International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 5, Issue 3, pp 627-631, March-2021

https://doi.org/10.47001/IRJIET/2021.503108

Prediction of Infant Mortality in Morocco Using Artificial Neural Networks

[1]Dr. Smartson. P. NYONI, [2]Thabani NYONI

[1]ZICHIRe Project, University of Zimbabwe, Harare, Zimbabwe
[2]Department of Economics, University of Zimbabwe, Harare, Zimbabwe

***Abstract* - In this research paper, the ANN approach was applied to analyze infant mortality rate in Morocco. The employed annual data covers the period 1960-2020 and the out-of-sample period ranges over the period 2021-2030. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is stable in forecasting infant mortality rate in Morocco. The results of study indicate that IMR will be around 17/1000 live births per year over the next decade. Therefore, in line with our policy advise; the government should intensify surveillance and control programs for maternal and child health in order to curb infant mortality in the country.**

Keywords: ANN, Forecasting, infant mortality rate.

I. INTRODUCTION

Artificial intelligence (AI) is a scientific discipline whose backbone lies in philosophy, mathematics and computer science. Its aim is to understand and develop systems that display properties of intelligence (Panch et al, 2018). Machine learning (ML) is a sub discipline of AI where computer programs (algorithms) learn associations of predictive power from examples (Zhao et al, 2020; Panch et al, 2018). ML is also defined as the application of statistical models to data using computers (Panch et al, 2018). There are 3 broad categories of ML: supervised, unsupervised and re-enforcement learning (Zhao et al, 2020; Panch et al, 2018;Weng et al, 2017, Kaushik & Sahi , 2018, Yan et al, 2018, Zhang , 2003; Fojnica et al, 2016). Supervised learning occurs when an algorithm learns the association between inputs and outputs through analysis of outputs of interest defined by the supervisor (Panch et al, 2018; Weng et al, 2017). When an algorithm discovers the hidden patterns or structures from the input data it is referred to as unsupervised learning (Panch et al, 2018; Weng et al, 2017). Re-enforcement learning occurs when an algorithm learns actions based on its ability to maximize on a defined reward (Panch et al, 2018).

Machine learning algorithms have gained prominence in public health and other fields. In medicine these computer programs can be used in screening, diagnosis and forecasting of diseases (Stanford University, 2018; Henglin et al, 2017). Furthermore, ML techniques are used to detect disease outbreaks early (Johnson et al, 2017). There are several ML algorithms that have proved to be useful in time series forecasting problems such as artificial neural networks (ANNs), support vector machine, tree based models, K-nearest neighbors, and Bayesian networks (Nyoni et al, 2020; Zhao et al, 2020). In this paper we aim to model and predict infant mortality rate in Morocco using artificial neural networks. The results of the study are expected to reveal future trends of infant mortality rate in Morocco and facilitate the evaluation of maternal and child health programs in order to prevent and control infant mortality in the country.

II. LITERATURE REVIEW

Nyoni & Nyoni (2020) modelled and forecasted infant deaths in Zimbabwe using ARIMA model. The study utilized annual time series data on total infant deaths in Zimbabwe from 1960 to 2018. The best model based on AIC was the ARIMA (1, 2, 5) model. The study findings indicated that the number of infant deaths per year, over the out-of-sample period, would follow a downward trend. In a related study, Nyoni & Nyoni (2020) used monthly time series data on neonatal deaths cases at Chitungwiza Central Hospital (CCH) from January 2013 to December 2018; to forecast neonatal deaths over the period January 2019 to December 2020 using the Box-Jenkins SARIMA approach. The parsimonious model was found to be the SARIMA (0, 0, 3) (2, 0, 0)12 model and its predictions indicate slow but steady decrease in neonatal deaths at CCH. Iriondo et al (2020) developed and validated different mortality predictive models, using Spanish data, to be applicable to centers with similar morbidity and mortality. Infants born alive, admitted in NICU, and registered in the SEN1500 database, were included. Multivariable regression models were used for the different time periods. The study concluded that using dynamic models to predict individual mortality can improve outcome estimations. Development of models in the prenatal period, first 24 hours, and during hospital admission, cover key stages of mortality prediction in preterm infants. Caluza (2018) utilized data mining technique using decision tree called

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 5, Issue 3, pp 627-631, March-2021

https://doi.org/10.47001/IRJIET/2021.503108

J48 algorithm in classifying child mortality rate, life expectancy at birth, annual population growth, and the gross domestic product. Results revealed that annual population growth is highly correlated in predicting child mortality and generate three distinct rules. The generated model had high acceptability with 97.4% ROC curve result of the three classes in predicting child mortality under five years old.

