

Approximating the Future Burden of Adolescent Fertility for Equatorial Guinea Using the Artificial Neural Network Technique

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Abstract - This study uses annual time series data on adolescent fertility rate for Equatorial Guinea 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 remain very high throughout the out of sample period. Therefore, we encourage the government of Equatorial Guinea to scale up awareness campaigns among communities, strictly enforce laws to protect women's rights, promote girl child education, and provide funding for youth empowerment programs.

Keywords: ANN, Forecasting, adolescent fertility rate.

I. INTRODUCTION

Adolescent pregnancy is a worldwide problem which continues to cause maternal and child mortality both in developing and developed countries but more so in developing regions (Vogel *et al.* 2015; Sedgh *et al.* 2015; Ajala, 2014). Preventing pregnancy among adolescents is critical as it helps to substantially reduce adverse maternal and child health outcomes such as maternal and neonatal morbidity and mortality (Karataşlı *et al.* 2019; Ogawa *et al.* 2019). Previous studies highlighted that teenage girls from poor families, living in the rural areas, with low education level, having little knowledge on family planning services and who lack parental guidance are at increased risk of experiencing unintended pregnancies (Geda, 2019; Wado *et al.* 2019; Caffé *et al.* 2017). The 3rd sustainable development goal (SDG-3) target 3.7.2 focuses on adolescent sexual and reproductive health as a way to end all preventable maternal and child deaths. It stresses the importance of identifying SRH needs of adolescents in every country and addressing them taking into consideration individual needs (UN, 2020; WHO, 2019; UNICEF, 2018; UN, 2016; UN, 2015). According to the World Bank figures, adolescent fertility in the Equatorial Guinea was 149 births per 1000 females aged 15-19 years in 2020. This shows that teenage pregnancy is still a huge problem which requires urgent government action. This paper applies a machine learning algorithm to model and forecast future trends of adolescent fertility in Equatorial Guinea. The results are expected to highlight likely future burden of adolescent fertility in the out of sample period. This will facilitate policy making, planning, and allocation of resources to teenage pregnancy prevention programs.

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 Equatorial Guinea.

Data Issues

This study is based on annual adolescent fertility rate in Equatorial Guinea 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	E
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	0.007405
MSE	0.181680
MAE	0.294703

