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Forecasting Art Coverage in Malaysia Using the Multilayer Perceptron Neural Network

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***Abstract* - In this research article, the ANN approach was applied to analyze ART coverage in Malaysia. The employed annual data covers the period 2000-2018 and the out-of-sample period ranges over the period 2019-2023. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied ANN (9, 12, 1) model indicate that the model is stable in forecasting ART coverage in Malaysia. The results of the study indicate that ART coverage is likely to drop drastically over the period 2019-2023. The government is encouraged to intensify demand creation for HIV testing and ART services, allocate financial resources for TB/HIV program collaboration and strengthen the system of tracking loss to follow up ART clients.**

Keywords: ANN, ART coverage, Forecasting.

I. INTRODUCTION

The HIV epidemic remains a public health problem even for Malaysia. In 2018 the country reported that there were about 87,041 people living with HIV(PLHIV) (Malaysia report, 2018) The country also reported that 55 % of PLHIV were receiving antiretroviral treatment (ART). New HIV infections were reported to be 3,293 in the same year and the cumulative number of deaths related to AIDS was 43,843. More than 70% of new HIV infections were reported among people aged 20-39 years while children less than 13years are approximately less than 1% (Country Progress Report, 2018). The government has made significant progress in the control of the HIV epidemic. At the end of 2018 the percentage of PLHIV who know their status was 86 %, the percentage of PLHIV on ART among those who know their status was 55 % and the percentage of PLHIV on ART who had viral load suppression was 97% (Country Progress Report, 2018). The main objective of the National ART program in Malaysia is to end the HIV epidemic as a public health threat by 2030. The vision is to reach zero new HIV infections, zero discrimination and zero AIDS related deaths. The strategy is based on testing and treatment, improving the quality and coverage of prevention program among key populations, reducing stigma and discrimination and quality strategic information and its use by policy makers and researchers. The ART program is characterized by the collaboration of HIV care and treatment with other public health programs such as the TB control and Reproductive Health programs. TB screening of all PLHIV is critical and those who do not have TB must be commenced on TB preventive therapy. All TB patients must have an HIV test. TB/HIV collaboration is envisioned to reduce morbidity and mortality due to TB and HIV. Early case detection and treatment of TB/HIV is important to improve treatment outcomes.

Predictive modeling has been successfully applied in Public health to model and forecast the incidence of infectious diseases. Such models can also be applied to forecast ART coverage in order to assess the impact of HIV care and treatment programs .Examples of such models include Autoregressive Integrated Moving Average (ARIMA), artificial neural networks (ANN), exponential and hybrid models. ARIMA models and artificial neural networks are the most widely used models in time series forecasting. The basic ARIMA model is specified as ARIMA (p, d, q) where p and q are the autoregressive (AR) and the moving average (MA) parts. The moving average parts are also called the forecast errors represents the order of nonseasonal differencing (Nyoni &Nyoni 2019a & b; Yan et al, 2019). In this study we applied the ANN model to predict ART coverage in Malaysia. The basic structure is made up of 3 layers namely the input, hidden and output layers connected by connection weights. The nodes in each layer are called processing elements (Fojnica et al, 2016; Zhang, 2003; Kaushik &Sahi, 2018). The findings of this study will be used as a tool to evaluate the impact of HIV care and treatment programs as well as progress towards the 2030 global goal of ending the HIV epidemic as a public health threat. There are no empirical studies in the country which have attempted to model and forecast ART coverage. However at global level such studies are available. Johnson et al (2017) assessed South Africa's progress towards the 2020 targets and variations in performance by province. A mathematical model was fitted to the HIV data for each of South Africa's provinces and for the country as a whole. The study results revealed that ART coverage varied between 43% in Gauteng and 63 % in Northern Cape and most provinces face challenges in reaching the remaining two 90% targets.

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Levira et al (2015) evaluated adult ART and pre ART care coverage by age and sex at CD4 <200, <350 and all people living with HIV in the Rufiji district of Tanzania from 2006 to 2010. The ALPHA model was used to predict the number in need of pre ART and ART by age and sex at CD4 <200 and CD4 <350. The study concluded that ART coverage in the Rufiji District was unevenly distributed and far from universal coverage target of 80% in particular among young men.

