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Identifying Future Trends of Adolescent Fertility for Barbados Using the Artificial Neural Network Technique

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***Abstract* - This research article employs annual time series data on adolescent fertility rate for Barbados 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 decline throughout the out of sample period. Therefore, the government of Barbados should continue supporting sexual and reproductive health programs with priority being given to strategies to prevent teenage pregnancy in order to avert adverse maternal and neonatal health outcomes.**

Keywords: ANN, Forecasting, adolescent fertility rate.

I. INTRODUCTION

The 1994 International conference on Population and development (ICPD) was a significant event for adolescent sexual and reproductive health as the signatories agreed to address sexual and reproductive problems of every individual especially for adolescents who are at high risk of unwanted pregnancy, STIs and unsafe abortions (UN, 1995). All the country representatives declared and decided to uphold sexual and reproductive health and rights as fundamental human rights. The laid down strategies included enacting appropriate legislative laws and enforcing them, offering universal education particularly promoting girl child education and addressing social, cultural and traditional beliefs which greatly influence adolescent sexual and reproductive health. It was recommended that national strategic plans and budgets should incorporate activities that are designed to reduce teenage pregnancies especially stopping voluntary or forced child marriages. In addition, strengthening program linkages and surveillance mechanisms will improve detection and management of sexual and reproductive health issues among the adolescent population. Literature shows that early and unwanted adolescent pregnancies are associated with adverse health, educational, social and economic outcomes (Ochen*et al.* 2019;Ayele*et al.* 2019;Darroch*et al.* 2016;Neal*et al.* 2012). Problems such as maternal deaths, low birth weight, school dropouts and poverty will persist if adolescent pregnancies are not prevented and managed properly. Under the 3rd sustainable development goal, target 3.7 focuses on ensuring quality sexual and reproductive health services including that of adolescents. The aim is to provide comprehensive SRH services and implement strategies to prevent teenage pregnancies. Ultimately, there should be evident and substantial reduction of maternal, neonatal and under five mortality by 2030 (UN, 2020; UNICEF, 2019; WHO, 2019; UNICEF, 2018; UN, 2016; UN, 2015).

The aim of this paper is to project future trends of adolescent fertility in Barbados using a machine learning technique and the findings are expected to inform policy makers to plan, make decisions and allocate adequate resources to national programs designed to end teenage pregnancies and manage complications related to adolescent pregnancies.

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 Barbados.

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Data Issues

This study is based on annual adolescent fertility rate in Barbados 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 (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	0.002172
MSE	0.239298
MAE	0.383989

