

Assessing the Feasibility of Achieving Substantial Reduction of Under Five Mortality by 2030 in Mozambique

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Abstract - This study uses annual time series data on under five mortality rate (U5MR) for Mozambique from 1963 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. The ANN model projections revealed that U5MR will remain very high throughout the out of sample period. Therefore, we encourage the Mozambican government to address all the major challenges that hinder the success of the maternal and child health (MNCH) program and ensure availability of medical supplies and staff at all levels of healthcare.

Keywords: ANN, Forecasting, U5MR.

I. INTRODUCTION

Time series prediction is the subject which is gaining tremendous recognition in various fields which include engineering, mathematics, information technology, agriculture, economics and Human Medicine. A time series is defined as the chronological record of observed values of a variable and can be continuous or discrete. It can display certain features such as trend, seasonality, cyclic behavior and irregular components. Descriptive statistics is used to characterize a time series. Parameters such as mean, mode, median and variance are of great importance when analyzing a time series. A time series with a constant mean and variance is called a stationary time series. A non-stationary series has a time varying mean and or variance. Various techniques are being used in time series projection and these are broadly classified into linear and non-linear methods. Traditional statistical techniques such as ARIMA are essentially linear methods and on the other hand machine learning techniques are useful in analyzing non-linear complex data (Zhao *et al.* 2020; Nyoni & Nyoni, 2020; Nyoni & Nyoni, 2019; Panch *et al.* 2018; Zhou *et al.* 2018). In line with the Cape Town global action plan (2017) and the Agenda 2030, in this study we analyzed a univariate time series data on under five mortality rate for Mozambique using a machine learning algorithm. The findings of this study are expected to inform child health policies and allocation of resources to MNCH program activities to end all preventable under five deaths by 2030.

II. LITERATURE REVIEW

A systematic review carried out by Masaba and Phetoe (2020) found out 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. 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. Damian *et al.* (2019) showed that estimates from both global metrics and institutional reporting, although widely divergent, indicate South Africa has not achieved MDG 4a and 5a goals but made a significant progress in reducing maternal and neonatal mortality. Rhoda *et al.* (2018) did a literature review of estimates of NMR, causes of neonatal deaths, and described how the mortality from preventable causes of death could be reduced in South Africa. The study concluded that there was need of high-impact interventions, adequate number of appropriately trained healthcare providers and a more active role played by ward-based community health workers and district clinical specialist teams. Kayode *et al.* (2017) examined the variation in neonatal mortality and identified underlying causes of variation in neonatal mortality in sub-Saharan Africa (SSA). The ecological study utilized 2012 publicly available data from WHO, the US Agency for International Development and the World Bank. Variation in neonatal mortality across 49 SSA countries was examined using control chart and explanatory spatial data analysis. Associations between country-level characteristics and neonatal mortality were examined using linear regression analysis. The findings indicated that there was a wide variation in neonatal mortality in SSA. A substantial part of this variation can be explained by differences in the quality of healthcare governance, prevalence of HIV and socioeconomic deprivation.

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 Mozambique.

Data Issues

This study is based on annual under five mortality rate in Mozambique for the period 1963 – 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	Q
Observations	46 (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	0.003199
MSE	1.812538
MAE	0.954525

