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

ISSN (online): 2581-3048

Volume 5, Issue 6, pp 261-266, June-2021

https://doi.org/10.47001/IRJIET/2021.506047

Forecasting Covid-19 New Cases in Guyana

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***Abstract* - In this study, the ANN approach was applied to analyze COVID-19 new cases in Guyana. 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 Guyana are likely to generally surge over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Guyana to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The artificial neural network (ANN) approach is regarded as one of the most efficient methods of analyzing huge data sets that can be analyzed computationally to uncover patterns, trends, prediction and forecasting (Tamang et al, 2020). It consists of a large number of single and highly interconnected processing elements resembling a biological neural system (Tamang et al, 2020; Fojnica et al, 2016; Zhang, 2003). The ANN framework can learn a nonlinear relationship between input and output variables (Zhang, 2003). The widely used ANN framework is the multilayer perceptron (MLP) which consists of three layers of neurons namely the input, hidden and output layer (Nyoni et al, 2021, Zhao et al, 2020; Nyoni et al, 2020). During the training process the network adjusts its weights to minimize the errors between the predicted and desired outputs (Tamang et al, 2020; Zhang, 2003). The back propagation algorithm is used to train the network and then the network is used to forecast (Zhao et al, 2020;Nyoni et al, 2020; Scavuzzo et al,2018; Gambhir et al, 2018; Laurean-Rosario et al, 2018; Yan et al, 2018; Kaushik & Sahi, 2018; Weng et al, 2017; Guo et al, 2017; Fojnica et al, 2016 ;Althouse et al, 2011; Zhang, 2003;Kishan, 1997; Patterson, 1995)

In this paper we apply the ANN (12, 12, 1) model to predict daily COVID-19 cases in Guyana. The study results are expected to highlight the likely future trends of COVID-19 cases and trigger a health response to curb the spread of the SARS-CoV2 virus in the country.

II. LITERATURE REVIEW

Predictive modeling in the era of COVID-19 is increasingly gaining attraction from many researchers across the globe. An epidemiology compartmental SIR model was utilized by Fargana et al (2020) susceptible, infected and recovered cases in Bangladesh. The study results showed that for the total population (100%), the epidemic peak would be at 214875 infected cases and 7743(death cases). Kinfu et al (2020)predicted COVID-19 confirmed cases and mortality in the African continent using a co-variate-based instrumental variable regression model. The study covered all countries that reported a confirmed case as of March 31, 2020. The authors concluded that countries that are least urbanized and have a low level of socioeconomic development, hence least connected to the outside world, are likely to register lower and slower transmissions, at least at the early stage of the epidemic. However, the same set of enabling factors that worked for their benefit are likely to go against them in implementing interventions that have lessened the impact of the disease elsewhere. Artificial neural approach was proposed by Nyoni et al (2020) to predict daily COVID-19 cases in France using data captured from Johns Hopkins University. The study concluded that daily COVID-19 cases in France would reach an equilibrium level of approximately 131824 cases per day around November 26, 2020 and this would persist throughout the rest of the out-of-sample period. The logistic regression method was employed by Janice et al (2020) to investigate the risk factors for severe COVID-19 disease. The study concluded that there are specific high-risk pre-existing comorbidities for COVID-19 hospitalization and related deaths in community based older men and women.

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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 Guyana.

Data Issues

This study is based on daily new cases of COVID-19 in Guyana 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	G
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	0.178117
MSE	214.481409
MAE	11.700788

