

Forecasting Total Fertility Rate (TFR) In Tunisia

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 paper, the ANN approach was applied to analyze TFR in Tunisia. 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 Tunisia. The results of the study indicate that annual total fertility rates in Tunisia are likely to remain around 2.1 births per woman over the out-of-sample period. Therefore, the authorities in Tunisia are encouraged to continue improving accessibility of family planning services for the Tunisian population and empowering women.

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

I. INTRODUCTION

Population size is determined by cumulative changes in the number of births, deaths and migration (Demena, 2005). Fertility is defined as the reproductive performance of an individual, group or population. It results in the increase in the size of the population. The widely recognized measures of fertility are 1) crude birth rate 2) Child woman ration 3) general fertility rate 4) Total fertility rate 5) age specific fertility rate and 6) Gross reproduction rate. Total fertility rate is the standard measure of fertility as it provides the best picture of how many children a woman can have currently. It is defined as the average number of children that would be born to a woman during her entire lifetime or reproductive years if she were to pass through her childbearing years at current age specific fertility rates (Demena, 2005).

Tunisia has a population size of about 11.8million and 69.8 % of the population are in urban areas. Total fertility rate has been declining over the years from 7.0 births per woman in 1950 to 2.3 births per woman in 2020 (Worldometer, 2020).The country recorded an infant mortality rate of 10.56 infant deaths per 1000 live births and under five mortality of 11.21 deaths per 1000 live births in 2020 (Worldometer, 2020). There are few previous studies that have examined or predicted fertility rates. Based on qualitative study, Egeh et al (2019) investigated Somali Islamic religious leaders' views on birth spacing. Qualitative individual interviews were conducted with 17 Somali Islamic religious leaders aged 28–59 years and analyzed through content analysis. The study results showed that according to the religious Islamic leaders, selected practice recommendations for contraceptive use is permitted in relation to birth spacing to promote the health of the mother and child. Raifman et al (2018) explored factors influencing provider attitudes about abortion and provider perspectives about abortion through in-depth interviews with providers at six facilities in Tunisia. The results showed that gatekeepers (counsellors and front office staff) generally believed abortion was immoral, while obstetricians and gynecologists were more likely to support an individual's right to access abortion. However, providers' actions do not necessarily align with their stated beliefs regarding abortion; some providers who said they support abortion access generally held personal beliefs about when and for whom abortion is appropriate which influenced their provision of care. System-level barriers to abortion provision, such as a lack of resources, hinder some providers who may otherwise be willing to provide the service. Amroussia et al (2017) conducted a qualitative study to examine the self-perceptions and childbirth experiences of single mothers at the public healthcare facilities in Tunisia. The study highlighted the need to ensure women's right to dignified, respectful healthcare during childbirth requires tackling the underlying causes of social inequalities leading to women's marginalization and discrimination.

The aim of this paper is to forecast TFR in Tunisia using a machine learning technique. The findings of this paper are envisioned to highlight likely fertility trends in the out of sample period. This will guide policy, facilitate planning and resource mobilization for health, education and employment sectors.

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 Tunisia.

Data Issues

This study is based on annual total fertility rate (births per woman) in Tunisia 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	T
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	0.066158
MSE	0.033772
MAE	0.147141