III. METHOD

The Artificial Neural Network (ANN), which we intend to employ; is a data processing system consisting of a large number of simple and highly interconnected processing elements resembling a biological neural system. It has the capability of learning from an experimental or real data set to describe the nonlinear and interaction effects with great accuracy. ANN-based curve fitting technique is one of the extensively applied artificial intelligence methods that are used for forecasting and prediction purpose. It consists of basically three layers i.e., input layer, hidden layer, and output layer, the present work includes the number of years as input layer and the annual TB incidence in Malaysia as output data for the network. In this research article, our ANN is based on the hyperbolic tangent function.

Data Issues

This study is based on annual ART coverages (referred to as H series in this study) in all age groups in Malaysia. The data covers the period 2000-2018 while the out-of-sample forecast covers the period 2019-2023. All the data employed in this research paper was gathered from the World Bank online database.

IV. FINDINGS OF THE STUDY

DESCRIPTIVE STATISTICS

Table 1: Descriptive statistics

Mean	Median	Minimum	Maximum
19.000	16.000	0.00000	48.000
Std. Dev.	C.V.	Skewness	Ex. kurtosis
14.549	0.76572	0.78236	-0.40572
5% Perc.	95% Perc.	IQ range	Missing obs.
undefined	48.000	19.000	0

ANN MODEL SUMMARY FOR ART COVERAGE IN MALAYSIA

Table 2: ANN model summary

Variable	H
Observations	10 (After Adjusting Endpoints)
Neural Network Architecture:	
Input Layer Neurons	9
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	0.33665
MSE	0.805947
MAE	0.753328

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Residual Analysis for the ANN model

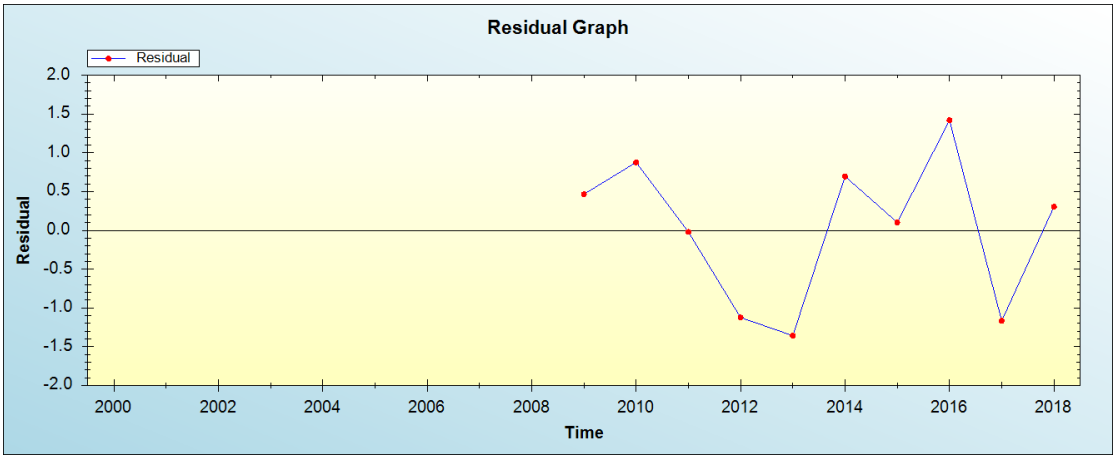

Figure 1: Residual analysis

In-sample Forecast for H

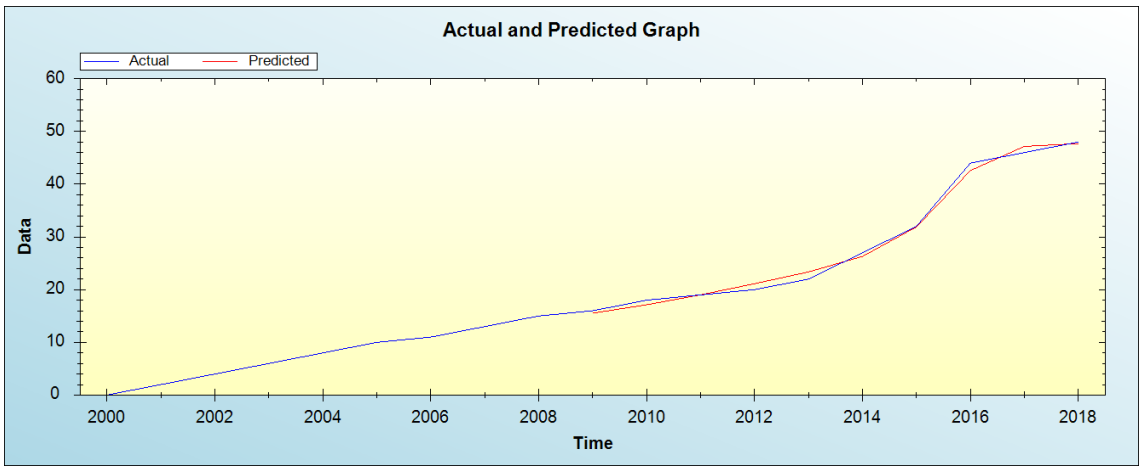

Figure 2: In-sample forecast for the H series

Figure 2 shows the in-sample forecast for H series.