Residual Analysis for the Applied Model

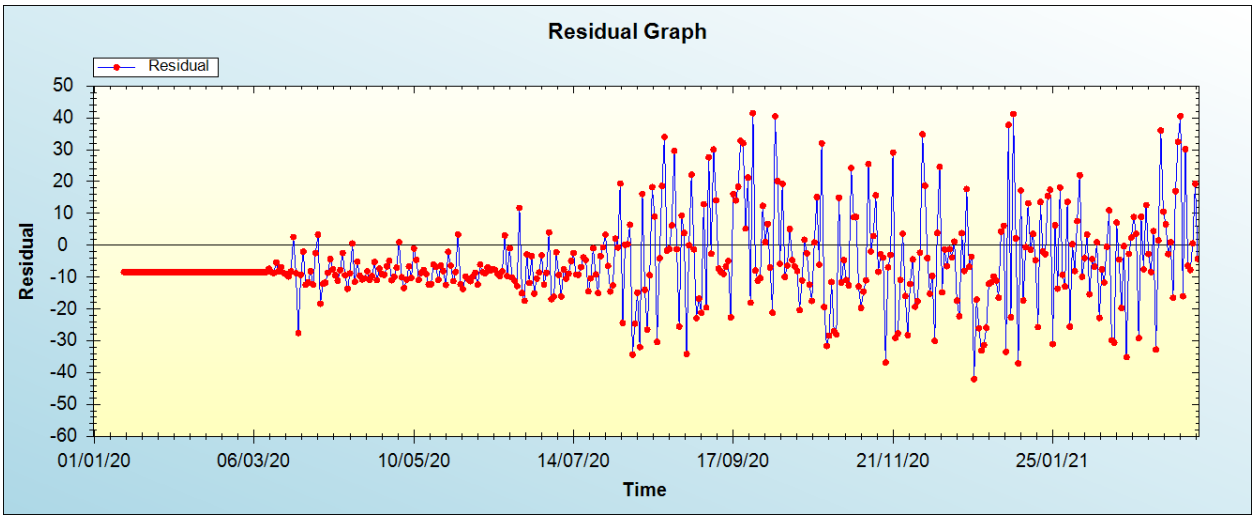

Figure 1: Residual analysis

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In-sample Forecast for G

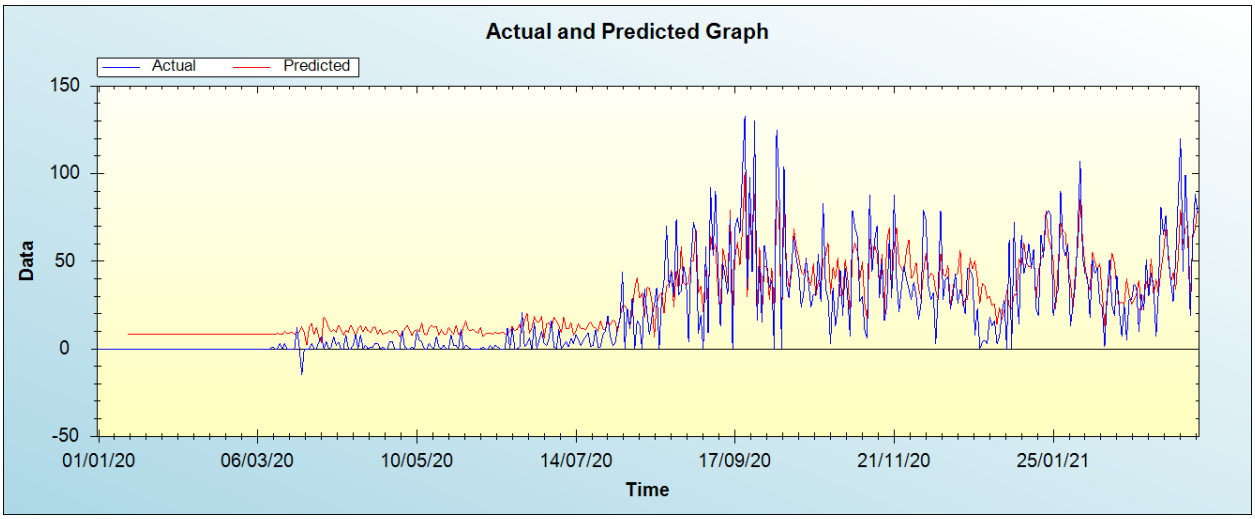

Figure 2: In-sample forecast for the G series

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

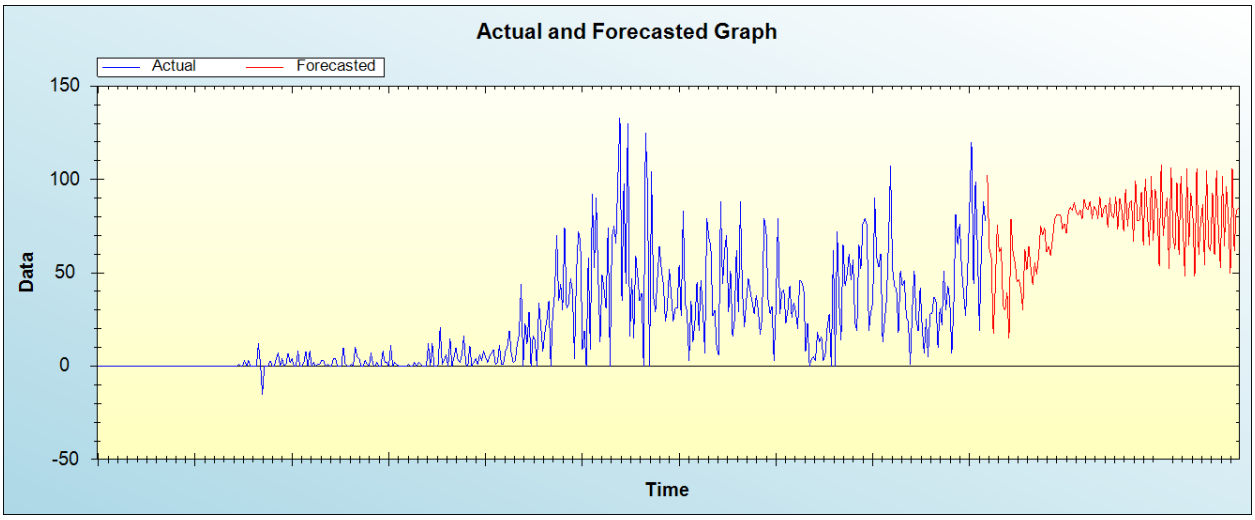

Figure 3: Out-of-sample forecast for G: actual and forecasted graph

Out-of-Sample Forecast for G: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	102.4574
27/03/21	63.0654
28/03/21	58.3898
29/03/21	17.4827
30/03/21	41.2053
31/03/21	75.3442
01/04/21	61.1743
02/04/21	63.3027
03/04/21	32.2233
04/04/21	29.8113
05/04/21	39.6616
06/04/21	14.6138
07/04/21	78.8846

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08/04/21	60.4479
09/04/21	55.7425
10/04/21	45.0441
11/04/21	46.2558
12/04/21	41.0432
13/04/21	30.1845
14/04/21	62.5252
15/04/21	51.5699
16/04/21	64.2971
17/04/21	52.4058
18/04/21	43.3990
19/04/21	55.3570
20/04/21	49.4442
21/04/21	58.7018
22/04/21	75.0674
23/04/21	70.0427
24/04/21	74.3242
25/04/21	60.9177
26/04/21	64.0618
27/04/21	59.4142
28/04/21	67.4896
29/04/21	78.2127
30/04/21	81.0946
01/05/21	80.8050
02/05/21	81.0195
03/05/21	73.3718
04/05/21	76.3140
05/05/21	70.9896
06/05/21	82.4672
07/05/21	85.0510
08/05/21	83.5711
09/05/21	87.4856
10/05/21	82.3243
11/05/21	80.9701
12/05/21	83.7909
13/05/21	78.8445
14/05/21	89.3352
15/05/21	84.8030
16/05/21	83.7442
17/05/21	88.3006
18/05/21	79.1648
19/05/21	85.4156
20/05/21	83.8996
21/05/21	79.0748
22/05/21	90.6868
23/05/21	79.7175
24/05/21	84.1423
25/05/21	86.2337
26/05/21	74.4240
27/05/21	89.9229
28/05/21	80.3795
29/05/21	79.4855
30/05/21	90.5896
31/05/21	73.3897
01/06/21	90.0024
02/06/21	83.5600
03/06/21	72.3443
04/06/21	94.8928
05/06/21	74.8500
06/06/21	87.2879
07/06/21	88.4136
08/06/21	66.9961
09/06/21	99.2876
10/06/21	77.8233

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11/06/21	78.2250
12/06/21	93.4864
13/06/21	64.5313
14/06/21	100.3784
15/06/21	81.6010
16/06/21	64.7709
17/06/21	101.5278
18/06/21	67.1286
19/06/21	94.7122
20/06/21	85.6899
21/06/21	53.7865
22/06/21	107.6897
