

Tracking Sri Lanka's Under Five Mortality Rate Using Artificial Neural Networks

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 for Sri Lanka from 1960 to 2021 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 indicate that U5MR will continue to decline throughout the out of sample period. Therefore, health authorities in Sri Lanka should continue supporting the maternal and child healthcare (MNCH) program in order to improve the quality of maternal and child healthcare services.

Keywords: ANN, Forecasting, U5MR.

I. INTRODUCTION

Sustainable development goals (SDGs) were established in September 2015 and they include specific targets for the reduction of neonatal and under five mortality rates to as low as 12 per 1000 live births and 25 deaths per 1000 live births in every country by 2030 (UN, 2020; WHO, 2019; UNICEF, 2019; UNICEF, 2018). High rates of neonatal mortality are being reported in Sub-Saharan Africa and Southern Asia (OCHA, 2018; Lawn *et al.* 2016). The global neonatal mortality rate has been declining at a slower rate than that of under 5 mortality (UNICEF, 2019; WHO, 2016; UNICEF, 2015). Tracking of SDG progress is essential in the planning process and allocation of resources. Utilization of time series forecasting techniques in public health surveillance acts as early warning tools that guide planning and stimulate prompt response to health challenges. This study applies the artificial neural network to forecast future trends of under-five mortality rate in Sri Lanka. The findings will trigger an early response to the problem of under-five mortality in this country.

II. LITERATURE REVIEW

Aghai *et al.* (2020) investigated the gender differences in neonatal mortality, stillbirths, and perinatal mortality in south Asia using the Global Network data from the Maternal Newborn Health Registry. It was noted that the risks of stillbirths, and early neonatal mortality were higher among male infants than their female counterparts. However, there was no gender difference in mortality after 7 days of age. A cross-sectional study was conducted by Soleman *et al.* (2020) in Indonesia to describe trends and main causes of children mortality in Indonesia from 2000 to 2017. The data was taken from World Health Organization Maternal Child Epidemiology Estimation from 2000 to 2017. The study found that the trend of three parameters of child mortality declined within 17 years and the main causes of mortality were premature birth in neonates, ARI in post neonates and premature birth in under five children. A prospective, population-based research study was conducted by Dhaded *et al.* (2020) to investigate neonatal deaths in rural Karnataka, India for the period 2014–2018. Study staff collected demographic and health care characteristics on eligible women enrolled with neonatal outcomes obtained at delivery and day 28. Cause of neonatal mortality at day 28 was assigned by algorithm using prospectively defined variables. Study found that infants who were preterm and low-birth weight remained at highest risk for 28-day neonatal mortality in India. A similar cross-sectional study in Ghana was done by Annan & Asiedu (2018) who applied the logistic regression model to assess the maternal, neonatal, and health system related factors that influence neonatal deaths in the Ashanti Region, Ghana. The authors concluded that there was a high number of neonatal deaths which were mainly caused by birth asphyxia, infections, congenital anomalies and respiratory distress syndrome. Ahmed *et al.* (2017) did a comparison of Pakistan's under-five mortality, neonatal mortality, and postnatal newborn care rates with those of other countries. Neonatal mortality rates and postnatal newborn care rates from the Demographic and Health Surveys (DHSs) of nine low- and middle-income countries (LMIC) from Asia and Africa were analyzed. Pakistan's maternal, newborn, and child health (MNCH) policies and programs, which have been implemented in the country since 1990, were also analyzed. The results indicated that postnatal newborn care in Pakistan was higher compared with the rest of countries, yet its neonatal mortality remained the worst.

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 in Sri Lanka.

