

# Tracking Future Trends of Under Five Mortality Rate for Singapore Using an Artificial Intelligence Technique

<sup>1</sup>Dr. Smartson. P. NYONI, <sup>2</sup>Thabani NYONI

<sup>1</sup>ZICHIRE Project, University of Zimbabwe, Harare, Zimbabwe

<sup>2</sup>Independent Researcher & Health Economist, Harare, Zimbabwe

**Abstract - This study uses annual time series data on under five mortality rate for Singapore 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 U5MR. ANN model predictions revealed that annual U5MR will remain around 3 deaths per 1000 live births throughout the out of sample period. Therefore, we implore health authorities in Singapore to continue supporting maternal and child health program activities to keep under five mortality under control.**

**Keywords:** ANN, Forecasting, U5MR.

## I. INTRODUCTION

Affordable, quality and accessible health service provision is the objective of the 3<sup>rd</sup> sustainable development goal (SDG3) (UN, 2015). It encompasses quality maternal and child care service provision. SDG-3 aims to reduce global maternal mortality ratio (MMR) to less than 70 maternal deaths per 100 000 live births, neonatal mortality rate (NMR) to at least 12 per 1000 live births and under five mortality rate to as low as 25 deaths per 1000 live births by 2030 (UN, 2020; WHO, 2019; UNICEF, 2019; WHO, 2018). The objective of this paper is to model and predict future trends of U5MR for Singapore using artificial neural networks. The results of this study are expected to inform policy and decision making in order to timeously respond to the problem of under-five deaths in the country.

## II. LITERATURE REVIEW

Rasmussen *et al.* (2021) examined the recent figures and explored if potential differences could be explained by the well-known educational and income inequalities in stillbirth and infant death using a novel approach. Stillbirth and infant mortality varied considerably according to country of origin, with only immigrants from China, Norway, and Poland having an overall lower risk than Danish women. Women of Pakistani, Turkish, and Somali origin had a particularly high risk of both outcomes. Regression analysis was employed by Jawad *et al.* (2021) to assess the association between conflict and maternal and child health globally. Data for 181 countries (2000–2019) from the Uppsala Conflict Data Program and World Bank were analyzed using panel regression models. The study findings showed that armed conflict is associated with substantial and persistent excess maternal and child deaths globally. Raymondville *et al.* (2020) examined the barriers and facilitators influencing facility-based childbirth in rural Haiti by conducting a mixed method study with a convergent design. The study concluded that pregnant women in rural Haiti must overcome substantial structural barriers and forfeit valued support from traditional birth attendants when they pursue facility-based childbirths. The effects of individual bio-demographic and socioeconomic components on infant mortality were investigated by Scalone *et al.* (2016). The study utilized micro data from births, deaths and marriages civil registers of Granarolo, an Italian rural municipality close to Bologna, from 1900 to 1939 and then reconstructed some typical bio-demographic characteristics and the socioeconomic status of parents. Cox and Piecewise constant exponential models were used to estimate the effects of the selected predictors. The study indicated that still in the first four decades of the twentieth century rural daily wagers experienced a lower level in infant survivor, whereas the upper class registered significantly higher ones.

## 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 Singapore.

Data Issues

This study is based on annual under five mortality rate in Singapore 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	0.004009
MSE	0.095191
MAE	0.219560

