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Forecasting Covid-19 New Cases in Jamaica

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***Abstract* - In this study, the ANN approach was applied to analyze COVID-19 new cases in Jamaica. 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 the pandemic may vanish in May 2021 in the country. Amongst other suggested policy directions, there is need for the government of Jamaica to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The use of artificial intelligence (AI) techniques in the analysis of big data has gained popularity in many fields including medicine (Khemasuwan et al, 2020). The technology has transformed healthcare delivery as many AI applications are being utilized in screening of health conditions, prognosis, diagnosis and prediction of diseases in order to improve the quality of healthcare in private and public health institutions (Panch et al, 2018). The use of AI technologies is a concept that started at the Dartmouth College in 1956 and the concept was fine tuned in the 1980s and then applied in the medicine (Grosan et al, 2011; Snow et al, 19988; Pan et al, 1985; Alkins et al, 1983). In public health several machine learning methods have been applied such as artificial neural networks, tree-based models, support vector machine, K-nearest neighbors, and graphical models (Nyoni et al, 2020; Zhao et al, 2020). In machine learning the algorithm learns the relationship between the input and output variables and comes up with a function which best describes the relationship. This function is referred to as the hypothesis or predictor function and thus will be used for prediction of future output values. Learning can be supervised or unsupervised. Supervised learning occurs when the algorithm learns a predictor function when both input and output values are provided by the supervisor whereas in unsupervised learning the algorithm discovers the hidden structures or patterns in the input data (Weng et al, 2017).In this paper we apply the multilayer perceptron neural network which performs supervised learning to predict daily COVID-19 cases in Jamaica. The back propagation algorithm is utilized in the training process (Nyoni et al, 2021; Fojnica et al, 2016; Zhang, 2003; Kishan, 1997; Patterson, 1995). The results of the study are expected to reveal future trends of COVID-19 in Jamaica and facilitate planning and allocation of resources in order to fight the epidemic in the country.

II. LITERATURE REVIEW

Ahmar & Boj (2020)applied the suttee ARIMA to forecast COVID-19 cases in the US and the results revealed that COVID-19 was surging in the US. Another group of authors in the US, Seyed etal (2020) applied the Compartmental based mathematical model and the Transition model under different scenarios to investigate COVID-19 cases and ICU admissions in the US. The results of the study revealed that Self-isolation within 24hrs substantially reduces the peak number of ICU beds by 75% required for covid -19 infected patients. Covid-19 outbreak will most likely overwhelm current hospital capacity and that expanding the number of ICU beds is an urgent issue. The Hierarchichal logistic growth model was utilized by Kriston (2020) to project cumulative COVID-19 case growth for six regions (Hubei in China, South Korea, Germany, United States, Brazil, South Africa).A Bayesian hierarchical fiveparameter logistic model was fited to observed data to estimate and project the cumulative number of cases in all regions and countries listed in the John Hopkins University dataset with at least one case. The study concluded that although the model's predictive validity needs further confirmation, the presented approach is likely to offer valuable insights into understanding and managing COVID-19. ARIMA models were applied by Singh et al (2020) to predict confirmed COVID-19 cases in Malaysia. An Autoregressive Integrated Moving Average (ARIMA) model was fitted to the training data of observed cases from 22 January to 31 March 2020, and subsequently validated using data on cases from 1 April to 17 April 2020. The ARIMA model satisfactorily forecasted the daily confirmed COVID-19 cases from 18 April 2020 to 1 May

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2020 (the testing phase).The random walk model was the best model and its predictions suggested a downward trend of COVID-19 cases until 1 May 2020.

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 Jamaica.

Data Issues

This study is based on daily new cases of COVID-19 in Jamaica 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	J
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	0.087768
MSE	1832.817286
MAE	25.302303