Data Issues

This study is based on annual under five mortality rate 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	Q
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	0.055745
MSE	4.936260
MAE	0.921959

Residual Analysis for the Applied Model

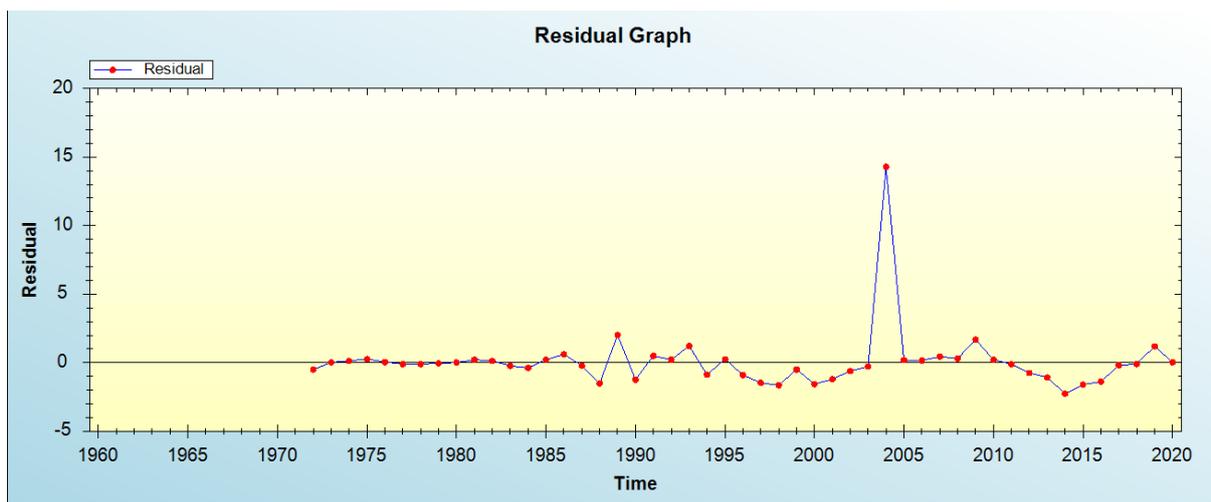


Figure 1: Residual analysis

In-sample Forecast for Q

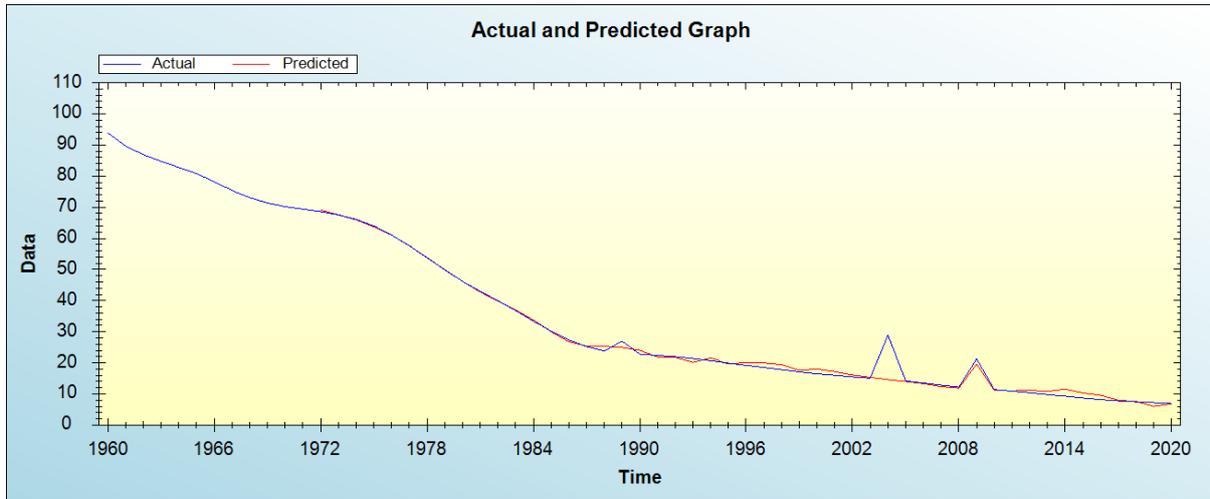


Figure 2: In-sample forecast for the Q series

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

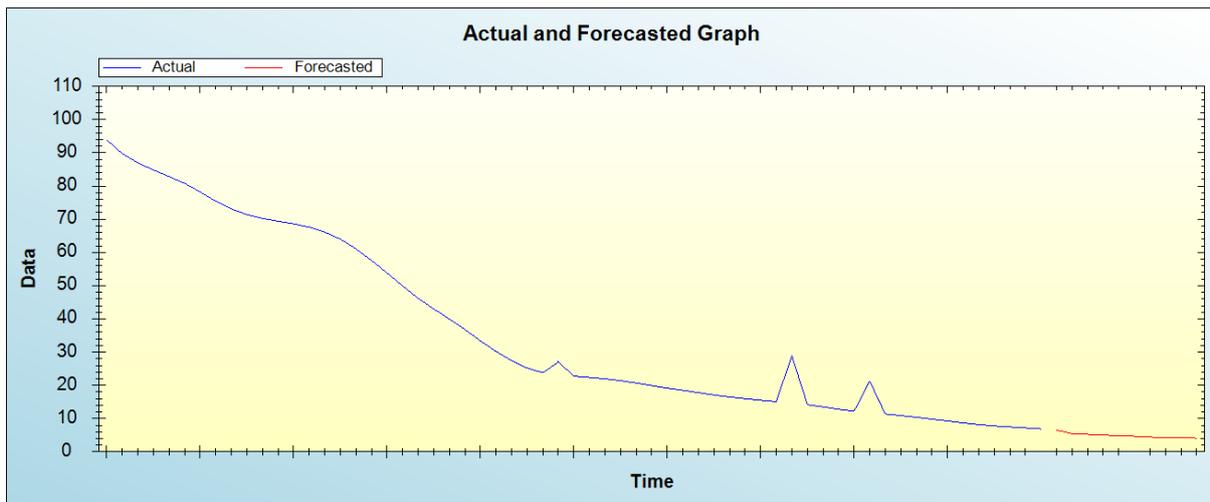


Figure 3: Out-of-sample forecast for Q: actual and forecasted graph

Out-of-Sample Forecast for Q: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	6.5199
2022	5.4692
2023	5.2574
2024	5.0376
2025	4.8708
2026	4.6986
2027	4.4572
2028	4.3397
2029	4.2427
2030	4.1456

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 continue to decline throughout the out of sample period.

V. POLICY IMPLICATION & CONCLUSION

South Central Asia has numerous challenges including the problem of under-five mortality. Socio-cultural, demographic and health system related factors significantly contribute to mortality among children below five years. This study applied the ANN model to project future trends of under-five mortality rate in Sri Lanka and the findings