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# Forecasting Total Fertility Rate (TFR) In Comoros

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***Abstract* - In this study, the ANN approach was applied to analyze TFR in Comoros. 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 Comoros. The results of the study indicate that annual total fertility rates in Comoros are likely to increase from 4.36 births per woman in 2019 to 4.70 births per woman in 2025 and then drop to 4.25 births per woman in 2030. Therefore, authorities in Comoros 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).

Comoros has witnessed a decline in fertility over the past decades from 7.1 births per woman in 1985 to 4.2 births per woman in 2020. The country also a recorded a downward trend in infant and under five mortality rate. IMR declined from 192.39 infant deaths per 1000 live births in 1950 to 48.75 infant deaths per 1000 live births in 2020 (Worldometer,2020). The fertility transition is partly a result of family planning services and female education. There are limited studies in the country and region which have examined fertility trends therefore in this article we will mention relevant studies that have been done. Based on a cross-sectional study, Mercer et al (2019) estimated the levels and trends of FP indicators at a sub national scale in Nigeria utilizing all available data and accounting for survey design and uncertainty. The study revealed that the overall rates and trends of mCPR and unmet need have remained low in Nigeria. Muanda et al (2018) examined adolescents' and young people's insights on their cultural norms, practices and attitudes towards SRH services. Fourteen focus group discussions were conducted with a total of 224 adolescents and young people aged 15–24 years in urban and rural areas of the DRC. The topics discussed and age groups of participants differed somewhat in the urban and rural areas. Data were analyzed to identify themes in the participants' discussion of their attitudes towards SRH. The study revealed that there is pressing need for information and services for young people in both urban and rural areas. Cavallaro et al (2017) examined FP trends over time among WRAU and subgroups, and trends in knowledge of FP and intention to use among women with unmet need for FP in Senegal. Study results showed that percent demand satisfied is lower among rural poor women and adolescents than WRAU (Women of reproductive age in union), although higher among unmarried women. Marked recent increases have been observed in all subgroups, however fewer than 50% of women in need of FP use modern contraception in Senegal. Knowledge of FP has risen steadily among women with unmet need; however, intention to use FP has remained stable at around 40% since 2005 for all groups except unmarried women (75% of whom intend to use).

The aim of this paper is to project TFR in Comoros 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 Comoros.

## 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

 

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activation function. This paper applies the Artificial Neural Network (ANN) approach in predicting annual total fertility rates in Comoros.

**Data Issues**

This study is based on annual total fertility rate (births per woman)in Comoros 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 | C |
| 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 | 0.077722 |
| MSE | 0.015680 |
| MAE | 0.103383 |