Residual Analysis for the Applied Model

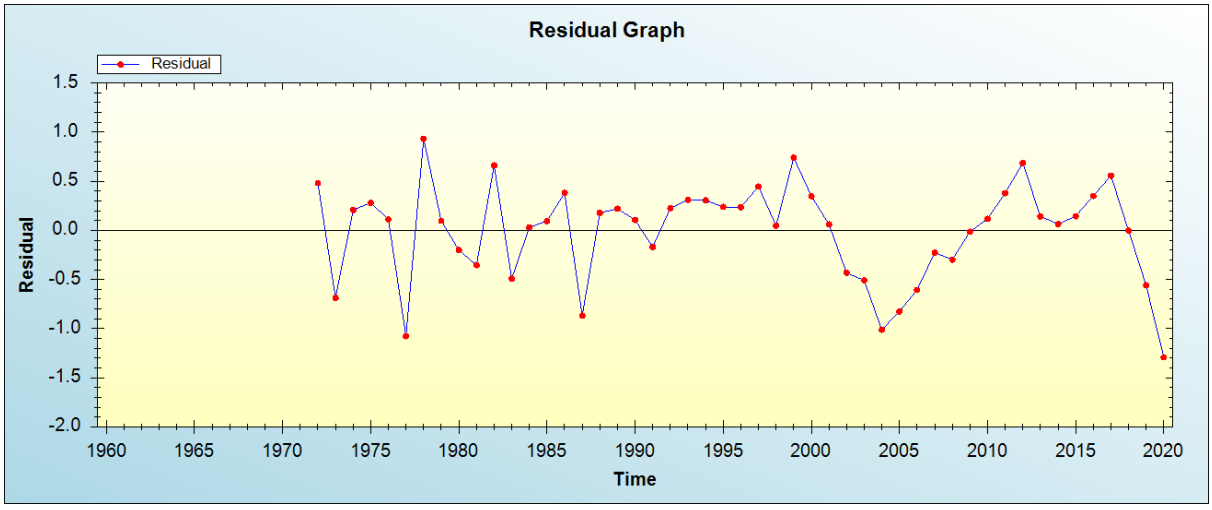

Figure 1: Residual analysis

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In-sample Forecast for R

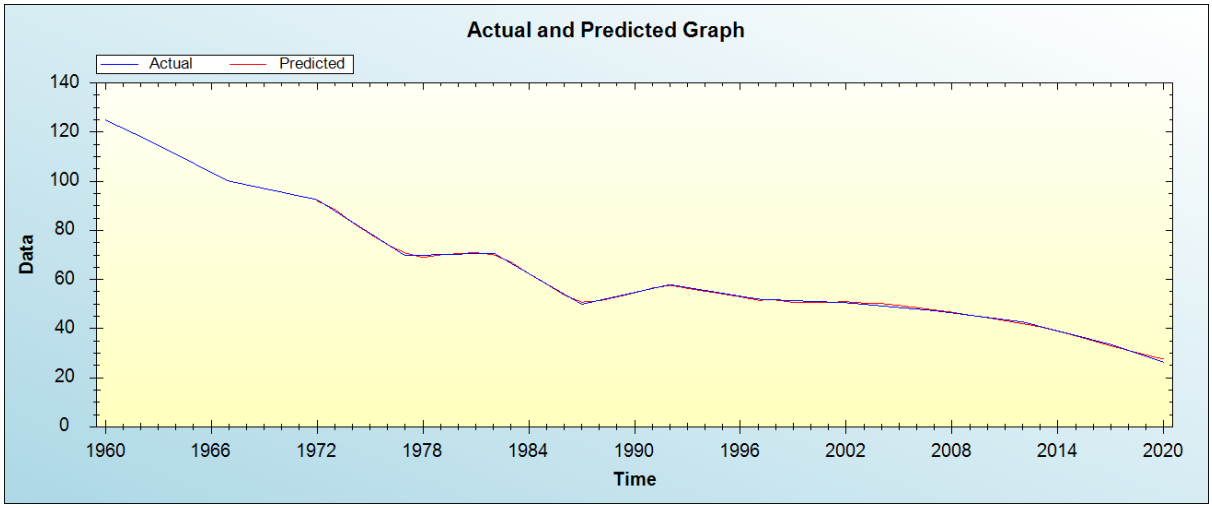

Figure 2: In-sample forecast for the R series

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

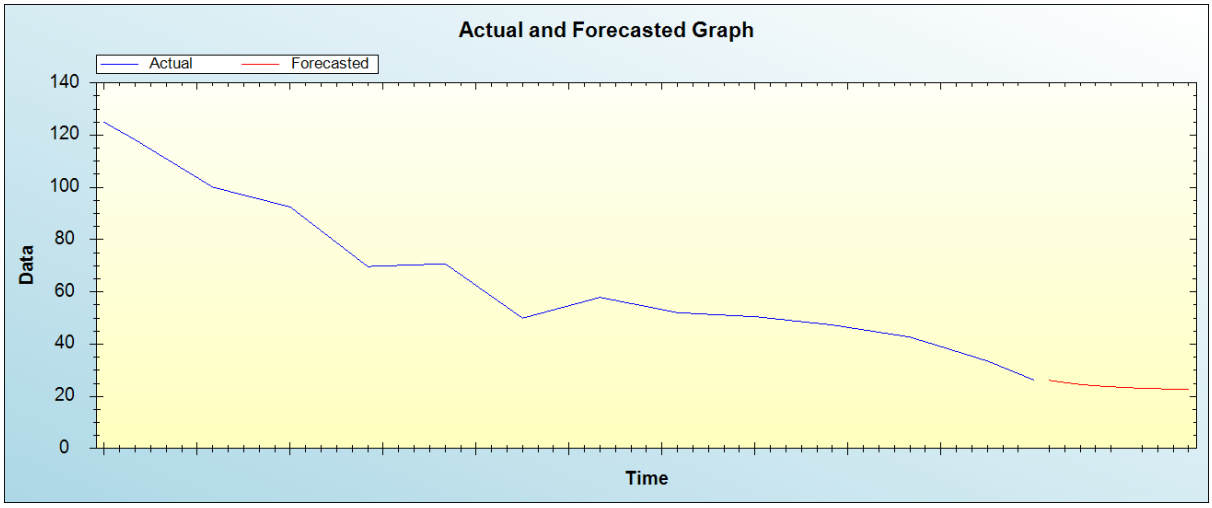

Figure 3: Out-of-sample forecast for R: actual and forecasted graph

Out-of-Sample Forecast for R: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted adolescent fertility rate
2021	26.1160
2022	25.2977
2023	24.5605
2024	24.0618
2025	23.6946
2026	23.3542
2027	23.1155
2028	22.9355
2029	22.8161
2030	22.6693

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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 adolescent fertility rate will decline throughout the out of sample period.

IV. POLICY IMPLICATION & CONCLUSION

Adolescent fertility in Barbados has been gradually declining over the period 1960-2020. This reflects the positive impact of government strategies such as the national family planning program, improvements in the education sector and better employment opportunities for women. This research article applied a machine learning technique to forecast future trends of adolescent fertility for Barbados. Our research findings indicate that adolescent fertility will continue to decline throughout the out of sample period. Therefore, the government must continue supporting sexual and reproductive health programs with priority being given to strategies to prevent teenage pregnancy in order to avert adverse maternal and neonatal health outcomes.

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