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

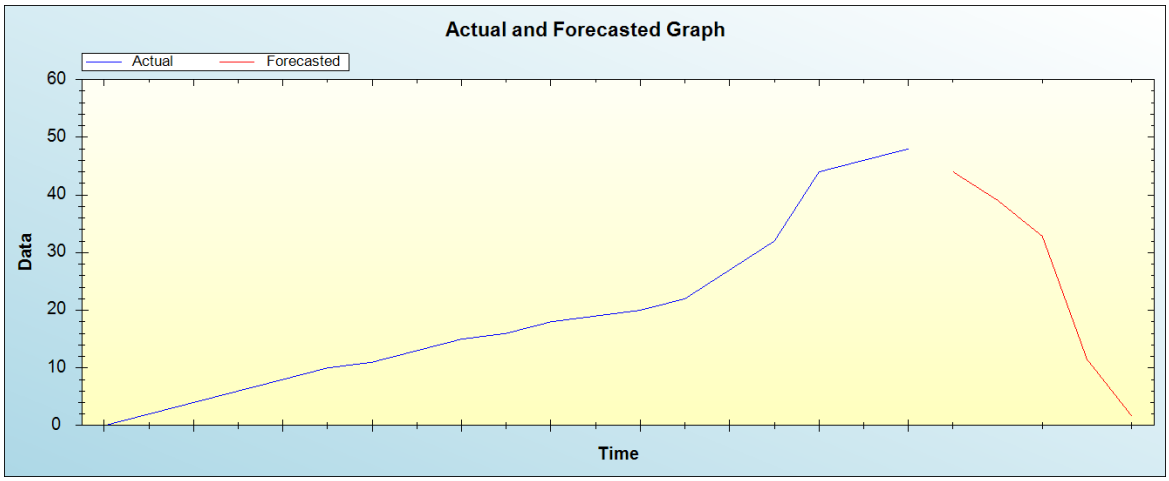

Figure 3: Out-of-sample forecast for H: actual and forecasted graph

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Out-of-Sample Forecast for H: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted ART coverage
2019	43.9907
2020	39.0483
2021	32.8175
2022	11.4880
2023	1.6450

Over the study period, the minimum and maximum ART coverage recorded was 0 and 48% respectively with an average value of 19 %. The national ART program rollout was commenced in 2001 hence zero reporting for ART coverage was noted in the year 2000. The utilized data is positively skewed with an excess kurtosis of -0.40572 meaning that the data is not normally distributed. The model evaluation statistics (Error, MSE, MAE) and the residual graph showed that the applied ANN model is stable and suitable for forecasting ART coverage in Malaysia. Figure 2 shows that the neural network model simulates the observed data very well. The model predicted that the country is likely to have a drastic drop in ART coverage over the period 2019-2023.

V. CONCLUSION & RECOMMENDATIONS

Malaysia recorded significant strides in providing access to Antiretroviral therapy over the period 2000-2018.However the country's gains are likely to be reversed as the model predicts a drastic fall in ART coverage over the period 2019-2023.Therefore the authorities must intensify demand creation for HIV testing and ART services and allocate more financial resources for HIV/TB program collaboration to meet the created demand .Authorities should strengthen tracking of loss to follow up ART clients so as to retain them in care.

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

[3] Nyoni S. P & Nyoni T (2019). Forecasting TB notifications at Zengeza clinic, Zimbabwe. Online at https://mpra.ub.uni-muenchen.de/97331/ MPRA Paper No. 97331, posted 02 Dec 2019 10:13 UTC

[4] Nyoni S. P., & Nyoni T (2019). Forecasting TB notifications at Silobela District Hospital, Zimbabwe.IJARIIE 5(6)2395-4396.

[5] The Global AIDS Monitoring Report, Malaysia (2019).

[6] Yan C Q., Wang R B., Liu C H., Jiang Y (2019). Application of ARIMA model in predicting the incidence of tuberculosis in China from 2018-2019.Zhonghua 40(6):633-637.

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

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