III. METHODOLOGY

The Artificial Neural Network (ANN), which we intend to apply in this study; is a data processing system consisting of a huge number of simple and highly interconnected processing elements resembling a biological neural system. It has the capability of learning from any data-set to describe the nonlinear and interaction effects with great accuracy. No strict rules exist for the determination of the ANN structure hence 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 infant mortality rates in Morocco.

Data Issues

This study is based on annual infant mortality rates in Morocco for the period 1960 – 2020. The out-of-sample forecast covers the period 2021 to 2030. Infact mortality rate, which is simply a proxy for infant deaths; for the purposes of this study, is defined as the number of infants dying before reaching one year of age, per 1000 live births in a given year. All the data employed in this paper was gathered from the World Bank.

IV. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	J
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	0.010607
MSE	0.568967
MAE	0.610247

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 5, Issue 3, pp 627-631, March-2021
https://doi.org/10.47001/IRJIET/2021.503108

Residual Analysis for the Applied Model

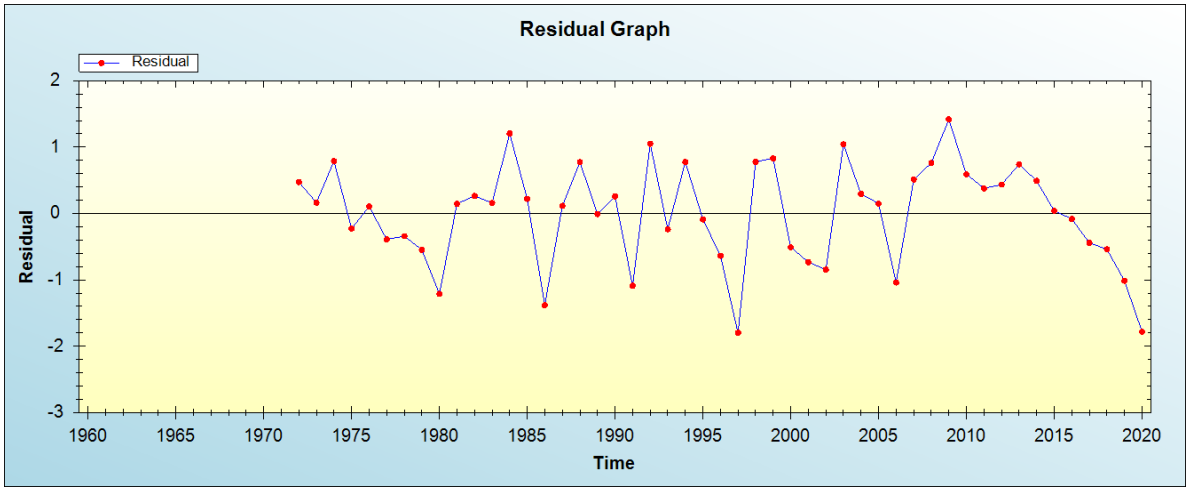

Figure 1: Residual analysis

In-sample Forecast for J

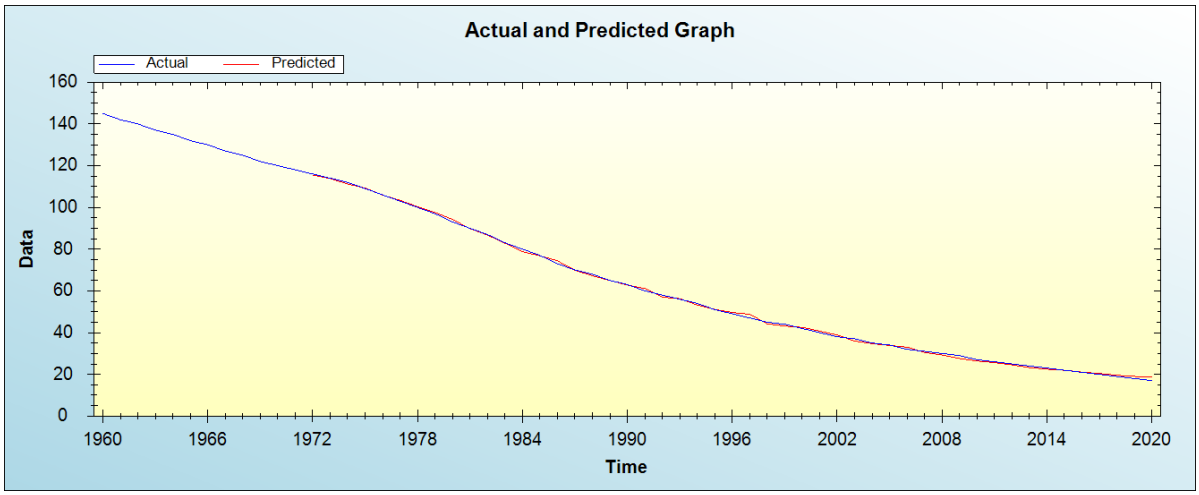

Figure 2: In-sample forecast for the J series

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

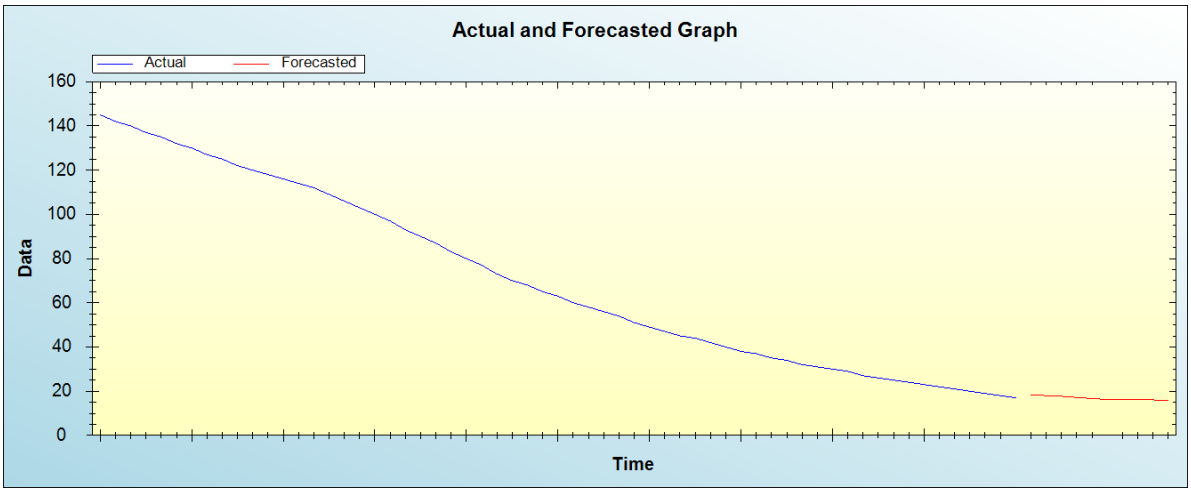

Figure 3: Out-of-sample forecast for J: actual and forecasted graph

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 5, Issue 3, pp 627-631, March-2021

https://doi.org/10.47001/IRJIET/2021.503108

Out-of-Sample Forecast for J: Forecasts only

Table 3: Tabulated out-of-sample forecasts

Year	Forecasts
2021	18.3929
2022	18.0355
2023	17.6870
2024	17.1413
2025	16.6955
2026	16.2493
2027	16.1661
2028	16.1415
2029	16.0703
2030	16.0086

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 infant mortality in Morocco is likely to remain around 17/1000 live births per year over the next decade.

