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Forecasting Total Fertility Rate (TFR) In Uzbekistan

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

[1]ZICHIRe Project, University of Zimbabwe, Harare, Zimbabwe
[2]Independent Health Economist, Zimbabwe
[3]SAGIT Innovation Center, Harare, Zimbabwe

***Abstract* - In this study, the ANN approach was applied to analyze TFR in Uzbekistan. 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 Uzbekistan. The results of the study indicate that annual total fertility rates in Uzbekistan are likely to hover around 2 births per woman over the out-of-sample period. Therefore, authorities in Uzbekistan are encouraged to focus on improving access to sexual and reproductive health (SRH) services among adolescents and young adults and fund women empowerment programs.**

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

I. INTRODUCTION

Adolescent girls and young women aged 10-24 constitute 33% of the total population in East and Southern Africa (UNESCO, 2013). Previous studies have revealed that adolescents and young women experience adverse SRH outcomes as a result of high rates of unintended pregnancies, sexually transmitted infections, and inconsistent use of condoms (Stock et al, 2014; Mavedzenge et al, 2011; Doyle et al, 2012). The major causes of adverse SRH outcomes include poverty, gender based violence and sexual abuse of women, gender imbalances and lack of education (Stock et al, 2014; Rani and Lule, 2004; Aggleton & Campbell, 2000).The aim of this paper is to project TFR in Uzbekistan using a machine learning algorithm. The findings are expected to reveal the likely fertility trends in the out of sample period. This will trigger an early response to the future health, education and employment needs of the people in Uzbekistan.

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 Uzbekistan.

Data Issues

This study is based on annual total fertility rate (births per woman)in Uzbekistan 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	A
Observations	47 (After Adjusting Endpoints)
Neural Network Architecture:	
Input Layer Neurons	12
Hidden Layer Neurons	12
Output Layer Neurons	1

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Activation Function	Hyperbolic Tangent Function
Back Propagation Learning:	
Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	0.113367
MSE	0.099168
MAE	0.249904

