

Predicting Future Trends of Under Five Mortality Rate for Mauritius Using Artificial Neural Networks

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Abstract - This study uses annual time series data on under five mortality rate (U5MR) for Mauritius from 1960 to 2020 to predict future trends of U5MR over the period 2021 to 2030. Residuals and forecast evaluation statistics 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 around 15 deaths per 1000 live births throughout the out of sample period. Therefore, we encourage the government of Mauritius to channel more resources to the maternal and child health program to ensure availability of adequate medical supplies and medical staff to keep under five mortality under control.

Keywords: ANN, Forecasting, U5MR.

I. INTRODUCTION

The success of the 2030 agenda for sustainable development is dependent on mobilization of adequate resources, political leadership participation, stakeholder involvement, review and follow up of progress (UN, 2016; UN, 2015). Governments are encouraged to mobilize local resources that are required in the implementation of the global action plan. Technical experts must be incorporated in every sector so that they provide technical guidance during the implementation process. Regular review meetings and follow up of SDG progress cannot be overemphasized. All stakeholders must be given the opportunity to offer their expertise and other resources that are necessary in the implementation of the global action plan. By 2030, it is desired that all UN member states should have managed to address all the major global issues in order to improve the quality of life of their people. They are expected to reduce neonatal and under five mortality to as low as 12 neonatal deaths per 1000 live births and 25 under five deaths per 1000 live births (UN, 2020; UNICEF, 2019; WHO, 2019; UNICEF, 2018; WHO, 2017). In line with the agenda 2030 for sustainable development, this research is carried out to forecast future trends of under-five mortality rate for Mauritius using a machine learning technique. The results will guide policy formulation and allocation of resources in order to end all preventable under five deaths.

II. LITERATURE REVIEW

A multisite retrospective Kenyan cohort study was conducted by Irimu *et al.* 2021 to find out the proportion of all admissions and deaths in the neonatal age group and examine morbidity and mortality patterns, stratified by birth weight, and their variation across hospitals. The results indicated that Intrapartum related complications was the single most common diagnosis among the neonates with birth weight of 2000 g or more who died. A threefold variation in mortality across hospitals was observed for birth weight categories 1000– 1499 g and 1500–1999g. A retrospective and descriptive study was conducted by Lahmini and Bourrous (2020) to investigate epidemiology of the pediatric mortality in the pediatric emergency department (PED), to determine its rate and identify its most frequent causes. The study was conducted over five years (1st January 2012 and 31st December 2016) including all children aged from 0 to 15 years old who died at the PED in the Mohamed VI Hospital in Marrakech. It was revealed that the most frequent causes of neonatal mortality were neonatal infections and prematurity. Sougou & Diouf (2020) conducted a secondary analysis of the 2017 DHS for Senegal to analyze the factors associated with neonatal deaths in Senegal in 2017. The study results indicated that significant predictors of neonatal mortality were newborns with a low birth weight < 2500 g, newborns who are considered "very small" by their mother at birth and birth by caesarean section. A cross-sectional study was conducted Burundi by Moise (2018) to describe the main causes of hospitalization and mortality in children during the neonatal period and at ages 1 to 59 months, for boys and girls, and to assess the total annual (2010) burden of under-five morbidity and mortality in hospitals using hospitalization records from 21 district hospitals. The study findings indicated that human malarial infections continue to be the main cause of hospitalization and mortality among under-five children in Burundi.

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 Mauritius.

Data Issues

This study is based on annual under five mortality rate in Mauritius 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	Z
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	0.008824
MSE	0.865162
MAE	0.661027

