

Forecasting Total Fertility Rate (TFR) In Syria

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 Syria. 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 Syria. The results of the study indicate that annual total fertility rates in Syria are likely to be around 3.1 throughout the out-of-sample period. Therefore; the Syrian government is encouraged to continuously improve accessibility of family planning services to prevent adverse maternal and child health outcomes and channel more resources towards women empowerment.

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

I. INTRODUCTION

The Syrian war has resulted in regrettable negative impacts such as destruction of health infrastructure, displacement of people, increase in infant mortality, disease outbreaks and limited access to health care services for people with chronic ailments (Cheung, 2020; Makdad et al, 2016; Akbarzada & Mackey, 2015; Taleb et al, 2015). The armed conflict in Syria has led to the death of a minimum of 400 000 Syrians and 5.6 million refugees were displaced from Syria (UN High Commission for Refugees, 2019; Syrian Observatory for Human rights, 2018; Syrian Centre for Policy Research, 2015). Syria has experienced fertility transition by recording a decline of total fertility rate of 7.6 births per woman in 1970 to 2.8 births per woman in 2020 (Worldometer, 2020). The country recorded an infant mortality rate of 11.3 infant deaths per woman in 2020 (Worldometer, 2020). In this paper we shall mention a few local and global studies which have been carried out. Cheung et al (2020) examined the impact of the Syrian conflict on Syrians' physical, mental, and social well-being using the Gallup World Poll. Face-to-face interview data of 11,452 Syrian participants from 2008 to 2015 showed that Syrians' physical (e.g., access to shelter), mental (e.g., life satisfaction), and social (e.g., social support) well-being decline substantially. Assessment the demographic impact of Syrian migration into Germany was performed by Newsham & Rowe (2018). Deterministic and Bayesian probabilistic projection methods were used to determine the contribution of Syrian migrants to aggregate total fertility rate and the likelihood of subsequent population growth. Findings revealed that Syrian migration is projected to increase German period total fertility but not by the required levels to prevent depopulation. Nasir (2010) evaluated the fertility profile of the Arians, an indigenous community in Pakistan. A random sample of 510 ever-married Arian women aged (15-49) years was selected from three districts in Pakistan where most of the Arian population lived. The authors concluded that fertility profile of Arians women was higher than their national counterparts.

The aim of this paper is to forecast total fertility rate in Syria using an artificial neural network approach. The findings of this piece of work are expected to reveal likely fertility trends in the out of sample period. This will trigger an appropriate scientific based response to the future health, education and employment needs of the Syrian population.

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 Syria.

Data Issues

This study is based on annual total fertility rate (births per woman) in Syria 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 | Y |
|------------------------------|--------------------------------|
| 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 | 0.082865 |
| MSE | 0.026784 |
| MAE | 0.118619 |

