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Forecasting Covid-19 New Cases in Cuba

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***Abstract* - In this study, the ANN approach was applied to analyze COVID-19 new cases in Cuba. 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 thatCOVID-19 cases are likely to be around 814 over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Cuba to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The new coronavirus, SARS-COV2 popularly known as coronavirus disease 19 (COVID-19) was first detected in Wuhan city, China in the Hubei Province (CDC, 2020). Since then the viral disease has spread to all the parts of the world raising fears as the entire world powers watched the shocking community transmissions accompanied by merciless fatalities which had not been witnessed before by mankind (Kinfu et al, 2020; Wang et al, 2020; Tang et al, 2020). Several countries went into lockdowns, temporarily banned public gatherings and limited the movement of people. In Cuba many measures were implemented to mitigate COVID-19 spread and to limit the severity of cases deaths and such measures included social distancing, wearing masks, isolation, hygiene practices, contact tracing and testing, treatment of cases and health education (Ramirez-Torres et al, 2021).In this paper we aim to model and predict daily COVID-19 cases in Cuba using the multilayer perceptron neural network. The model is made up of 3 layers of neurons i.e. input, hidden layer and the output layer connected by acyclic links (Zhao et al, 2020; Kaushik & Sahi, 2018; Fojnica et al, 2016; Zhang, 2003). The artificial intelligence technique has been utilized recently to predict incidence of TB and COVID-19 (Nyoni & Nyoni, 2021; Nyoni et al, 2021), ART coverage and immunization coverage (Nyoni & Nyoni, 2021; Maradze et al, 2021) and Infant mortality rate (Nyoni & Nyoni, 2021). The results of the study are envisioned to provide an insight of the likely future trends of COVID-19 daily new cases in Cuba and facilitate planning and allocation of resources to fight the spread of the virus.

II. LITERATURE REVIEW

COVID-19 prediction was performed by Medina-Mendieta et al (2020) using the logistic regression and Gompetz curves. An inferential, predictive study was conducted using logistic and Gompertz growth curves, adjusted with the least squares method and informatics tools for analysis and prediction of growth in COVID-19 cases and deaths. The study results revealed that both models showed good fi t, low mean square errors, and all parameters were highly significant. Cabore et al (2020) utilized the Markov chain model to predict the potential effects of the COVID-19 pandemic in the WHO African region. A risk of exposure, and vulnerability index are used to make the probabilities country specific. The results predict a high risk of exposure in states of small size, together with Algeria, South Africa and Cameroon. Nigeria will have the largest number of infections, followed by Algeria and South Africa. Mauritania would have the fewest cases, followed by Seychelles and Eritrea. Per capita, Mauritius, Seychelles and Equatorial Guinea would have the highest proportion of their population affected, while Niger, Mauritania and Chad would have the lowest. The Artificial neural network approach was applied by Braga et al (2020) for short-term forecasting of cases, deaths, and hospital beds occupancy in the COVID-19 pandemic at the Brazilian Amazon. Six scenarios with different periods were used to identify the quality of the generated forecasting and the period in which they start to deteriorate. Results indicated that the computational model adapted capably to the training period and was able to make consistent short-term forecasts, especially for the cumulative variables and for demand hospital beds. In another study, an artificial neural network with Prey Predator Algorithm for Prediction of the COVID-19 was applied by Hamadneh et al (2020) to forecast COVID-19 cases in Brazil and Mexico. It was demonstrated that the ANN models have the highest performance in predicting the number of infections

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(active cases), recoveries, and deaths in Brazil and Mexico. The simulation results of the ANN models showed very well predicted values.

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 Cuba.

Data Issues

This study is based on daily new cases of COVID-19 in Cuba 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	C
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	0.075370
MSE	1910.972019
MAE	24.904665

