

# Forecasting Covid-19 New Cases in Haiti

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

**Keywords:** ANN, COVID-19, Forecasting.

## I. INTRODUCTION

Modeling and forecasting the incidence COVID-19 is of global public health importance (Mollalo et al, 2020). The novel coronavirus was first detected in Wuhan City, China and the virus was characterized by rapid spread across the whole world (WHO, 2020). The SARS-CoV 2 virus is the causative agent of COVID-19 disease and primarily presents with upper respiratory symptoms. Many studies have shown that pre-existence of chronic medical conditions such as cardiovascular condition, respiratory disease, malignancy infection and substance abuse can increase morbidity and mortality of COVID-19 (Zheng et al, 2020; Lippi & Henry, 2020; You et al, 2020; Cox et al, 2020; Marsden et al, 2020). Machine learning methods are useful in time series modeling and forecasting and have been applied in many fields such as agriculture, environmental science and medicine (Nyoni et al, 2020; Mollalo et al, 2018; Reddy et al, 2017; Marohasy & Abbot, 2015; Keshavarzi et al, 2010; Kiang et al, 2006). Machine learning techniques such as artificial neural networks (ANNs), K-nearest neighbors (KNN), support vector machine (SVM), ensembles and graphical models (Bayesian networks) are widely used in predictive modeling (Nyoni et al, 2021, Nyoni et al, 2020; Zhao et al, 2020).

In this paper we apply the ANN approach to predict daily COVID-19 cases in Haiti. The findings of this study are envisioned to provide an insight of the likely future evolution of the COVID-19 epidemic in the country and trigger an evidence based health response in order to effectively curb the spread of the deadly virus.

## II. LITERATURE REVIEW

Guo & He (2021) applied artificial intelligence to predict global confirmed cases and deaths. They developed an artificial neural network (ANN) for modeling of the confirmed cases and deaths of COVID-19. The confirmed cases and deaths data are collected from January 20 to November 11, 2020 by the World Health Organization (WHO). The study indicated that the predicted confirmed cases and deaths of COVID-19 are very close to the actual confirmed cases and deaths. Ettensperger (2020) investigated thoroughly the link between poverty related indicators and case and mortality rates of the outbreak using multivariate, multilevel regression while also considering the urban-rural divide in Germany. As proxies for poverty the unemployment rate, the per capita presence of general practitioners (physicians), per capita GDP, and the rate of employees with no professional job training is evaluated in relation to the accumulated case and mortality numbers on district level taken from RKI data of June and July 2020. The study concluded that there is no evidence for a poverty-related effect on mortality for German districts. Furthermore, only employment in low qualification jobs approximated by the job training variable consistently affected case numbers in urban districts in the expected direction. Andronico (2020) evaluated the impact of curfews and other measures on SARS-CoV-2 transmission in French Guiana using mathematical modeling. The study concluded that the interventions reduced the basic reproduction number of SARS-CoV-2 from 1.7 to 1.1, which was sufficient to avoid saturation of hospitals.

### 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 Haiti.

#### Data Issues

This study is based on daily new cases of COVID-19 in Haiti 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	0.148015
MSE	545.383677
MAE	18.082725

