

# Forecasting Total Fertility Rate (TFR) In Peru

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**Abstract - In this research paper, the ANN approach was applied to analyze TFR in Peru. The employed annual data covers the period 1960-2018 and the out-of-sample period ranges over the period 2019-2030. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is stable in forecasting TFR in Peru. The results of the study indicate that annual total fertility rates in Peru are likely to decline slightly over the out-of-sample period. Therefore, the authorities in the country are encouraged to continuously focus on addressing challenges faced by adolescents and young adults in accessing family planning services as well as women empowerment.**

**Keywords:** ANN, Forecasting, Total fertility rate (TFR).

## I. INTRODUCTION

Many developing countries have made significant strides in improving quality and access to maternal and child health services, however maternal mortality ratio remains high in Sub-Saharan Africa with approximately 550 maternal deaths per 100 000 live births in 2015 (WHO, 2015). Lack of quality care, unsafe abortions and poor health infrastructure are the major causes of maternal and neonatal deaths (WHO, 2017; Haddad, 2009). Several governments are committed to the 1994 International conference on Population and development (ICPD) and adopted recommendations by WHO to respond to women’s sexual and reproductive health rights and needs such as health education, access to information on family planning, improved quality of prenatal, antenatal and postnatal care (Sullivan et al, 2020). Globally approximately 40 % of all pregnancies are unintended and half of them end up in abortion (Sedgh et al, 2006). Furthermore commercial sexwork is rampant in developing countries and there is lack of comprehensive knowledge on family planning services among adolescent girls and young women (Workie et al, 2019). The aim of this study is to forecast fertility rates in Peru using an artificial intelligence algorithm. The results of the study are expected to highlight likely fertility trends in the out of sample period to facilitate policy making and resource mobilization for the health sector, education and employment creation.

## II. METHODOLOGY

The Artificial Neural Network (ANN) approach, which is flexible and capable of nonlinear modeling; 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 total fertility rates in Peru.

### Data Issues

This study is based on annual total fertility rate (births per woman)in Peru for the period 1960 – 2018.The out-of-sample forecast covers the period 2019 – 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	A
Observations	47 (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	0.112987
MSE	0.098504
MAE	0.258799

