

Forecasting Total Fertility Rate (TFR) In the United Arab Emirates (UAE)

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 the United Arab Emirates (UAE). 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 the UAE. The results of the study indicate that annual total fertility rates in the UAE are likely to hover around 2 births per woman over the out-of-sample period. Therefore, the authorities in the country are encouraged to continuously focus on addressing challenges faced by adolescents and young adults in accessing family planning services as well as women empowerment.

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

I. INTRODUCTION

Many developing countries have made significant strides in improving quality and access to maternal and child health services, however maternal mortality ratio remains high in Sub-Saharan Africa with approximately 550 maternal deaths per 100 000 live births in 2015 (WHO, 2015). Lack of quality care, unsafe abortions and poor health infrastructure are the major causes of maternal and neonatal deaths (WHO, 2017; Haddad, 2009). Several governments are committed to the 1994 International conference on Population and development (ICPD) and adopted recommendations by WHO to respond to women's sexual and reproductive health rights and needs such as health education, access to information on family planning, improved quality of prenatal, antenatal and postnatal care (Sullivan et al, 2020). Globally approximately 40 % of all pregnancies are unintended and half of them end up in abortion (Sedgh et al, 2006). Furthermore commercial sexwork is rampant in developing countries and there is lack of comprehensive knowledge on family planning services among adolescent girls and young women (Workie et al, 2019). The aim of this study is to forecast fertility rates in the United Arab Emirates (UAE) using an artificial intelligence algorithm. The results of the study are expected to highlight likely fertility trends in the out of sample period to facilitate policy making and resource mobilization for 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 the United Arab Emirates (UAE).

Data Issues

This study is based on annual total fertility rate (births per woman) in the UAE 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
Activation Function	Hyperbolic Tangent Function
Back Propagation Learning:	
Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	0.103300
MSE	0.082337
MAE	0.209492

