

# Time Series Forecasting Of Total Fertility Rate (TFR) In Saudi Arabia

<sup>1</sup>Dr. Smartson. P. NYONI, <sup>2</sup>Tatenda. A. CHIHOHO, <sup>3</sup>Thabani NYONI

<sup>1</sup>ZICHIRE Project, University of Zimbabwe, Harare, Zimbabwe

<sup>2</sup>Independent Health Economist, Zimbabwe

<sup>3</sup>SAGIT Innovation Center, Harare, Zimbabwe

**Abstract - High period fertility and birth rates used to characterize Saudi Arabia over the past decades. In this research article, the ANN approach was applied to analyze TFR in Saudi Arabia. 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 Saudi Arabia. The results of the study indicate that annual total fertility rates in the country are likely to decline slightly over the out-of-sample period. Therefore, the government of Saudi Arabia is encouraged to (1) create more demand for family planning services so as to prevent undesirable sexual and reproductive health (SRH) outcomes among adolescent girls and young women, and (2) promote female education and women's rights to curb child marriages and violation of women's rights.**

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

## I. INTRODUCTION

Child bearing is considered an important event in the life cycle of a woman during her reproductive years (Yaya & Ghose, 2018). Therefore it is very critical for governments to channel more resources towards women's health so as to get the best outcomes. Unwanted pregnancies should be addressed in order to reduce high fertility levels which characterize resource limited settings or developing countries. Many adolescents and youths lack comprehensive knowledge on SRH services. At global level, a large percentage of women are unaware of the advantages of family planning and get pregnant without proper or recommended preparations. Unwanted pregnancies increase the risk of unsafe abortions and obstetric complications (Horvath et al, 2017; Dastgiri et al, 2017; Melese et al, 2017; Bishwajit et al, 2017). In Angola the modern contraceptive prevalence rate is 12.8% with significant variations across regions (Nieto-Andrade et al, 2017). The aim of this study is to project TFR in Saudi Arabia using a machine learning algorithm. The results of the study are expected to provide an insight of the likely fertility trends in the out of sample period. This will facilitate planning and allocation of resources towards health, 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 Saudi Arabia.

### Data Issues

This study is based on annual total fertility rate (births per woman) in Saudi Arabia 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	0.103728
MSE	0.083021
MAE	0.230919

