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

ISSN (online): 2581-3048

Volume 5, Issue 6, pp 522-526, June-2021

https://doi.org/10.47001/IRJIET/2021.506091

Forecasting Covid-19 New Cases in Sierra Leone

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***Abstract* - Understanding the pattern of COVID-19 is important for purposes of formulating and implementing appropriate precautionary measures to mitigate the spread of the epidemic. In this study, the ANN approach was applied to analyze daily COVID-19 cases in Sierra Leone. This study is based on monthly new cases of COVID-19 in Sierra Leone for the period 1 January 2020 – 25 March 2021. The out-of-sample forecast covers the period 26 March 2021 – 31 July 2021. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the model used in this study indicate that the model is stable in forecasting daily COVID-19 cases in the country. It is projected that daily COVID-19 cases in Sierra Leone are likely to slightly increase and hover around a daily equilibrium of 26 cases over the bulk of the out-of-sample period. The government of Sierra Leone should continue to enforce adherence to the WHO sanitary rules and guidelines in order to suppress any further increase in the number of cases. In this regard, we also encourage the government to upscale the vaccination programme in the country.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The first case of COVID-19 originated from Wuhan, China, after which the disease spread to the rest of the world (Alharbi *et al*., 2020) including Sierra Leone. Patients with COVID-19 can develop mild to severe symptoms following infection, for instance; signs of fever, cough, dyspnea, myalgia, and fatigue can arise in patients mildly affected. The virus can also lead to severe pneumonia, acute respiratory distress syndrome (ARDS), or multi-organ failure in some patients (Huang *et al*., 2020). The main purpose of this paper is to forecast COVID-19 daily cases in Sierra Leone in order to explain the future dynamic spread of the disease and to support the allocation of scarce COVID-19-related resources throughout the country.

II. 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 in Sierra Leone.

Data Issues

This study is based on daily new cases of COVID-19 in Sierra Leone 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).

III. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	SL
Observations	438 (After Adjusting Endpoints)
Neural Network Architecture:	
Input Layer Neurons	12
Hidden Layer Neurons	12

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Output Layer Neurons	1
Activation Function	Hyperbolic Tangent Function
Back Propagation Learning:	
Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	0.101226
MSE	67.413020
MAE	5.722212