Residual Analysis for the Applied Model

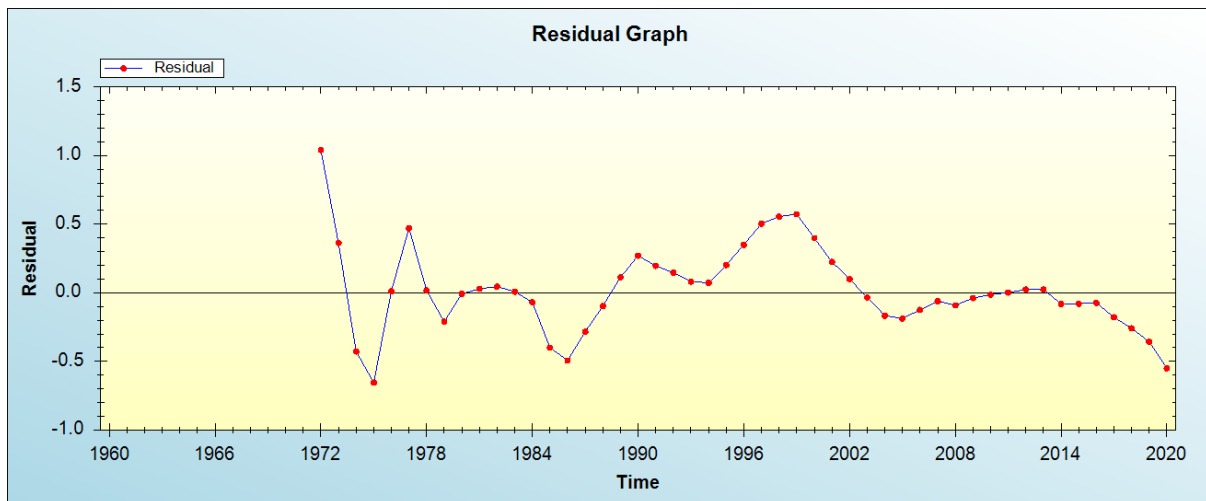


Figure 1: Residual analysis

In-sample Forecast for G

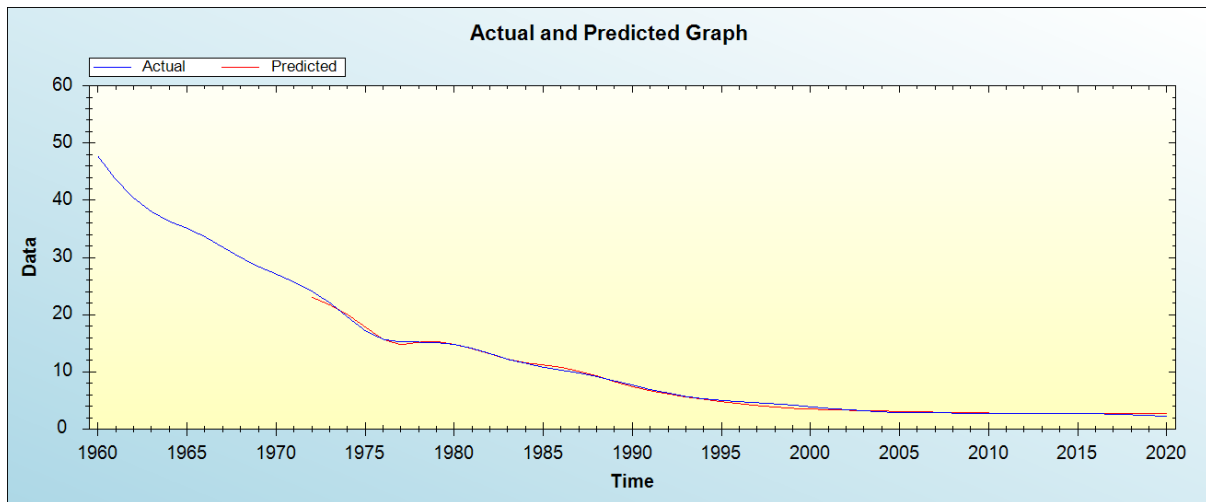


Figure 2: In-sample forecast for the G series

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

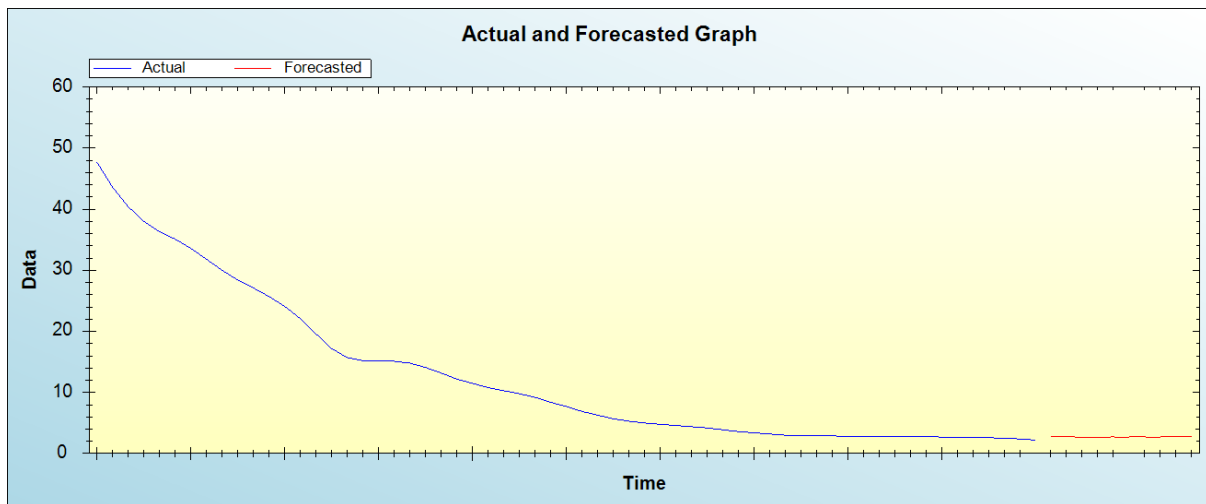


Figure 3: Out-of-sample forecast for G: actual and forecasted graph

Out-of-Sample Forecast for G: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	2.7255
2022	2.7273
2023	2.7144
2024	2.6726
2025	2.7243
2026	2.7149
2027	2.7172
2028	2.7132
2029	2.7803
2030	2.7661

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

## V. POLICY IMPLICATION & CONCLUSION

Ending preventable under five deaths should be the aim of every child health intervention program. Early identification of root causes of mortality among this age group is critical to facilitate timeous implementation of preventive measures. Tracking progress towards substantial reduction of under-five mortality will facilitate planning and allocation of resources to child health programs. This study applies the ANN model to project future trends of under-five mortality rate in Singapore and forecast results indicate that annual U5MR will remain around 3 deaths per 1000 live births throughout the out of sample period. Therefore, the government must continue supporting the maternal and child health program to keep under five mortality under control.

## 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.

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