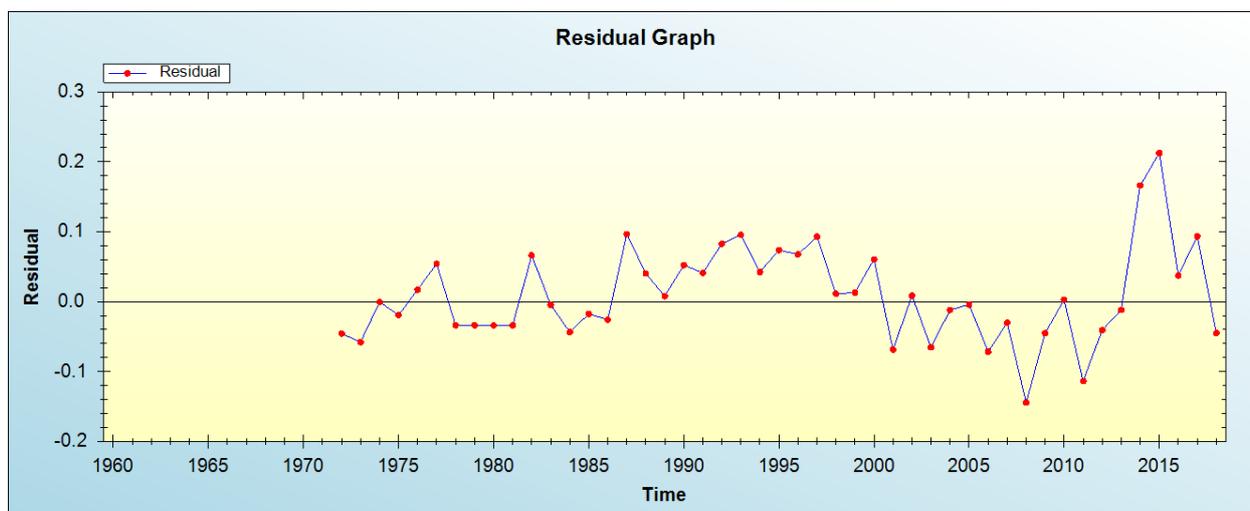


Figure 1: Residual analysis

In-sample Forecast for E

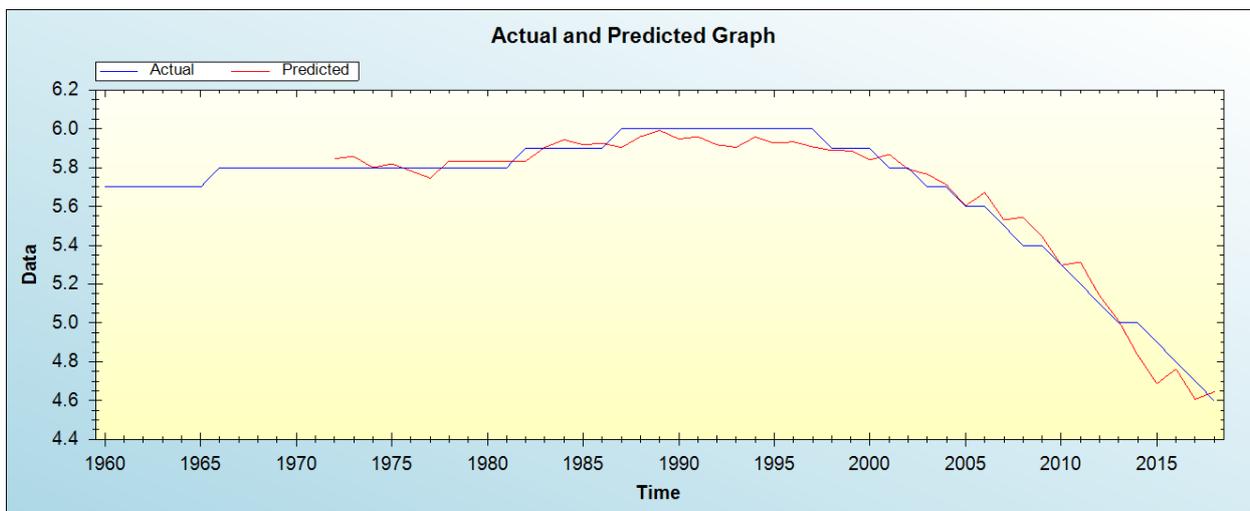


Figure 2: In-sample forecast for the E series

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

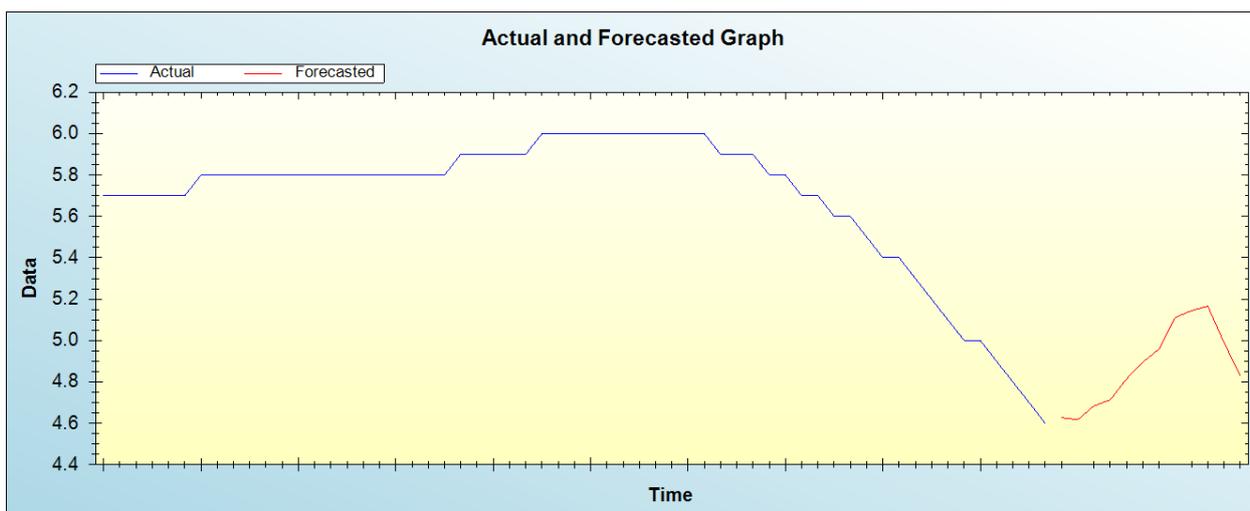


Figure 3: Out-of-sample forecast for E: actual and forecasted graph

Out-of-Sample Forecast for E: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	4.6271
2020	4.6177
2021	4.6842
2022	4.7143
2023	4.8143
2024	4.8950
2025	4.9591
2026	5.1116
2027	5.1446
2028	5.1665
2029	4.9915
2030	4.8316

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 Equatorial Guinea are likely to raise first up to 5.2 births per woman in 2028 and then decline over the rest of the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

The African region is facing developmental problems linked to high fertility rates, poverty, hunger and civil conflict. Adolescent or teenage pregnancies continue to be regional SRH problem which is contributing to high fertility rates. In this study we applied the artificial neural network approach to project total fertility rate in Equatorial Guinea. The ANN model projections suggested that annual total fertility rates in Equatorial Guinea are likely to rise first up to 5.2 births in 2028 and then decline over the rest of the out-of-sample period. Therefore, the government should focus on creating more demand for family planning services by targeting adolescents and young adults, and promote women empowerment.

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