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Forecasting Confirmed Covid-19 Daily Cases in Equatorial Guinea Using Artificial Neural Networks

[1]Dr. Smartson. P. NYONI, [2]Thabani NYONI, [3]Tatenda. A. CHIHOHO

[1]ZICHIRe Project, University of Zimbabwe, Harare, Zimbabwe
[2]SAGIT Innovation Centre, Harare, Zimbabwe
[3]Independent Researcher, Harare, Zimbabwe

***Abstract* - In this research paper, the ANN approach was applied to analyze daily COVID-19 cases in Equatorial Guinea. The employed data covers the period 1 January 2020 to 31 December 2020 and the out-of-sample period ranges over the period 1 January 2021 to 31 May 2021. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is stable in forecasting daily COVID-19 cases in Equatorial Guinea. The applied ANN (12, 12, 1) predictions suggest that daily COVID-19 cases will generally be between 0-10 cases over the out of sample period. Therefore the government is encouraged to continue enforcing WHO guidelines on prevention and control of COVID-19.**

Keywords: *ANN, Forecasting, COVID-19.*

I. INTRODUCTION

According to UNICEF, the COVID-19 pandemic affected more than 188 countries including the entire African continent. By the 24th of August 2020 there were 23, 057,288 confirmed cases and 800,906 fatalities globally. Equatorial Guinea recorded her first case of COVID-19 on the 14th August 2020 and by the 18th of August 2020 the country had reported 4,892 confirmed cases (UNICEF, 2020). The government responded to the pandemic by implementing measures such as social distancing, regular hand washing, wearing facemasks, isolation and treatment of cases and contact tracing. The response to the pandemic also included training on infection prevention and control (IPC) of priority health care facilities, health education, distribution of food and basic hygiene items to the underprivileged members of the society as part of the social protection programme.

In this paper the objective is to model and forecast daily new COVID-19 cases in Equatorial Guinea using the artificial neural network (ANN) approach. The ANN technique is a machine learning (ML) algorithm which is based on the structure and function of the human brain (Arora et al, 2020; Nyoni et al, 2020; Quazi et al, 2015; Yan et al, 2006). ML algorithms are becoming more important in time series forecasting and they have been found to be superior to traditional statistical methods such as the ARIMA model (Zhao et al, 2020; Nyoni et al, 2020; Gambhir, 2018; Scavuzzo et al, 2018; Laureano-Rosario, 2018; Kaushik & Sahi, 2018; Yan et al, 2018; Weng et al, 2017; Guo et al, 2017; Fojnica et al, 2016; Althouse et al, 2011; Zhang, 2003; Kishan, 1997; Patterson, 1995).

II. LITERATURE REVIEW

Table 1: Literature Review

Author (s)	Study period	Method	Findings
Balah & Djeddou (2020)	March – April, 2020	ARFIMA models	The ARFIMA (0, 0.431779, 0) build for Algeria, has a long memory and an upward trend over the next 15 days, which coincides with the holy month of Ramadhan
Deressa & Duresa (2020)	March – August, 2020	Compartmental Model	The diseases free and endemic equilibrium

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			points are locally and globally asymptotically stable. A combination of optimal preventive strategies such as public health education, personal protective measures and treatment of hospitalized cases are effective to significantly decrease the number of COVID-19 cases in the country
Maru et al (2020)	March – September, 2020	Logistic Regression Model	Having diabetes mellitus, fever and shortness of breath are significant predictors of death in severe COVID-19 patients
Nyoni et al (2020)	13 March 2020 to 31 October 2020	ANN model	Daily new COVID-19 cases in Ethiopia are likely to continue declining over the period November 2020 to April 2021.

III. METHODOLOGY

The Artificial Neural Network (ANN) will be applied in this study. It has the capability of learning from any data-set to describe the nonlinear and interaction effects with great accuracy. Arguably, explicit guidelines 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.

Data Issues

This study is based on daily new cases of COVID-19 in Equatorial Guinea for the period 1 January – 31 December 2020. The out-of-sample forecast covers the period January 2021 – May 2021. All the data employed in this paper was gathered from the World Bank.

