

# Predicting Future Trends of Under Five Mortality Rate for Honduras Using Artificial Neural Networks

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**Abstract** - This study uses annual time series data on under five mortality rate (U5MR) for Honduras from 1960 to 2020 to predict future trends of U5MR over the period 2021 to 2030. Residuals and forecast evaluation statistics indicate that the applied ANN (12, 12, 1) model is stable in forecasting U5MR. The results of this study indicated that annual U5MR will continue to decline over the out of sample period. Hence, we implore the authorities in Honduras to allocate more resources to the maternal and child health (MNCH) program and address all the issues that affect the health of under five children particularly in the rural areas.

**Keywords:** ANN, Forecasting, U5MR.

## I. INTRODUCTION

The implementation of sustainable development goals is going on well in several parts of the world with most countries reporting a decline in under five mortality (World Bank, 2019). However, several challenges are contributing significantly to mortality among under five children which include long distances to the health facilities, social and cultural practices, and demographic factors (Ezeh, 2017; Abir *et al.* 2015; Akinyemi *et al.* 2015). The existing challenges demand serious commitment and a collaborative approach. All UN member states agreed to fight poverty, hunger, economic challenges and global health problems (UN, 2016; UN, 2015). Health challenges that require urgent attention include maternal and child health issues. Maternal, newborn and under five mortality have emerged to be a big problem for developing countries which are currently struggling to solve other issues such as poverty, climate change effects and economic challenges (UNICEF, 2019). It is critical at this juncture for global partners to direct more resources to low and middle income countries so that they accelerate the implementation process of the global action plan. Ensuring good health and promotion of well-being for all at all stages of life is the focus of the 3<sup>rd</sup> sustainable development goal. SDG 3 target 3.2 was designed to bring down neonatal and under five mortality to levels as low as 12 neonatal deaths per 1000 live births and 25 under five deaths per 1000 live births by 2030 (UN, 2020; UNICEF, 2019; WHO, 2019; UNICEF, 2018). The aim of this study is to forecast future trends of under-five mortality rate for Honduras using the artificial neural network approach. The findings of this research will guide child health policies, planning and allocation of resources in order to end all preventable under five deaths.

## II. LITERATURE REVIEW

Bariki *et al.* (2020) investigated factors affecting infant mortality among the general population of Ethiopia, 2016. A Community-based cross-sectional study was conducted in all regions of Ethiopia from January 18 to June 27, 2016. A total of 10,641 live births were included in the analysis. Data were analyzed and reported with both descriptive and analytic statistics. Bivariable and multivariable multilevel logistic regression models were fitted by accounting correlation of individuals within a cluster. Adjusted odds ratio (AOR) with 95% confidence interval was reported to show the strength of the association and its significance. The study findings indicated that sex of the child, multiple births, prematurity, and residence were notably associated with infant mortality. The risk of infant mortality has also shown differences across different regions. Juarez *et al.* (2020) conducted a quality improvement study to increase the detection of neonatal complications by lay midwives in rural Guatemala, thereby increasing referrals to a higher level of care. A quality improvement team in Guatemala reviewed drivers of neonatal health services provided by lay midwives. Improvement interventions included training on neonatal warning signs, optimized mobile health technology to standardize assessments and financial incentives for providers. The primary quality outcome was the rate of neonatal referral to a higher level of care. It was found that structured improvement interventions, including mobile health decision support and financial incentives, significantly increased the detection of neonatal complications and referral of neonates to higher levels of care by lay midwives operating in rural home-based settings in Guatemala. A study by Souza *et al.* (2019) investigated the determinants of neonatal mortality in Foz do Iguassu in Brazil. The authors analyzed all neonatal deaths that occurred in Foz do Iguassu from 2012 to 2016. Birth and mortality data were extracted from two national governmental databases (SINASC and SIM). It was found that high rate of neonatal death in Foz do Iguassu is strongly associated with newborn characteristics and not associated with maternal socio-demographic characteristics. A cross-sectional survey was conducted by Biracyaza & Habimana (2019) to investigate predictors of infant mortality in Rwanda from 2011 to 2015. A survey was conducted using data from 2014/2015 Rwanda Demographic and Health Survey. Target population was women aged 15-49 years from sampled households. All 492 of the clusters selected were surveyed for 2014/2015 RDHS. The study findings showed that factors

associated with IM were grouped into community, ecological, socio-economic and proximate factors and identified that each group consists of multifactor that influence the infant mortality rate.