Residual Analysis for the Applied Model

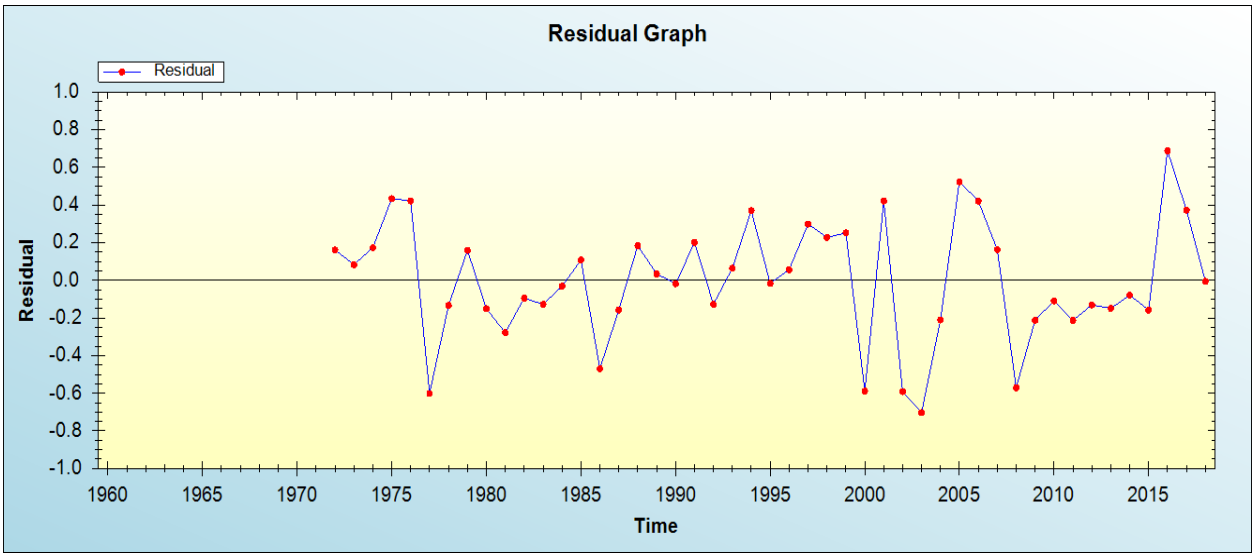

Figure 1: Residual analysis

In-sample Forecast for A

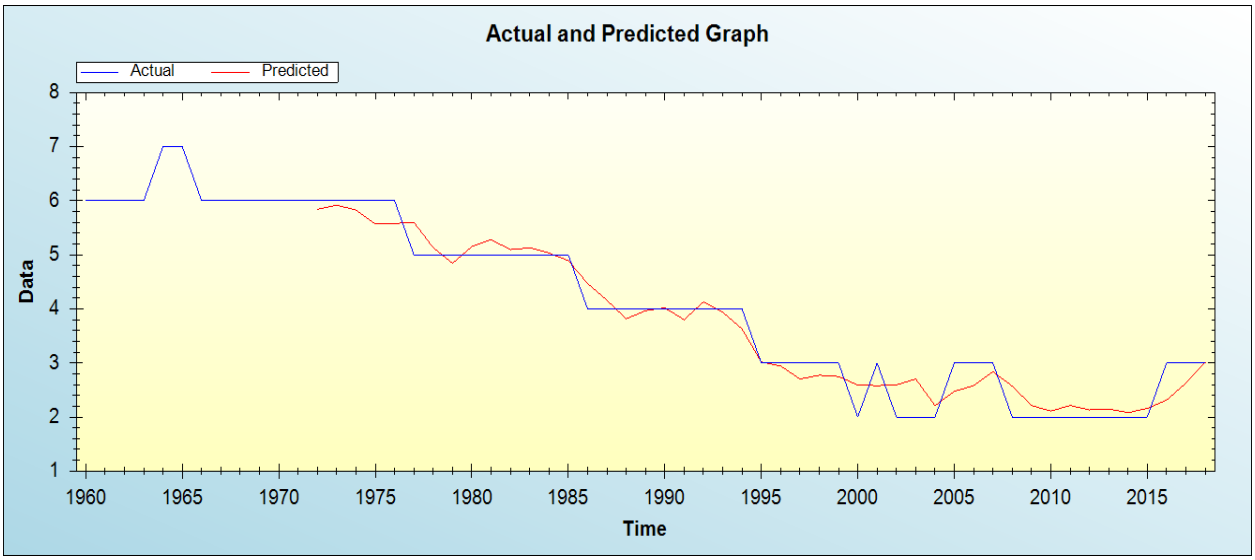

Figure 2: In-sample forecast for the A series

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

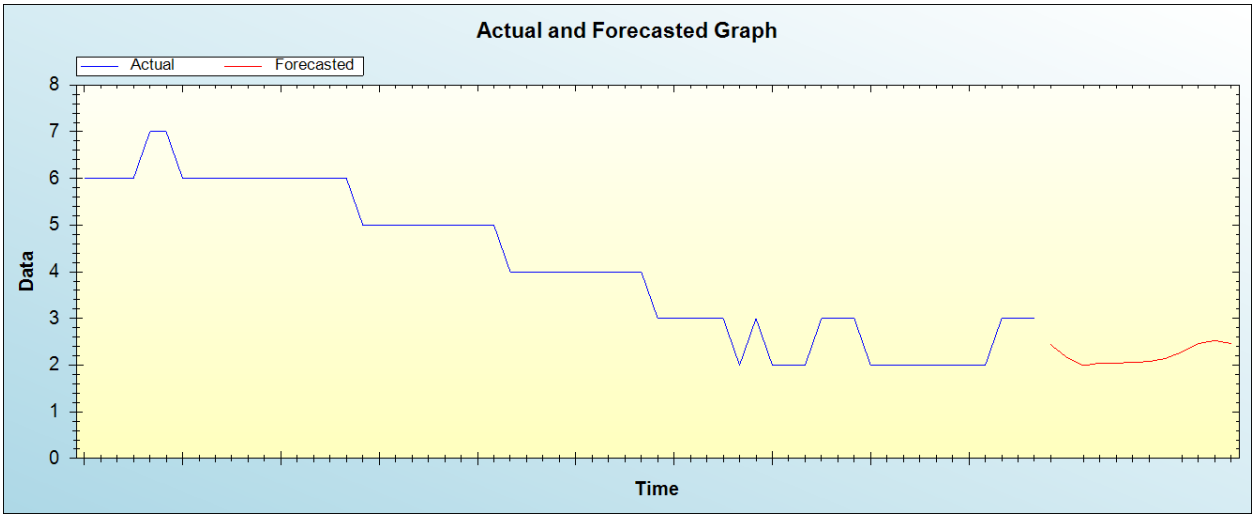

Figure 3: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	2.4333
2020	2.1618
2021	1.9906
2022	2.0448
2023	2.0429
2024	2.0565
2025	2.0785
2026	2.1424
2027	2.2800
2028	2.4621
2029	2.5251
2030	2.4608

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 Uzbekistan are likely to remain around 2 births per woman over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

Adolescents and youths are entitled to quality family planning services so that they can realize the life goals and contribute meaningfully to the economic development of their countries. However high fertility rates among this group is a cause for concern since it predisposes them to adverse maternal and child health outcomes. In this paper we employed the artificial neural network approach to predict total fertility rate in Uzbekistan. The model projections revealed annual total fertility rates in Uzbekistan are likely to hover around 2 births per woman in the out-of-sample period. Therefore the government of Uzbekistan is encouraged to focus on improving access to sexual and reproductive health (SRH) services among adolescents and young adults, and fund women empowerment programs.

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