

Forecasting Future Trends of Adolescent Fertility for Cameroon Using the Artificial Neural Network Approach

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Abstract - This research article employs annual time series data on adolescent fertility rate for Cameroon from 1960 to 2020 to predict future trends of adolescent fertility rate over the period 2021 to 2030. The forecast evaluation criteria of the applied model indicate that the ANN (12, 12, 1) model is stable. The neural network model projections revealed that adolescent fertility will continue to decline but remain high throughout the out of sample period. Therefore, we encourage authorities in Cameroon to intensify health educational programs, promote girl child education and allocate more resources towards SRH program activities to ensure availability of quality and affordable family planning services.

Keywords: ANN, Forecasting, adolescent fertility rate.

I. INTRODUCTION

In this phase of sustainable development goals adolescent pregnancy is among the leading causes of maternal and child mortality (Gurung *et al.* 2020; Sukra *et al.* 2020; Kassa *et al.* 2018; Odimegwu & Mkwanaenzi, 2016; WHO, 2016; Neal *et al.* 2012). The 3rd sustainable development goal pays particular attention on ensuring good health and promotion of well-being for all at every stage of life. Target 3.1 and 3.2 focuses on the substantial reduction of maternal and child mortality, and target 3.7.2 aims at addressing sexual and reproductive health concerns especially that of adolescent girls and women (UN, 2020; WHO, 2019; UNICEF, 2018; UN, 2016, Patton *et al.* 2016; UN, 2015). Several studies conducted in developing countries revealed that maternal mortality can result from obstetric hemorrhage, eclampsia and sepsis (Althabe *et al.* 2015; Ganchimeg *et al.* 2014; Malabareye *et al.* 2012). On the other hand, other authors established that neonatal deaths are mainly caused by hypoxia, sepsis and severe prematurity (Kaphagawani & Kalipeni, 2017; Sedgh *et al.* 2016). Among other factors low socio-economic status has been identified as a major determinant of teenage pregnancy in low and middle income countries (Wado *et al.* 2019). The decline in adolescent fertility levels around the world can be attributed to increased use of modern methods of contraception, improvements in educational level and poverty reduction (Birhanu *et al.* 2019). Teenage pregnancy remains a huge public health problem in Cameroon. Adolescent fertility rate was reported to be standing at 99 births per 1000 women aged 15-19 in 2020 (World Bank, 2020).

This paper applies a machine learning approach to forecast adolescent fertility for Cameroon. The findings of this paper are expected to depict the future burden of adolescent fertility in the out of sample period. This will trigger a quick response to the challenge of teenage pregnancy through allocation of adequate resources to teenage pregnancy prevention programs in the country.

II. METHODOLOGY

The Artificial Neural Network (ANN) approach, which is flexible and capable of nonlinear modelling; 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 adolescent fertility rate for Cameroon.

Data Issues

This study is based on annual adolescent fertility rate in Cameroon for the period 1960 – 2020. The out-of-sample forecast covers the period 2021 – 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	R
Observations	49
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	0.004233
MSE	0.489308
MAE	0.488282