Residual Analysis for the Applied Model

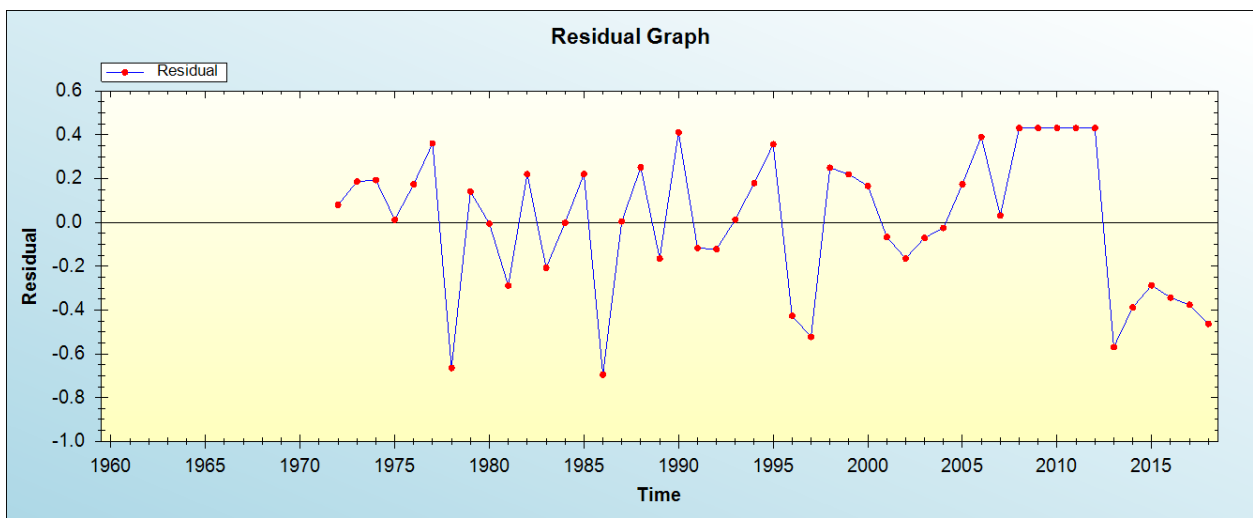


Figure 1: Residual analysis

In-sample Forecast for A

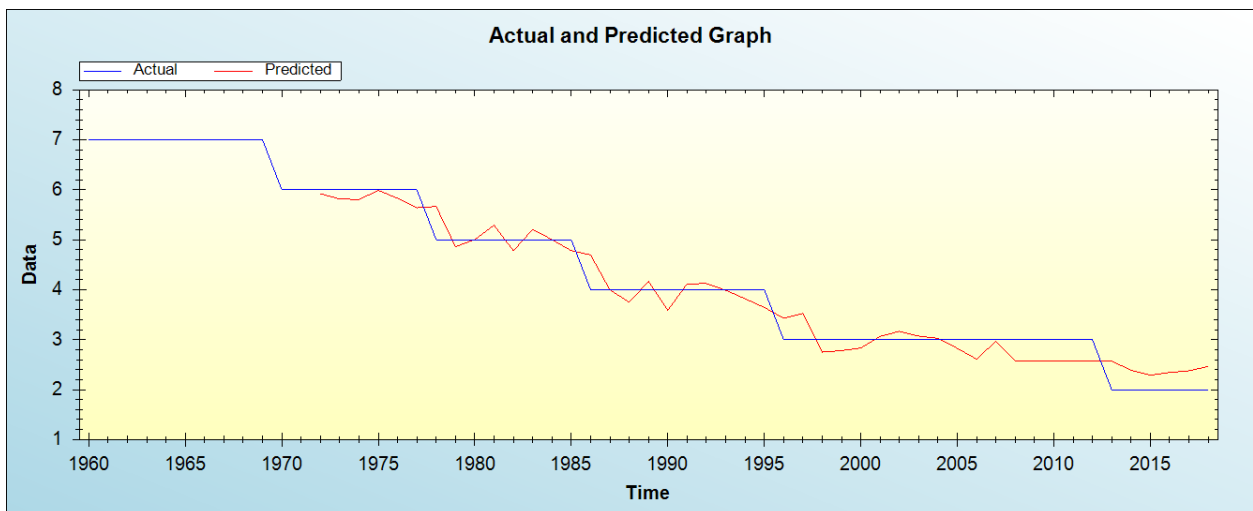


Figure 2: In-sample forecast for the A series

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

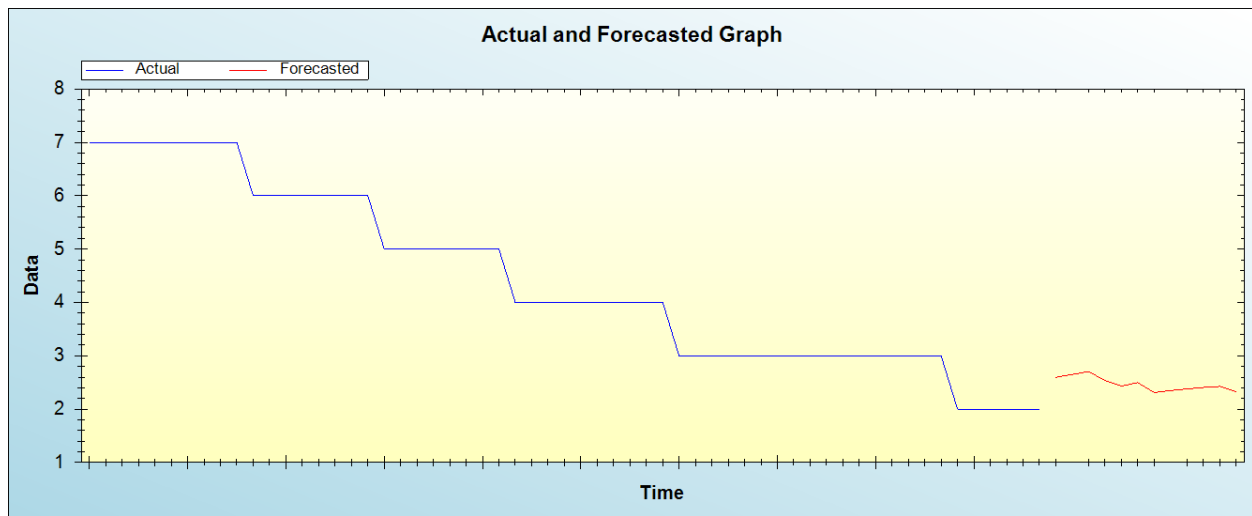


Figure 3: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	2.5972
2020	2.6499
2021	2.7043
2022	2.5366
2023	2.4319
2024	2.4975
2025	2.3102
2026	2.3490
2027	2.3779
2028	2.4062
2029	2.4260
2030	2.3241

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 total fertility rates in Peru are likely to slightly decline over the out-of-sample period.

**IV. CONCLUSION & RECOMMENDATIONS**

Sexual and reproductive health is a fundamental human right. Adolescents and youths across the globe must enjoy this right and contribute to economic development in their settings. In this study we applied the artificial neural network approach to project total fertility rates in Peru. The ANN model projections suggest that annual total fertility rates in the country are likely to decline over the out-of-sample period. Therefore, the government of Peru should continuously focus on addressing challenges faced by adolescents and young adults in accessing family planning services as well as women empowerment.

**REFERENCES**

- [1] World Health Organization, U., UNFPA. World Bank group and the United Nations population division (2015). Trends in maternal mortality: 1990 to 2015.
- [2] WHO (2017). World Health Organization & Health statistics 2017 (2017). Monitoring health for the SDGs. W. press, Editor. Geneva: World Health Organization; 2017.
- [3] Haddad LB., & Nour N M (2009). Unsafe abortion: unnecessary maternal mortality. Rev Obstet Gynecol. 2009; 2(2):122–6.

- [4] Sedgh G, et al (2016). Abortion incidence between 1990 and 2014: global, regional, and sub-regional levels and trends. *Lancet*, 388(10041):258–67.
- [5] Workie H M., & Kassie TW Hailegiyorgis (2016). Knowledge, risk perception, and condom utilization pattern among female sex workers in Dire Dawa, Eastern Ethiopia: a cross-sectional study. *Pan African Med J.* 2019; 32: 185. <https://doi.org/10.11604/pamj.2019.32.185.16574>.
- [6] Gentiane Perrault Sullivan., Fernand Aimé Guédou., Georges Batona., Frédéric Kintin., Luc Béhanzin., Lisa Avery., Emmanuelle Bédard., Marie-Pierre Gagnon., Djimon Marcel Zannou., Adolphe Kpatchavi and Michel Alary (2020). Overview and factors associated with pregnancies and abortions occurring in sex workers in Benin, *BMC Women's Health* (2020) 20:248 <https://doi.org/10.1186/s12905-020-01091-6>.

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