### III. 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 under five mortality rate for Honduras.

#### Data Issues

This study is based on annual under five mortality rate in Honduras 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.

### IV. FINDINGS OF THE STUDY

#### ANN Model Summary

Table 1: ANN model summary

Variable	H
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	0.046050
MSE	17.730466
MAE	1.923676

#### Residual Analysis for the Applied Model

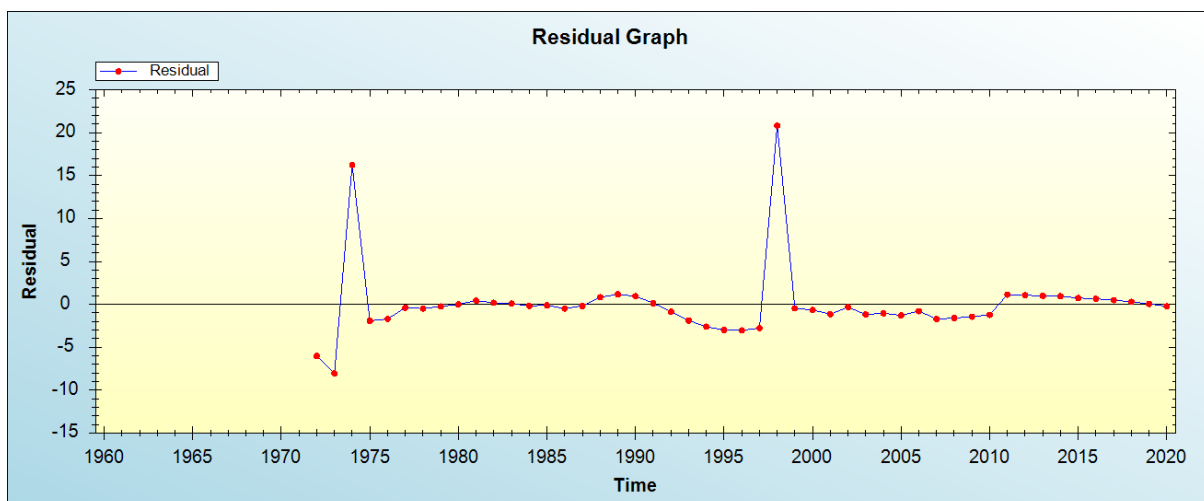


Figure 1: Residual analysis

In-sample Forecast for H

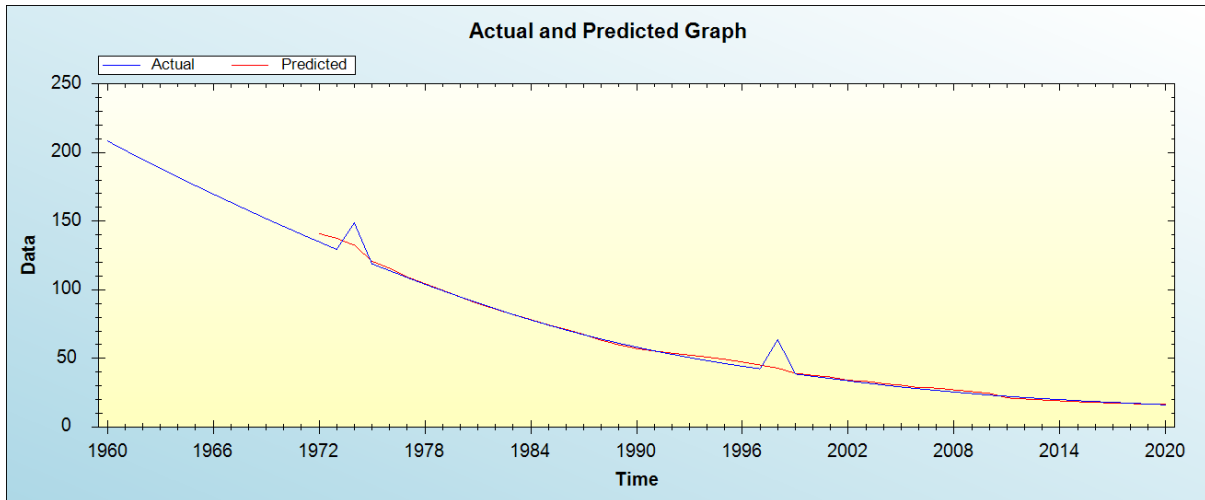


Figure 2: In-sample forecast for the H series

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

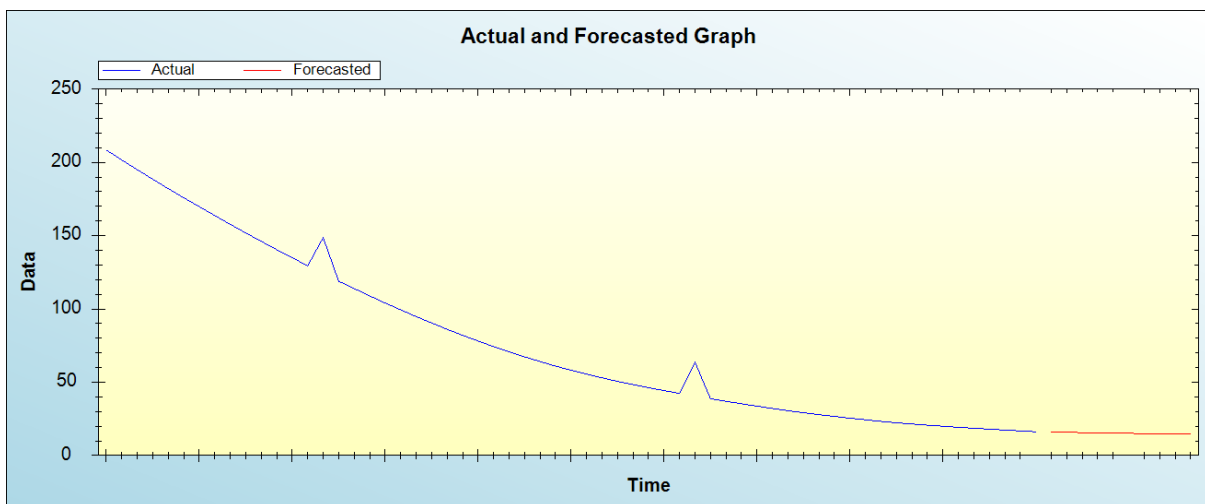


Figure 4: Out-of-sample forecast for H: actual and forecasted graph

Out-of-Sample Forecast for H: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	16.1542
2022	15.9003
2023	15.6766
2024	15.4766
2025	15.2986
2026	15.1458
2027	15.0064
2028	14.8882
2029	14.7817
2030	14.6963

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 U5MR will continue to decline over the out of sample period.

## V. POLICY IMPLICATION & CONCLUSION

Honduras has made significant progress in the reduction of under-five mortality as the country has reported a downward trend in under five mortality rate over the past decades. This study applied the ANN model to predict U5MR in Honduras. The study findings revealed that annual U5MR will continue to decline over the out of sample period. Therefore, we encourage the authorities in Honduras to allocate more resources to the maternal and child health (MNCH) program and address all the issues that affect the health of under five children especially in the rural areas.

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