

Tracking Niger's Future Progress towards Achieving Substantial Reduction of Mortality among under Five Children

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Abstract - This study uses annual time series data on under five mortality rate (U5MR) for Niger from 1967 to 2020 to predict future trends of U5MR over the period 2021 to 2030. Residuals and forecast evaluation criteria indicate that the applied ANN (12, 12, 1) model is stable in forecasting under five mortality rate. ANN model projections revealed that U5MR will remain very high. Therefore, we encourage the government of Niger to address all the existing challenges in order to improve child survival and substantially reduce under five mortality to levels as low as 25 deaths per 1000 live births.

Keywords: ANN, Forecasting, U5MR.

I. INTRODUCTION

Time series forecasting techniques are essential early surveillance tools that help to detect abnormal trends of diseases (Nyoni *et al.* 2020; Zhao *et al.* 2020; Panch *et al.* 2018; Teutsch & Churchill, 2000). Utilization of these techniques in tracking sustainable development goal progress should be thoroughly explored as this will inform planning and allocation of resources. However, it is important for national statistical offices in various countries to oversee data collection, processing, analysis and dissemination of useful information which is necessary for the implementation of effective strategies. Capacity building is a key factor in monitoring or tracking SDG progress (UN, 2020; UNICEF, 2019; WHO, 2019; UNICEF, 2018; UN, 2016; UN, 2015). There is need to train and provide technical assistance to cadres that collect and process data at all levels from the subnational level to the international level (UN, 2016; UN, 2015). The central statistical offices in any country should coordinate all statistical activities and share data with local and international global partners that have a responsibility of acting on the data. It is encouraged that countries should capture disaggregated data so that more specific information is obtained for policy formulation and planning. In this study we apply the artificial neural network technique to forecast future trends of under-five mortality rate for Niger. The results will inform policy, planning and resource mobilization to end all avoidable under five deaths.

II. LITERATURE REVIEW

Adjei *et al.* (2021) investigated the effect of community-, household- and individual-level factors on the risk of neonatal mortality in two districts in Ghana. The longitudinal study used the Kintampo Health and Demographic Surveillance System as a platform to select 30,132 neonatal singletons with 634 deaths. Multilevel cox frailty model was used to examine the effect of community-, household- and individual-level factors on the risk of neonatal mortality. The conclusion from the study was that there is risk of neonatal mortality at the individual- and household-levels in the Kintampo Districts. A cross-sectional study carried out by Edem *et al.* (2020) examined the health practices, care-seeking behavior, and referral of sick out-born neonates to a district and regional hospital in the Upper West Region of Ghana. The study findings suggested that socio-cultural factors strongly influence health seeking behavior and the health outcome of neonates in this setting. Garcia *et al.* (2020) described changes over time in the use of childbirth care in Egypt, focusing on location and sector of provision (public versus private) and the content of immediate postpartum care. The authors used five Demographic and Health Surveys conducted in Egypt between 1995 and 2014 to explore national and regional trends in childbirth care. The study findings revealed that Egypt achieved large increases in the percentage of women delivering in facilities and with skilled birth attendants. However, most women and newborns did not receive essential elements of high quality immediate postpartum care. An Indonesian study by Suparmi *et al.* (2016) applied the cox proportion hazard regression analyze the contribution of low birth weight on neonatal mortality. The study findings revealed that children born with low birth weight and born from younger mothers had higher risk of neonatal mortality.

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 Niger.

Data Issues

This study is based on annual under five mortality rate in Niger for the period 1967 – 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	N
Observations	42 (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	0.002528
MSE	2.739306
MAE	1.080356

