

Forecasting Covid-19 New Cases in Liberia

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Abstract - In this study, the ANN approach was applied to analyze COVID-19 new cases in Liberia. The employed data covers the period 1 January 2020 – 25 March 2021 and the out-of-sample period ranges over the period 26 March – 31 July 2021. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is quite stable. The results of the study indicate that daily COVID-19 cases in Liberia are likely to surge over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Liberia to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The COVID-19 pandemic emerged in Wuhan city, China in December 2019 and WHO declared it as a global health threat on the 11th of March 2020 (CDC, 2020). The pandemic is characterized by high morbidity and mortality, economic meltdown and increased vulnerability of the elderly, informal sector workers, migrant workers and disabled people (UN, 2020). By 8 April 2020, Liberia had reported 31 confirmed cases and 4 deaths (Nordgreen & Kumar, 2020). The government promptly responded to the COVID-19 outbreak by closure of schools, religious centers, bars and markets. Public health measures to mitigate the transmission of the SARS-COV2 virus were enforced by the authorities. The pandemic severely affected the country's economy aggravated by the double shocks of Ebola and low commodity prices which led to a fall in GDP growth rates (Nordgreen & Kumar, 2020). The aim of this paper is to model and predict daily COVID-19 cases in Liberia using the multilayer perceptron neural network. The artificial intelligence technique is now popular in time series forecasting and several studies have revealed its forecasting accuracy and reliability of results (Maradze et al, 2021; Nyoni et al, 2021; Nyoni & Nyoni, 2021; Nyoni et al, 2020; Zhao et al, 2020). The results of this study is envisioned to reveal the likely future trends of COVID-19 in Liberia and this will help decision makers to plan and allocate resources towards fighting the epidemic.

II. LITERATURE REVIEW

Zoabi et al (2020) proposed a machine-learning model that predicts a positive SARS-CoV-2 infection in a RT-PCR test by asking eight basic questions. The model was trained on data of all individuals in Israel tested for SARS-CoV-2 during the first months of the COVID-19 pandemic. The study concluded that the model can be implemented globally for effective screening and prioritization of testing for the virus in the general population. The random forest algorithm was applied by Pramanik et al (2020) to examine the risk factors for COVID-19 transmission. The study findings revealed that Temperature seasonality has the highest contribution for COVID-19 transmission in the humid continental region. September and October have favorable climatic conditions for the COVID-19 spread in the arctic and humid continental regions. From June to August the high favorable zone for COVID-19 spread will shift towards the subarctic region from the continental region. The impact of COVID-19 mitigation measures were assessed by Fang et al (2020) by applying the ARIMA models. The study concluded that Russian's health system can effectively respond to the COVID-19 pandemic. Janice et al (2020) examined the risk factors for severe COVID-19 disease using logistic regression. The study findings indicated that there are specific high-risk pre-existing comorbidities for COVID-19 hospitalization and related deaths in community based older men and women.

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 new COVID-19 cases Liberia.

Data Issues

This study is based on daily new cases of COVID-19 in Liberia for the period 1 January 2020 – 25 March 2021. The out-of-sample forecast covers the period 26 March 2021 – 31 July 2021. All the data employed in this research paper was gathered from the Johns Hopkins University (USA).

IV. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	L
Observations	438 (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	0.165730
MSE	79.763140
MAE	4.941090