Residual Analysis for the Applied Model

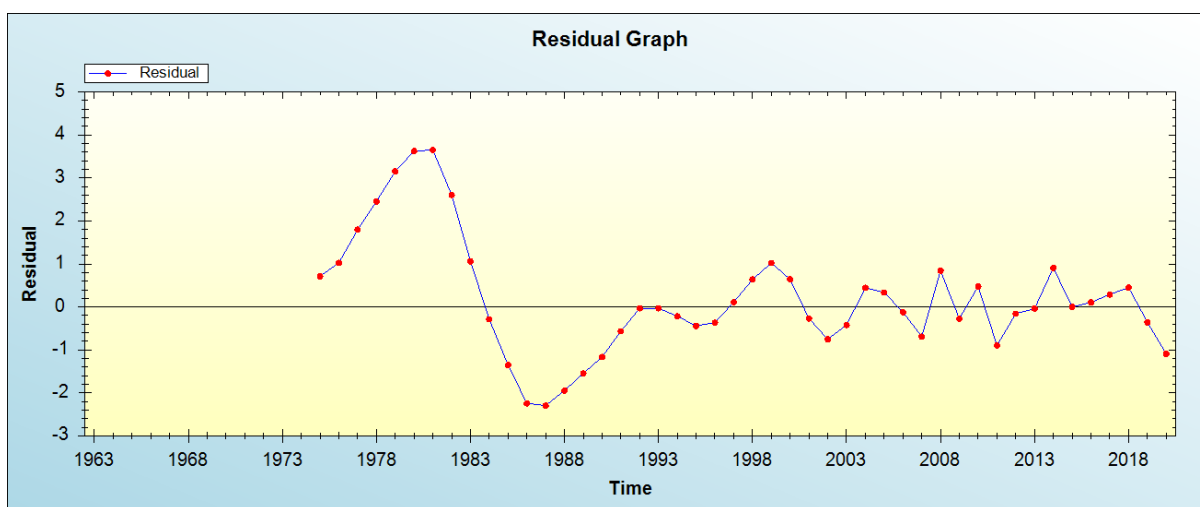


Figure 1: Residual analysis

In-sample Forecast for Q

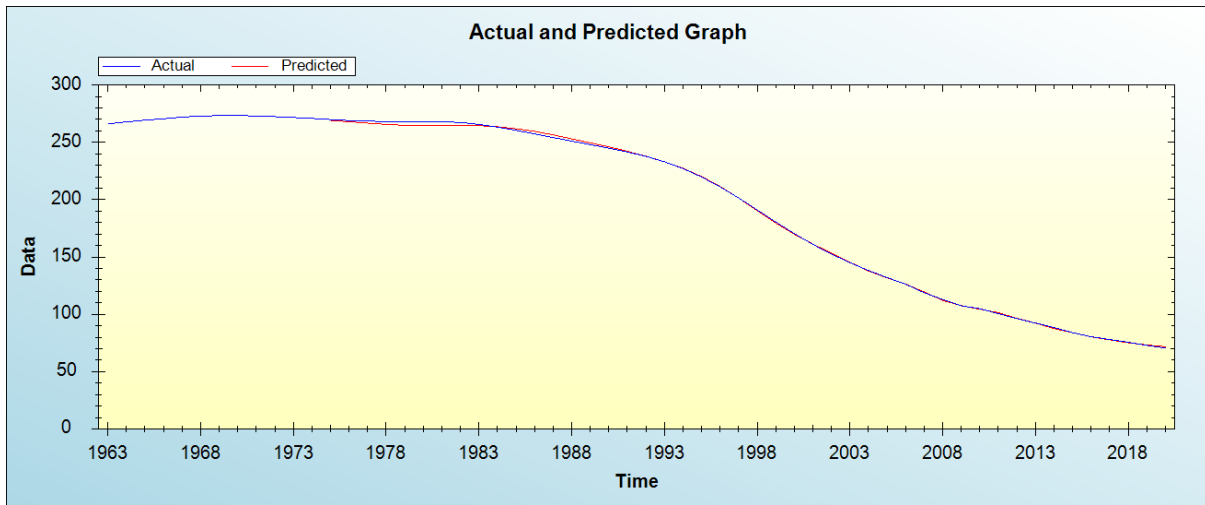


Figure 2: In-sample forecast for the Q series

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

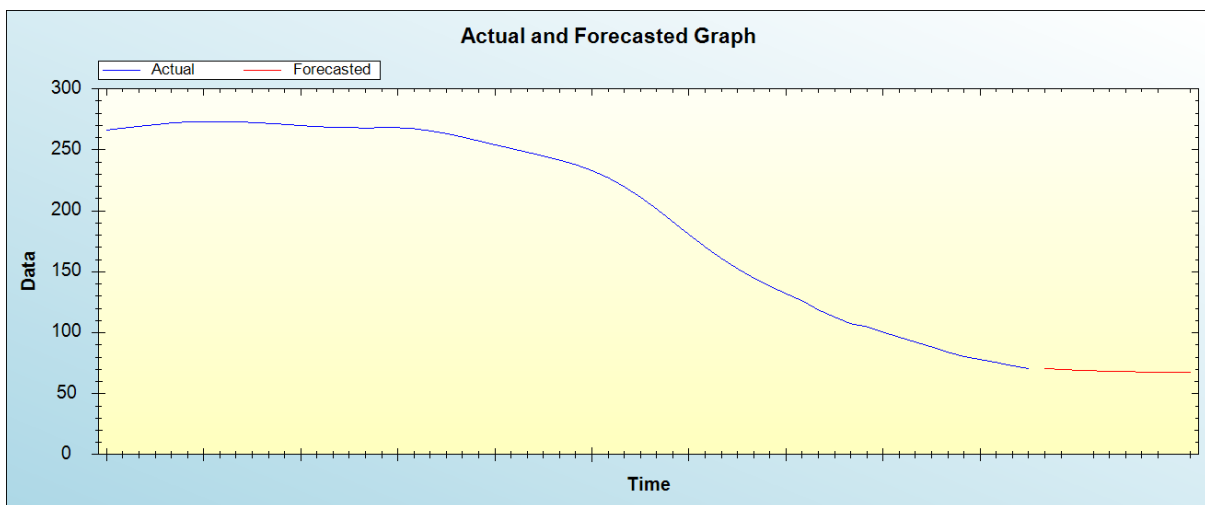


Figure 3: Out-of-sample forecast for Q: actual and forecasted graph

Out-of-Sample Forecast for Q: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	70.6877
2022	69.9206
2023	69.2259
2024	68.7908
2025	68.3598
2026	68.1137
2027	67.8559
2028	67.7250
2029	67.5983
2030	67.5257

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 throughout the out of sample period.

V. POLICY IMPLICATION & CONCLUSION

The government of Mozambique is facing numerous challenges such as civil conflict, floods and poverty. Maternal and child health indicators are not pleasing as the country continues to report high absolute numbers of maternal and under five deaths. Projection of under-five mortality will inform child health policies, decisions and allocation of resources. This study applied the ANN model to project future trends of under-five mortality rate and forecast results suggested that U5MR will remain very high throughout the out of sample period. Therefore, we encourage the Mozambican government to address all the challenges that contribute to mortality among under five children and ensure availability of medical supplies and staff at all levels of healthcare.