Residual Analysis for the Applied Model

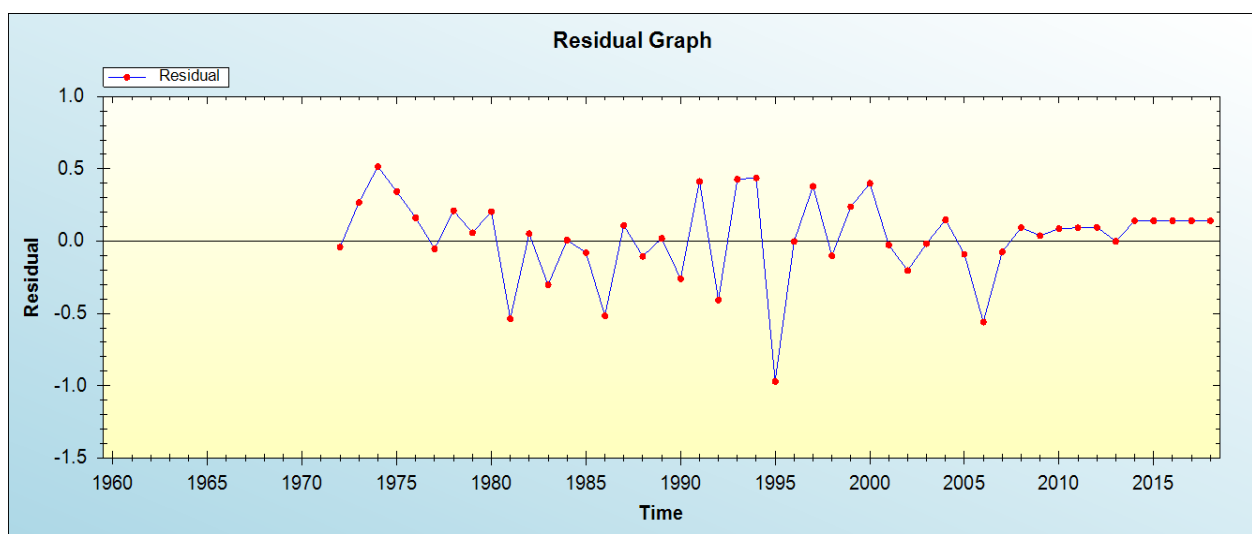


Figure 1: Residual analysis

In-sample Forecast for A

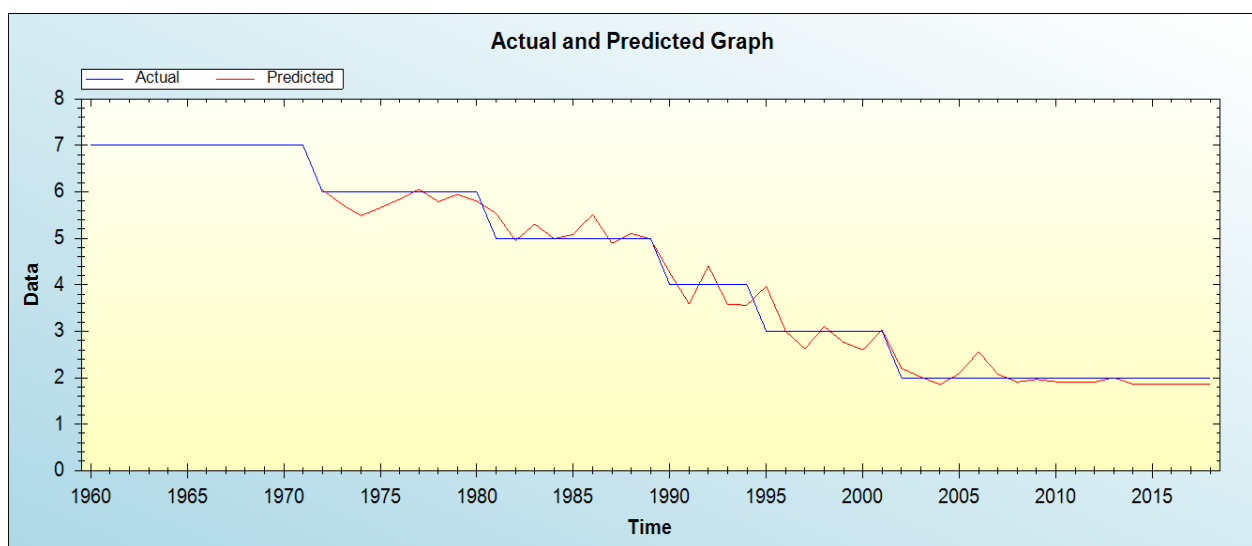


Figure 2: In-sample forecast for the A series

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

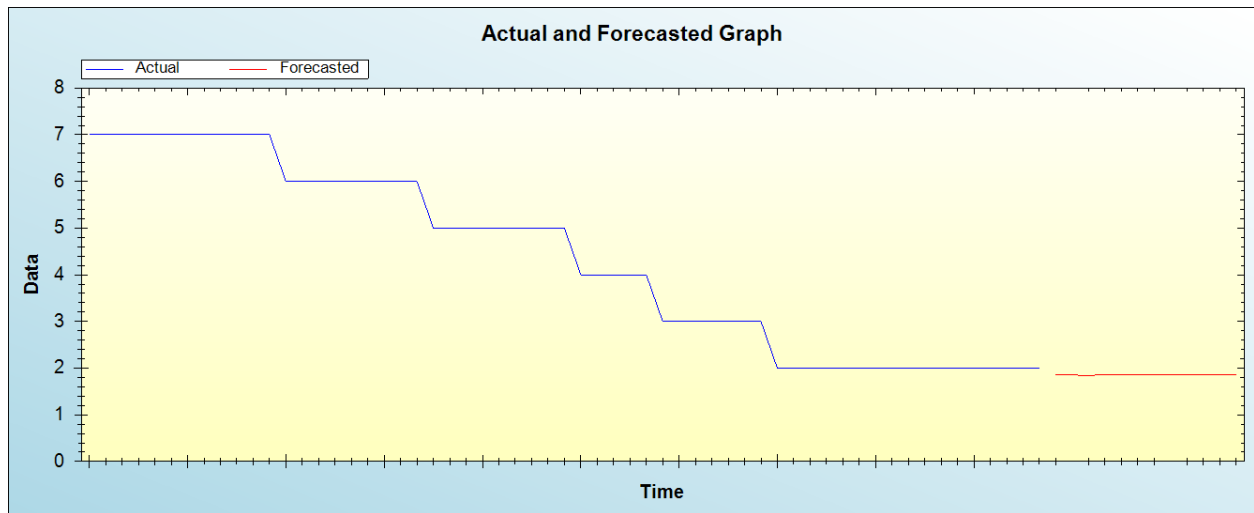


Figure 3: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	1.8594
2020	1.8513
2021	1.8445
2022	1.8544
2023	1.8588
2024	1.8660
2025	1.8582
2026	1.8627
2027	1.8585
2028	1.8598
2029	1.8587
2030	1.8681

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

IV. CONCLUSION & RECOMMENDATIONS

Sexual and reproductive health is a fundamental human right. Adolescents and youths across the globe must enjoy this right and contribute to economic development in their settings. In this study we applied the artificial neural network approach to project total fertility rates in the UAE. The ANN model projections suggest that annual total fertility rates in the country are likely to hover around 2 births per woman over the out-of-sample period. Therefore, the government of UAE should continuously focus on addressing challenges faced by adolescents and young adults in accessing family planning services as well as women empowerment.

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