

Tracking the Future Progress towards Achieving Substantial Reduction of Under Five Mortality in Burkina Faso By 2030

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Abstract - This study uses annual time series data on under five mortality rate for Burkina Faso from 1960 to 2020 to predict future trends of U5MR over the period 2021 to 2030. Residuals and model evaluation statistics indicate that the applied ANN (12, 12, 1) model is stable in forecasting U5MR. The neural network model projections revealed that U5MR will remain high over the out of sample period. Therefore, we encourage health authorities to focus on capacitating healthcare facilities at all levels of healthcare and address various challenges that affect under five children in the country.

Keywords: ANN, Forecasting, U5MR.

I. INTRODUCTION

At the beginning of the era of sustainable development goals, UN member states appreciated the challenges that they would face in the implementation of the global action plan, however they remained resilient and committed to bring peace, end all forms of poverty, ensure that people's rights are respected, improve access to quality healthcare and education, and foster economic growth (UN, 2020; WHO, 2019; UNICEF, 2019; UNICEF, 2018; UN, 2016; UN, 2015). Burkina Faso has made significant progress towards achieving Sustainable development goal 3 by 2030. The country reported a maternal mortality ratio (MMR) of 320 per 100 000 live births and under five mortality rate of 88 deaths per 1000 live births (World Bank, 2020; Ouedraogo *et al.* 2020). Health authorities have worked tirelessly to address the key drivers of mortality in neonates and under five children (Ouedraogo *et al.* 2015). In line with the SDGs agreed by all UN member states, this study applies an artificial neural network technique to forecast future trends of under-five mortality rate for Burkina Faso. The aim is to have an insight of the likely future trends of U5MR to facilitate planning, decision making and allocation of resources to MNCH programs in the country. This will specifically inform Child policies and stimulate implementation of intervention strategies to substantially reduce U5MR by 2030.

II. LITERATURE REVIEW

Gage & Bauhoff (2020) assessed the impact of PBF on early neonatal health outcomes and associated health care utilization and quality in Burundi, Lesotho, Senegal, Zambia and Zimbabwe. Authors utilized data from Demographic and Health Surveys and Multiple Indicator Cluster Surveys and applied difference-in-differences analysis to estimate the effect of PBF projects supported by the World Bank on early neonatal mortality and low birth weight and concluded that PBF had no impact on early neonatal health outcomes in the five African countries studied and had limited and variable effects on the utilization and quality of neonatal health care. Masaba & Phetoe (2020) described the trends of neonatal mortality within the two sub-Saharan countries. The study concluded that in 2018, the neonatal mortality rate for Kenya was 19.6 deaths per 1000 live births. The neonatal mortality rate had fallen gradually from 35.4 deaths per 1000 live births in 1975. On the other hand, South Africa had its neonatal mortality rate fall from 27.9 deaths per 1000 live births in 1975 to 10.7 deaths per 1000 live births in 2018. Mishra *et al.* (2019) applied the ARIMA model to forecast infant mortality rates (2017 – 2025). The forecast of the sample period (1971 – 2016) showed accuracy by the selected ARIMA (2, 1, 1) model. The post-sample forecast with ARIMA (2, 1, 1) model showed a decreasing trend of infant mortality (2017 – 2025). The forecast infant mortality rate for 2025 in India is 15/1000 live births. Caluza (2018) utilized data mining technique using decision tree called J48 algorithm in classifying child mortality rate, life expectancy at birth, annual population growth, and the gross domestic product. Results revealed that annual population growth is highly correlated in predicting child mortality and generate three distinct rules. The generated model had high acceptability with 97.4% ROC curve result of the three classes in predicting child mortality under five years old.

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 Burkina Faso.

Data Issues

This study is based on annual under five mortality rate in Burkina Faso 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	K
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	0.000880
MSE	0.659036
MAE	0.474083