Residual Analysis for the Applied Model

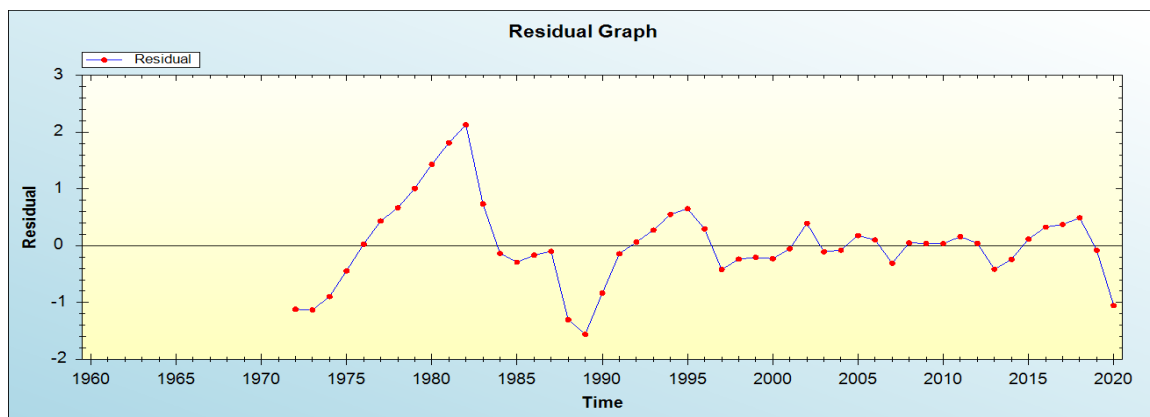


Figure 1: Residual analysis

In-sample Forecast for R

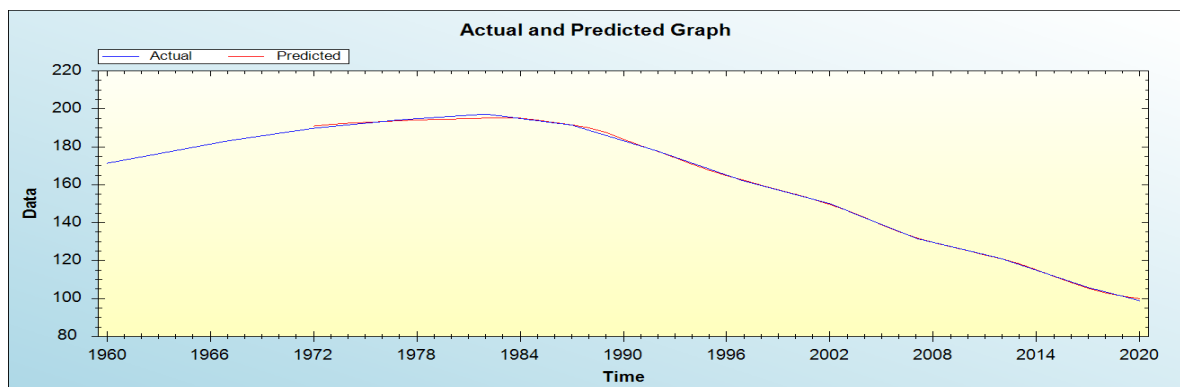


Figure 2: In-sample forecast for the R series

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

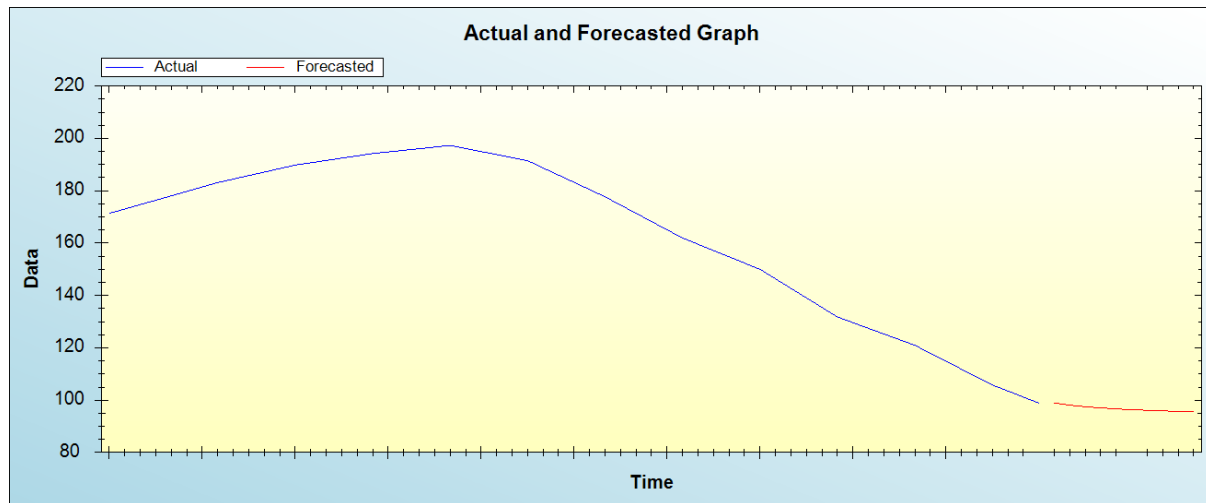


Figure 3: Out-of-sample forecast for R: actual and forecasted graph

Out-of-Sample Forecast for R: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	98.9130
2022	98.0894
2023	97.4871
2024	97.0637
2025	96.6630
2026	96.3733
2027	96.1235
2028	95.9094
2029	95.7798
2030	95.6364

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 adolescent fertility will continue to decline but remain high throughout the out of sample period.

IV. POLICY IMPLICATION & CONCLUSION

Teenage pregnancy remains a huge public health problem in Cameroon. Adolescent fertility rate was reported to be standing at 99 births per 1000 women aged 15-19 in 2020. This study applied a machine learning technique to forecast adolescent fertility for Cameroon. We established that adolescent fertility will continue to decline but remain high throughout the out of sample period. Therefore, we encourage the government to intensify health educational programs, promote girl child education and allocate more resources towards SRH program activities to ensure availability of quality and affordable family planning services.

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Citation of this Article:

Smartson. P. NYONI, Thabani NYONI, “Forecasting Future Trends of Adolescent Fertility for Cameroon Using the Artificial Neural Network Approach” Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 6, Issue 12, pp 167-170, December 2022. Article DOI <https://doi.org/10.47001/IRJIET/2022.612031>