revealed that U5MR will continue to decline throughout the out of sample period. Therefore, we encourage the government of Sri Lanka to continue supporting the maternal and child health (MNCH) program to improve the quality of maternal and child healthcare services across the country.

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] World Bank (2019). Mortality rate, under 5.
- [4] UN (2020) sustainable development goals. <https://www.un.org/sustainabledevelopment/development-agenda>
- [5] UNICEF (2018). Every Child alive. New York: UNICEF
- [6] World Health Organization (WHO) (2019). SDG 3: Ensure healthy lives and promote wellbeing for all at all ages.
- [7] UN Office for Coordination of Humanitarian Affairs (OCHA) (2018). Global Humanitarian Overview: 2018. Geneva.
- [8] Lawn J. E., Blencowe H., Kinney M.V., Bianchi F., and Graham W. J (2016). Evidence to inform the future for maternal and newborn health. *Best Pract Res Clin Obstetr Gynaecol.* 2016, 36, 169–83.
- [9] World Health Organization (2016). Fact Sheet. 2016. <http://www.who.int/media/Centre/factsheets/fs178/en/>.
- [10] UNICEF (2015). Levels & Trends in child mortality. UNICEF, WHO, World Bank Group, UN. https://www.unicef.org/media/files/IGME_Report_Final2.pdf.

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