Residual Analysis for the Applied Model

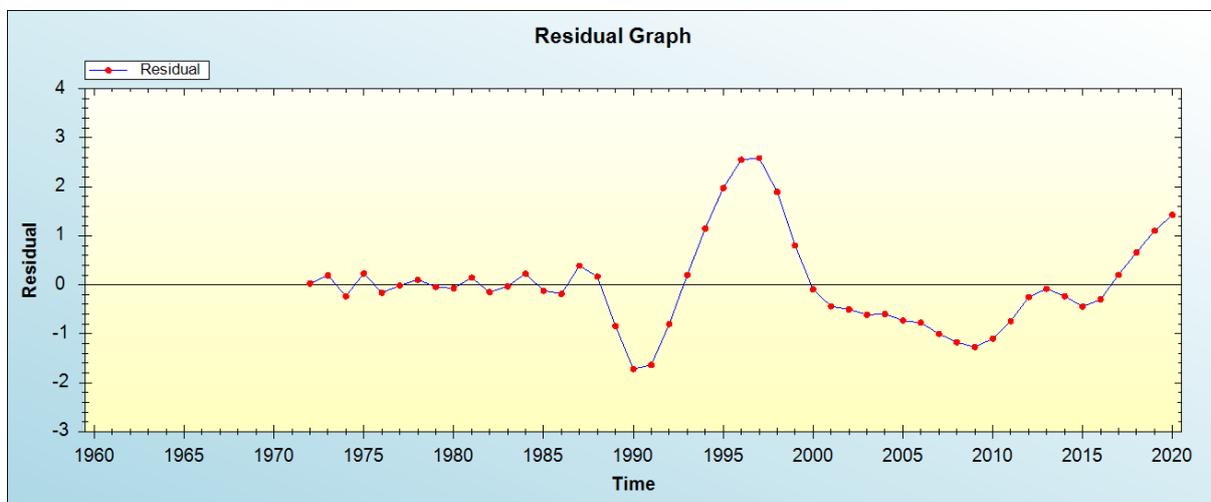


Figure 1: Residual analysis

In-sample Forecast for Z

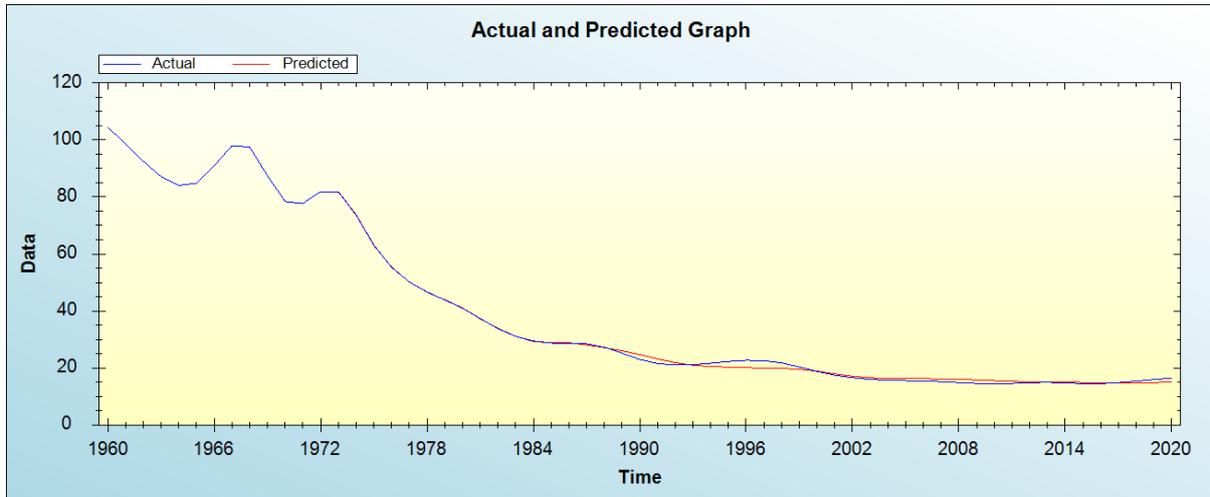


Figure 2: In-sample forecast for the Z series

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

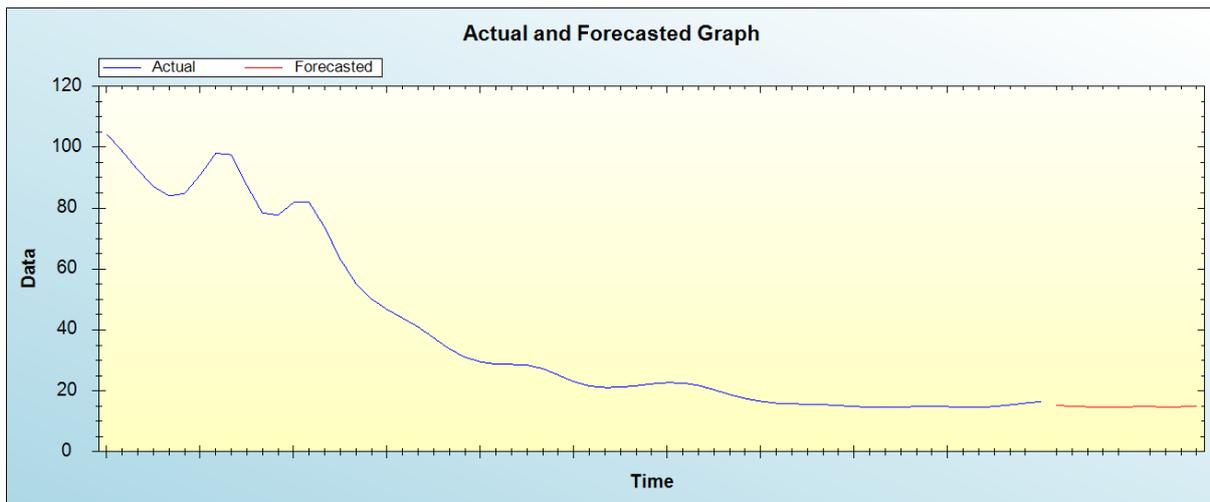


Figure 3: Out-of-sample forecast for Z: actual and forecasted graph

Out-of-Sample Forecast for Z: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	15.1835
2022	14.9902
2023	14.7685
2024	14.6429
2025	14.6880
2026	14.7979
2027	14.8399
2028	14.7548
2029	14.7750
2030	14.8024

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 around 15 deaths per 1000 live births throughout the out of sample period.

V. POLICY IMPLICATION & CONCLUSION

Mauritius has witnessed a downward trend in under five mortality rate over the past decades indicating the country's commitment to the agenda 2030 for sustainable development. This study applied the ANN model to project future trends of under-five mortality rate and the findings revealed that U5MR will remain around 15 deaths per 1000 live births throughout the out of sample period. Therefore, we implore health authorities in Mauritius to allocate more resources to the maternal and child health (MNCH) program to ensure availability of medical supplies and staff at all levels of healthcare.

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Citation of this Article:

Dr. Smartson. P. NYONI, Thabani NYONI, "Predicting Future Trends of Under Five Mortality Rate for Mauritius Using Artificial Neural Networks" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 6, Issue 7, pp 374-377, July 2022. Article DOI <https://doi.org/10.47001/IRJIET/2022.607080>
