

Forecasting Total Fertility Rate (TFR) In Burundi

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Abstract - In this research article, the ANN approach was applied to analyze TFR in Burundi. The employed 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 Burundi. The results of the study indicate that annual total fertility rates in Burundi are likely to be between 5.4 and 5.7 births per woman over the out-of-sample period. Therefore, the government of Burundi is encouraged to focus on addressing challenges being encountered by adolescents and young adults so as to prevent unwanted pregnancies and other undesirable sexual and reproductive health (SRH) outcomes, and prioritize women empowerment programs.

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

I. INTRODUCTION

Universal access to health is very critical for socio-economic development. The 1994 International conference on Population and development emphasized the need for improvement in the access of sexual and reproductive (SRH) services for adolescent girls and young women. Furthermore the signatories recognized the sexual and reproductive rights of men and women. An individual or couple has a right to decide on the number children, birth spacing and time of childbirths. Both sexes have a right to education, health and employment opportunities. Many adolescent girls and young women in developing countries are at risk of having unwanted pregnancies, unsafe abortions, and unsafe sex practices which predispose them to adverse SRH outcomes. Health information and education is key for this age group to prevent unintended pregnancies and to improve women's health and economic well-being of individual families and communities (Braeken & Rondinelli, 2012; Kennedy et al, 2011; Crawford et al, 2009; Wilson et al, 1994).

Over the past 3 decades Burundi has been experiencing a downward trend in fertility rates from 7.5 births per woman in 1990 to 5.5 births per woman in 2020 (Worldometer, 2020). Infant mortality rate dropped from 166.26 infant deaths per 1000 live births in 1950 to 36.74 infant deaths per 1000 live births in 2020 (Worldometer, 2020). This indicates that the country has invested a lot of resources in the health sector to improve the quality of maternal and child health services although fertility rates are still high. There are limited studies that have focused on examining trends in fertility in the region as well as time series prediction TFR. In this paper we shall highlight relevant available studies. Bado et al (2020) explored the perspectives of men and women on barriers to contraceptive use and to identify the strategies to increase male involvement in family planning. The results show that men's attitudes are still a significant barrier to women's use of modern contraceptives. Drabo (2020) provided detailed information on the ethnographic findings that show the complexity of family planning within the social context of women's lives and care-seeking trajectories. It drew on participant observation in Ouagadougou, Burkina Faso's capital, and interviews with women with a wide range of reproductive experiences and providers of family planning services. The author concluded that women's use of contraceptive methods and abortion is embedded in the wider social dilemmas relating to marriage, sexuality, and gendered relationships. Based on a cross-sectional survey, Moise et al (2017) examined the density of RHS availability; assessed spatial patterns of RHC facilities; and identified youth-friendly practices associated with adolescents' use of services in post-conflict Burundi. The study findings showed that there is need to improve youth-friendly service practices in the provision of RHS to adolescents in Burundi and suggest that current approaches to provider training may not be adequate for improving these vital practices. Chaumont et al (2015) analyzed public expenditure levels and trends with regards to RH in Burundi between the years 2010 to 2012, looking specifically at financing agents, health providers, and health functions. The analysis was performed using standard RH sub-account methodology. Information regarding public expenditures was gathered from national budgets, the Burundi Ministry of Public Health information system, and from other relevant public institutions. The study concluded that the flow patterns and levels of public funds to RH in Burundi suggest that RH funding correctly reflects governmental priorities for the period between 2010 and 2012.

The aim of this study is to project TFR in Burundi using a neural network approach. The findings of this study are expected to reveal likely trends of fertility in the out of sample period. This will facilitate allocation of resources to the health sector, education and employment creation.

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 Burundi.

Data Issues

This study is based on annual total fertility rate (births per woman) in Burundi 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	B
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	0.092488
MSE	010561
MAE	0.088578