REFERENCES

- [1] Zhao N., Charland K., Carabali M., Elaine O., Nsoesie., MaheuGiroux M., Rees E., Yuan M., Balaguera C G., Ramirez G J., & Zinszer K (2020). Machine learning and dengue forecasting: Comparing random forests and artificial neural networks for predicting dengue burden at national and sub-national scales in Colombia. *PLOS Neglected Tropical Diseases* | <https://doi.org/10.1371/journal.pntd.0008056>
- [2] Panch T., Szolovits P., & Atun R (2018). Artificial intelligence, machine learning and health systems, 5, 2, 020303.
- [3] Zhou L., Zhao P., Wu D., Cheng C and Huang H (2018) Time series model for forecasting the number of new admission inpatients *BMC Medical Informatics and Decision Making*, 18, 39. <https://doi.org/10.1186/s12911-018-0616-8>
- [4] Nyoni S P & Nyoni T (2020). Modelling and forecasting infant deaths in Zimbabwe using ARIMA models. *Novateur Publications Journal*, 6, 7, 2581 - 4230.
- [5] Nyoni & Nyoni T (2019). Forecasting TB notifications at Silobela District Hospital, Zimbabwe, *IJARIE*, 5,6, 2395-4396.
- [6] Nyoni & Nyoni T (2019). Forecasting TB notifications at Zengeza clinic, Zimbabwe. Online at <https://mpra.ub.uni-muenchen.de/97331/> MPRA Paper No. 97331.

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