

Projection of Total Fertility Rate (TFR) In Sao Tome and Principe

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

¹ZICHIRE Project, University of Zimbabwe, Harare, Zimbabwe

²Independent Health Economist, Zimbabwe

³SAGIT Innovation Center, Harare, Zimbabwe

Abstract - In this research article, the ANN approach was applied to analyze TFR in Sao Tome and Principe. 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 Sao Tome and Principe. The results of the study indicate that annual total fertility rates in Sao Tome and Principe are likely to initially rise from 4.6 births per woman in 2019 to 5.87 births per woman in 2025 and then decline to 4.42 births per woman in 2030. Therefore, the authorities in Sao Tome and Principe should focus on addressing adolescent and young adult challenges, create more demand for family planning services and channel more funds towards women empowerment program activities.

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

I. INTRODUCTION

Adolescent girls and young women's sexual and reproductive health issues are increasingly becoming a global health challenge because of the high numbers of unintended pregnancies, STIs, unsafe abortions, and obstetric complications (Woog et al, 2015). About 13 million young women aged 15-19 years give birth each year representing 11% of the global births and 95% of childbirths occur in developing countries (UN, 2013). Pregnancy and delivery related complications are the second leading causes of death among adolescents aged 15-19 years worldwide (WHO, 2014). In Sao Tome and Principe there are 44 000 adolescents aged 10-19 years and they constitute 21.7% of the total population (WHO, 2016; WHO, 2014). Approximately 77.8% of all adolescent girls in union aged 15-19 years are not using contraception (WHO, 2016).

Sao Tome and Principe has witnessed a fertility transition from a TFR of 6.5 births per woman in 1975 to 4.4 births per woman in 2020. The country recorded a decline in infant mortality rate (IMR) from 138.17 infant deaths per 1000 live births in 1950 to 22.51 infant deaths per 1000 live births in 2020 (Worldometer, 2020). There are few papers in the country that have examined or forecasted fertility rates. In this paper we will mention the most relevant ones. Based on a cross-sectional study, 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. Multivariable logistic regression was used to identify factors associated with modern CP use. The study results showed 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. Iyanda et al (2020) examined the association between incorrect knowledge of ovulation and unintentional pregnancy and child among young women in sub-Saharan Africa countries. Using Pearson's Chi-square, t test, multiple logistic regressions, and likelihood ratio test, they analyzed Demographic and Health Survey data (2008–2017) of 169,939 young women (15–24 year). The study revealed that Adolescent women (15–19) generally have poor knowledge of ovulation and are more likely to report an unintentional pregnancy/child than women between ages 20–24. Mac-Seing et al (2019) investigated the relationships between equity-focused legislation and policy and the utilization of SRH services by vulnerable populations in sub-Saharan Africa. They 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. Santhya and Jejeebhoy (2015) reviewed the evidence on sexual and reproductive health and rights (SRHR) of adolescent girls in low-income and middle-income countries (LMIC) in light of the policy and programme commitments made at the International Conference on Population and Development (ICPD), analyses progress since 1994, and maps challenges in and opportunities for protecting their health and human rights. Findings indicated that many countries have yet to make significant progress in delaying marriage and childbearing, reducing unintended childbearing, narrowing gender disparities that put girls at risk of poor SRH outcomes, expanding health awareness or enabling access to SRH services.

The aim of this paper is to project TFR in Sao Tome and Principe using the multilayer perceptron neural network. The results of the study are expected to reveal the likely future trends of TFR in the country. This will assist in policy making and stimulate an evidence based response to the future health, education and employment needs of the people in Sao Tome and Principe.

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 Sao Tome and Principe.