*Residual Analysis for the Applied Model*

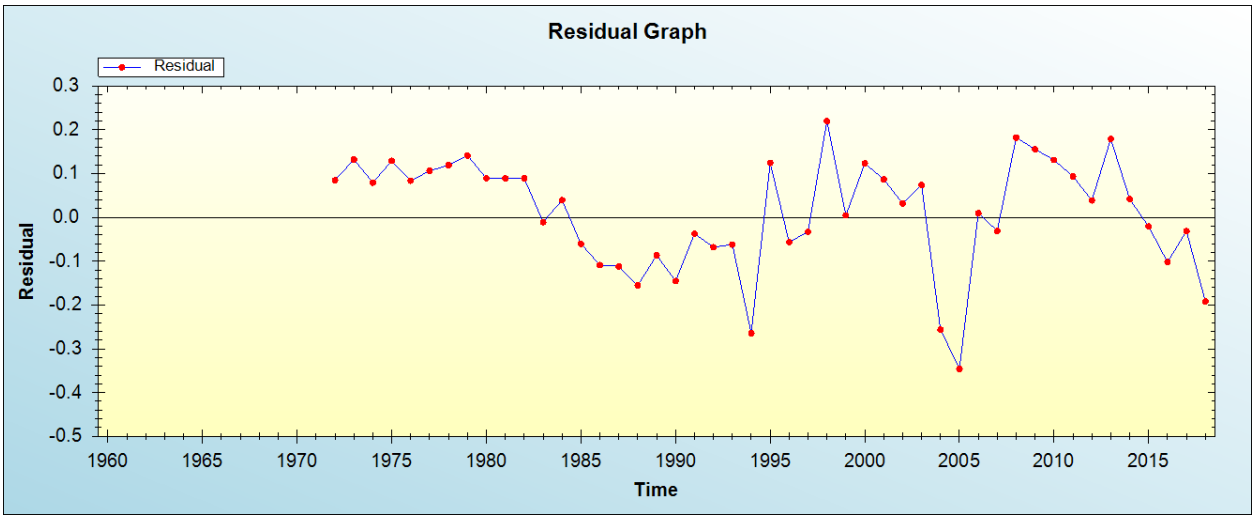


**Figure 1: Residual analysis**

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*In-sample Forecast for C*

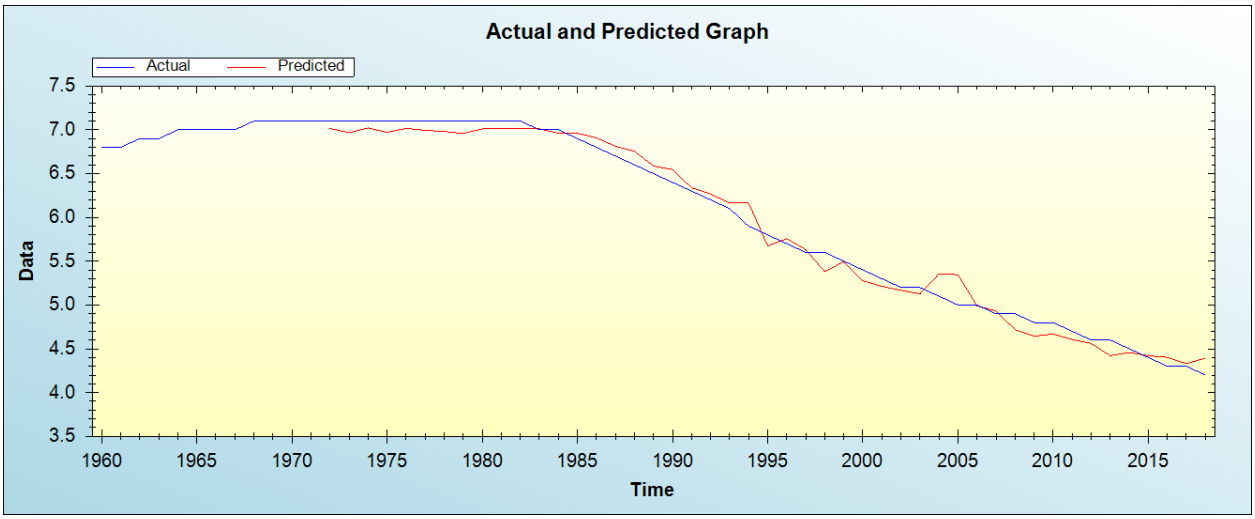


**Figure 2: In-sample forecast for the C series**

*Out-of-Sample Forecast for C: Actual and Forecasted Graph*

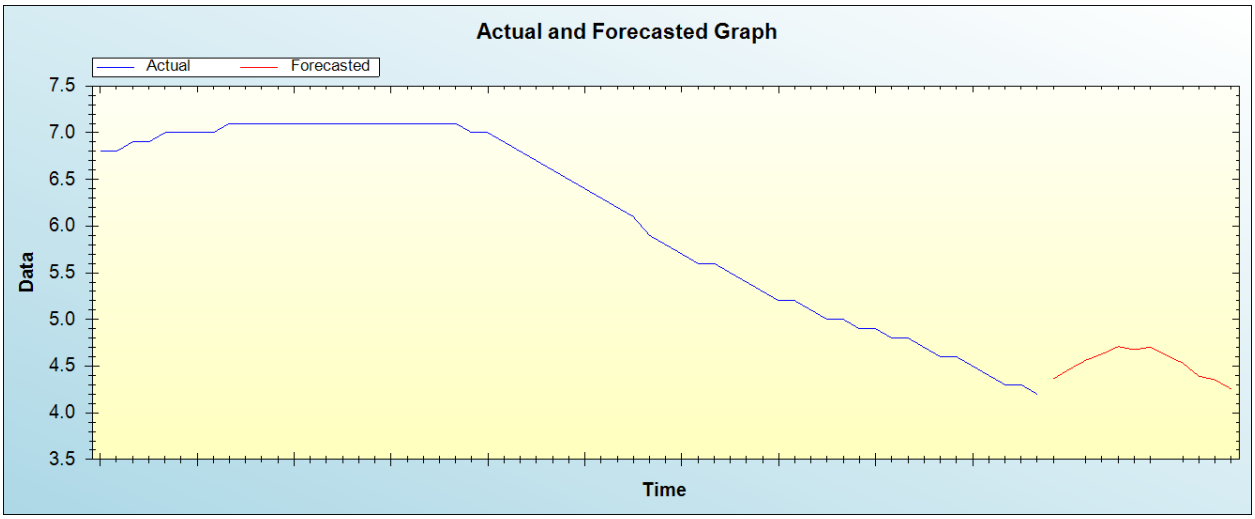


**Figure 3: Out-of-sample forecast for C: actual and forecasted graph**

*Out-of-Sample Forecast for C: Forecasts only*

**Table 2: Tabulated out-of-sample forecasts**

| Year | Forecasts |
|---|---|
| 2019 | 4.3623 |
| 2020 | 4.4671 |
| 2021 | 4.5630 |
| 2022 | 4.6290 |
| 2023 | 4.7079 |
| 2024 | 4.6753 |
| 2025 | 4.7031 |
| 2026 | 4.6135 |
| 2027 | 4.5335 |
| 2028 | 4.3918 |
| 2029 | 4.3525 |
| 2030 | 4.2555 |

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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 Comoros are likely to increase from 4.36 births per woman in 2019 to 4.70 births per woman in 2025 and then drop to 4.25 births per woman in 2030.

## 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 Comoros. The model projections revealed annual total fertility rates in Comoros are likely to increase from 4.36 births per woman in 2019 to 4.70 births per woman in 2025 and then drop to 4.25 births per woman in 2030. Therefore the government of Comoros 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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