Residual Analysis for the Applied Model

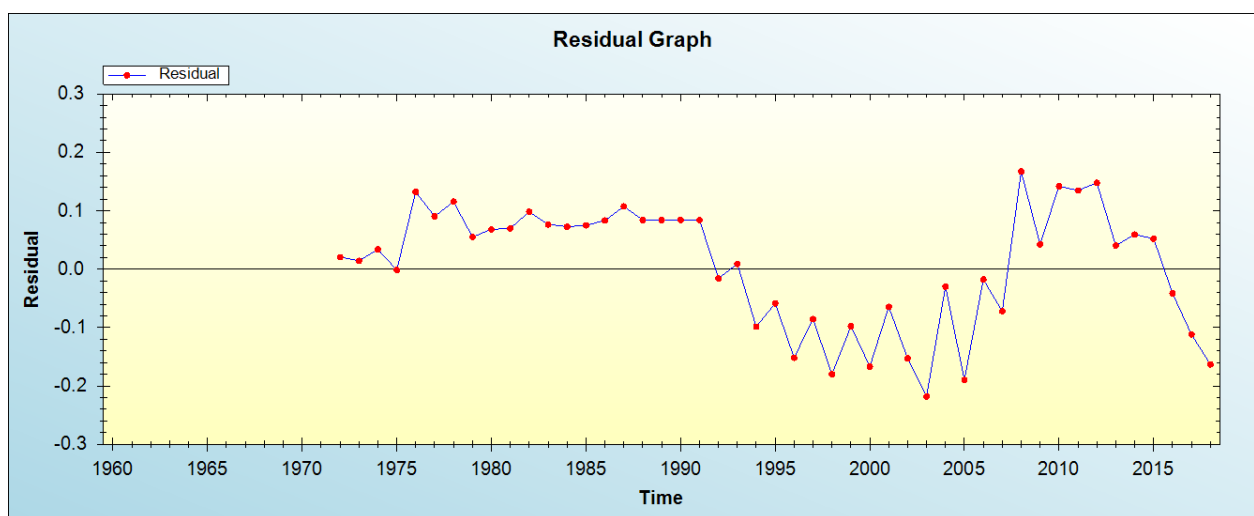


Figure 1: Residual analysis

In-sample Forecast for B

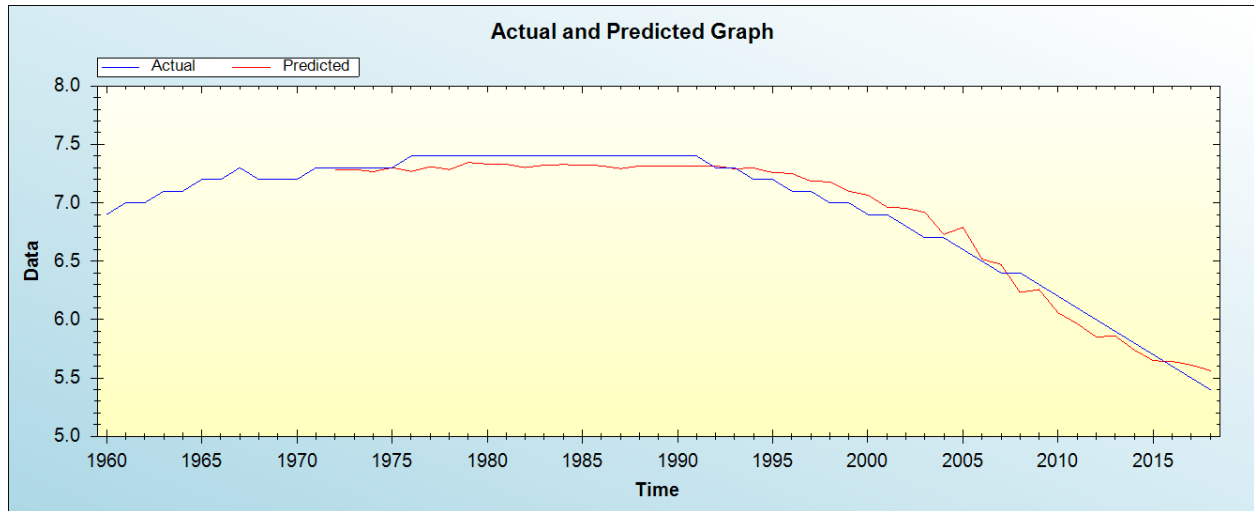


Figure 2: In-sample forecast for the B series

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

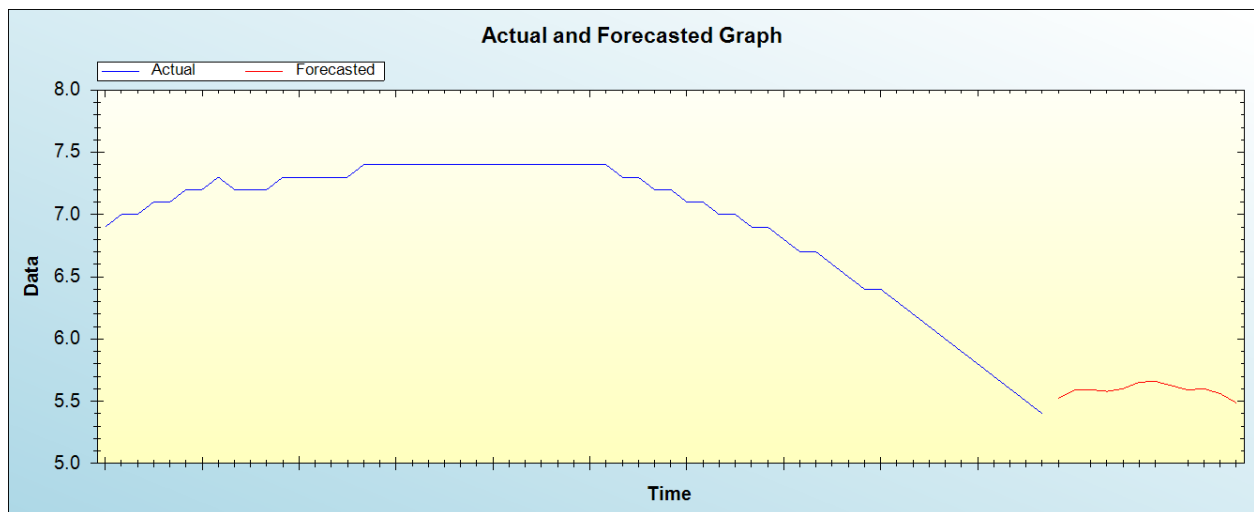


Figure 3: Out-of-sample forecast for B: actual and forecasted graph

Out-of-Sample Forecast for B: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	5.5240
2020	5.5886
2021	5.5924
2022	5.5789
2023	5.6001
2024	5.6530
2025	5.6596
2026	5.6253
2027	5.5912
2028	5.5999
2029	5.5617
2030	5.4885

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 Burundi are likely to be between 5.4 and 5.7 births per woman over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

Adolescent pregnancies are the major drivers of high fertility rates in the country therefore prediction of total fertility rates will reveal the future population dynamics. In this paper we applied an artificial intelligence technique to project total fertility rates in Burundi. The findings indicate that annual total fertility rates in Burundi are likely to be between 5.4 and 5.7 births per woman over the out-of-sample period. Hence, authorities in Burundi are encouraged to focus on women empowerment and address challenges being encountered by adolescents and young adults so as to prevent unwanted pregnancies and other adverse sexual and reproductive (SRH) outcomes.

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