Residual Analysis for the Applied Model

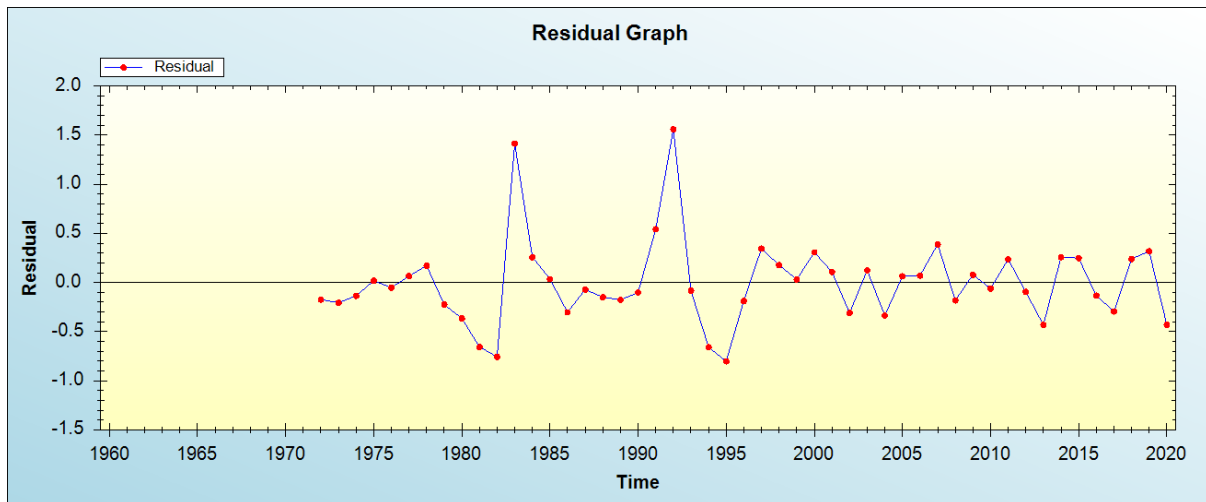


Figure 1: Residual analysis

In-sample Forecast for E

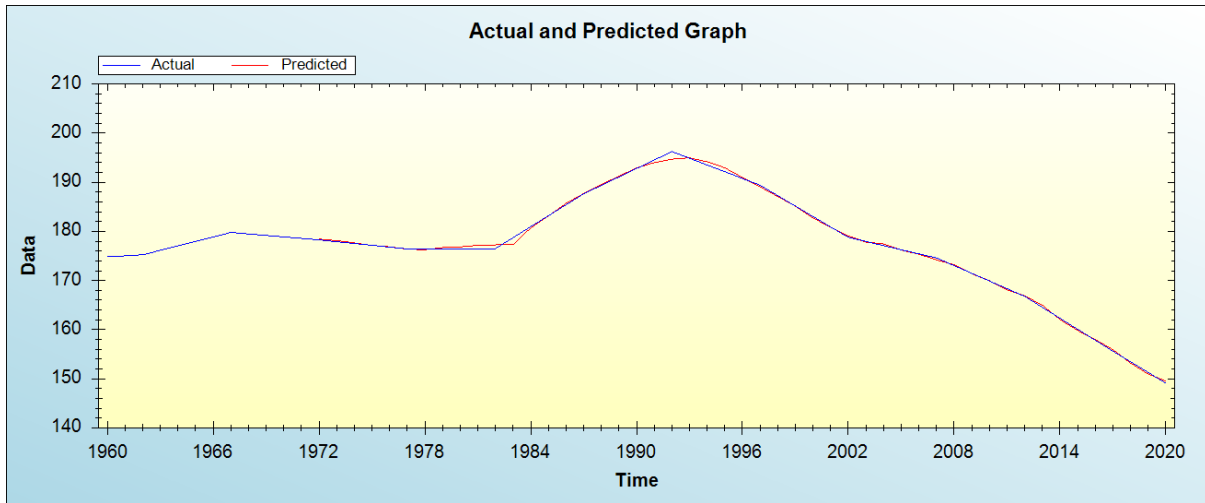


Figure 2: In-sample forecast for the E series

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

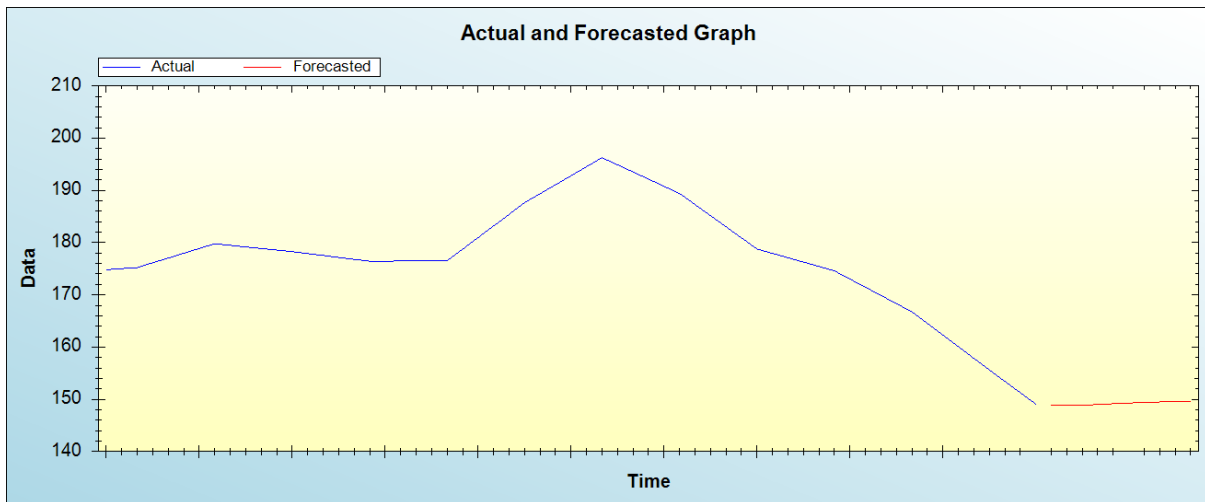


Figure 3: Out-of-sample forecast for E: actual and forecasted graph

Out-of-Sample Forecast for R: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted adolescent fertility rate
2021	148.8984
2022	148.8102
2023	148.8667
2024	149.0275
2025	149.1711
2026	149.3101
2027	149.4082
2028	149.5033
2029	149.5560
2030	149.5929

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 remain very high throughout the out of sample period.

IV. POLICY IMPLICATION & CONCLUSION

Adolescent pregnancy is a worldwide problem which continues to cause maternal and child mortality both in developing and developed countries but more so in developing regions. Teenage girls from poor families, living in the rural areas, with low education level, having little knowledge on family planning services and who lack parental guidance are at increased risk of experiencing unintended pregnancies and other adverse pregnancy outcomes. Adolescent fertility in Equatorial Guinea gradually declined during the period 1960-2020. However, fertility level remains very high as the country reported 149 births per 1000 females aged 15-19 years in 2020. This shows that teenage pregnancy and child birth is still a huge problem which requires urgent government action. This study applied a machine learning technique to forecast future trends of adolescent fertility for Equatorial Guinea. Our study findings revealed that adolescent fertility will remain very high throughout the out of sample period. Therefore, the government must scale up awareness campaigns among communities, strictly enforce laws to protect women's rights, promote girl child education, and provide funding for youth empowerment programs.

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