

Analyzing Under Five Mortality Rate for Togo Using a Machine Learning Technique

¹Dr. Smartson. P. NYONI, ²Thabani NYONI

¹ZICHIRE Project, University of Zimbabwe, Harare, Zimbabwe

²Independent Researcher & Health Economist, Harare, Zimbabwe

Abstract - This study uses annual time series data on under five mortality rate (U5MR) for Togo from 1960 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 suggest that U5MR will remain high throughout the out of sample period. Hence, authorities in Togo must address all the major challenges that hinder the successful implementation of the third sustainable development goal (SDG3).

Keywords: ANN, Forecasting, U5MR.

I. INTRODUCTION

The global sustainable development goals (SDGs) are a set of 17 objectives and associated 169 targets that were crafted during the UN general Assembly at the UN Headquarters in New York in September 2015. They were designed to finish up what the Millennium development goals did not manage to achieve. All UN member states hoped to eradicate all forms of deprivations and inequalities that exist in this world. The main goal was to attend to all the three dimensions of sustainable development namely social, economic and environmental dimensions. This global Agenda although ambitious is targeting to alleviate all forms of human suffering such as poverty, hunger, human rights violations, gender imbalances, health and economic challenges (UN, 2016; UN, 2015). Maternal and child health problems are among the issues that require urgent attention as many low and middle income countries are struggling to effectively address the various factors that significantly contribute to mortality among pregnant mothers and under five children (UN, 2020; UNICEF, 2019; WHO, 2019; UNICEF, 2018).

It is important to acknowledge the big role that is being played by global partners in solving MNCH problems in developing countries. Several strategies are being implemented such as results based financing (RBF) which has yielded positive results especially by improving the quantity and quality of healthcare services (Gage & Bauhoff, 2020). These global partners have done tremendous work in providing resources for the prevention and control of preventable epidemic diseases such TB, HIV and malaria. These epidemic diseases significantly contribute to mortality among pregnant mothers and children in developing countries (WHO, 2019; UNICEF, 2019). Maternal and child health issues is the focus of SDG3 targets 3.1 and 3.2. The goal is to reduce global maternal mortality ratio to levels below 70 deaths per 100 000 live births by 2030, reducing neonatal and under five mortality to as low as 12 deaths per 1000 live births and 25 deaths per 1000 live births respectively by 2030 (UNICEF, 2019).

The objective of this research is to predict future trends of under-five mortality for Togo using the artificial neural network approach. The findings are envisioned to inform policy and allocation of resources in order to keep mortality among children under control.

II. LITERATURE REVIEW

Raymondville *et al.* (2020) conducted a convergent, mixed methods study to assess barriers and facilitators to facility based childbirth at Hôpital Universitaire de Mirebalais (HUM) in Mirebalais, Haiti. A secondary analyses of a prospective cohort of pregnant women seeking antenatal care at HUM was performed and quantitatively assessed predictors of not having a facility-based childbirth at HUM. The study also prospectively enrolled 30 pregnant women and interviewed them about their experiences delivering at home or at HUM. It was found that living further from the hospital, poverty and household hunger were associated with not having a facility-based childbirth. Primigravid women were more likely to have a facility-based childbirth. 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 suggested 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. Nyoni & Nyoni, 2020 utilized the Box-Jenkins ARIMA methodology to predict neonatal deaths in Zimbabwe using annual time series data on neonatal deaths in Zimbabwe from 1966 to 2018. The ARIMA (8, 2, 0) was found to be the optimal model. The study findings revealed that the numbers of neonatal deaths per year would decline sharply over the next 25 years. A similar forecasting study by Nyoni &

Nyoni, 2020 utilized the ARIMA model to model and forecast infant mortality in Zimbabwe. The ARIMA (1, 2, 5) was the best model and the forecast results indicated that the number of infant deaths per year, over the out-of-sample period, will follow a downward trend.

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 Togo.

