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Estimating the Future Burden of Adolescent Births for Comoros Using a Machine Learning Algorithm

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***Abstract* - This study employs annual time series data on adolescent fertility rate for Comoros 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 hover around 60 births per 1000 women aged 15-19 throughout the out of sample period. Therefore, we encourage Comoros authorities to scale up educational campaigns and improve access to quality and affordable sexual and reproductive health services among adolescents.**

Keywords: ANN, Forecasting, adolescent fertility rate.

I. INTRODUCTION

Pregnancy during the adolescence stage is considered as a worldwide public health issue of concern (Darroch *et al.* 2016). Adverse pregnancy outcomes can be short and long term. Short term adverse SRH outcomes include pregnancy induced hypertension, antepartum hemorrhage, preterm delivery and low birth weight (Brosens *et al.* 2019; Bokslang *et al.* 2016; Medhi *et al.* 2016). On the other hand long term complications such as mental disorders and repeat cycle of poverty can occur (Mathewos & Mekuria, 2018). Many previous authors identified risk factors of teen pregnancy such as living in poverty, lack of formal education, having family members who have experienced adolescent pregnancy, first sexual contact at young age, multiple sexual partners, inconsistent use of condoms; parental absence, child headed families, single parent household, peer pressure, lack of comprehensive SRH knowledge and exposure to social media (WHO, 2020; Bain *et al*. 2020; Reed *et al.* 2019; Makiwane *et al.* 2018; Smith *et al.* 2018;Yakubu & Salisu, 2018;Guilamo-Ramos*et al.* 2016; Diaz& Fiel, 2016; Azevedo *et al.* 2015; Lang & Weinstein, 2015). Teenage pregnancy continues to be a public health problem in Comoros. The country recorded a decline of adolescent fertility from 120 births per 1000 women aged 15-19 in 1960 down to 61 births per 1000 women aged 15-19 in 2020 (World Bank, 2020). This study applies a machine learning algorithm to forecast adolescent fertility in Comoros. The research findings are expected to depict the future burden of adolescent births in the out of sample period. This is expected to guide policy, planning and 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 Comoros.

Data Issues

This study is based on annual adolescent fertility rate in Comoros 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

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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	0.006171
MSE	0.303473
MAE	0.433699