Residual Analysis for the Applied Model

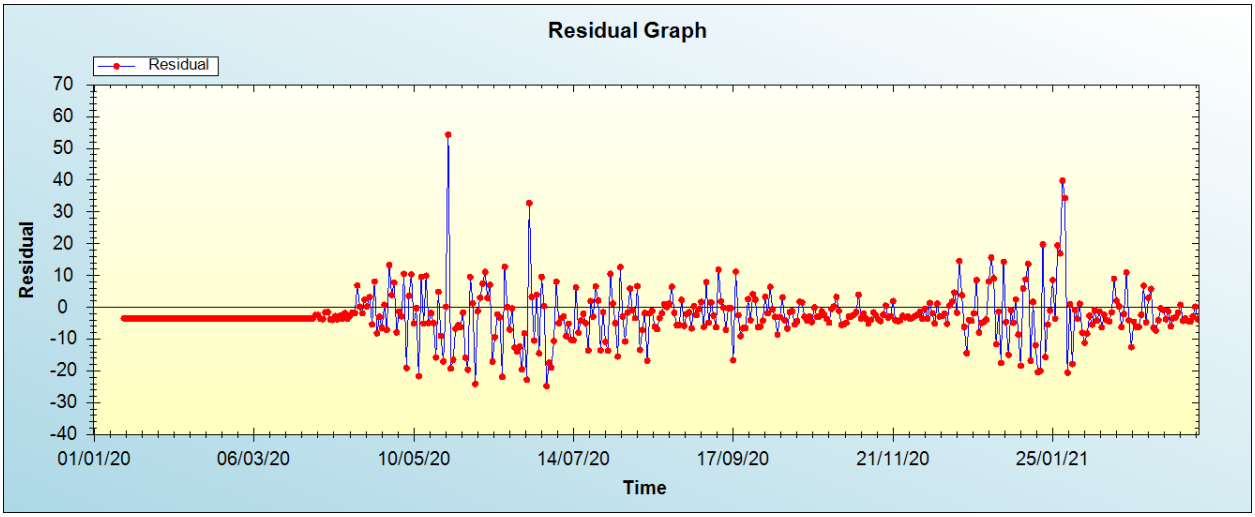

Figure 1: Residual analysis

In-sample Forecast for SL

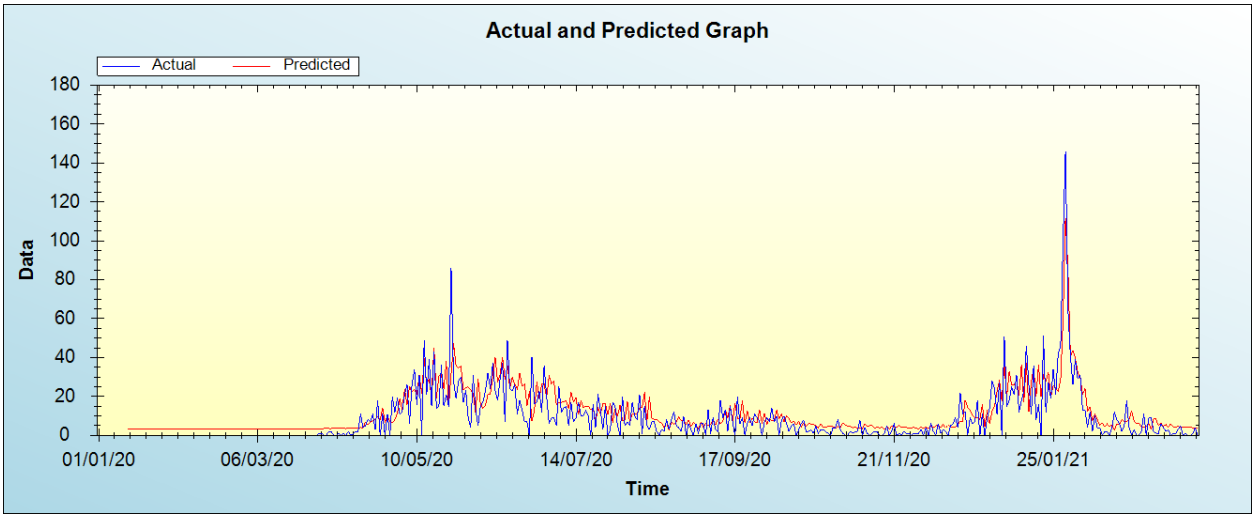

Figure 2: In-sample forecast for the SL series

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

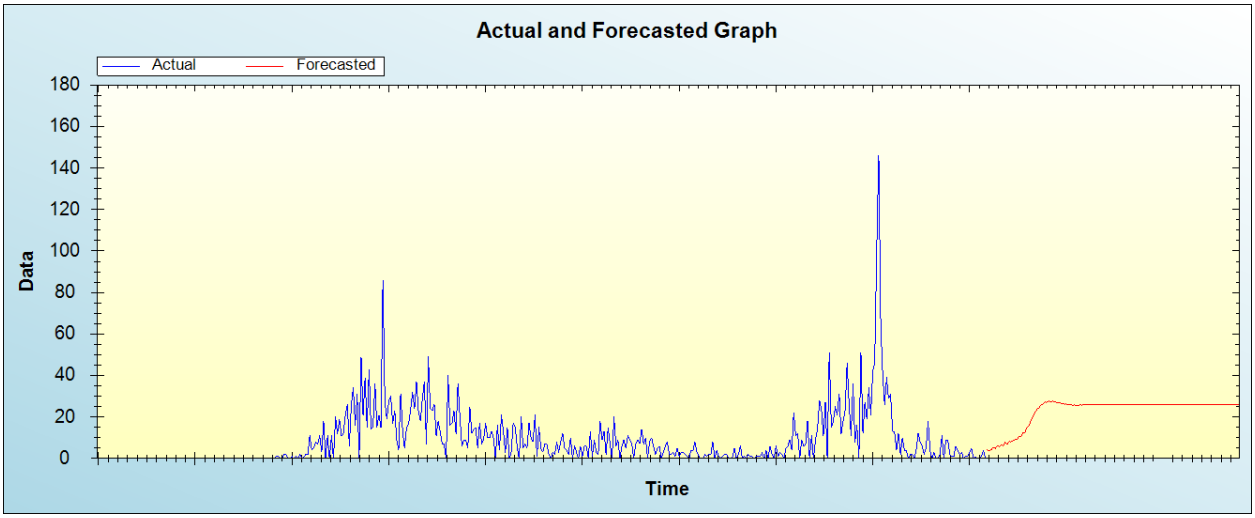

Figure 3: Out-of-sample forecast for SL: actual and forecasted graph

Out-of-Sample Forecast for SL: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
26/03/21	4.2446
27/03/21	3.5721
28/03/21	4.2053
29/03/21	5.3007
30/03/21	4.7794
31/03/21	6.0354
01/04/21	5.7011
02/04/21	6.6836
03/04/21	6.0962
04/04/21	7.8406
05/04/21	6.7610
06/04/21	8.1206
07/04/21	8.0385
08/04/21	8.4427
09/04/21	9.2903
10/04/21	9.2095
11/04/21	10.5749
12/04/21	10.4692
13/04/21	12.3225
14/04/21	12.3788
15/04/21	14.8497
16/04/21	15.6669
17/04/21	18.2700
18/04/21	20.0641
19/04/21	21.8298
20/04/21	23.6323
21/04/21	24.3128
22/04/21	25.7858
23/04/21	25.9481
24/04/21	27.1481
25/04/21	26.9958
26/04/21	27.7615
27/04/21	27.4243
28/04/21	27.5664
29/04/21	27.3285
30/04/21	27.1078
01/05/21	27.0581

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02/05/21	26.6250
03/05/21	26.6767
04/05/21	26.1287
05/05/21	26.2604
06/05/21	25.7655
07/05/21	25.9480
08/05/21	25.6523
09/05/21	25.7758
10/05/21	25.6715
11/05/21	25.6921
12/05/21	25.7577
13/05/21	25.6989
14/05/21	25.8954
15/05/21	25.7804
16/05/21	26.0225
17/05/21	25.8816
18/05/21	26.0858
19/05/21	25.9767
20/05/21	26.1069
21/05/21	26.0596
22/05/21	26.0994
23/05/21	26.1128
24/05/21	26.0664
25/05/21	26.1288
26/05/21	26.0293
27/05/21	26.1198
28/05/21	26.0082
29/05/21	26.0938
30/05/21	26.0004
31/05/21	26.0573
01/06/21	26.0032
02/06/21	26.0225
03/06/21	26.0160
04/06/21	25.9982
05/06/21	26.0305
06/06/21	25.9856
07/06/21	26.0393
08/06/21	25.9853
09/06/21	26.0418
10/06/21	25.9953
11/06/21	26.0387
12/06/21	26.0105
13/06/21	26.0309
14/06/21	26.0255
15/06/21	26.0221
16/06/21	26.0372
17/06/21	26.0158
18/06/21	26.0432
19/06/21	26.0131
20/06/21	26.0431
21/06/21	26.0142
22/06/21	26.0383