Residual Analysis for the Applied Model

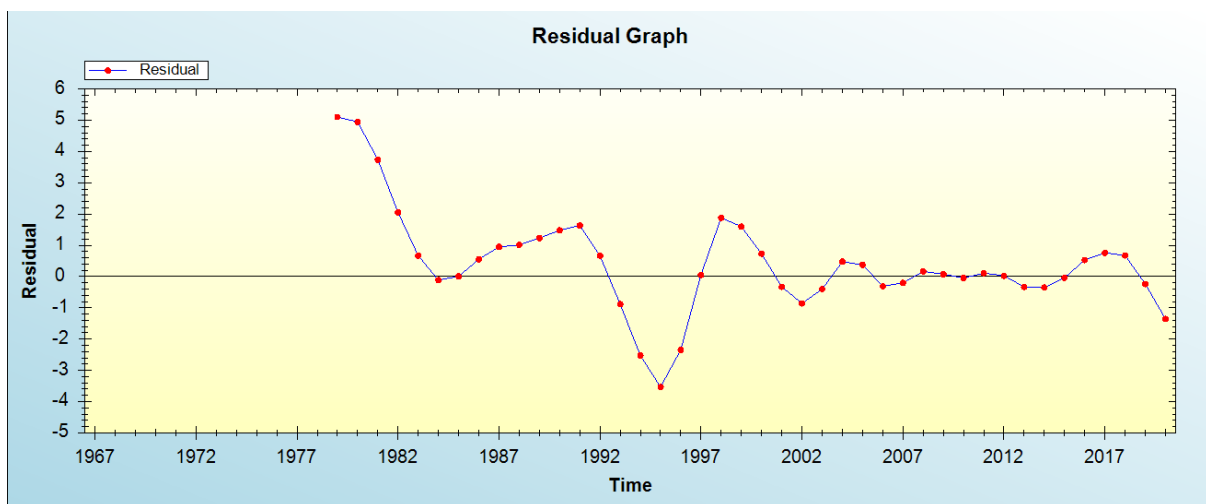


Figure 1: Residual analysis

In-sample Forecast for N

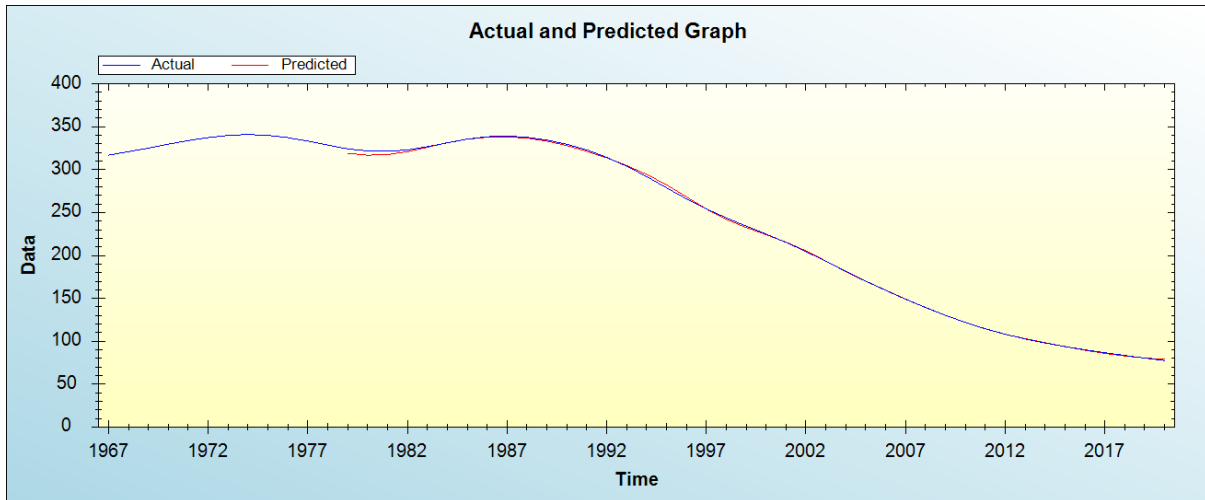


Figure 2: In-sample forecast for the N series

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

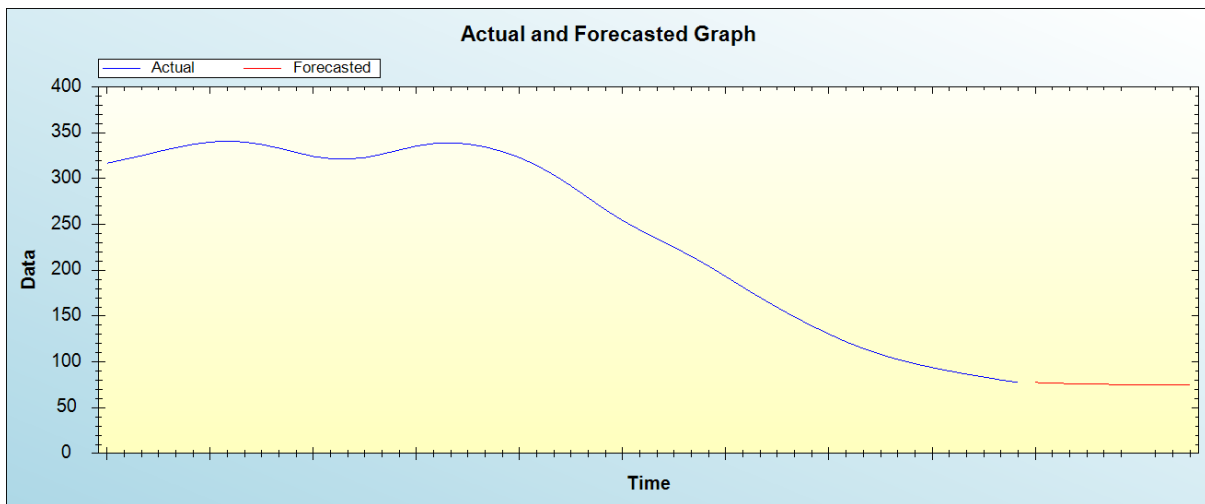


Figure 3: Out-of-sample forecast for N: actual and forecasted graph

Out-of-Sample Forecast for N: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	77.6577
2022	76.8628
2023	76.3040
2024	75.8869
2025	75.5748
2026	75.3508
2027	75.1844
2028	75.0535
2029	74.9332
2030	74.8399

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 remain very high over the out of sample period.

V. POLICY IMPLICATION & CONCLUSION

High teenage pregnancies in Niger significantly contribute to the adverse maternal and child health outcomes therefore the government must channel resources towards family planning programs to curb un-intended pregnancies. The government has made significant progress in the reduction of under-five mortality as evidenced by the decline of under-five and neonatal mortality rates over the past decades. Projection of under-five mortality rate is expected to guide child health policies, decisions and allocation of resources to the MNCH program. The results of this study indicated that U5MR will remain very high. Therefore, we encourage the government of Niger to allocate more resources to the maternal and child health (MNCH) program to address existing challenges with the aim of improving child survival and substantially reducing under five mortality.

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