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Forecasting Total Fertility Rate (TFR) in Cameroon

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***Abstract* - In this research article, the ANN approach was applied to analyze TFR in Cameroon. 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 Cameroon. The results of the study indicate that annual total fertility rates in Cameroon are likely to rise over the out-of-sample period. Therefore, the authorities in Cameroon should create more demand for family planning services and address challenges being faced by adolescents and young adults in accessing sexual and reproductive health (SRH) services as well as women empowerment.**

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

I. INTRODUCTION

Sexual and reproductive health is a key component of health and sustainable development (Starrs et al, 2018). Many developing countries are witnessing adverse maternal and neonatal health outcomes such as abortions, HIV infections and pregnancy related adverse outcomes aggravated by sexual and gender based violence (Glasier et al, 2006; Eczati et al, 2002).There is strong evidence to suggest that there are benefits in investing in reproductive health and spending in this sector is likely to have a positive impact on maternal and child health outcomes, and also reduce poverty (Borghi et al, 2006; Adam, 2004; Ensor, 2005; UNFHR, 2004; Jowett, 2000).

Cameroon has witnessed a drop in fertility rates over the past decades from 6.7 births per woman in 1985 to 4.6 births per woman in 2020 (Worldometer, 2020). A similar trend has been observed in infant mortality rate. The country reported an infant mortality rate of 154.96 infant deaths per 1000 live births in 1950 to 54 infant deaths per 1000 live births in 2020 (Worldometer, 2020) reflecting significant progress made in reducing infant mortality and improving child survival although IMR remains high. There are few studies in the region that have predicted or examined fertility rates. Genus (2020) examined the determinants of trends wanted and unwanted fertility in SSA using fixed-effects regressions of country-level data. Data came from 103 DHS surveys in 25 countries in SSA with at least two DHS surveys between 1989 and 2019. The study revealed that Women's education and family planning programs are found to be the dominant determinants of fertility decline and their effects operate by reducing both wanted and unwanted fertility. Bado et al (2020) explored the perspectives of men and women on barriers to contraceptive use and to identified the strategies to increase male involvement in family planning. The results showed that men's attitudes are still a significant barrier to women's use of modern contraceptives. Drabo (2020) provided detailed information on the ethnographic findings that show the complexity of family planning within the social context of women's lives and care-seeking trajectories. It drew on participant observation in Ouagadougou, Burkina Faso's capital, and interviews with women with a wide range of reproductive experiences and providers of family planning services. The study indicated that women's use of contraceptive methods and abortion is embedded in the wider social dilemmas relating to marriage, sexuality, and gendered relationships. Nkata et al (2019) did a systematic review of the available published information on sexual and reproductive health among Tanzanian adolescents. The results of the study results indicated that Adolescents engage in high-risk sexual behaviors and experience its adverse consequences

The aim of this study is to project TFR in Cameroon using a machine learning algorithm. The results of the study will provide an insight of the likely fertility trends in Cameroon in the out of sample period. This will assist in policy formulation, planning 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 Cameroon.

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Data Issues

This study is based on annual total fertility rate (births per woman)in Cameroon 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	0.091004
MSE	0.011272
MAE	0.084824