Data Issues

This study is based on annual total fertility rate (births per woman) in Sao Tome and Principe 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	S
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	0.100760
MSE	0.015166
MAE	0.102066

Residual Analysis for the Applied Model

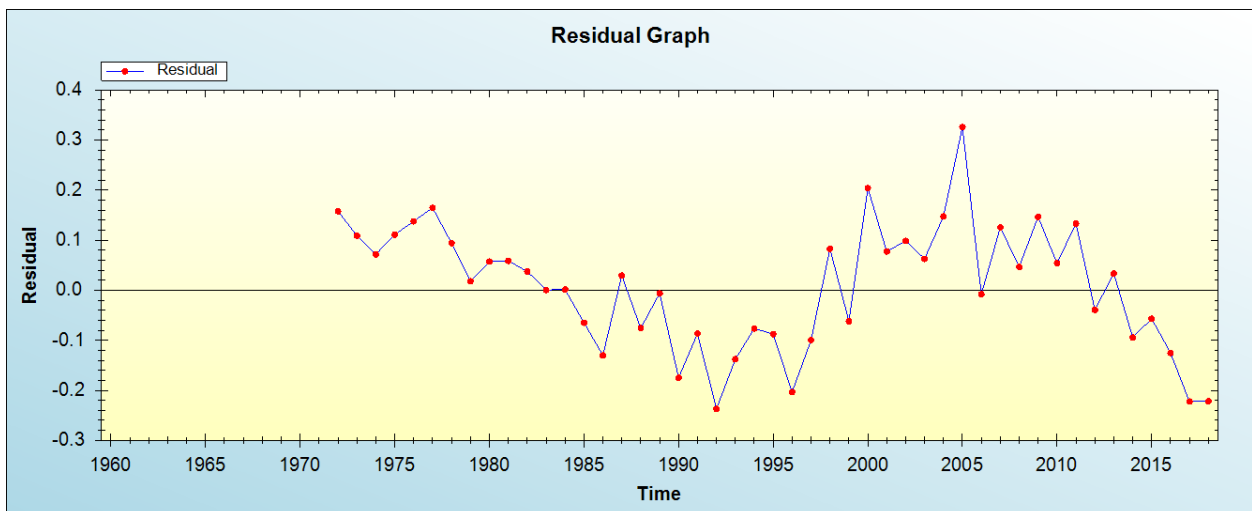


Figure 1: Residual analysis

In-sample Forecast for S

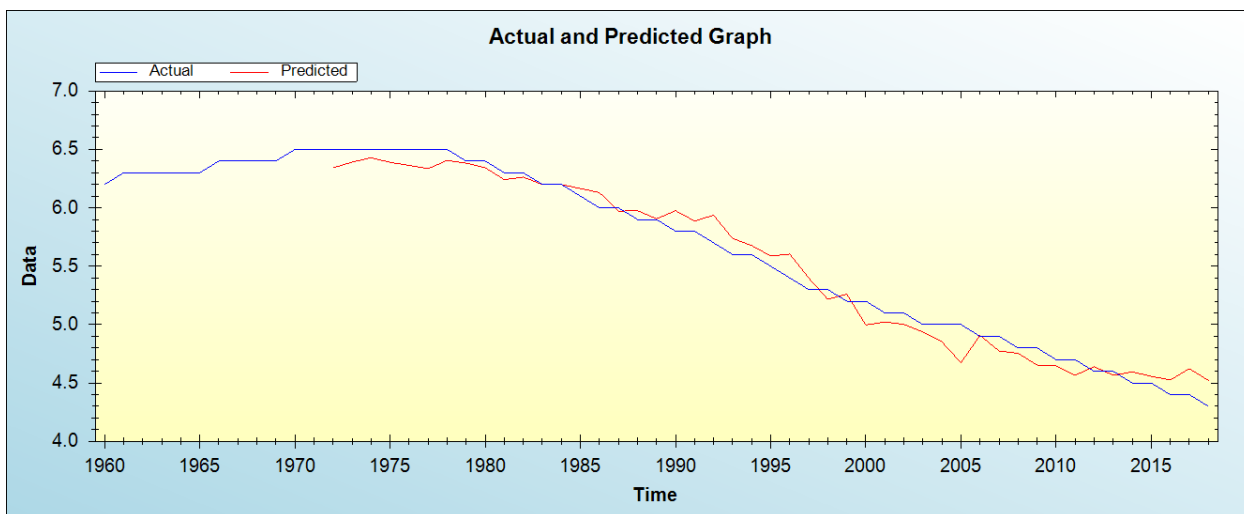


Figure 2: In-sample forecast for the S series

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

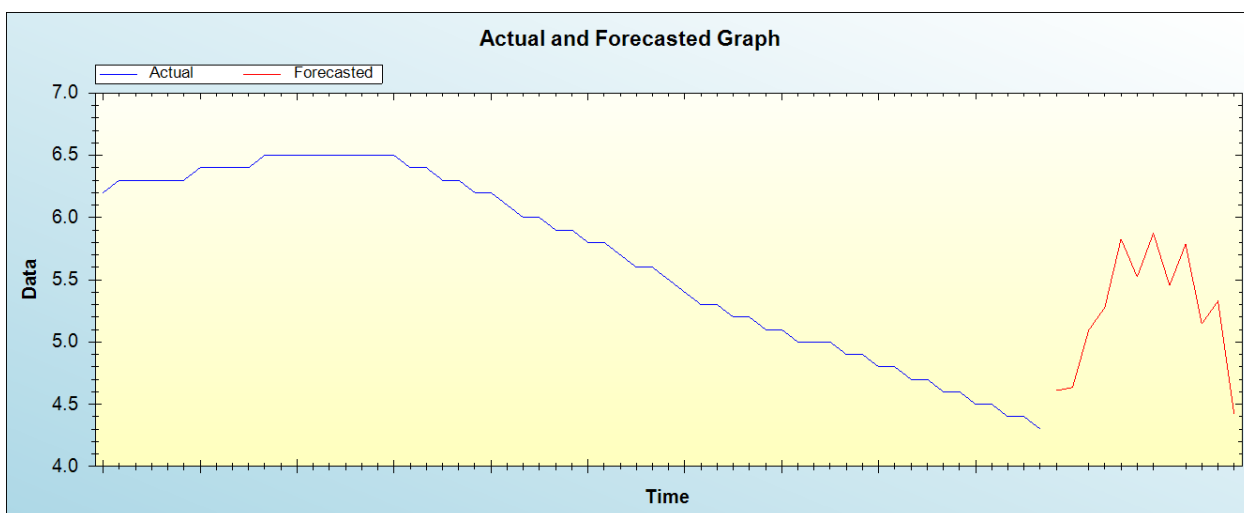


Figure 3: Out-of-sample forecast for S: actual and forecasted graph

Out-of-Sample Forecast for E: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	4.6099
2020	4.6357
2021	5.0953
2022	5.2781
2023	5.8274
2024	5.5226
2025	5.8741
2026	5.4538
2027	5.7858
2028	5.1454
2029	5.3286
2030	4.4240

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 Sao Tome and Principe are likely to initially rise from 4.6 births per woman in 2019 to 5.87 births per woman in 2025 and then decline to 4.42 births per woman in 2030.

IV. CONCLUSION & RECOMMENDATIONS

A decline in fertility rates in Sao Tome and Principe have been witnessed over the years and a commendable decrease in infant and child mortality rates have also been reported over the past 3 decades. In this paper we proposed an artificial neural network approach to project total fertility rate in Sao