

# Tracking Future Trends of Under Five Mortality Rate for Iraq Using a Machine Learning Algorithm

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**Abstract - This study uses annual time series data on under five mortality rate (U5MR) for Iraq 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 model is stable in forecasting U5MR. The ANN (12, 12, 1) model projections indicate that U5MR will remain around 25 deaths per 1000 live births throughout the out of sample period. Therefore, we encourage the government of Iraq to address all the factors that influence under five mortality in the country including improvement of working conditions for healthcare workers and ensuring availability of adequate medical supplies at all levels of healthcare.**

**Keywords:** ANN, Forecasting, U5MR

## I. INTRODUCTION

The 3<sup>rd</sup> sustainable development goal focuses on good health and promotion of well-being for all at all stages (UN, 2016; UN, 2015). SDG3 covers all the major health priorities. All countries must endeavor to come up with strategies to address problems such as maternal, newborn and under five mortality. Under five mortality remains a global health issue particularly for low and middle income countries (Liu *et al.* 2016). It is a core indicator of development of families, societies and the world at large (Yaya *et al.* 2018). Remarkable SDG progress has been recorded over the past decades, however more effort and new strategies are required to maintain the current successes (UN, 2020; UNICEF, 2019; WHO, 2019; UNICEF, 2018). It is important to highlight that SDG3 should not be tackled in isolation from other sustainable development goals since there is a strong link between SDG3 and other health related SDGs. Achievement of the set SDG targets for health related SDGs has a positive impact on the health of a population. For example poverty and hunger reduction will result in the improvement of the nutritional status of a population and thereby improving the health status of a population. The purpose of this paper is to model and project under five mortality rate for Iraq using the artificial neural network approach. The findings are expected to inform child health policies, planning and allocation of resources in order to end all preventable under five deaths in the country.

## II. LITERATURE REVIEW

Beluzo *et al.* (2020) proposed a novel approach to classify newborns that may be susceptible to neonatal mortality by applying supervised machine learning methods on public health features. The approach was evaluated in a sample of 15,858 records extracted from SP Neo Death dataset, which were created from SINASC and SIM databases from Sao Paulo city ~ (Brazil). As a result an average AUC of 0.96 was achieved in classifying samples as susceptible to death or not with SVM, XGBoost, Logistic Regression and Random-Forests machine learning algorithms. An Asian study by Khan *et al.* (2019) modelled and forecasted infant mortality rates of Asian countries in the perspective of GDP. Secondary data of IMR and GDP (PPP) from 1980 to 2015 was analyzed and forecast was done from 2016 to 2025. AR (1) was found to be suitable for all the countries except Japan and Nepal for which ARIMA (1, 1, 1) model was appropriate based on FMSE and FRMSE. A cross-sectional study by Weddhi *et al.* (2019) investigated factors associated with neonatal mortality at the Referral Hospital in Nouakchott, Mauritania. The study was conducted between January 2013 and December 2013 and included neonatal patients hospitalized at the National Referral Hospital (NRH). Data were collected by reviewing the medical charts and through questionnaires administered to the parents. The authors concluded that neonatal mortality remains a significant burden in Mauritania. They identified different socioeconomic and clinical risk factors indicating the need for more intensified prenatal care and improved transport of high risk neonates, especially in the regions outside the capital. Akinwande *et al.* (2016) Analyzed Infant and Child (Under-five) Mortality in Zaria using a regression Analysis Approach. The study was carried out using secondary data from Ahmadu Bello University Teaching Hospital, Zaria, on infant and child (under-five) mortality and delivery rates. Findings from the study indicated that both infant and child mortality rates have a direct relationship with delivery rates. The correlation analysis result showed that there is a very strong and positive relationship between mortality and delivery rates. The study revealed that infant and child mortality rates will continue to decrease if there can be improvement in the factors under study.