Residual Analysis for the Applied Model

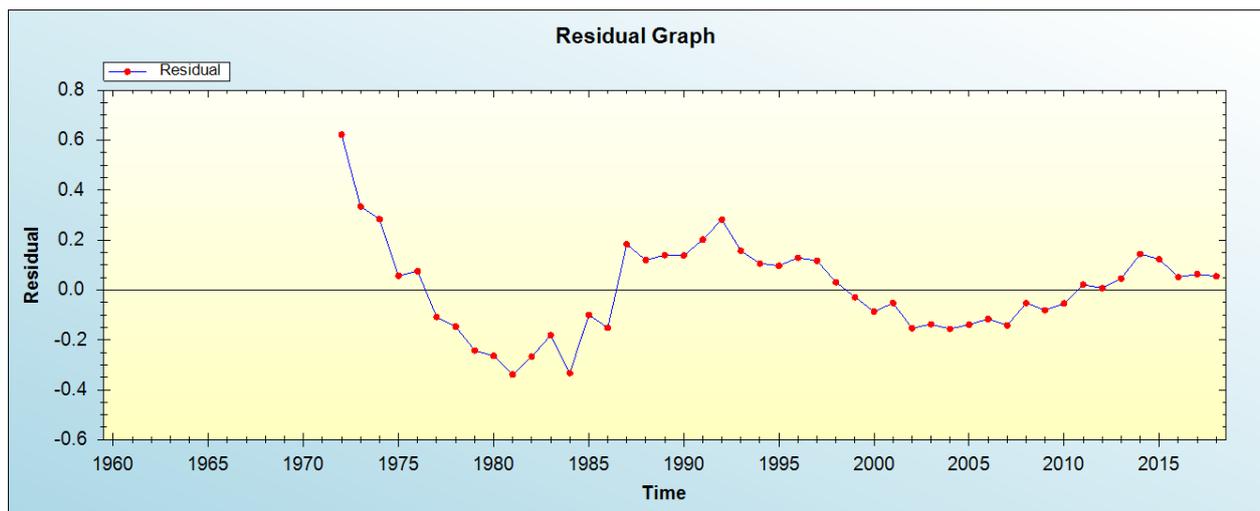


Figure 1: Residual analysis

In-sample Forecast for T

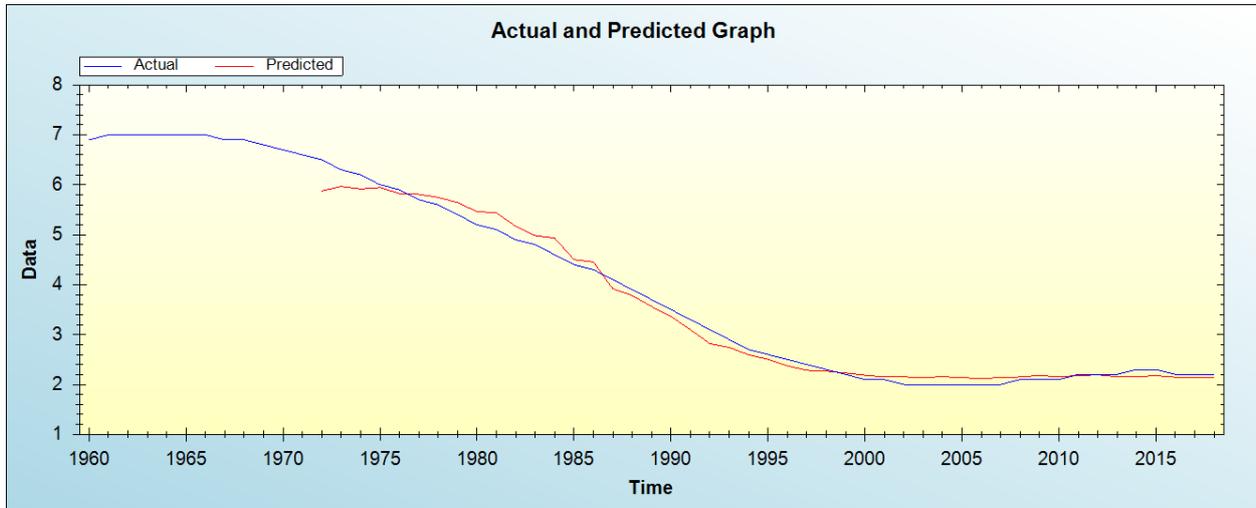


Figure 2: In-sample forecast for the T series

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

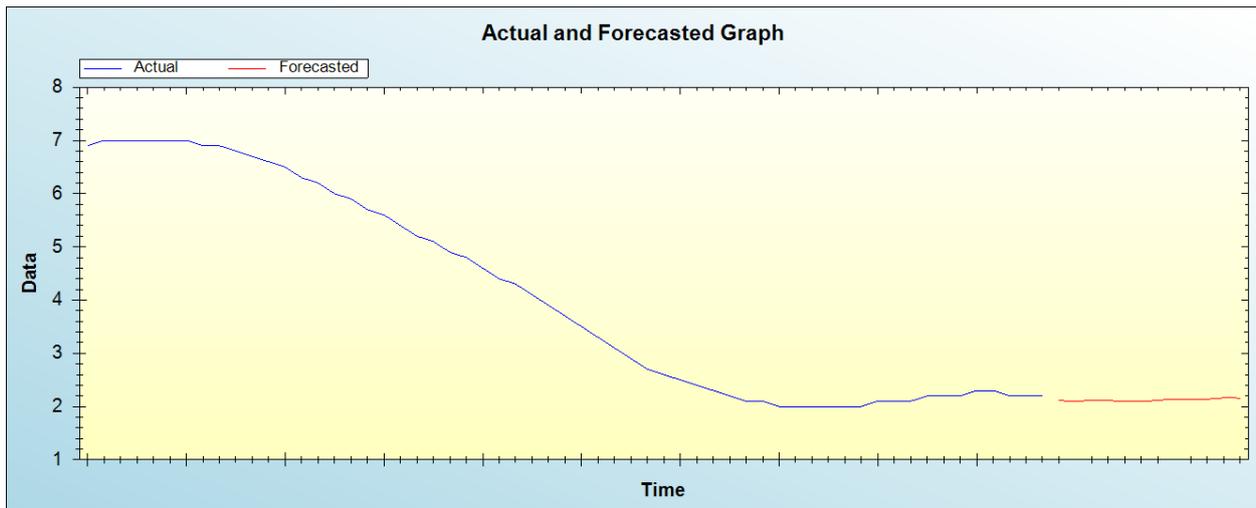


Figure 3: Out-of-sample forecast for T: actual and forecasted graph

Out-of-Sample Forecast for T: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	2.1118
2020	2.0966
2021	2.1178
2022	2.1120
2023	2.0956
2024	2.0929
2025	2.1159
2026	2.1417
2027	2.1345
2028	2.1373
2029	2.1643
2030	2.1594

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 Tunisia are likely to remain around 2.1 births per woman over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

Total fertility rates in Tunisia have declined over the years alongside infant and child mortality rates reflecting the country's commitment in achieving the sustainable development goals. In this paper we applied an artificial intelligence technique to predict total fertility rate in Tunisia. The results indicated that annual total fertility rates in Tunisia are likely to remain around 2.1 births per woman over the out-of-sample period. Therefore, the Tunisian government is encouraged to continue improving accessibility to family planning services for the Tunisian population and empowering women.

REFERENCES

- [1] Worldometer (2020). Tunisia demographics. <https://www.worldometers.info>
- [2] Melake Demena (2005). Population and Development. Lecture notes for Health Science Students. pp 1-153

Citation of this Article:

Dr. Smartson. P. NYONI, Tatenda. A. CHIHOHO, Thabani NYONI, "Forecasting Total Fertility Rate (TFR) In Tunisia"
Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 8, pp
470-473, August 2021. Article DOI <https://doi.org/10.47001/IRJIET/2021.508106>