Residual Analysis for the Applied Model

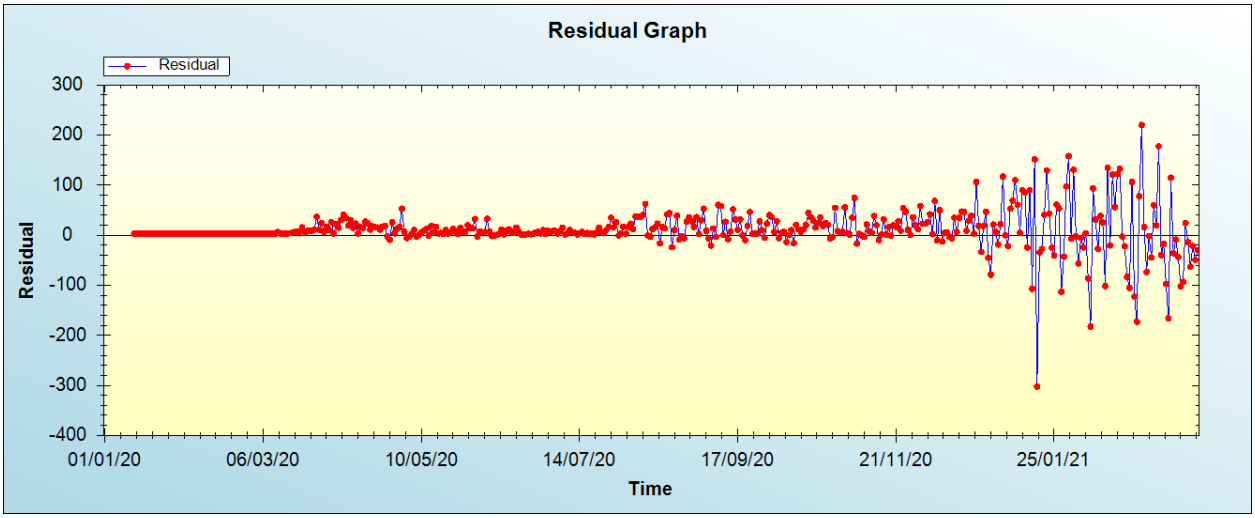

Figure 1: Residual analysis

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In-sample Forecast for C

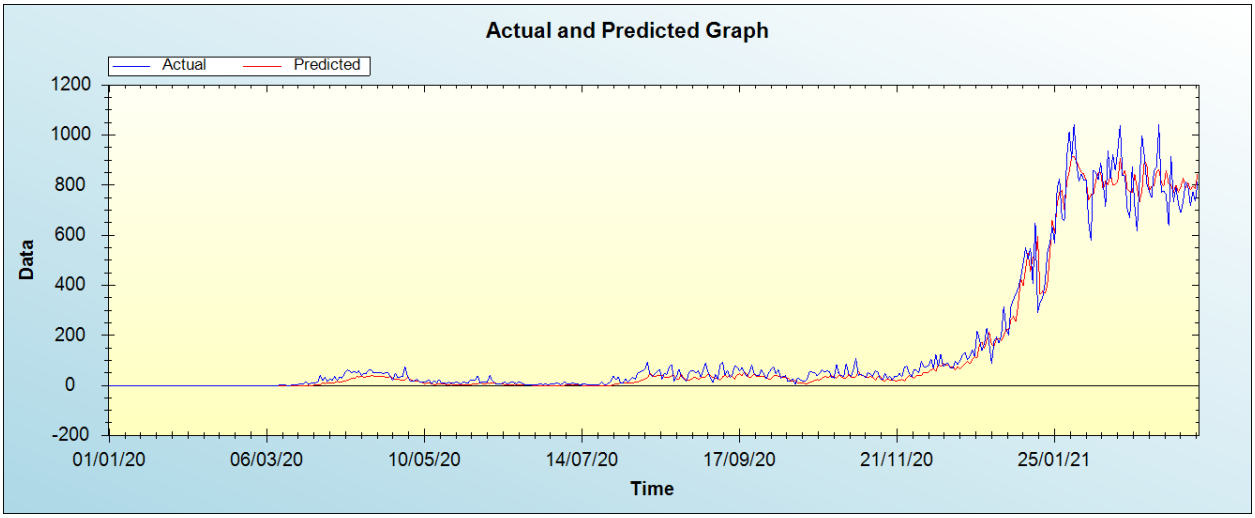

Figure 2: In-sample forecast for the C series

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

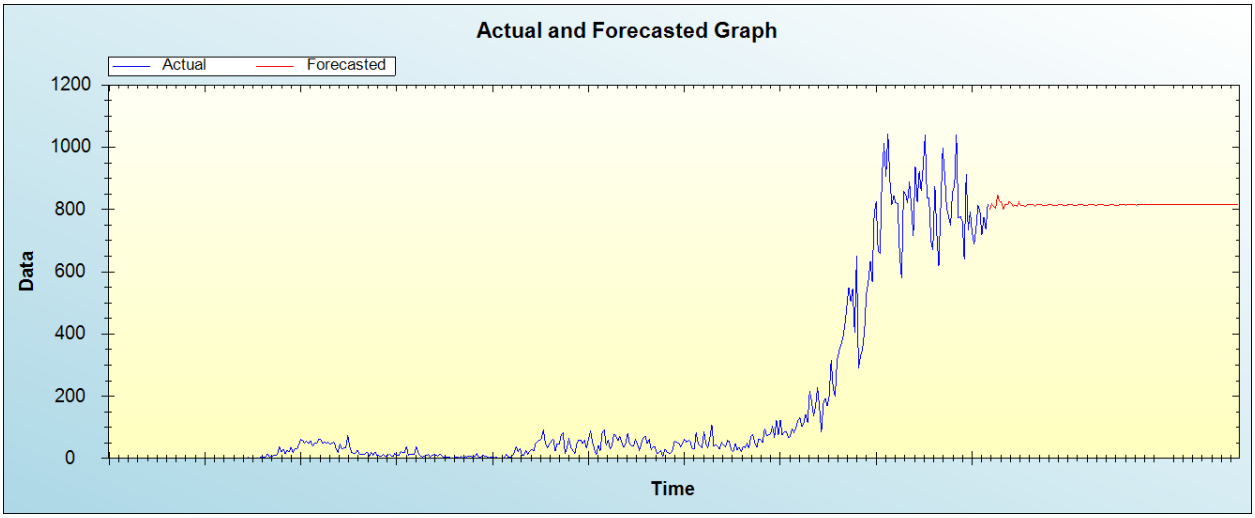

Figure 3: Out-of-sample forecast for C: actual and forecasted graph

Out-of-Sample Forecast for C: Forecasts only

Table 3: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	800.0424
27/03/21	818.7025
28/03/21	809.7471
29/03/21	802.6969
30/03/21	847.1102
31/03/21	827.5440
01/04/21	824.4903
02/04/21	800.5674
03/04/21	817.3442
04/04/21	813.3766
05/04/21	826.2969
06/04/21	820.8734
07/04/21	810.9658
08/04/21	813.8178
09/04/21	810.7091

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10/04/21	824.6473
11/04/21	811.9937
12/04/21	812.8907
13/04/21	809.3089
14/04/21	813.5362
15/04/21	816.8479
16/04/21	815.7418
17/04/21	815.3986
18/04/21	810.6086
19/04/21	814.8471
20/04/21	814.4519
21/04/21	817.0638
22/04/21	813.3803
23/04/21	813.3106
24/04/21	814.0397
25/04/21	814.5258
26/04/21	816.2627
27/04/21	814.1750
28/04/21	814.4095
29/04/21	813.2922
30/04/21	814.9982
01/05/21	814.9798
02/05/21	814.7642
03/05/21	814.1474
04/05/21	813.8861
05/05/21	814.7268
06/05/21	814.5788
07/05/21	815.0077
08/05/21	814.1238
09/05/21	814.2921
10/05/21	814.3168
11/05/21	814.6948
12/05/21	814.7195
13/05/21	814.3404
14/05/21	814.3892
15/05/21	814.2979
16/05/21	814.6663
17/05/21	814.5401
18/05/21	814.5435
19/05/21	814.3363
20/05/21	814.3995
21/05/21	814.5369
22/05/21	814.5374
23/05/21	814.5429
24/05/21	814.3761
25/05/21	814.4593
26/05/21	814.4582
27/05/21	814.5507
28/05/21	814.4977
29/05/21	814.4497
30/05/21	814.4433
31/05/21	814.4606
01/06/21	814.5255
02/06/21	814.4850
03/06/21	814.4813
04/06/21	814.4399
05/06/21	814.4771
06/06/21	814.4903
07/06/21	814.4947
08/06/21	814.4795
09/06/21	814.4559
10/06/21	814.4753
11/06/21	814.4789