Residual Analysis for the Applied Model

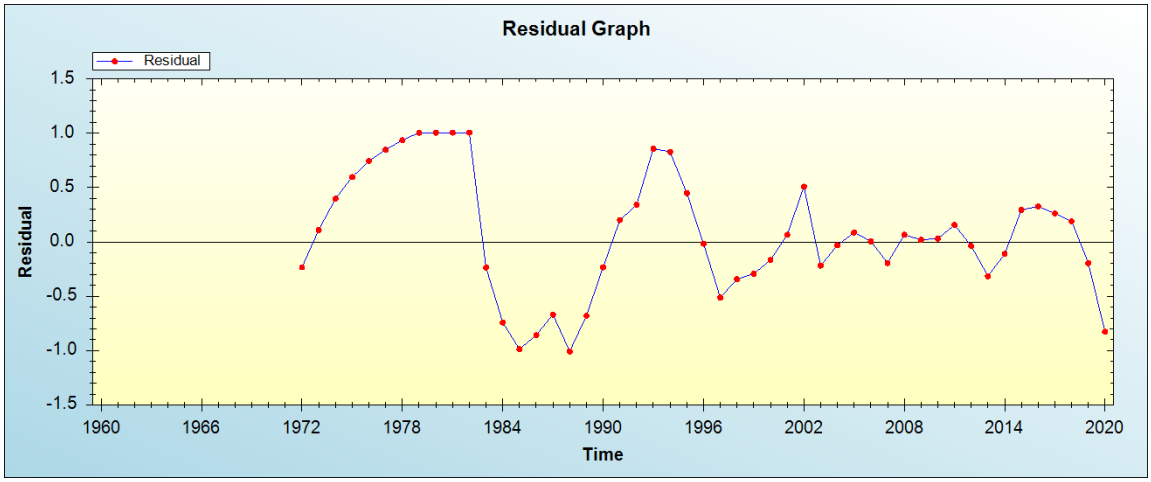

Figure 1: Residual analysis

In-sample Forecast for R

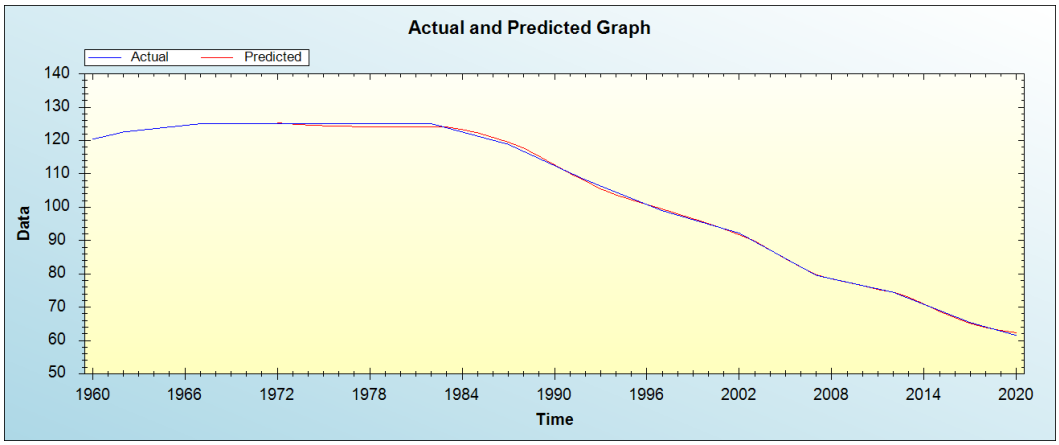

Figure 2: In-sample forecast for the R series

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

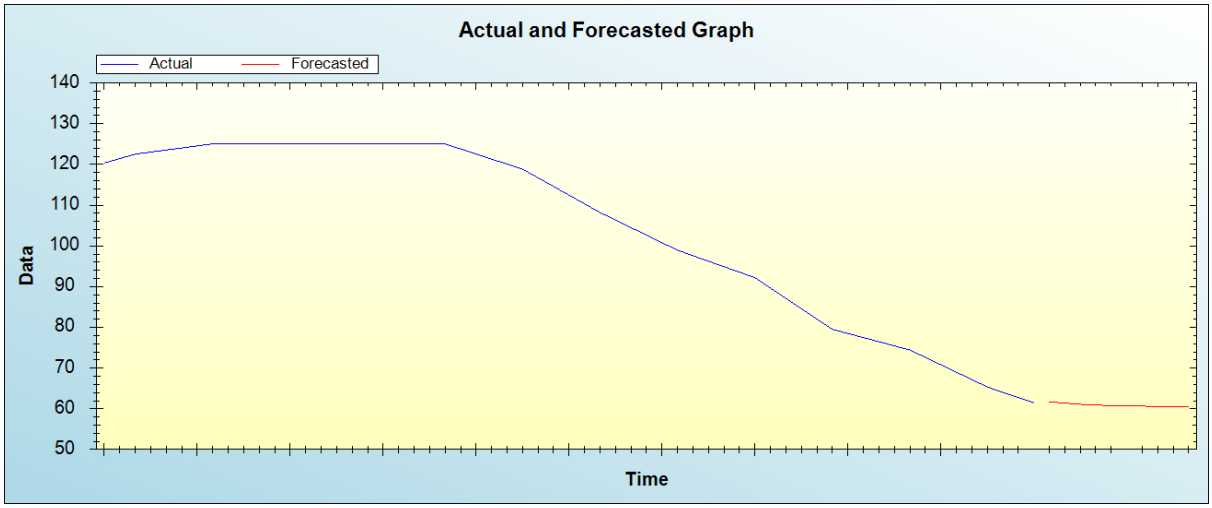

Figure 3: Out-of-sample forecast for R: actual and forecasted graph

Out-of-Sample Forecast for R: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted adolescent fertility rate
2021	61.7442
2022	61.4026
2023	61.0989
2024	60.9116
2025	60.8060
2026	60.7657
2027	60.6587
2028	60.5878
2029	60.5867
2030	60.5517

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 rate will hover around 60 births per 1000 women aged 15-19 throughout the out of sample period.

IV. POLICY IMPLICATION & CONCLUSION

Teenage pregnancy continues to be a huge public health problem in Comoros. The country recorded a decline of adolescent fertility from 120 births per 1000 women aged 15-19 in 1960 down to 61 births per 1000 women aged 15-19 in 2020. This study applied a machine learning technique to forecast future trends of adolescent fertility for Comoros. Our study findings indicate that adolescent fertility will hover around 60 births per 1000 women aged 15-19 throughout the out of sample period. Therefore, we encourage the government to scale up educational campaigns and improve access to quality and affordable sexual and reproductive health services among adolescents.

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