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

ISSN (online): 2581-3048

Volume 5, Issue 6, pp 230-235, June-2021

https://doi.org/10.47001/IRJIET/2021.506042

Forecasting Covid-19 New Cases in Honduras

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***Abstract* - In this study, the ANN approach was applied to analyze COVID-19 new cases in Honduras. 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 Honduras are likely to decline to around 21 cases per day over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Honduras 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 an artificial intelligence technique which is biologically inspired by human learning and predicts future data (Ahmad & Asad, 2020). ANN applications have been found to be useful in pattern recognition, function approximation, prediction and time series forecasting (Zhang, 2003). They are able to analyze huge and complex data and perform decisions that human beings cannot do (Lisbon & Taktak, 2006; Baboo & Shereef, 2010; Kisi, 2007). ANNs are made up of neurons which can transmit signals to other neurons via connection weights. The widely applied ANN is the multilayer perceptron which is made up of 3layers of neurons i.e. input, hidden and output neurons connected by acyclic links. The ANN is able to learn from the given data and adjust weights accordingly in order to predict data which has not been observed before (Ahmad & Asad, 2020). The activation function is the actual power of the ANN and is selected based on the problem. In this study we apply the ANN (12, 12, 1) model to predict daily COVID-19 cases in Honduras. The model has been successfully applied in time series forecasting (Maradze et al, 2021; Nyoni et al, 2021; Nyoni & Nyoni, 2021; Nyoni et al, 2020; Zhao et al, 2020). The results of the study are expected to reveal the future trends of COVID-19 in Honduras and stimulate an evidence based national response to the epidemic

II. LITERATURE REVIEW

Zambrano et al (2020) analyzed the incidence, incidence rates, and evolution of COVID-19 cases in Honduras from February 18-April 24, 2020 using daily epidemiological data from surveillance about COVID-19 in Honduras, calculated the rates of incidence (cases/100,000 population), and developed at national, departmental, and municipal levels GIS-based maps. The findings of the study showed that February 18 - April 24, 2020, a sum of 3,169 suspected COVID-19 cases have been assessed by RT-PCR, 533 (16.8%) of them were positive, for an incidence rate of 5.73 cases/100,000 pop. The highest peak was reached on March 31 (48 cases). The department with the highest number of cases and incidence rate was Cortes (383 cases, 71.9% of the total, 21.45 cases/100,000 pop). Ardabili et al (2020) did a comparative analysis of machine learning and soft computing models to predict the COVID-19 outbreak as an alternative to SIR and SEIR models. Among a wide range of machine learning models investigated, two models showed promising results (i.e., multi-layered perceptron, MLP, and adaptive network-based fuzzy inference system, ANFIS).The study suggested machine learning as an effective tool to model the outbreak. Shorten et al (2021) explored how Deep Learning has battled the COVID-19 pandemic and provided directions for future research on COVID-19. The study covered Deep Learning applications in Natural Language Processing, Computer Vision, Life Sciences, and Epidemiology, then described how each of these applications vary with the availability of big data and how learning tasks are constructed. Evaluation of the current state of Deep Learning and conclude with key limitations of Deep Learning for COVID-19 applications was performed. These limitations include Interpretability, Generalization Metrics, Learning from Limited Labeled Data, and Data Privacy. Natural Language Processing applications include mining COVID-19 research for Information Retrieval and Question Answering, as well as Misinformation Detection, and Public Sentiment Analysis. Computer Vision applications cover Medical Image Analysis, Ambient Intelligence, and Vision-based Robotics. Within Life Sciences, the survey looked at how Deep Learning

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can be applied to Precision Diagnostics, Protein Structure Prediction, and Drug Repurposing. Deep Learning has additionally been utilized in Spread Forecasting for Epidemiology. The literature review revealed many examples of Deep Learning systems to fight COVID-19.

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 Honduras.

Data Issues

This study is based on daily new cases of COVID-19 in Honduras 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	H
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	0.183233
MSE	48885.624772
MAE	151.464061