IV. FINDINGS OF THE STUDY

ANN Model Summary

Table 2: ANN model summary

Variable	L
Observations	354 (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	2.370866
MSE	12727.810738
MAE	21.767703

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Residual Analysis for the Applied Model

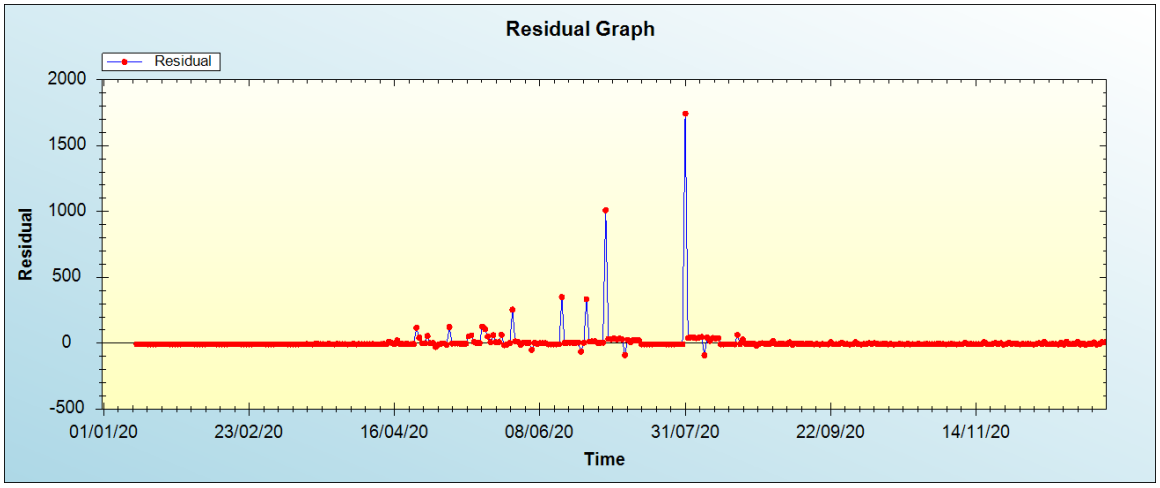

Figure 1: Residual analysis

In-sample Forecast for L

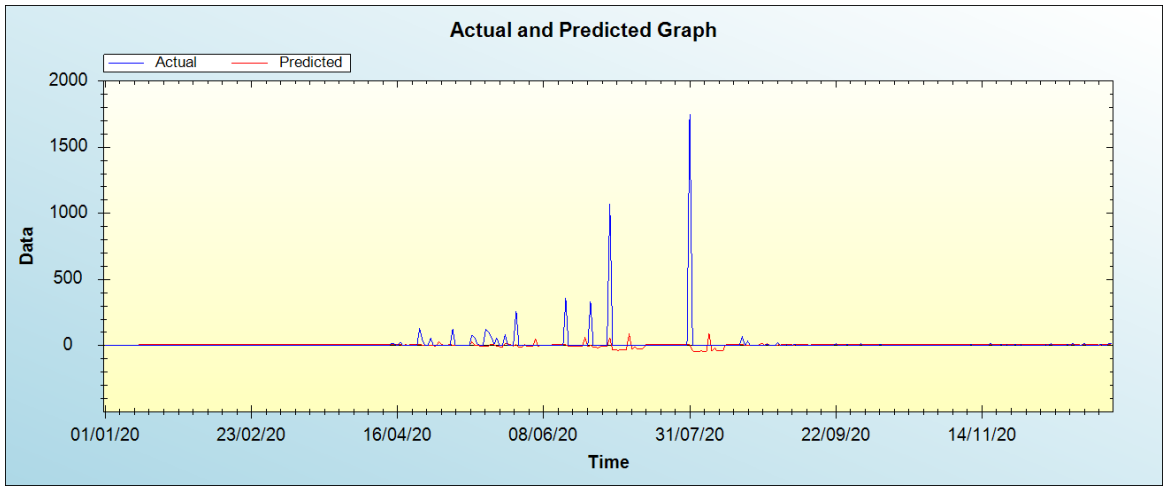

Figure 2: In-sample forecast for the L series

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

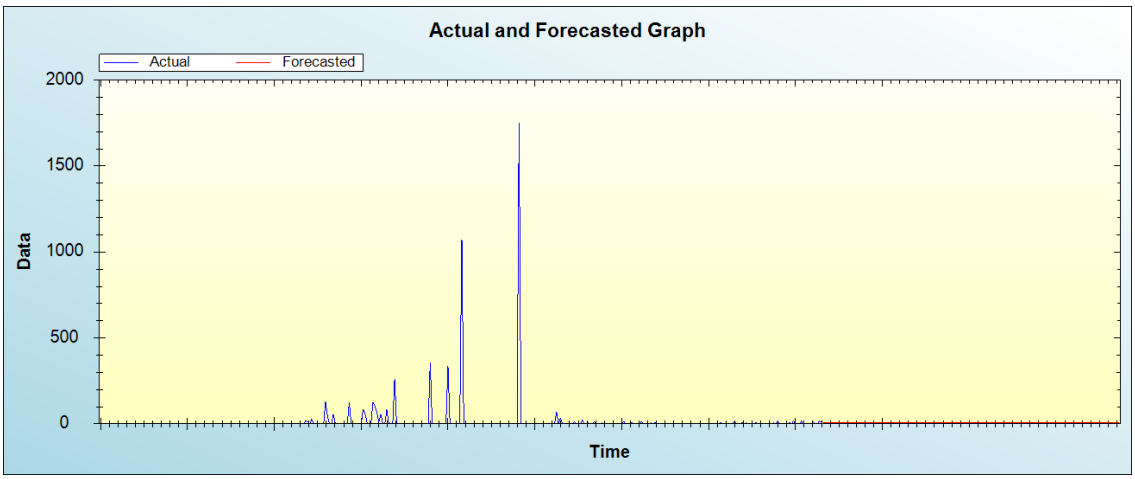

Figure 3: Out-of-sample forecast for L: actual and forecasted graph

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Out-of-Sample Forecast for L: Forecasts only

Table 3: Tabulated out-of-sample forecasts

Day/Month/ Year	Forecasted daily COVID-19 cases
01/01/21	5.4944
02/01/21	5.1520
03/01/21	8.2968
04/01/21	5.3297
05/01/21	5.4184
06/01/21	8.6750
07/01/21	7.7873
08/01/21	6.1024
09/01/21	6.1497
10/01/21	6.6101
11/01/21	5.7429
12/01/21	6.0885
13/01/21	6.9803
14/01/21	6.7483
15/01/21	6.3676
16/01/21	6.4224
17/01/21	6.4795
18/01/21	6.2518
19/01/21	6.4012
20/01/21	6.6291
21/01/21	6.5677
22/01/21	6.4814
23/01/21	6.4947
24/01/21	6.4825
25/01/21	6.4197
26/01/21	6.4690
27/01/21	6.5250
28/01/21	6.5089

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29/01/21	6.4899
30/01/21	6.4921
31/01/21	6.4818
01/02/21	6.4653
02/02/21	6.4807
03/02/21	6.4949
04/02/21	6.4916
05/02/21	6.4881
06/02/21	6.4883
07/02/21	6.4839
08/02/21	6.4798
09/02/21	6.4843
10/02/21	6.4880
11/02/21	6.4875
12/02/21	6.4870
13/02/21	6.4869
14/02/21	6.4853
15/02/21	6.4842
16/02/21	6.4855
17/02/21	6.4864
18/02/21	6.4864
19/02/21	6.4864
20/02/21	6.4863
21/02/21	6.4857
22/02/21	6.4855
23/02/21	6.4858
24/02/21	6.4860
25/02/21	6.4861
26/02/21	6.4861
27/02/21	6.4861
28/02/21	6.4859

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01/03/21	6.4858
02/03/21	6.4859
03/03/21	6.4860
04/03/21	6.4860
05/03/21	6.4860
06/03/21	6.4860
07/03/21	6.4859