Data Issues

This study is based on annual under five mortality rate in Togo 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	G
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	0.000524
MSE	0.244522
MAE	0.329640

Residual Analysis for the Applied Model

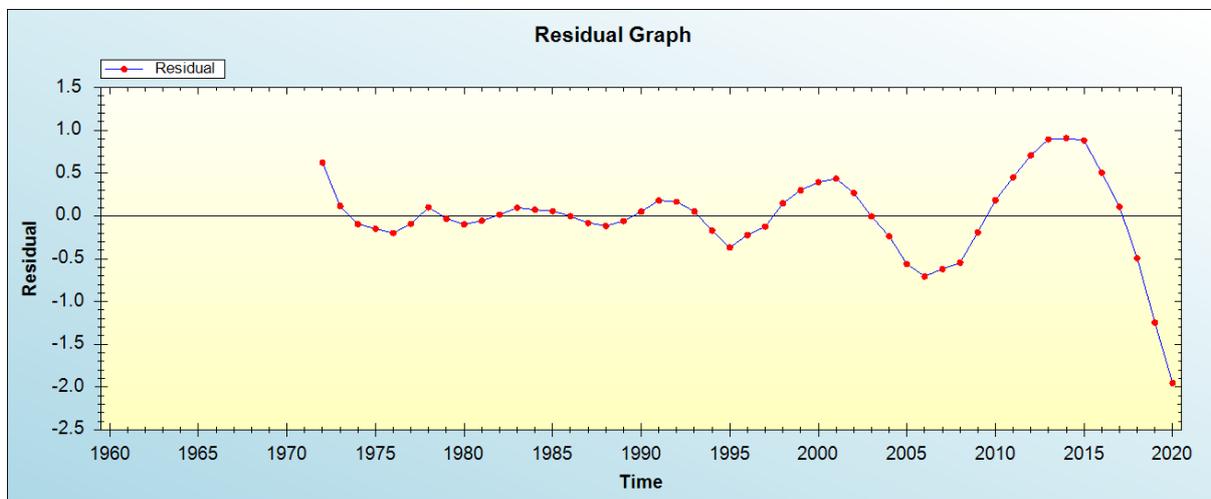


Figure 1: Residual analysis

In-sample Forecast for G

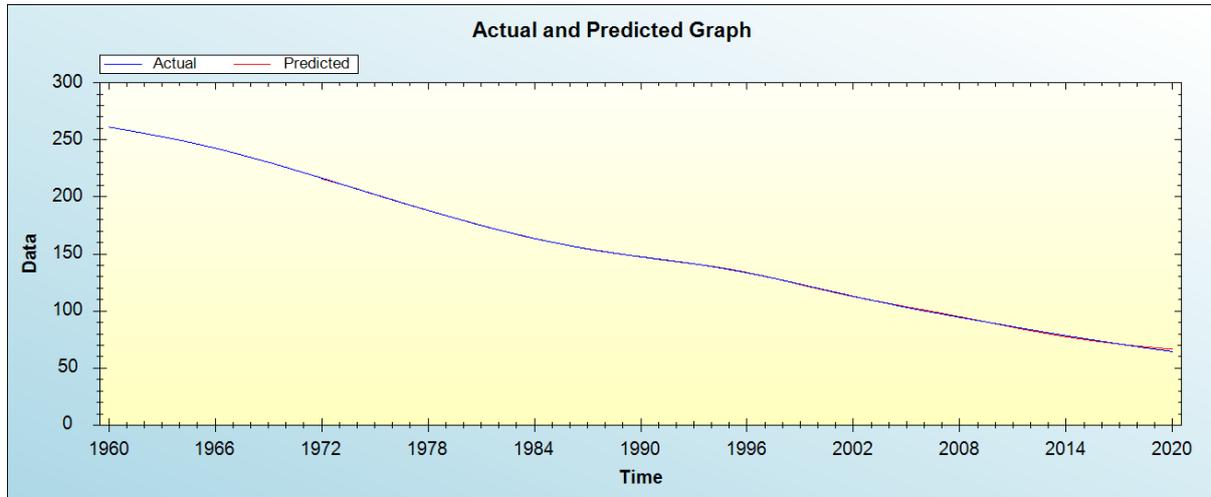


Figure 2: In-sample forecast for the G series

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

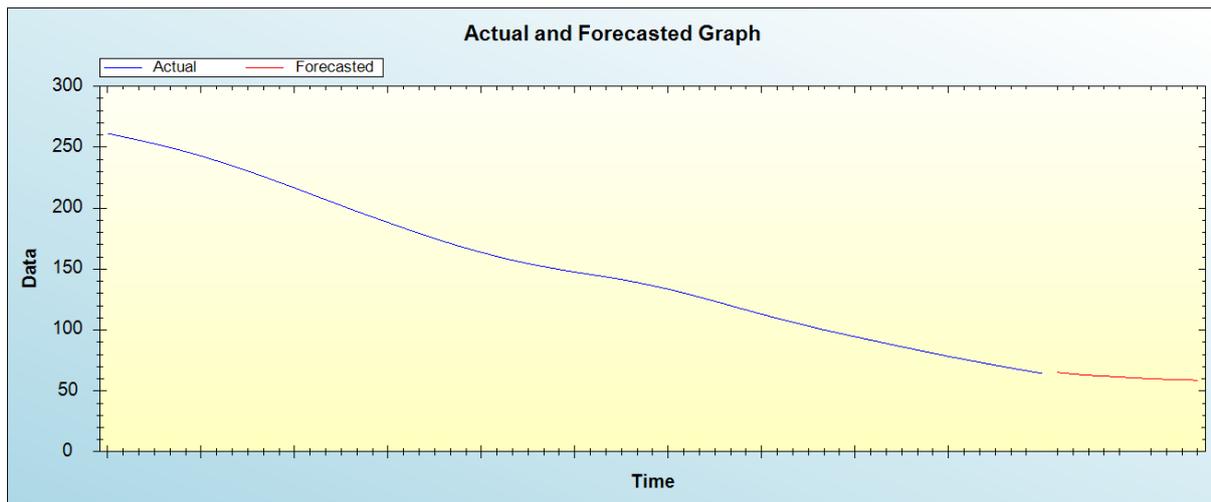


Figure 3: Out-of-sample forecast for G: actual and forecasted graph

Out-of-Sample Forecast for G: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	65.0863
2022	63.8293
2023	62.8377
2024	62.1398
2025	61.4044
2026	60.6511
2027	60.0287
2028	59.5371
2029	59.0857
2030	58.8046

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 throughout the out of sample period.

V. POLICY IMPLICATION & CONCLUSION

The successful implementation of the 3rd sustainable development goals requires government's commitment and the involvement of all stakeholders. Early identification of challenges and implementation of appropriate strategies is key in the reduction of under-five mortality. This study applies the ANN model to forecast under five mortality rate in Togo and projections revealed that U5MR will remain high throughout the out of sample period. Therefore, authorities in Togo must address all the challenges that hinder the successful implementation of the 3rd sustainable development goal (SDG3).

REFERENCES

- [1] UNICEF. (2019). Levels and trends in child mortality: report 2019. Estimates developed by the UN Inter-agency Group for child mortality estimation. New York: UNICEF.
- [2] United Nations. (2015). transforming our world: The 2030 agenda for sustainable development, A/RES/70/1. New York: UN General Assembly.
- [3] UN (2020) sustainable development goals. <https://www.un.org/sustainabledevelopment/development-agenda>
- [4] UNICEF (2018). Every Child alive. New York: UNICEF
- [5] World Health Organization (WHO) (2019). SDG 3: Ensure healthy lives and promote wellbeing for all at all ages.
- [6] United Nation. Transforming our world: The 2030 agenda for sustainable development 2016.
- [7] Gage A., and Bauhoff S (2021). The effects of performance-based financing on neonatal health outcomes in Burundi, Lesotho, Senegal, Zambia and Zimbabwe. *Health Policy and Planning*, 36, 3, 332–340.

Citation of this Article:

Dr. Smartson. P. NYONI, Thabani NYONI, "Analyzing Under Five Mortality Rate for Togo Using a Machine Learning Technique" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 6, Issue 7, pp 509-512, July 2022. Article DOI <https://doi.org/10.47001/IRJIET/2022.607113>