Residual Analysis for the Applied Model

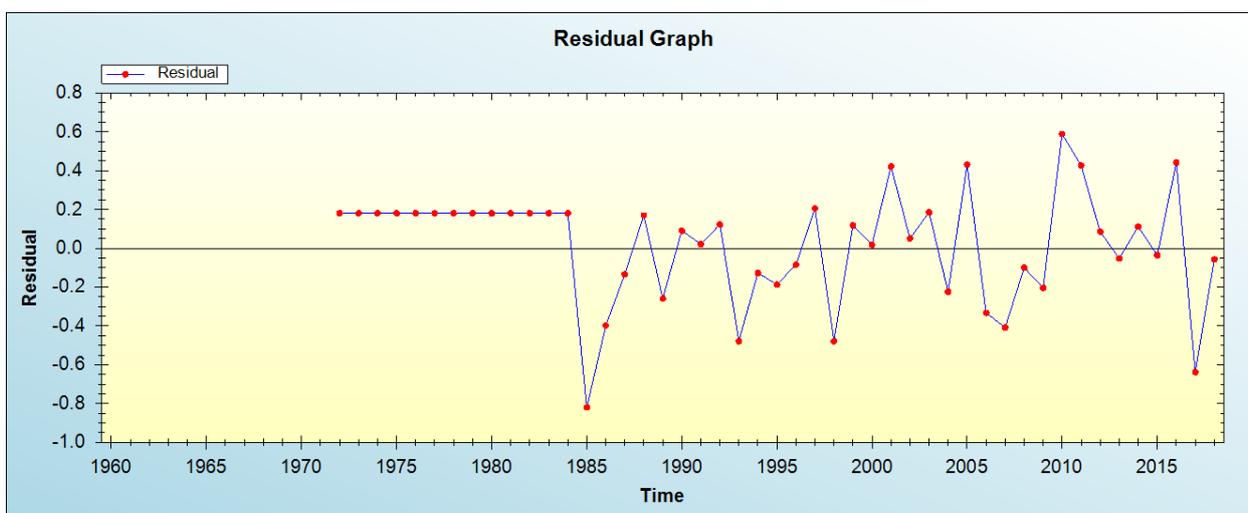


Figure 1: Residual analysis

In-sample Forecast for A

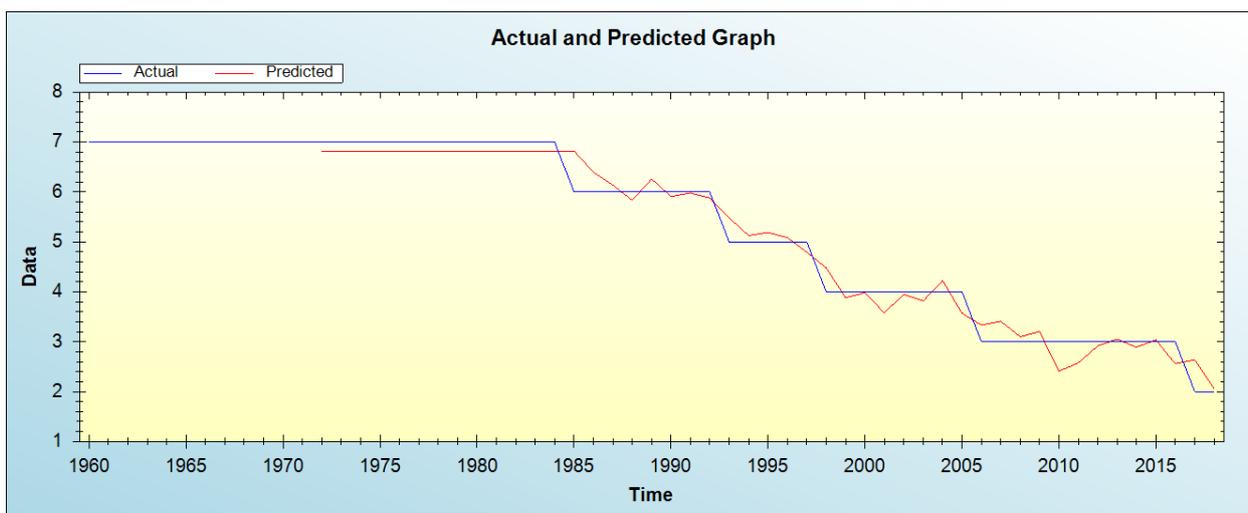


Figure 2: In-sample forecast for the A series

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

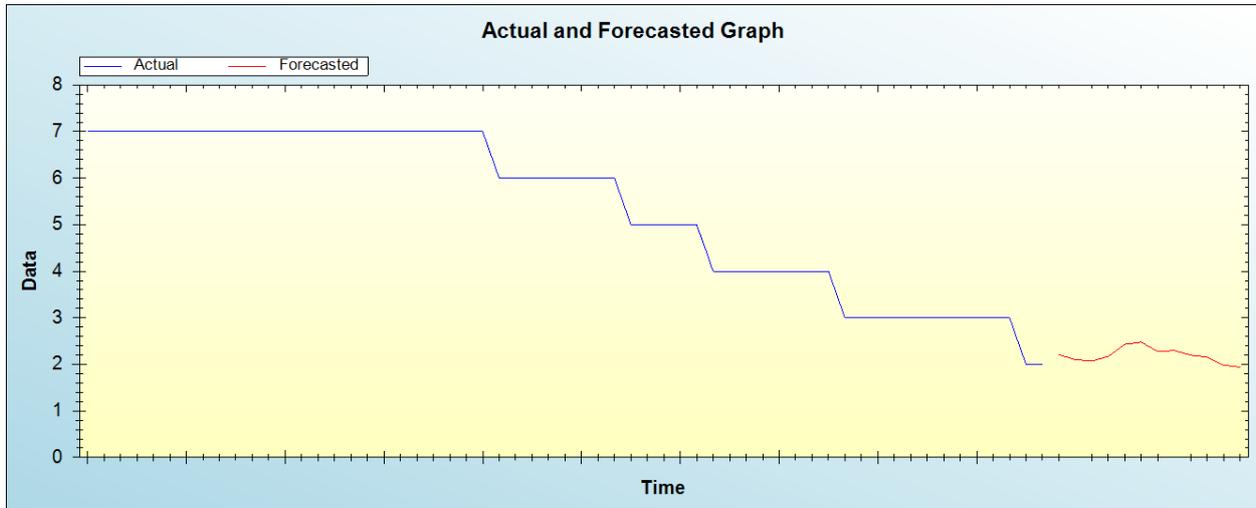


Figure 3: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	2.2050
2020	2.1025
2021	2.0690
2022	2.1704
2023	2.4309
2024	2.4753
2025	2.2751
2026	2.2976
2027	2.1947
2028	2.1560
2029	1.9827
2030	1.9402

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 Saudi Arabia are likely to slightly decline over the out-of-sample period.

**IV. CONCLUSION & RECOMMENDATIONS**

High teenage pregnancies could be singled out as the major drivers of high fertility rates in many countries including Saudi Arabia and therefore intervention strategies should aim to address challenges and concerns of adolescent girls and young women which include forced child marriages, sexual abuse of girls and women and lack of formal education. Forecasting fertility rates is crucial to have an insight of the likely fertility trends in the future and facilitate early resource mobilization. In this study we employed a machine learning approach to predict TFR in Saudi Arabia. The findings showed that annual total fertility rates in Saudi Arabia are likely to decline slightly over the out-of-sample period. We therefore implore the government to create more demand for family planning services amongst other measures so as to prevent unwanted pregnancies among adolescent girls and young women.