23/06/21	69.7189
24/06/21	81.7240
25/06/21	89.8828
26/06/21	52.0030
27/06/21	106.2590
28/06/21	69.4145
29/06/21	62.7659
30/06/21	98.1048
01/07/21	59.6916
02/07/21	101.6685
03/07/21	74.6385
04/07/21	48.2343
05/07/21	105.4428
06/07/21	64.5568
07/07/21	92.9232
08/07/21	81.0177
09/07/21	47.8504
10/07/21	105.7512
11/07/21	59.6618
12/07/21	77.4031
13/07/21	86.3236
14/07/21	54.3747
15/07/21	104.7217
16/07/21	64.0958
17/07/21	61.9116
18/07/21	92.8907
19/07/21	59.7437
20/07/21	104.5484
21/07/21	72.6769
22/07/21	52.8366
23/07/21	101.8150
24/07/21	64.3453
25/07/21	96.2478
26/07/21	78.9616
27/07/21	49.3714
28/07/21	105.8571
29/07/21	61.5674
30/07/21	83.2223
31/07/21	84.4514

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 Guyana are likely to generally surge over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

The global pandemic, COVID-19 emerged in late December 2019 in a mysterious way as the World Health Organization was notified of a deadly infectious respiratory disease which was fast wiping away people and thousands suffering from an unknown kind of pneumonia. As the virus spread to every part of the globe many researchers began to see the need to model the evolution of the pandemic to inform decision making and allocation of resources to fight the scourge. Artificial neural networks is

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one of the techniques which is suitable for predicting COVID-19 cases. In this study the artificial neural approach was applied to forecast COVID-19 daily case volumes in Guyana. The findings of this study revealed that daily COVID-19 cases in Guyana are likely to generally surge over the out-of-sample period. Therefore authorities in Guyana should encourage citizens to adhere to WHO guidelines on prevention and control of COVID-19 including vaccination against the COVID-19 virus.

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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 Guyana" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 6, pp 261-266, June 2021. Article DOI https://doi.org/10.47001/IRJIET/2021.506047

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