Residual Analysis for the Applied Model

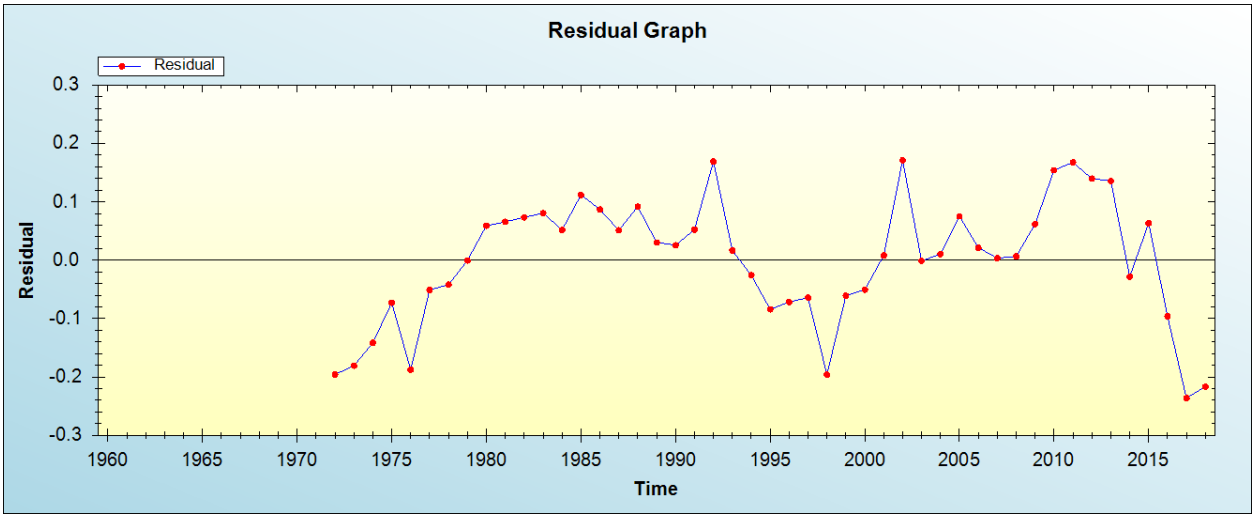

Figure 1: Residual analysis

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In-sample Forecast for C

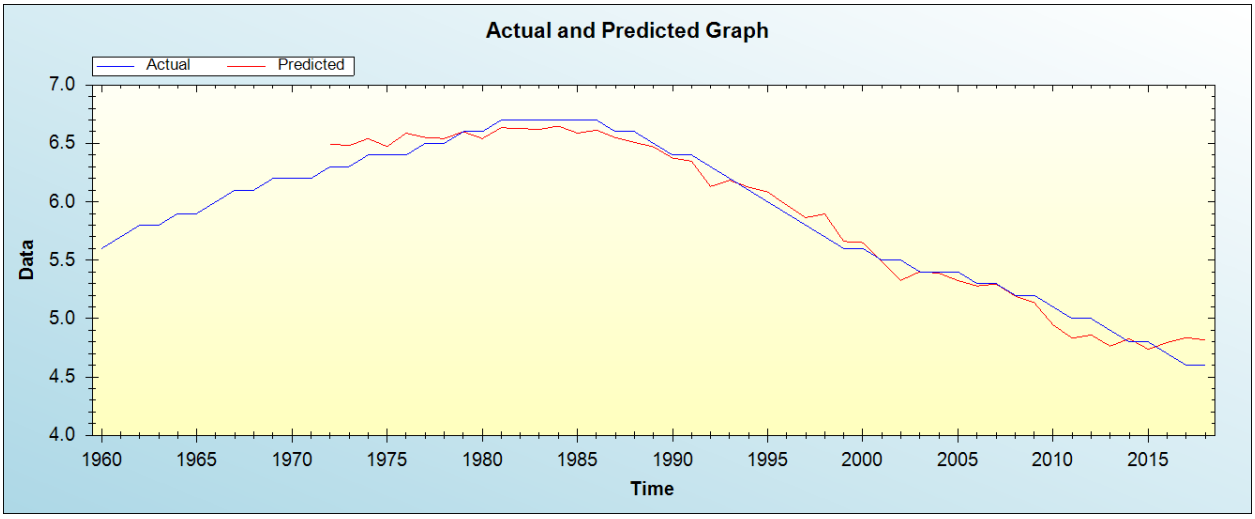

Figure 2: In-sample forecast for the C series

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

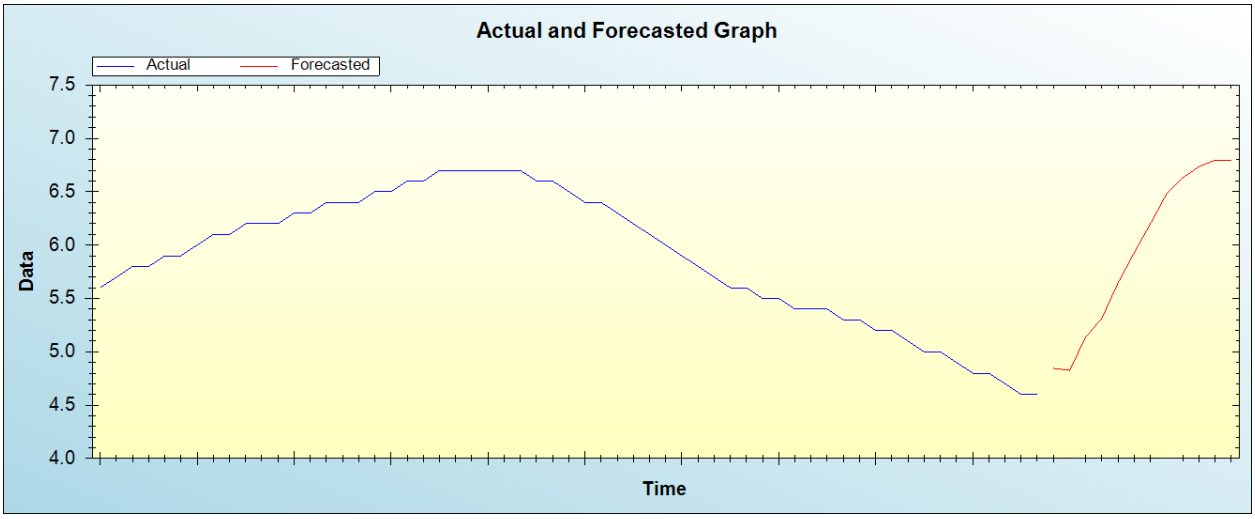

Figure 3: Out-of-sample forecast for C: actual and forecasted graph

Out-of-Sample Forecast for C: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	4.8453
2020	4.8255
2021	5.1370
2022	5.3146
2023	5.6454
2024	5.9270
2025	6.1986
2026	6.4811
2027	6.6290
2028	6.7337
2029	6.7950
2030	6.7970

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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 Cameroon are likely to rise over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

Machine learning with its high predictive accuracy is suitable for predicting total fertility rates in Cameroon. In this study we applied the multilayer perceptron neural network to predict total fertility rate in Cameroon. The model projections indicate that annual total fertility rates in Cameroon are likely to rise over the out-of-sample period. Therefore, the government should create more demand for family planning services and address challenges being faced by adolescents and young adults in accessing sexual and reproductive health (SRH) services. The government should also engage on an empowerment drive for women to improve their labor participation and contribution to economic development.

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