Residual Analysis for the Applied Model

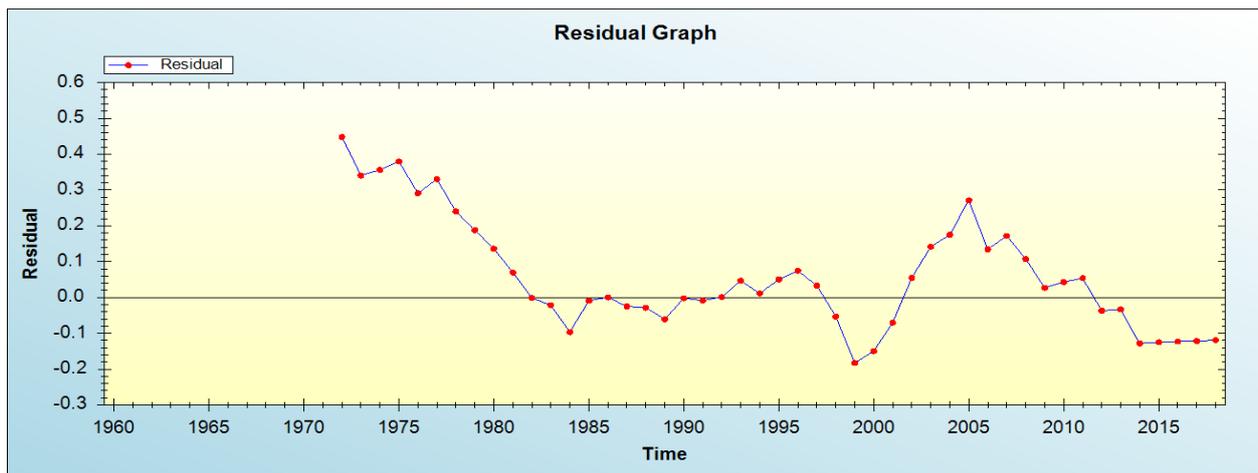


Figure 1: Residual analysis

In-sample Forecast for Y

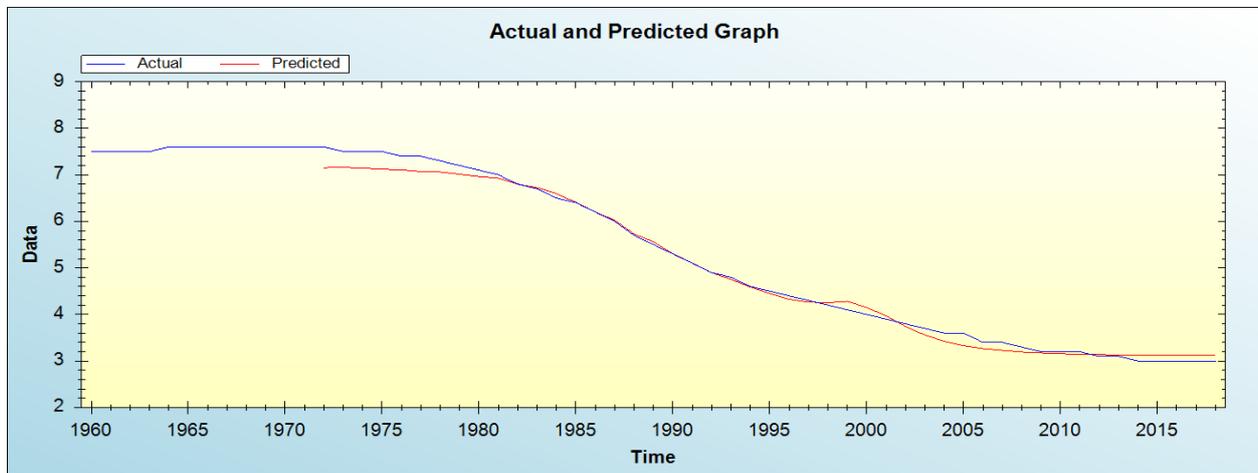


Figure 2: In-sample forecast for the Y series

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

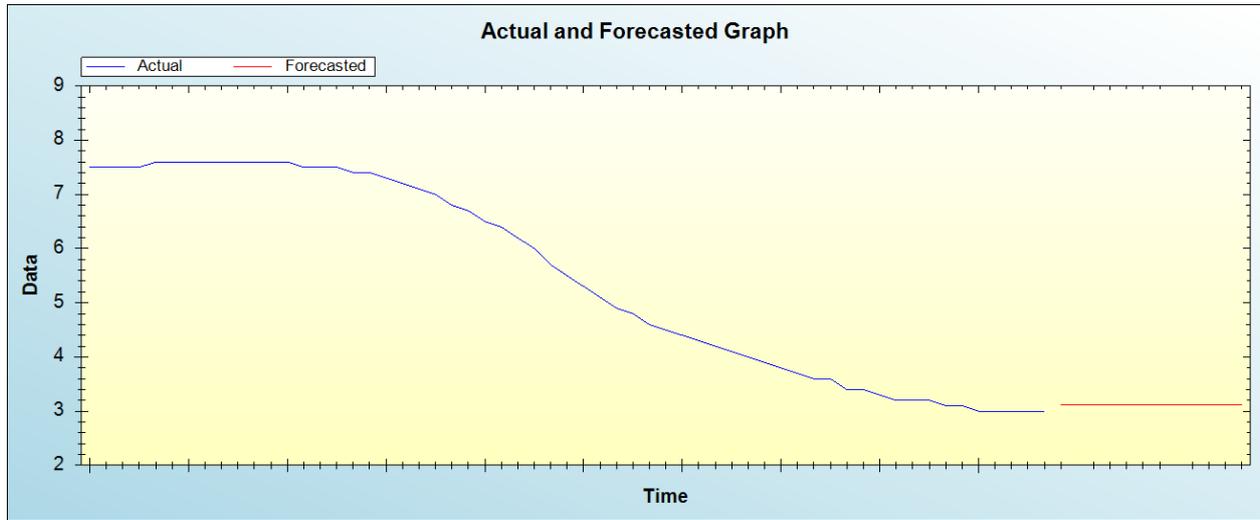


Figure 3: Out-of-sample forecast for Y: actual and forecasted graph

Out-of-Sample Forecast for Y: Forecasts only

Table 2: Tabulated out-of-sample forecasts

| Year | Forecasted TFR values |
|------|-----------------------|
| 2019 | 3.1194 |
| 2020 | 3.1188 |
| 2021 | 3.1192 |
| 2022 | 3.1197 |
| 2023 | 3.1208 |
| 2024 | 3.1210 |
| 2025 | 3.1225 |
| 2026 | 3.1222 |
| 2027 | 3.1223 |
| 2028 | 3.1227 |
| 2029 | 3.1226 |
| 2030 | 3.1221 |

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 Syria are likely to be around 3.1 throughout the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

The armed conflict in Syria is regrettable and has resulted in the destruction of infrastructure. In this paper we proposed a machine learning technique to predict total fertility rate in Syria. The findings of this study revealed that annual total fertility rates in Syria are likely to be around 3.1 throughout the out-of-sample period. Therefore, the Syrian government is encouraged to continuously improve accessibility of family planning services to prevent adverse maternal and child health outcomes and channel resources towards women empowerment.

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