Residual Analysis for the Applied Model

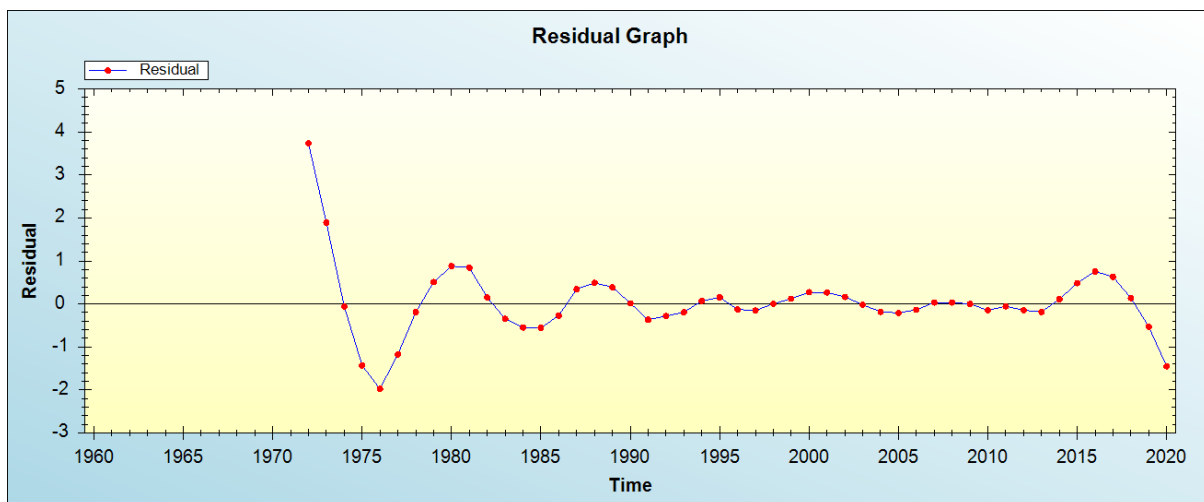


Figure 1: Residual analysis

In-sample Forecast for K

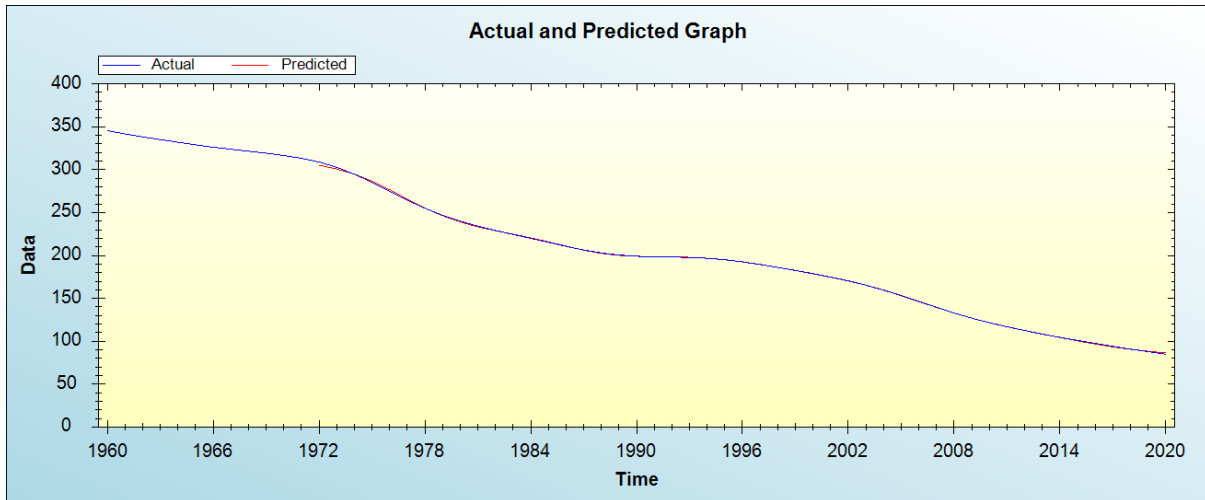


Figure 2: In-sample forecast for the K series

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

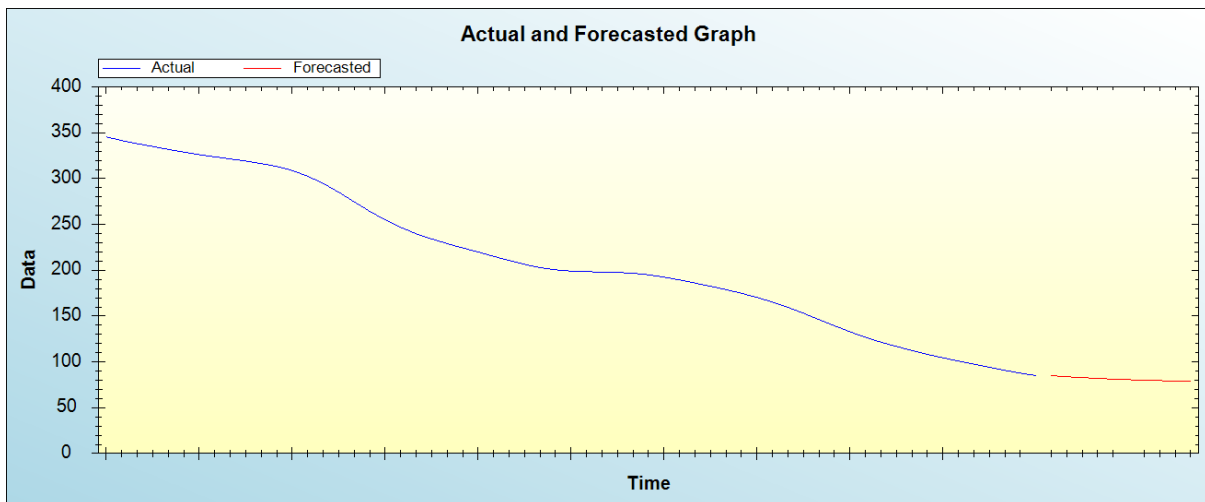


Figure 3: Out-of-sample forecast for K: actual and forecasted graph

Out-of-Sample Forecast for K: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	84.9565
2022	83.7944
2023	82.8588
2024	82.0277
2025	81.2438
2026	80.6167
2027	80.0464
2028	79.6212
2029	79.2204
2030	78.9679

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 high in the out of sample period.

V. POLICY IMPLICATION & CONCLUSION

Mortality among under five children is an issue of concern especially in Sub-Saharan Africa which continues to report high absolute numbers of under five deaths. Appropriate measures must be instituted quickly in order to alleviate suffering and death among this group. This study utilizes the ANN model to project future trends of under-five mortality in Burkina Faso. The findings highlighted that U5MR will remain high in the out of sample period. Therefore we encourage health authorities in Burkina Faso to focus on addressing various challenges that affect under five children in the country.

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