#### Residual Analysis for the Applied Model

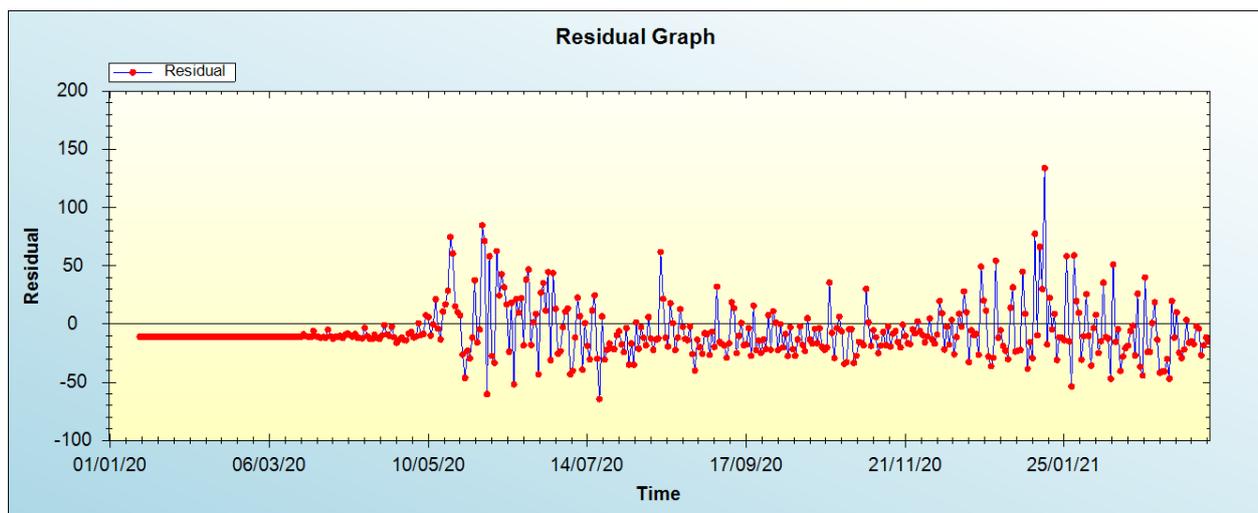
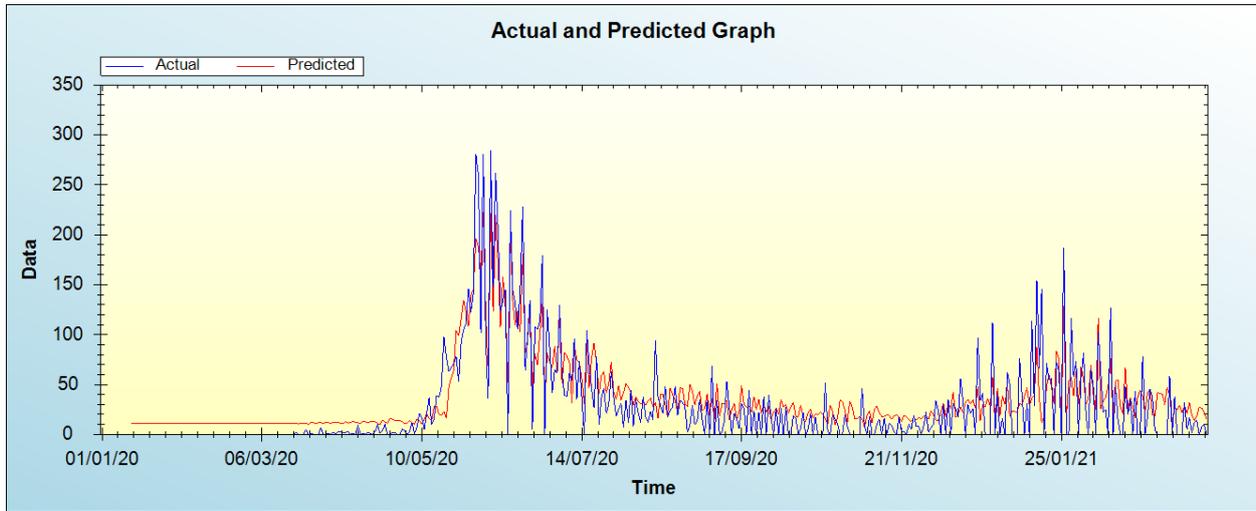


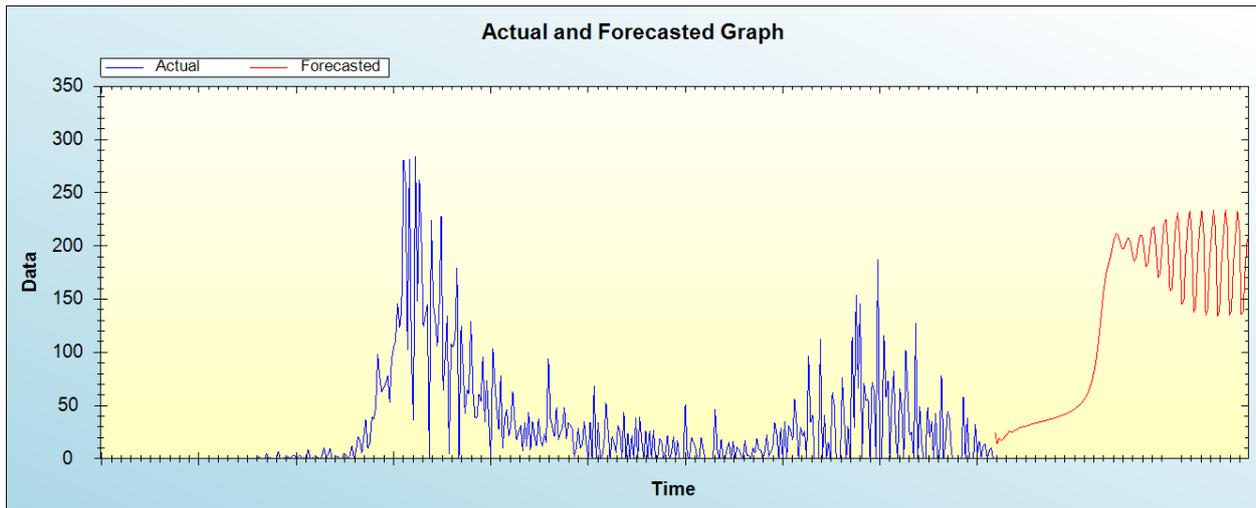
Figure 1: Residual analysis

*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 3: Tabulated out-of-sample forecasts**

