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Forecasting Future Trends of Adolescent Fertility for Afghanistan Using Artificial Neural Networks

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***Abstract* - This research article employs annual time series data on adolescent fertility rate for Afghanistan 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 55 births per 1000 women aged 15-19 years throughout the out of sample period. Therefore, we encourage the government to improve access to quality and affordable sexual and reproductive health services among adolescents, promote girl child education and protect sexual and reproductive health rights of women and girls.**

Keywords: ANN, Forecasting, adolescent fertility rate.

I. INTRODUCTION

Sexual and reproductive health services are essential for the achievement of the 3rdsustainable development goal (Starrset al. 2018). The 2015 Agenda 2030 for sustainable development and the 1994 International conference on Population and health both emphasized the importance of sexual and reproductive health as a fundamental human right. Sexual and reproductive health rights of women and girls should be respected and women should be accorded equal opportunities with their male counterparts so that they make their contribution to economic development. Individuals must have rights to choose sexual partners, number of children and timing of having children. Bad socio-cultural practices contribute significantly to the physical and sexual abuse of women in low-middle income countries. Research has shown that many developing countries are witnessing adverse pregnancy outcomes such as abortions and HIV infections which are aggravated by sexual and gender based violence (Glasier et al. 2006; Eczati et al. 2002).Investing in reproductive health and spending has been proven to yield a positive impact on maternal and child health outcomes, and also reduce poverty (UN, 2019; Borghi et al. 2006; Adam, 2004; Ensor, 2005; UNFHR, 2004; Jowett, 2000). In line with the agenda 2030 for sustainable development, this paper applies a machine learning algorithm to forecast future trends of adolescent fertility for Afghanistan. The findings thereof are expected to provide an insight of the scale of adolescent birth rates in the out of sample period. This will guide policy makers to draft evidenced based policies that will help substantially reduce teenage pregnancies in order to avert adverse maternal and child health outcomes.

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 ratefor Afghanistan.

Data Issues

This study is based on annual adolescent fertility rate in Afghanistan 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.

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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	0.007572
MSE	1.015842
MAE	0.734603

