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Forecasting Infant Mortality Rate in Algeria Using Artificial Neural Networks

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***Abstract* - In this research article, the ANN approach was applied to analyze infant mortality rate in Algeria. The employed annual data covers the period 1960-2020 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 Algeria. The ANN (12, 12, 1) model projections suggest that infant mortality will be around 21 infant deaths per 1000 live births per annum over the next 10 years in Algeria. The government is encouraged to intensify maternal and child health surveillance and control programs amongst other measures in order to curb infant mortality in Algeria. This can be specifically done by adopting the suggested 7-fold policy recommendations.**

Keywords: ANN, Forecasting, Infant mortality.

I. OVERVIEW

Artificial neural networks (ANNs) are electronic models based on the neural structure of the human brain (Kohli et al, 2014). The human brain essentially learns from experience. ANNs are currently a hot research area in medicine and it is projected that they will be widely used in biological systems. The basic processing element of a neural network is a neuron (node). A biological neuron receives input from other neurons and then performs a nonlinear transformation on the result and then outputs the final result (Zhang, 2003; Zhao, 2020; Patterson, 1995). A similar things happens with ANNs. ANNs can be described as structures composed of densely interconnected adaptive simple processing elements called neurons that are capable of performing massive paradoxical computations for data processing and knowledge presentation (Nielsen, 1990; Schalkoff, 1997). ANNs are applied in time series forecasting problems because of their inherent capability of nonlinear modeling without basing on any assumptions. The model is adaptively formed based on the given data (Zhang, 2003, Zhang et al, 1998). The widely used ANNs in forecasting problems are the multilayer perceptrons (MLPs) which use a single layer feed forward network (FNN) (Zhang, 2003; Zhang, 1998). The model is composed of 3 layers of neurons which are input, hidden and output layer. The layers are connected by connection weights (Nyoni et al, 2020; Kaushik et al, 2018; Yan et al, 2018; Fojnica et al, 2016; Zhang, 2003; Kishan, 1997). In this piece of work the MLP is applied to predict infant mortality in Algeria. The findings of the study will be used to evaluate maternal and child health programs which are meant to achieve sustainable development goals by 2030.

II. METHODOLOGY

The Artificial Neural Network (ANN), which we intend to apply in this study; is a data processing system consisting 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 Algeria.

Data Issues

This study is based on annual infant mortality rates in Algeria for the period 1960 – 2020. The out-of-sample forecast covers the period 2021 to 2030. Infact 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.

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III. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	T
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	0.012708
MSE	0.829463
MAE	0.723117

Residual Analysis for the Applied Model

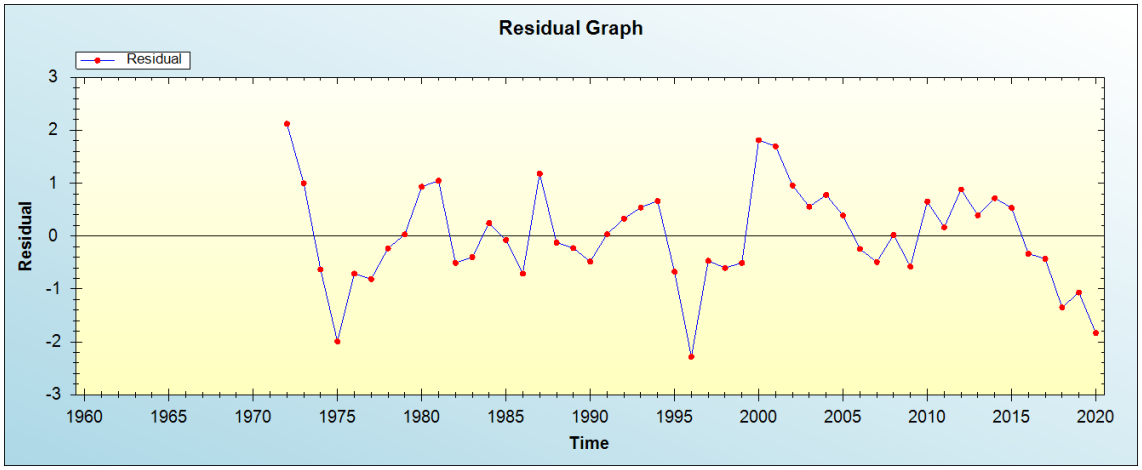

Figure 1: Residual analysis

In-sample Forecast for T

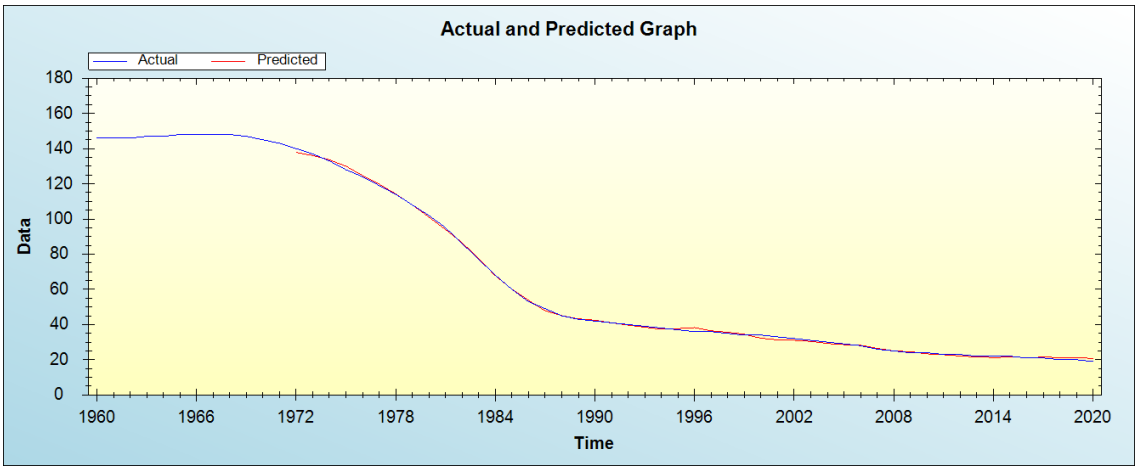

Figure 2: In-sample forecast for the T series

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Out-of-Sample Forecast for T: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2021	20.5583
2022	20.5317
2023	20.5922
2024	20.5774
2025	20.1859
2026	20.8446
2027	21.3554
2028	21.6575
2029	21.4975
2030	21.8508

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 Algeria is likely to remain around 21 infant deaths/1000 live births per year over the next decade.

IV. CONCLUSION AND POLICY RECOMMENDATIONS

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

i. The Algerian government should continue to encourage mothers to breast-feed their babies adequately.
ii. There is need for all Algerian child-bearing women to be vaccinated against common illnesses.
iii. There is need to prevent birth defects in Algeria.
iv. The government of Algeria should address preterm birth, low birth-weight and their outcomes.
v. The government of Algeria 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 Algeria need to use newborn screening activities in order to detect hidden conditions.

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