08/03/21	6.4859
09/03/21	6.4859
10/03/21	6.4859
11/03/21	6.4860
12/03/21	6.4860
13/03/21	6.4860
14/03/21	6.4859
15/03/21	6.4859
16/03/21	6.4859
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28/03/21	6.4859
29/03/21	6.4859
30/03/21	6.4859
31/03/21	6.4859

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01/04/21	6.4859
02/04/21	6.4859
03/04/21	6.4859
04/04/21	6.4859
05/04/21	6.4859
06/04/21	6.4859
07/04/21	6.4859
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02/05/21	6.4859
03/05/21	6.4859
04/05/21	6.4859
05/05/21	6.4859
06/05/21	6.4859
07/05/21	6.4859
08/05/21	6.4859
09/05/21	6.4859
10/05/21	6.4859
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26/05/21	6.4859
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28/05/21	6.4859
29/05/21	6.4859
30/05/21	6.4859
31/05/21	6.4859

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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 daily COVID-19 cases will generally be between 0-10 cases over the out of sample period.

V. CONCLUSION & RECOMMENDATIONS

The COVID-19 pandemic has brought too much suffering to people across the globe. The developed world is leading with regards to morbidity and mortality (WHO, 2020) whereas the African continent is more vulnerable to the scourge due to preexisting poverty, conflicts and presence of epidemics of HIV,TB and Malaria (WHO, 2019; WHO,2010; Mudie et al, 2019). Whilst lockdowns seem to be very beneficial to the developed countries as they are the most hard hit, developing countries cannot sustain these lockdowns as most people live on hand to mouth that is they survive on their small projects which have been temporally banned during the pandemic. The findings of this study indicate that daily COVID-19 cases will generally be between 0-10 cases over the out of sample period. Therefore the government is encouraged to continue enforcing WHO guidelines on prevention and control of COVID-19 including vaccination.

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