Residual Analysis for the Applied Model

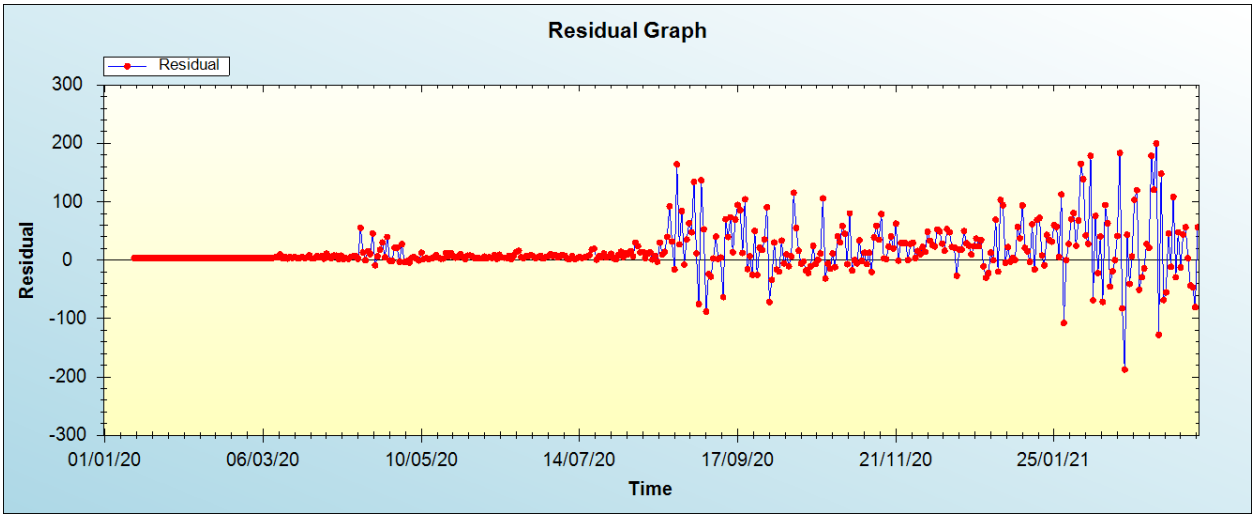

Figure 1: Residual analysis

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In-sample Forecast for J

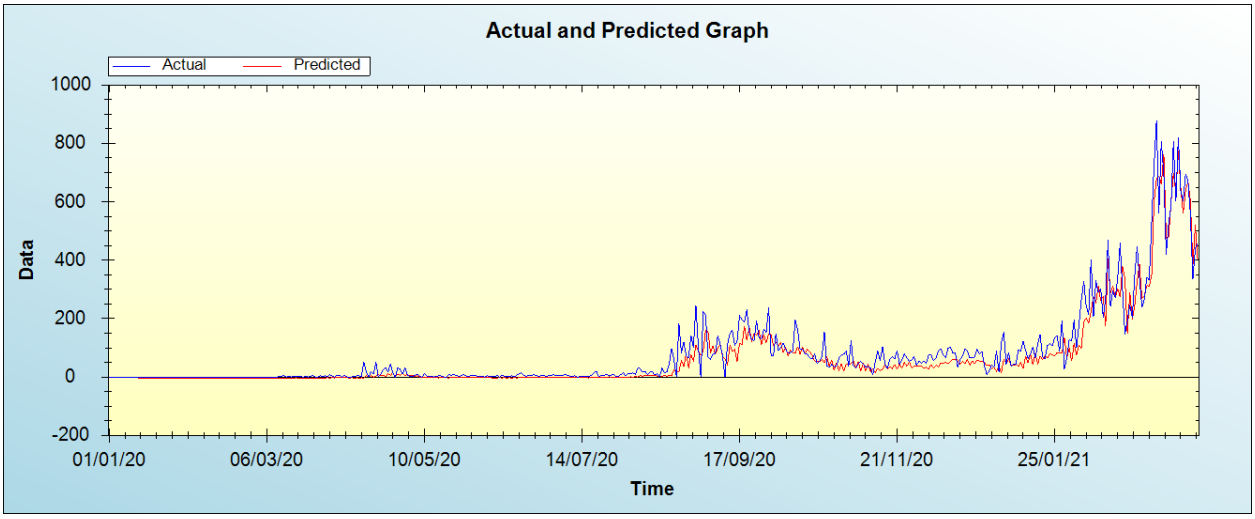

Figure 2: In-sample forecast for the J series

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

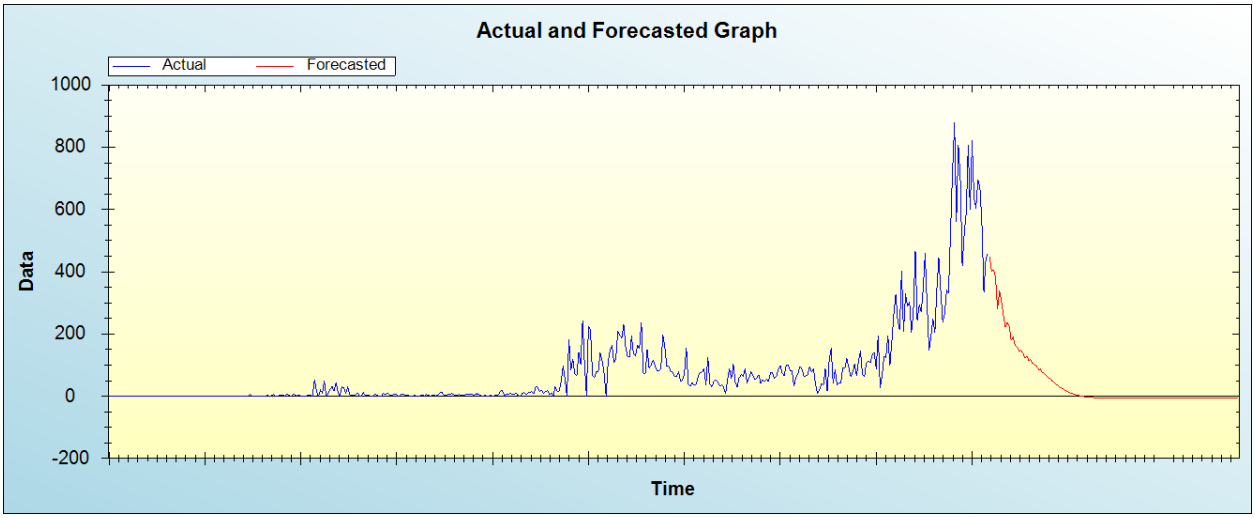

Figure 3: Out-of-sample forecast for J: actual and forecasted graph

Out-of-Sample Forecast for J: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	447.0186
27/03/21	400.0582
28/03/21	406.1336
29/03/21	381.3710
30/03/21	281.5332
31/03/21	339.5616
01/04/21	305.3660
02/04/21	261.0498
03/04/21	221.7622
04/04/21	237.2266
05/04/21	224.5328
06/04/21	179.8510
07/04/21	191.2946
08/04/21	161.8460
09/04/21	158.2944

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10/04/21	145.8142
11/04/21	147.7455
12/04/21	139.2171
13/04/21	123.1629
14/04/21	129.3686
15/04/21	114.2907
16/04/21	117.8133
17/04/21	104.9097
18/04/21	101.1134
19/04/21	96.4960
20/04/21	85.9799
21/04/21	86.5022
22/04/21	75.7647
23/04/21	73.3832
24/04/21	64.6312
25/04/21	60.3254
26/04/21	55.2711
27/04/21	48.3760
28/04/21	44.8077
29/04/21	37.7661
30/04/21	34.4221
01/05/21	28.7448
02/05/21	25.2431
03/05/21	21.1930
04/05/21	17.3538
05/05/21	14.5519
06/05/21	11.2509
07/05/21	9.1806
08/05/21	6.5744
09/05/21	4.8743
10/05/21	3.0290
11/05/21	1.5914
12/05/21	0.3636
13/05/21	-0.7952
14/05/21	-1.6332
15/05/21	-2.5262
16/05/21	-3.1246
17/05/21	-3.7522
18/05/21	-4.2075
19/05/21	-4.6317
20/05/21	-4.9840
21/05/21	-5.2665
22/05/21	-5.5325
23/05/21	-5.7243
24/05/21	-5.9158
25/05/21	-6.0536
26/05/21	-6.1862
27/05/21	-6.2884
28/05/21	-6.3772
29/05/21	-6.4537
30/05/21	-6.5135
31/05/21	-6.5694
01/06/21	-6.6109
02/06/21	-6.6504
03/06/21	-6.6802
04/06/21	-6.7073
05/06/21	-6.7292
06/06/21	-6.7475
07/06/21	-6.7636
08/06/21	-6.7761
09/06/21	-6.7877
