

# Forecasting Infant Mortality Rate in Somalia Using Artificial Neural Networks

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**Abstract** - In this research article, the ANN approach was applied to analyze infant mortality rate in Somalia. The employed data covers the period 1982-2020 and the out-of-sample period ranges over the period 2021-2030. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is stable in forecasting infant mortality rate in Somalia. The ANN (12, 12, 1) model predicted that infant mortality in the country is likely to surge up to as high as 109/1000 live births per annum around 2027. These results are an early warning of a possible disastrous situation that can be experienced in Somalia if drastic action is not taken now. Therefore the government is encouraged to ensure high coverage of child immunizations, Vitamin A supplementation, exclusive breast feeding of babies for at least 6 months and institutional deliveries. The suggested 7-fold policy directions summarize what the government ought to do in order to address infant mortality in Somalia.

**Keywords:** ANN, Forecasting, Infant mortality rate.

## I. INTRODUCTION

Public health surveillance is the collection of health data for use in health planning, disease control and health promotion. It is used to monitor changes or trends in health factors such as prevalence and incidence of disease, emerging diseases or health events, geographic distribution and risk group distribution (Zhang et al, 2014; Weng et al, 2017). It is also used to detect outbreaks or utilized as early warning systems. Surveillance helps to provide information that can be used to design interventional programs or activities and to assess the effectiveness of intervention strategies. Health institutions in any country should strengthen their health information systems to facilitate timely and proper collection of data (Camilla et al, 2018) Public health authorities should ensure that every health facility has standard reporting tools or reporting forms. Site supervisors should ensure that relevant data collection tools are available at site level and must be completed timely before preparation of monthly or quarterly reports. Several governments in low and middle income countries have adopted the electronic health information systems although there is a lot that needs to be done for example improving internet access, addressing system challenges and adequate training of health personnel on the use of the electronic health information system. Time series modelling and forecasting techniques are very important tools in public health surveillance. They serve as early warning tools by detecting abnormal likely future trends of infectious diseases or health related events thereby facilitating planning and emergency preparedness and response. In this paper we apply artificial neural network, ANN (12, 12, 1) model to project infant mortality rate in Somalia. The model is called the multilayer perceptron consisting of 3 layers of neurons namely input, hidden and output neurons which are connected by connection weights (Zhao et al, 2020; Nyoni et al, 2020; Kaushik & Sahi, 2018; Yan et al, 2018; Fojnica et al, 2016; Zhang, 2003).

## II. METHODOLOGY

The Artificial Neural Network (ANN); is a data processing system composed of a huge number of simple and highly interconnected processing elements resembling a biological neural system. It has the capability of learning from any data-set to describe the nonlinear and interaction effects with great accuracy. No strict rules exist for the determination of the ANN structure hence 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 infant mortality rates in Somalia.

### Data Issues

This study is based on annual infant mortality rates in Somalia for the period 1982 – 2020. The out-of-sample forecast covers the period 2021 to 2030. Infant mortality rate, which is simply a proxy for infant deaths; for the purposes of this study, is defined as the number of infants dying before reaching one year of age, per 1000 live births in a given year. All the data employed in this paper was gathered from the World Bank.

## III. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	B
Observations	27 (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	0.022812
MSE	0.296962
MAE	0.434441