12/06/21	814.4954

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13/06/21	814.4749
14/06/21	814.4714
15/06/21	814.4694
16/06/21	814.4800
17/06/21	814.4867
18/06/21	814.4782
19/06/21	814.4757
20/06/21	814.4697
21/06/21	814.4802
22/06/21	814.4806
23/06/21	814.4813
24/06/21	814.4752
25/06/21	814.4739
26/06/21	814.4777
27/06/21	814.4792
28/06/21	814.4808
29/06/21	814.4760
30/06/21	814.4762
01/07/21	814.4761
02/07/21	814.4793
03/07/21	814.4791
04/07/21	814.4775
05/07/21	814.4766
06/07/21	814.4764
07/07/21	814.4786
08/07/21	814.4783
09/07/21	814.4782
10/07/21	814.4767
11/07/21	814.4771
12/07/21	814.4778
13/07/21	814.4782
14/07/21	814.4780
15/07/21	814.4771
16/07/21	814.4773
17/07/21	814.4775
18/07/21	814.4781
19/07/21	814.4778
20/07/21	814.4775
21/07/21	814.4773
22/07/21	814.4775
23/07/21	814.4779
24/07/21	814.4778
25/07/21	814.4777
26/07/21	814.4774
27/07/21	814.4776
28/07/21	814.4777
29/07/21	814.4778
30/07/21	814.4776
31/07/21	814.4775

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 Cuba are likely to be around 814 over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

The COVID-19 pandemic has troubled the whole world both developing and developed nations. Countries have adopted the WHO guidelines to curb the spread of the virus. However, the emergence of the mutant strains of the virus which are more transmissible and possibly causing severe disease has brought distress to health authorities and political leaders. The increased demand for health resources continues to strain many countries. In this study we predicted daily COVID-19 cases in Cuba using the artificial neural network approach. The results of the study indicate that COVID-19 cases are likely to be around 814 over the

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out-of-sample period.Therefore the Cuban authorities should continue enforcing adherence to WHO guidelines on prevention and control of COVID-19 including COVID-19 vaccination.

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