23/06/21	26.0186
24/06/21	26.0312
25/06/21	26.0242
26/06/21	26.0240
27/06/21	26.0292
28/06/21	26.0186
29/06/21	26.0323
30/06/21	26.0162
01/07/21	26.0329
02/07/21	26.0168
03/07/21	26.0313
04/07/21	26.0195

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05/07/21	26.0282
06/07/21	26.0233
07/07/21	26.0249
08/07/21	26.0268
09/07/21	26.0223
10/07/21	26.0291
11/07/21	26.0209
12/07/21	26.0300
13/07/21	26.0209
14/07/21	26.0293
15/07/21	26.0222
16/07/21	26.0277
17/07/21	26.0240
18/07/21	26.0257
19/07/21	26.0259
20/07/21	26.0240
21/07/21	26.0272
22/07/21	26.0229
23/07/21	26.0277
24/07/21	26.0227
25/07/21	26.0275
26/07/21	26.0233
27/07/21	26.0267
28/07/21	26.0242
29/07/21	26.0256
30/07/21	26.0253
31/07/21	26.0247

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 Sierra Leone are likely to slightly increase and hover around a daily equilibrium of 26 cases over the bulk of the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

The COVID-19 outbreak continues to spread rapidly across the world and Sierra Leone is among the countries that have been affected by the deadly disease. In this study, we applied the ANN (12, 12, 1) model to forecast daily COVID-19 daily cases in the country. It is projected that daily COVID-19 cases in Sierra Leone are likely to slightly increase and hover around a daily equilibrium of 26 cases over the bulk of the out-of-sample period. The government of Sierra Leone should continue to enforce adherence to the WHO sanitary rules and guidelines in order to suppress any further increase in the number of cases. In this regard, we also encourage the government to upscale the vaccination programme in the country.

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Citation of this Article:

Dr. Smartson. P. NYONI, Mr. Thabani NYONI, Mr. Tatenda. A. CHIHOHO, "Forecasting Covid-19 New Cases in Sierra Leone" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 6, pp 522-526, June 2021. Article DOI https://doi.org/10.47001/IRJIET/2021.506091

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