Residual Analysis for the Applied Model

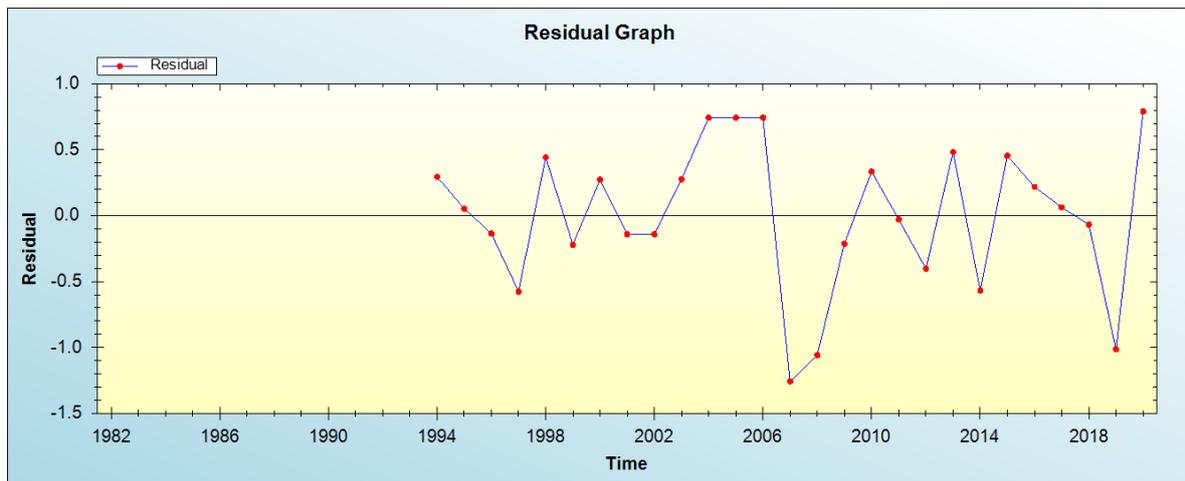


Figure 1: Residual analysis

In-sample Forecast for B

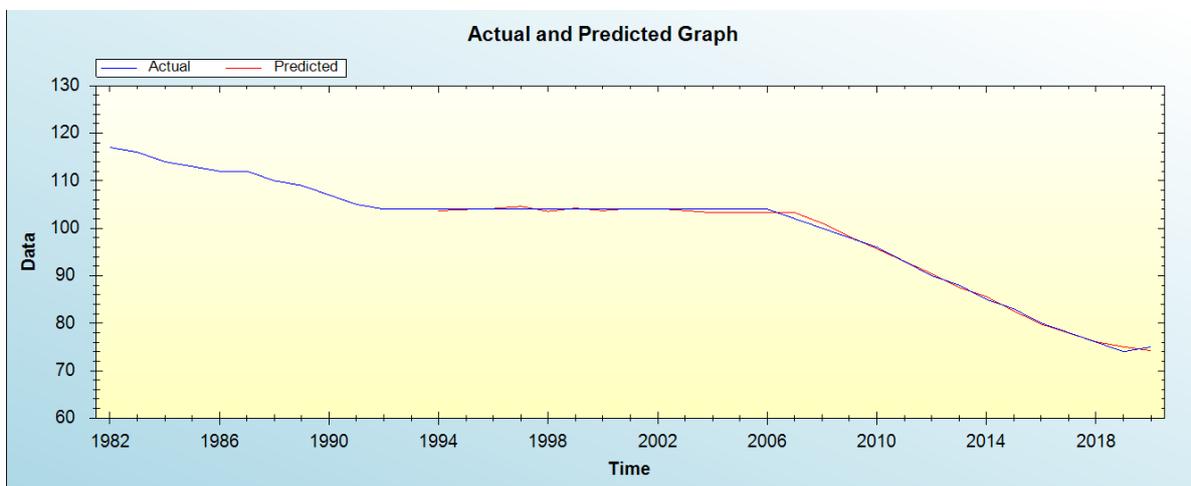


Figure 2: In-sample forecast for the B series

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

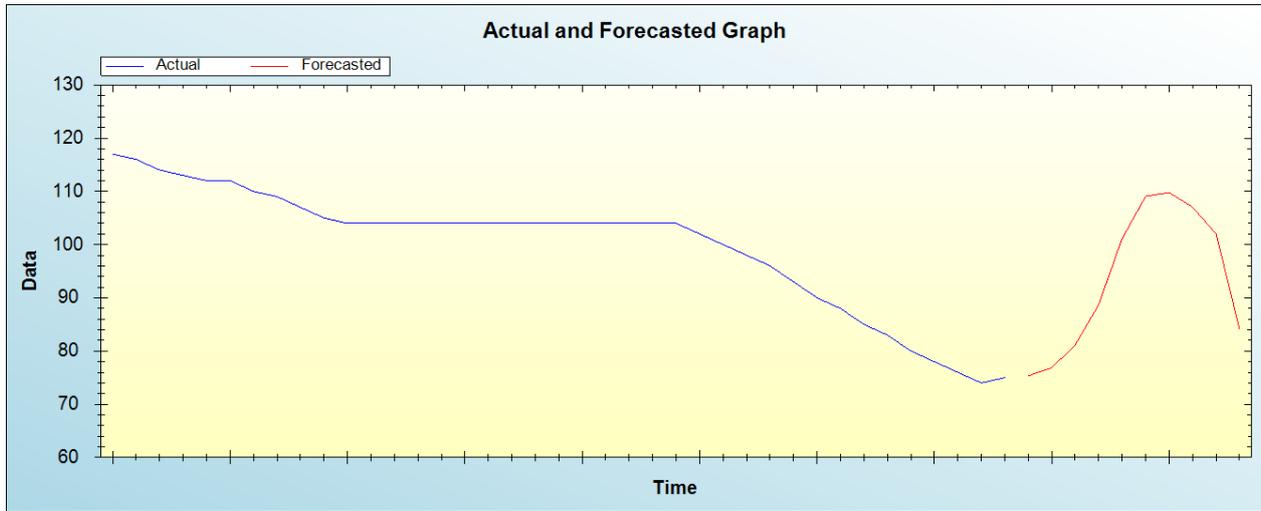


Figure 3: Out-of-sample forecast for B: actual and forecasted graph

Out-of-Sample Forecast for B: Forecasts only

Table 3: Tabulated out-of-sample forecasts

Year	Forecasts
2021	75.3279
2022	76.8695
2023	81.1461
2024	88.7068
2025	101.1242
2026	109.1167
2027	109.7645
2028	107.0300
2029	102.0308
2030	84.1347

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 infant mortality in Somalia is likely to generally follow an upwards trend as shown in table 3 above. This is an early warning sign to public health policy makers in the country.

**IV. CONCLUSION AND POLICY RECOMMENDATIONS**

Preventing infant mortality remains one of the main objectives of the health ministry in Somalia. The Somali government remains committed to ending preventable deaths infants in the country. The study used annual data to analyze the trends of infant mortality in Somalia. The applied model is the ANN model. In order to make sure that infant mortality in the country significantly declines, the government of Somalia ought to consider the following policy suggestions:

- i. The Somali government should continue to encourage mothers to breast-feed their babies adequately.
- ii. There is need for all Somali child-bearing women to be vaccinated against common illnesses.
- iii. There is need to prevent birth defects in Somalia.
- iv. The government of Somalia should address preterm birth, low birth-weight and their outcomes.
- v. The government of Somalia should also ensure adequate access to pre-pregnancy and prenatal care.
- vi. There is need to educate, especially, mothers on the importance of creating a safe infant sleep environment in the country.

- vii. Healthcare providers in Somalia need to use newborn screening activities in order to detect hidden conditions.

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