Residual Analysis for the Applied Model

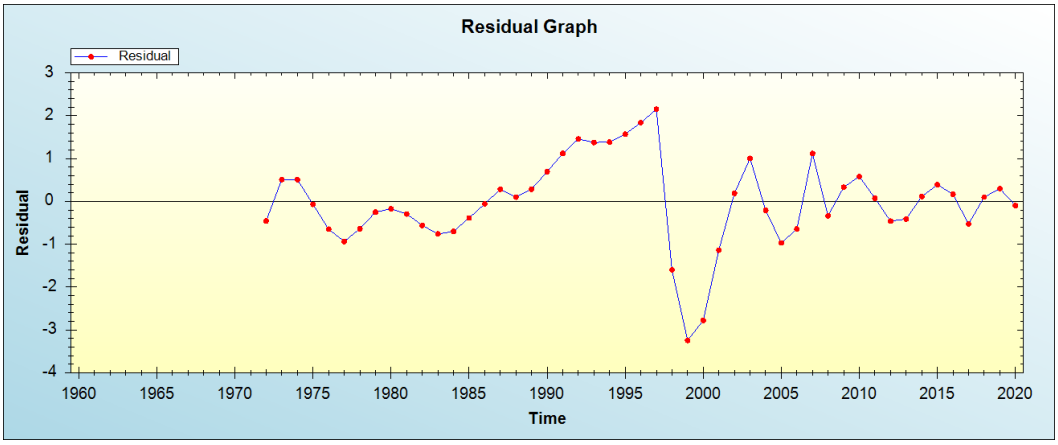

Figure 1: Residual analysis

In-sample Forecast for R

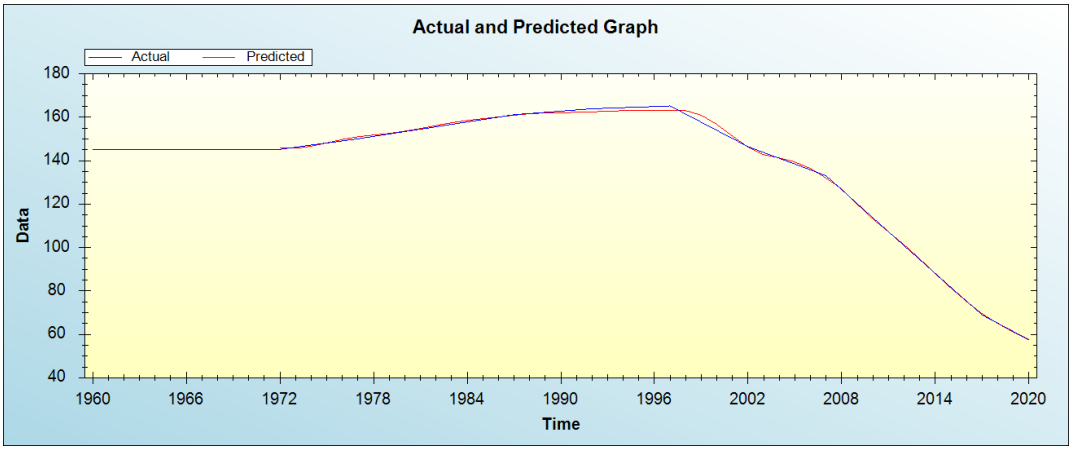

Figure 2: In-sample forecast for the R series

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

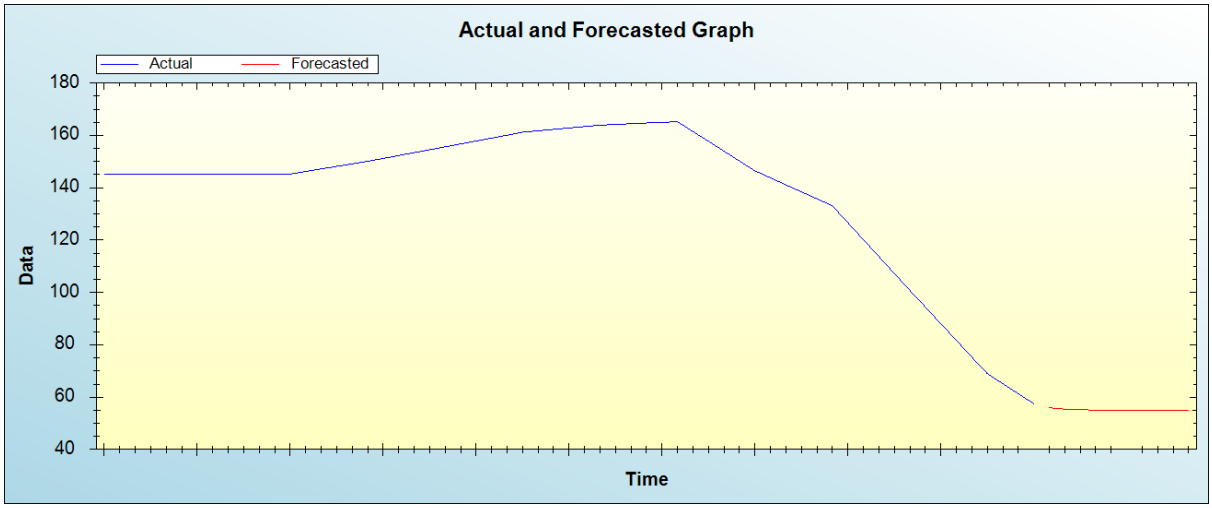

Figure 3: Out-of-sample forecast for R: actual and forecasted graph

Out-of-Sample Forecast for R: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted adolescent fertility rate
2021	55.9735
2022	55.4051
2023	55.1986
2024	55.1084
2025	55.0686
2026	55.0495
2027	55.0366
2028	55.0303
2029	55.0313
2030	55.0352

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 hover around 55 births per 1000 women aged 15-19 over the out of sample period.

IV. POLICY IMPLICATION & CONCLUSION

The 1994 International Conference on Population and Development (ICPD) was a landmark event for advancing gender equality and upholding women's rights. Signatories to the conference agreed to recognize the importance of sexual and reproductive health rights for every individual. Every individual has the right to access SRH services at any time. Girls should be given a chance to go to school so that they can realize their lifetime goals. In addition, women should have equal employment opportunities as their male counterparts. Eliminating harmful cultural practices which promote early child marriages is vital in the reduction of teenage pregnancy. This study applied the artificial neural network approach to forecast future trends of adolescent fertility for Afghanistan. Our study findings revealed that adolescent fertility will hover around 55 births per 1000 women aged 15-19 throughout the out of sample period. Therefore, the government is encouraged to improve access to quality and affordable sexual and reproductive health services among adolescents, promote girl child education and protect sexual and reproductive health rights of women and girls.

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