Day/Month/Year	Forecasts
26/03/21	24.5659
27/03/21	14.0139
28/03/21	19.2915
29/03/21	17.2024
30/03/21	18.1466
31/03/21	21.3841
01/04/21	22.3376
02/04/21	26.1591
03/04/21	25.2771
04/04/21	25.2356
05/04/21	26.8310
06/04/21	27.4498
07/04/21	29.1798
08/04/21	29.2504
09/04/21	30.2990

10/04/21	30.1143
11/04/21	30.9377
12/04/21	31.5322
13/04/21	32.4913
14/04/21	32.5568
15/04/21	33.3477
16/04/21	33.5901
17/04/21	34.2378
18/04/21	34.6003
19/04/21	35.3262
20/04/21	35.7112
21/04/21	36.2391
22/04/21	36.7033
23/04/21	37.3429
24/04/21	37.8120
25/04/21	38.4099
26/04/21	39.0487
27/04/21	39.6584
28/04/21	40.3076
29/04/21	41.0127
30/04/21	41.8138
01/05/21	42.5849
02/05/21	43.4903
03/05/21	44.4619
04/05/21	45.5744
05/05/21	46.7176
06/05/21	48.1197
07/05/21	49.6708
08/05/21	51.4862
09/05/21	53.5920
10/05/21	56.1774
11/05/21	59.3140
12/05/21	63.2112
13/05/21	68.1928
14/05/21	74.7108
15/05/21	83.3011
16/05/21	94.6085
17/05/21	109.2654
18/05/21	126.8824
19/05/21	145.5278
20/05/21	161.9587
21/05/21	173.7194
22/05/21	181.6148
23/05/21	188.8815
24/05/21	197.7983
25/05/21	206.9017
26/05/21	211.8344
27/05/21	210.0649
28/05/21	203.1320
29/05/21	197.1125
30/05/21	197.9884
31/05/21	203.6774
01/06/21	207.5174
02/06/21	204.4637
03/06/21	193.8899
04/06/21	185.1969
05/06/21	188.4273
06/06/21	200.2951
07/06/21	210.2497
08/06/21	209.8452
09/06/21	195.6680
10/06/21	180.3266
11/06/21	183.6423
12/06/21	201.2339

13/06/21	216.2288
14/06/21	218.0083
15/06/21	197.8780
16/06/21	170.3412
17/06/21	172.8480
18/06/21	198.3548
19/06/21	219.9195
20/06/21	225.3799
21/06/21	201.2684
22/06/21	157.4277
23/06/21	159.1987
24/06/21	194.8641
25/06/21	221.4260
26/06/21	230.7079
27/06/21	206.6536
28/06/21	145.2629
29/06/21	147.9540
30/06/21	192.2483
01/07/21	219.4927
02/07/21	232.8633
03/07/21	210.8382
04/07/21	137.3295
05/07/21	142.0464
06/07/21	189.5122
07/07/21	215.3255
08/07/21	233.4298
09/07/21	213.3122
10/07/21	134.2642
11/07/21	140.0696
12/07/21	186.0316
13/07/21	212.0106
14/07/21	233.5354
15/07/21	215.2762
16/07/21	134.1468
17/07/21	139.2253
18/07/21	183.6059
19/07/21	209.9273
20/07/21	233.5025
21/07/21	217.0992
22/07/21	134.7070
23/07/21	138.8320
24/07/21	181.9581
25/07/21	208.2977
26/07/21	233.3940
27/07/21	218.4166
28/07/21	135.3952
29/07/21	138.5786
30/07/21	180.6238
31/07/21	206.8437

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 Haiti are likely to increase significantly over the out-of-sample period.

### V. CONCLUSION AND POLICY RECOMMENDATIONS

Infectious disease modeling and forecasting is crucial in the control of epidemic incidences because it guides policy and decision making and helps health systems to prepare for any eventuality. Several models have been proposed in Literature such as statistical methods, artificial intelligence techniques and compartmental models. The most important feature of artificial intelligence techniques is their high level of predictive accuracy and ability to model nonlinear data. In this study we apply the artificial neural network approach to predict daily cases of COVID-19 in Haiti. The results of the study revealed that daily

COVID-19 cases in Haiti are likely to increase significantly over the out-of-sample period. Therefore, the people in Haiti should adhere to public health mitigation measures to control the spread of the SARS-COV2 virus.

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