Residual Analysis for the Applied Model

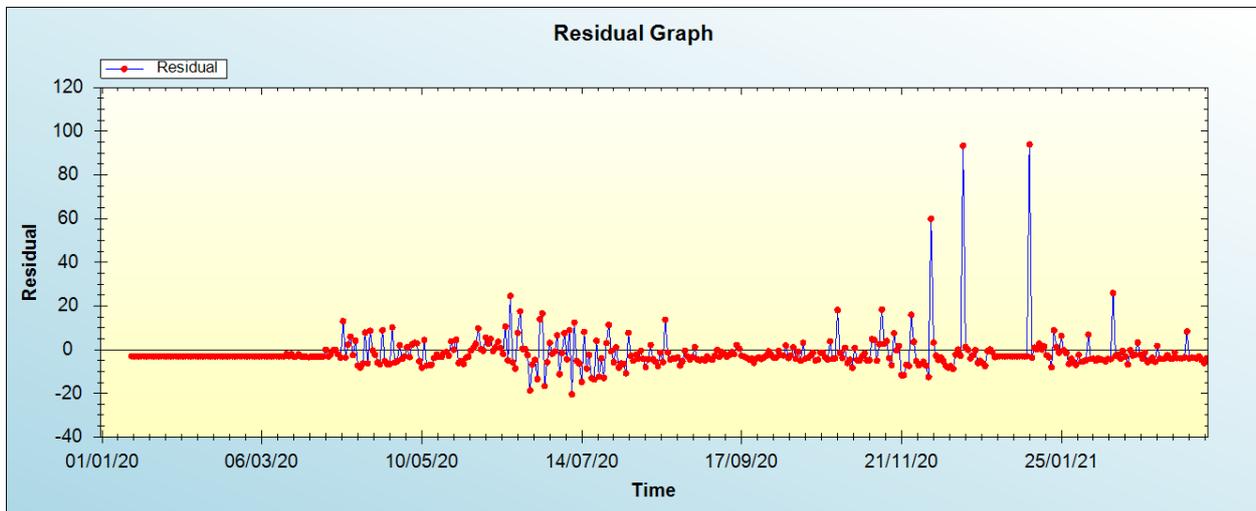


Figure 1: Residual analysis

In-sample Forecast for L

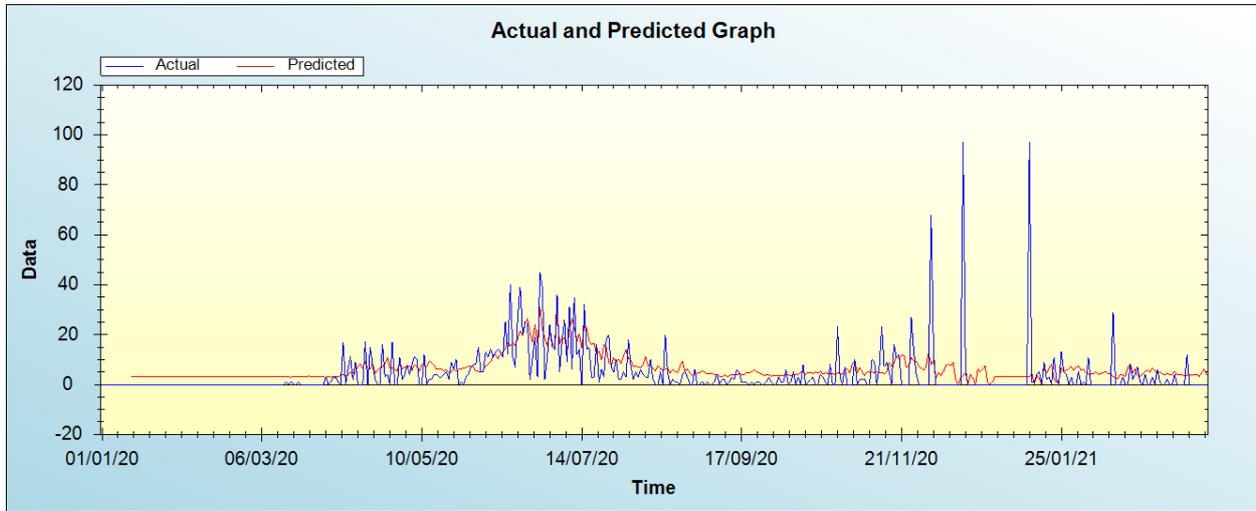


Figure 2: In-sample forecast for the L series

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

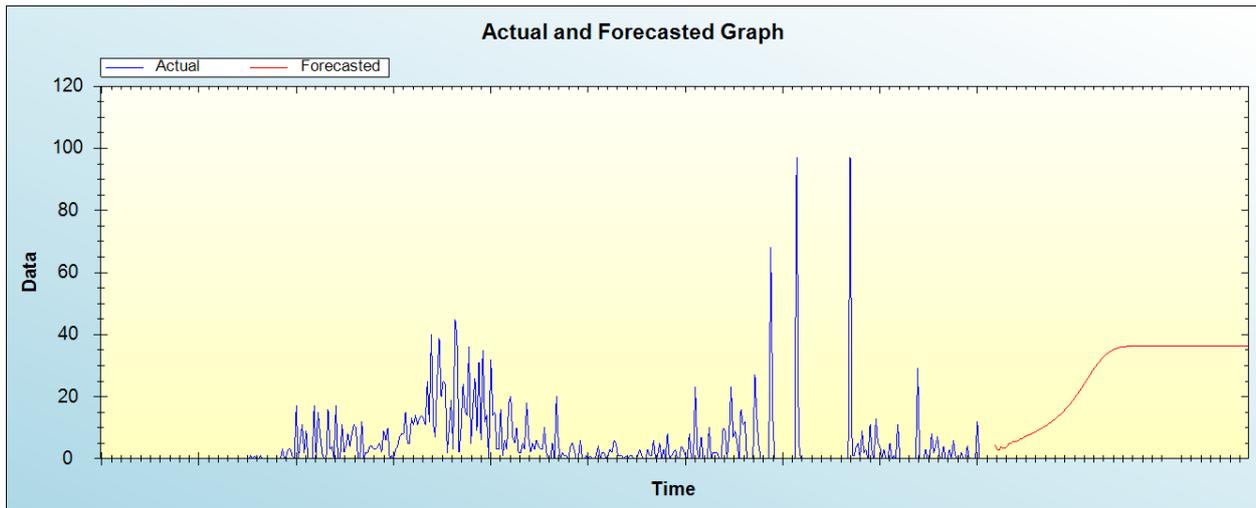


Figure 3: Out-of-sample forecast for L: actual and forecasted graph

Out-of-Sample Forecast for L: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	4.4557
27/03/21	3.0683
28/03/21	2.7263
29/03/21	3.7836
30/03/21	3.2935
31/03/21	3.3103
01/04/21	4.0159
02/04/21	4.8890
03/04/21	4.8545
04/04/21	5.5479
05/04/21	5.6313
06/04/21	5.5651
07/04/21	6.1555
08/04/21	6.4075
09/04/21	6.6998

10/04/21	7.1215
11/04/21	7.4838
12/04/21	7.6284
13/04/21	7.9562
14/04/21	8.3177
15/04/21	8.5738
16/04/21	8.9975
17/04/21	9.3712
18/04/21	9.6943
19/04/21	10.0723
20/04/21	10.4663
21/04/21	10.8416
22/04/21	11.2827
23/04/21	11.7691
24/04/21	12.2231
25/04/21	12.7278
26/04/21	13.2588
27/04/21	13.7925
28/04/21	14.3792
29/04/21	15.0126
30/04/21	15.6681
01/05/21	16.3648
02/05/21	17.1060
03/05/21	17.8681
04/05/21	18.6747
05/05/21	19.5297
06/05/21	20.4146
07/05/21	21.3376
08/05/21	22.2934
09/05/21	23.2651
10/05/21	24.2516
11/05/21	25.2500
12/05/21	26.2452
13/05/21	27.2304
14/05/21	28.1978
15/05/21	29.1304
16/05/21	30.0204
17/05/21	30.8614
18/05/21	31.6437
19/05/21	32.3631
20/05/21	33.0175
21/05/21	33.6019
22/05/21	34.1153
23/05/21	34.5605
24/05/21	34.9387
25/05/21	35.2546
26/05/21	35.5149
27/05/21	35.7245
28/05/21	35.8894
29/05/21	36.0168
30/05/21	36.1122
31/05/21	36.1816
01/06/21	36.2312
02/06/21	36.2656