**REFERENCES**

[1] Yaya S., & Ghose B (2018). Prevalence of unmet need for contraception and its association with unwanted pregnancy among married women in Angola. PLoS ONE 13(12): e0209801. <https://doi.org/10.1371/journal.pone.0209801>

[2] Horvath S & Schreiber CA (2017). Unintended Pregnancy, Induced Abortion, and Mental Health. Curr Psychiatry Rep, 19:77. <https://doi.org/10.1007/s11920-017-0832-4> PMID: 28905259

- [3] Dastgiri S., Yoosefian M., Garjani M., & Kalankesh (2017). LR. Induced Abortion: a Systematic Review and Metanalysis. *Mater Socio-Medica*. 2017; 29:58–67.
- [4] Melese T., Habte D., Tsima BM., Mogobe KD., Chabaesele K., & Rankgoane G (2017). High Levels of Post-Abortion Complication in a Setting Where Abortion Service Is Not Legalized. *PLoS ONE*. 2017; 12. <https://doi.org/10.1371/journal.pone.0166287> PMID: 28060817
- [5] Bishwajit G., Tang S., Yaya S., & Feng Z (2017). Unmet need for contraception and its association with unintended pregnancy in Bangladesh. *BMC Pregnancy Childbirth*, 17:186. <https://doi.org/10.1186/s12884-017-1379-4> PMID: 28606062

**Citation of this Article:**

Dr. Smartson. P. NYONI, Tatenda. A. CHIHOHO, Thabani NYONI, “Time Series Forecasting Of Total Fertility Rate (TFR) In Saudi Arabia” Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 8, pp 392-395, August 2021. Article DOI <https://doi.org/10.47001/IRJIET/2021.508087>

\*\*\*\*\*