### 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 Iraq.

#### Data Issues

This study is based on annual under five mortality rate in Iraq 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	0.000477
MSE	0.177950
MAE	0.357465

#### Residual Analysis for the Applied Model

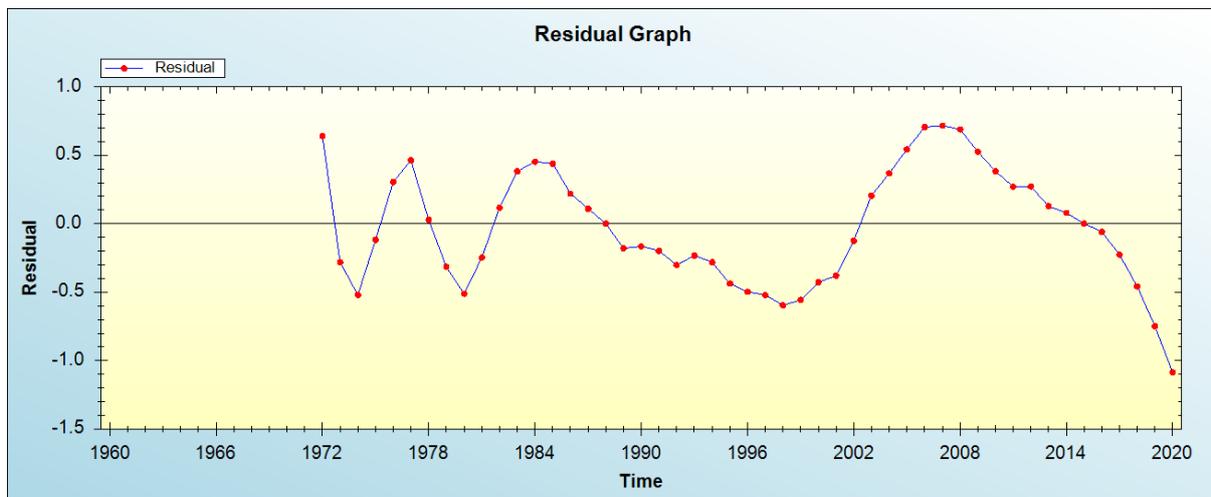


Figure 1: Residual analysis

In-sample Forecast for Q

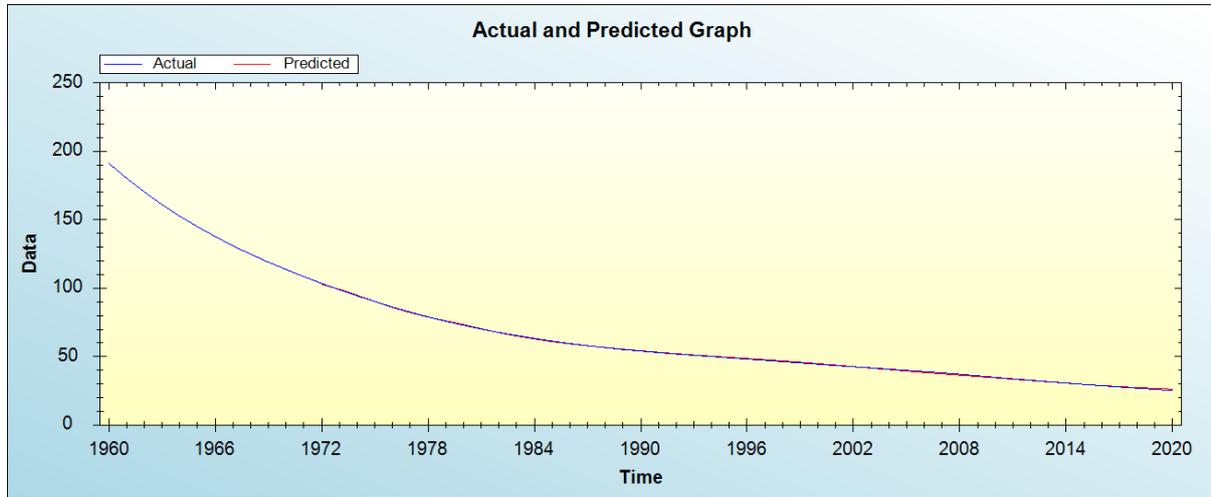


Figure 2: In-sample forecast for the Q series

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

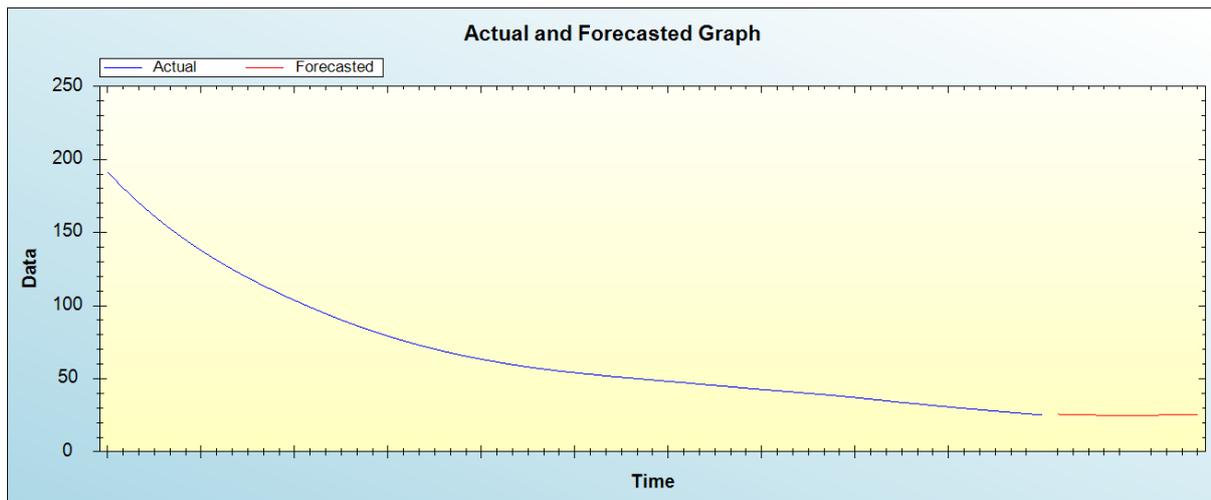


Figure 3: Out-of-sample forecast for Q: actual and forecasted graph

Out-of-Sample Forecast for Q: Forecasts only

Table 2: Tabulated out-of-sample forecasts

2021	25.7883
2022	25.5513
2023	25.2902
2024	25.0354
2025	24.8693
2026	24.8680
2027	25.0973
2028	25.2366
2029	25.2413
2030	25.2500

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

## V. POLICY IMPLICATION & CONCLUSION

The increase in the utilization of machine learning algorithms in time series prediction problems has improved the quality of healthcare services as a result of reliable forecasts that inform policies, decisions and allocation of resources. In this study we applied the ANN (12, 12, 1) model to project future trends of U5MR in Iraq and forecast results revealed that U5MR will remain around 25 deaths per 1000 live births throughout the out of sample period. Therefore, we encourage the authorities in Iraq to address all the factors that contribute to under five mortality across the country including the improvement of working conditions of healthcare workers and ensuring availability of medical supplies at all levels of healthcare.

## 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] Yaya S, Bishwajit G, Okonofua F, Uthman OA (2018) Under five mortality patterns and associated maternal risk factors in sub-Saharan Africa: A multi-country analysis. PLoS ONE 13(10): e0205977. <https://doi.org/10.1371/journal.pone.0205977>
- [8] Liu L, Oza S, Hogan D et al., Global, regional, and national causes of under-5 mortality in 2000–15: an updated systematic analysis with implications for the Sustainable Development Goals. Lancet 2016; 388: 3027–35 [https://doi.org/10.1016/S0140-6736\(16\)31593-8](https://doi.org/10.1016/S0140-6736(16)31593-8) PMID: 27839855
- [9] United Nation. Transforming our world: The 2030 agenda for sustainable development 2016.

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