Residual Analysis for the Applied Model

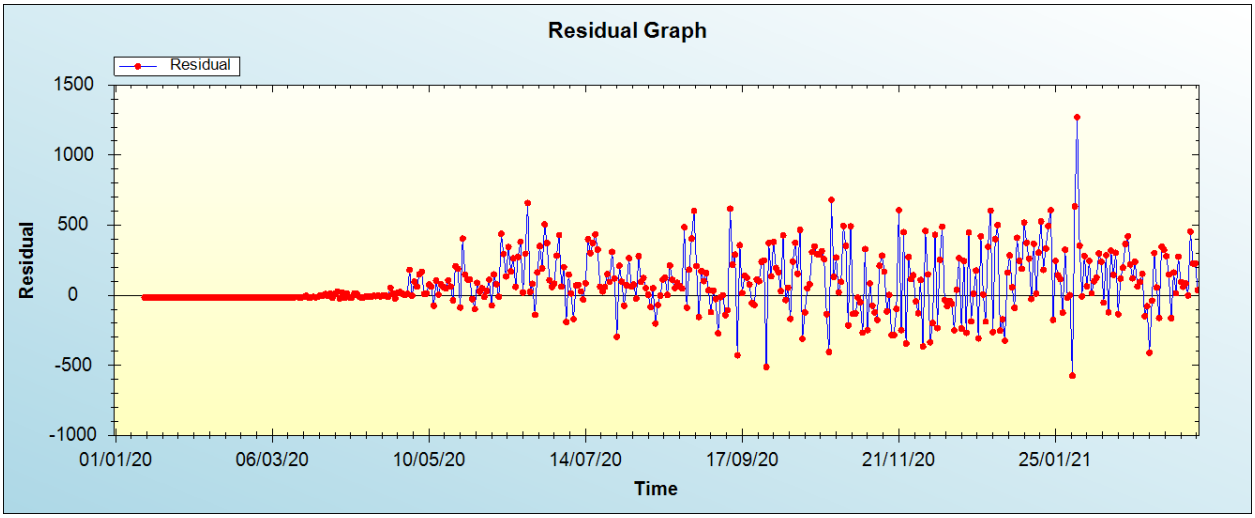

Figure 1: Residual analysis

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In-sample Forecast for H

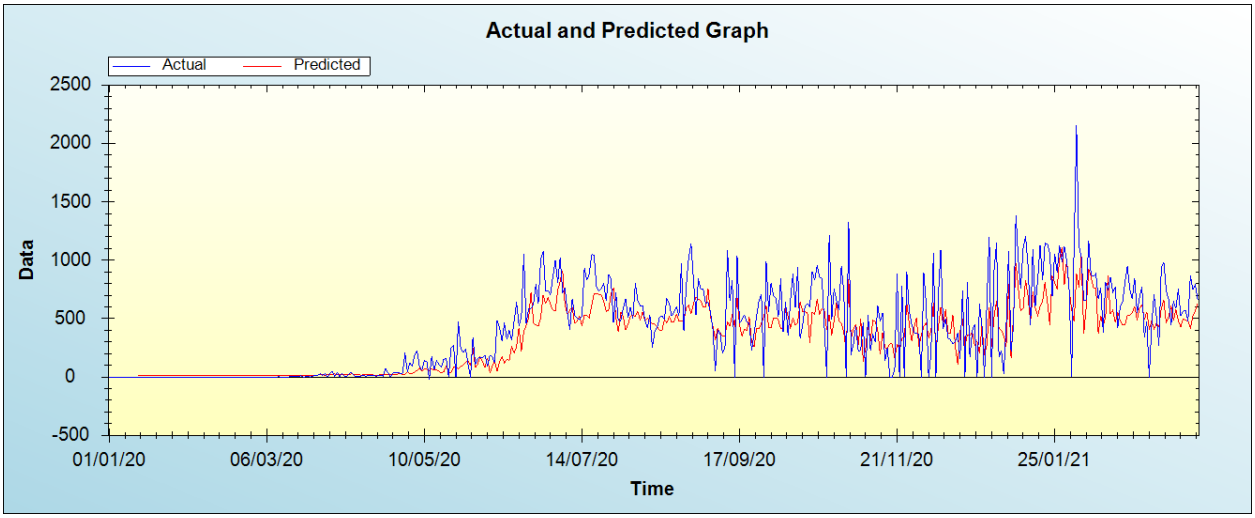

Figure 2: In-sample forecast for the H series

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

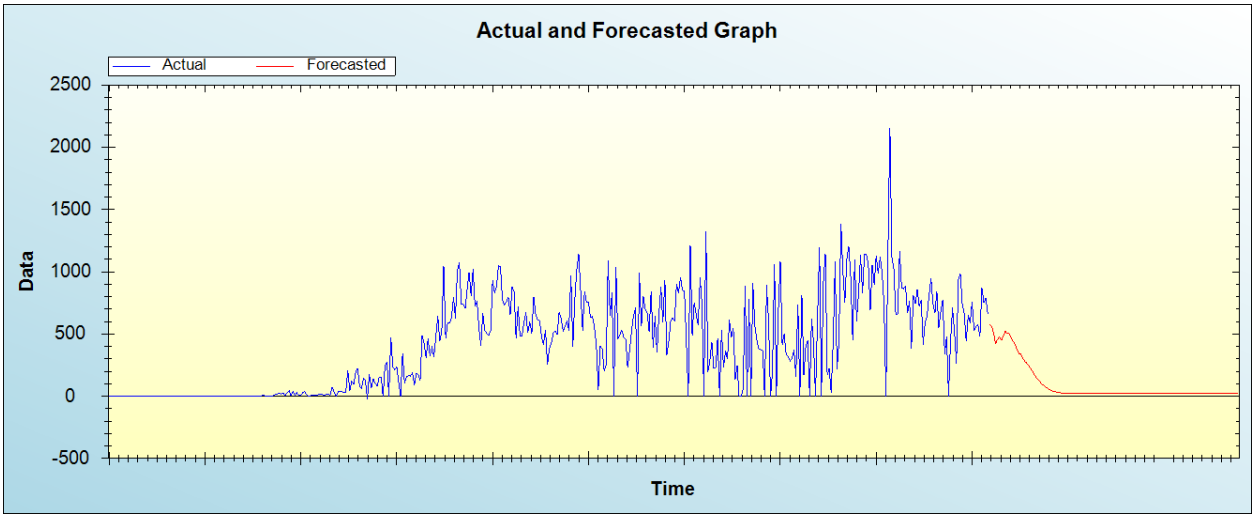

Figure 3: Out-of-sample forecast for H: actual and forecasted graph

Out-of-Sample Forecast for H: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	572.4284
27/03/21	564.2507
28/03/21	509.3506
29/03/21	422.9919
30/03/21	456.1974
31/03/21	475.6001
01/04/21	447.9188
02/04/21	487.5943
03/04/21	522.4522
04/04/21	503.5078
05/04/21	504.1100
06/04/21	468.8934
07/04/21	441.7790
08/04/21	415.0999
09/04/21	371.9688

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10/04/21	340.4797
11/04/21	337.5314
12/04/21	306.2617
13/04/21	279.7740
14/04/21	266.2864
15/04/21	247.3764
16/04/21	219.3593
17/04/21	199.4481
18/04/21	167.7506
19/04/21	147.9084
20/04/21	130.6594
21/04/21	109.0195
22/04/21	91.3007
23/04/21	83.9404
24/04/21	69.1468
25/04/21	58.6920
26/04/21	50.5792
27/04/21	43.3084
28/04/21	38.0698
29/04/21	34.6994
30/04/21	29.3385
01/05/21	27.4438
02/05/21	25.9130
03/05/21	23.3814
04/05/21	22.3200
05/05/21	21.9309
06/05/21	21.1347
07/05/21	21.0126
08/05/21	20.6753
09/05/21	20.2574
10/05/21	20.4902
11/05/21	20.4135
12/05/21	20.2327
13/05/21	20.4324
14/05/21	20.4632
15/05/21	20.4064
16/05/21	20.4805
17/05/21	20.4431
18/05/21	20.4639
19/05/21	20.5532
20/05/21	20.5146
21/05/21	20.5176
22/05/21	20.5650
23/05/21	20.5370
24/05/21	20.5340
25/05/21	20.5528
26/05/21	20.5427
27/05/21	20.5559
28/05/21	20.5608
29/05/21	20.5436
30/05/21	20.5506
31/05/21	20.5542
01/06/21	20.5455
02/06/21	20.5510
03/06/21	20.5531
04/06/21	20.5494
05/06/21	20.5519
06/06/21	20.5495
07/06/21	20.5474
08/06/21	20.5510
09/06/21	20.5502
10/06/21	20.5491
11/06/21	20.5508
12/06/21	20.5498

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13/06/21	20.5492