V. CONCLUSION AND POLICY RECOMMENDATIONS

Preventing infant mortality remains one of the main objectives of the health ministry in Morocco. The government remains committed to ending preventable deaths infants in the country. The study used annual data to analyze the trends of infant mortality in Morocco. The applied model is the ANN model. In order to make sure that infant mortality in the country significantly declines, the government of Morocco ought to consider the following policy suggestions:

i. The government should continue to encourage mothers to breast-feed their babies adequately.

ii. There is need for all child-bearing women to be vaccinated against common illnesses.

iii. There is need to prevent birth defects in Morocco.

iv. The government of Morocco should address preterm birth, low birth-weight and their outcomes.

v. The government of Morocco should also ensure adequate access to pre-pregnancy and prenatal care.

vi. There is need to educate, especially, mothers on the importance of creating a safe infant sleep environment in the country.

vii. Healthcare providers in Morocco need to use newborn screening activities in order to detect hidden conditions.

REFERENCES

[1] Fojnica, A., Osmanoviae & Badnjeviae A (2016). Dynamic model of tuberculosis-multiple strain prediction based on artificial neural network. In proceedings of the 2016 5th Mediterranean conference on embedded computing pp290-293.

[2] Henglin M., Stein G., Hushcha PV., Snoek J., Wiltschko AB & Cheng S (2017). Machine learning approaches in cardiovascular imaging. Circ Cardiovasc Imaging. 2017; 10:e005614. Medline:28956772 doi:10.1161/CIRCIMAGING.117.005614

[3] Johnson AE., Pollard TJ., Mark RG (2017).Reproducibility in critical care: a mortality prediction case study. Machine Learning for Healthcare Conference 2017. JMLR W&C Track Volume 68. Available: http://proceedings.mlr.press/v68/johnson17a/johnson17a.pdf

[4] Kaushik AC & Sahi. S (2018). Artificial neural network-based model for orphan GPCRs.Neural.Comput.Appl. 29,985-992

ISSN (online): 2581-3048
Volume 5, Issue 3, pp 627-631, March-2021
https://doi.org/10.47001/IRJIET/2021.503108

[5] Naizhuo Zhao., Katia Charland., Mabel Carabali., Elaine O., Nsoesie., Mathieu MaheuGiroux., Erin Rees., Mengru Yuan., Cesar Garcia Balaguera., Gloria Jaramillo Ramirez., & Kate Zinszer (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

[6] Smartson. P. Nyoni, Thabani Nyoni, Tatenda. A. Chihoho (2020) Prediction of new Covid-19 cases in Ghana using artificial neural networks. IJARIIE Vol-6 Issue-6 2395-4396

[7] Smartson. P. Nyoni., Thabani Nyoni., Tatenda. A. Chihoho (2020) Prediction of daily new Covid-19 cases in Egypt using artificial neural networks.IJARIIE- Vol-6 Issue-6 2395-4396

[8] Stanford University (2017). Algorithm outperforms radiologists at diagnosing pneumonia [Internet]. Stanford News. Available: https://news.stanford.edu/2017/11/15/algorithm-outperforms-radiologists-diagnosing-pneumonia/. Accessed: 20 March 2018.

[9] Trishan Panch., Peter Szolovits., & Rifat Atun (2018).Artificial intelligence, machine learning and health systems. Viewpoints• doi: 10.7189/jogh.08.020303 5 • Vol. 8 No. 2 • 020303

[10] Weng SF., Reps J., Kai J., Garibaldi JM &Qureshi N (2017).Can machine learning improve cardiovascular risk prediction using routine clinical data? Plos One

[11] Zhang G P, "Time series forecasting using a hybrid ARIMA and neural network model", Neurocomputing 50: 159–175.

Citation of this Article:

Dr. Smartson. P. NYONI, Thabani NYONI, "Prediction of Infant Mortality in Morocco Using Artificial Neural Networks" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 3, pp 627-631, March 2021. Article DOI https://doi.org/10.47001/IRJIET/2021.503108

****