10/06/21	-6.7965
11/06/21	-6.8045
12/06/21	-6.8109

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13/06/21	-6.8164
14/06/21	-6.8210
15/06/21	-6.8248
16/06/21	-6.8282
17/06/21	-6.8308
18/06/21	-6.8332
19/06/21	-6.8350
20/06/21	-6.8367
21/06/21	-6.8380
22/06/21	-6.8392
23/06/21	-6.8401
24/06/21	-6.8409
25/06/21	-6.8416
26/06/21	-6.8422
27/06/21	-6.8426
28/06/21	-6.8430
29/06/21	-6.8434
30/06/21	-6.8437
01/07/21	-6.8439
02/07/21	-6.8441
03/07/21	-6.8443
04/07/21	-6.8444
05/07/21	-6.8445
06/07/21	-6.8446
07/07/21	-6.8447
08/07/21	-6.8448
09/07/21	-6.8448
10/07/21	-6.8449
11/07/21	-6.8449
12/07/21	-6.8450
13/07/21	-6.8450
14/07/21	-6.8450
15/07/21	-6.8450
16/07/21	-6.8450
17/07/21	-6.8451
18/07/21	-6.8451
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24/07/21	-6.8451
25/07/21	-6.8451
26/07/21	-6.8451
27/07/21	-6.8451
28/07/21	-6.8451
29/07/21	-6.8451
30/07/21	-6.8451
31/07/21	-6.8451

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 the pandemic may vanish in May in the country.

V. CONCLUSION AND POLICY RECOMMENDATIONS

The COVID-19 pandemic has brought too much fear and uncertainties all over the world. Many investors are holding onto their money due to concerns over the suitability of the period to do massive investments when several economies are on their down turn. At the moment many resources are being channeled to COVID-19 prevention and control leaving other important issues unattended. Prediction of COVID-19 cases will facilitate proper planning and allocation of resources. Therefore in this study we applied the artificial neural network approach to predict daily COVID-19 cases in Jamaica. The study results indicate that the pandemic may vanish in May 2021 in the country. Hence the government should make sure people are adhering to COVID-19 public health mitigation measures.

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