14/06/21	20.5499
15/06/21	20.5493
16/06/21	20.5497
17/06/21	20.5503
18/06/21	20.5496
19/06/21	20.5496
20/06/21	20.5499
21/06/21	20.5495
22/06/21	20.5497
23/06/21	20.5499
24/06/21	20.5497
25/06/21	20.5498
26/06/21	20.5498
27/06/21	20.5496
28/06/21	20.5497
29/06/21	20.5498
30/06/21	20.5497
01/07/21	20.5498
02/07/21	20.5498
03/07/21	20.5497
04/07/21	20.5498
05/07/21	20.5497
06/07/21	20.5497
07/07/21	20.5498
08/07/21	20.5498
09/07/21	20.5497
10/07/21	20.5498
11/07/21	20.5497
12/07/21	20.5497
13/07/21	20.5498
14/07/21	20.5498
15/07/21	20.5498
16/07/21	20.5498
17/07/21	20.5497
18/07/21	20.5497
19/07/21	20.5498
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22/07/21	20.5498
23/07/21	20.5498
24/07/21	20.5498
25/07/21	20.5498
26/07/21	20.5498
27/07/21	20.5498
28/07/21	20.5498
29/07/21	20.5498
30/07/21	20.5498
31/07/21	20.5498

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 Honduras are likely to decline to around 21 cases per day over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

Machine learning algorithms have gained recognition from many researchers in various disciplines. Artificial neural networks, random forest and hybrid models have been successfully used to predict the spread of COVID-19 in many countries. In this study, the artificial neural network approach was applied to predict daily new COVID-19 cases in Honduras. The results indicate that daily COVID-19 cases in Honduras are likely to decline to around 21 cases per day over the out-of-sample period. Therefore, the government must enforce adherence to COVID-19 public health mitigation measures.

ISSN (online): 2581-3048
Volume 5, Issue 6, pp 230-235, June-2021
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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 Honduras" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 6, pp 230-235, June 2021. Article DOI https://doi.org/10.47001/IRJIET/2021.506042

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