Tome and Principe. The findings of the study revealed that annual total fertility rates in Sao Tome and Principe are likely to initially rise from 4.6 births per woman in 2019 to 5.87 births per woman in 2025 and then decline to 4.42 births per woman in 2030. Therefore, the government must focus on addressing adolescent and young adult challenges, create more demand for family planning services and channel more funds towards women empowerment program activities.

REFERENCES

- [1] Worldometer (2020). Sao Tome and Principe demographics. <https://www.worldometers.info>
- [2] Vanessa Woog., Susheela Singh, Alyssa Browne and Jesse Philbin (2015). Adolescent Women's Need for and Use of Sexual and Reproductive Health Services in Developing Countries, pp 1-63
- [3] UN (2013). Population Division, United Nations (UN) Department of Economic and Social Affairs, World Population Prospects: The 2012 Revision, New York.
- [4] WHO (2014). Health for the World's Adolescents, Geneva.
- [5] WHO (2016). Adolescent contraceptive use. [who.int/reproductive health/adol-contraceptive-use](http://who.int/reproductive-health/adol-contraceptive-use)

Citation of this Article:

Dr. Smartson. P. NYONI, Tatenda. A. CHIHOHO, Thabani NYONI, "Projection of Total Fertility Rate (TFR) In Sao Tome and Principe" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 8, pp 319-322, August 2021. Article DOI <https://doi.org/10.47001/IRJIET/2021.508069>