03/06/21	36.2885
04/06/21	36.3038
05/06/21	36.3134
06/06/21	36.3190
07/06/21	36.3226
08/06/21	36.3250
09/06/21	36.3266
10/06/21	36.3283
11/06/21	36.3298
12/06/21	36.3311

13/06/21	36.3325
14/06/21	36.3337
15/06/21	36.3348
16/06/21	36.3358
17/06/21	36.3367
18/06/21	36.3374
19/06/21	36.3380
20/06/21	36.3384
21/06/21	36.3386
22/06/21	36.3388
23/06/21	36.3389
24/06/21	36.3390
25/06/21	36.3390
26/06/21	36.3391
27/06/21	36.3390
28/06/21	36.3390
29/06/21	36.3390
30/06/21	36.3390
01/07/21	36.3389
02/07/21	36.3390
03/07/21	36.3390
04/07/21	36.3390
05/07/21	36.3390
06/07/21	36.3390
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26/07/21	36.3390
27/07/21	36.3390
28/07/21	36.3390
29/07/21	36.3390
30/07/21	36.3390
31/07/21	36.3390

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 in Liberia are likely to surge over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

Liberia currently faces multiple internal problems which are being worsened by the COVID-19 pandemic, currency depreciation, declining external assistance, weak domestic revenue generation, and limited expenditure adjustments. An estimated 1.6 million people are moderately or severely food insecure (WFP, 2021). This study seeks to model and forecast daily COVID-19 cases in Liberia in order to fully understand the likely future trends of the COVID-19 epidemic for planning purposes and resource allocation so as to minimize the impact of the outbreak in the country. The findings of the study suggest that daily COVID-19 cases in Liberia are likely to surge over the out-of-sample period.

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