

Forecasting Covid-19 New Cases in Cabo Verde

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

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

Time series modeling and forecasting is an important component of health surveillance. The concept is based on understanding the nature of historical data and using it to predict future values of a variable. It is imperative to obtain reliable and correct historical data in order to obtain accurate forecasts. The popular traditional time series forecasting methods include the Box Jenkins ARIMA models and the exponential smoothing models. The ARIMA models were proposed by Box and Jenkins in the 1970s and they are meant to analyze linear time series. The general ARIMA Model is represented as ARIMA (p,d,q) where p and q represent the non seasonal autoregressive and moving average terms and d is the nonseasonal differencing order (Nyoni & Nyoni, 2020; Nyoni & Nyoni, 2019). The 3 stage iterative procedure for ARIMA model building involves model identification, parameter estimation and diagnostic checking. Artificial intelligence methods have now overtaken the use of traditional statistical forecasting methods because of their ability to model or analyze complex and big data (Zhao et al, 2020, Kaushik &Sahi, 2018; Fojnica et al, 2016; Zhang, 2003). In this paper we apply the multilayer perceptron neural network to predict daily COVID-19 cases in Cabo Verde. The machine learning technique has gained popularity in medical science where it has been utilized to predict epidemiological incidences and health related problems (Nyoni & Nyoni, 2021; Maradze et al, 2021; Nyoni et al, 2021; Zhao et al, 2020). The findings of this study are expected to reveal the likely future trends of daily COVID-19 case in Cabo Verde and stimulate an appropriate response in order to curb the spread of the deadly virus.

II. LITERATURE REVIEW

Silva (2020) modelled COVID-19 cases in Cape Verde Islands using the SIR model. The simulation was done for Santiago and Boavista Islands, ant then for Cape Verde in general. Observations made after the date of the simulations were carried out corroborated well with the projections. Mollalo et al (2020) predicted the COVID-19 incidence in the continental United States. They collected and prepared a database of 57 candidate explanatory variables to examine the performance of multilayer perceptron (MLP) neural network in predicting the cumulative COVID-19 incidence rates across the continental United States. The results indicated that a single-hidden-layer MLP could explain almost 65% of the correlation with ground truth for the holdout samples. Traditional statistical models are also important in COVID-19 forecasting for example, Takele (2020) applied the Autoregressive Integrated Moving Average (ARIMA) modeling approach for projecting coronavirus (COVID-19) prevalence patterns in East Africa Countries, mainly Ethiopia, Djibouti, Sudan and Somalia. The data for the study were obtained from the reports of confirmed COVID-19 cases by the official website of Johns Hopkins University from 13th March, 2020 to 30th June, 2020. The results of the study, then, showed that in the coming four month, the number of COVID-19 positive people in Ethiopia may reach up to 56,610 from 5,846 on June 30, 2020 in averagerate scenario. However, in worst case scenario forecast, the model showed that the cases will be around 84,497.

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 Carbo Verde.

Data Issues

This study is based on daily new cases of COVID-19 in Carbo Verde 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	CV
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	0.183682
MSE	263.258751
MAE	11.084407

Residual Analysis for the Applied Model

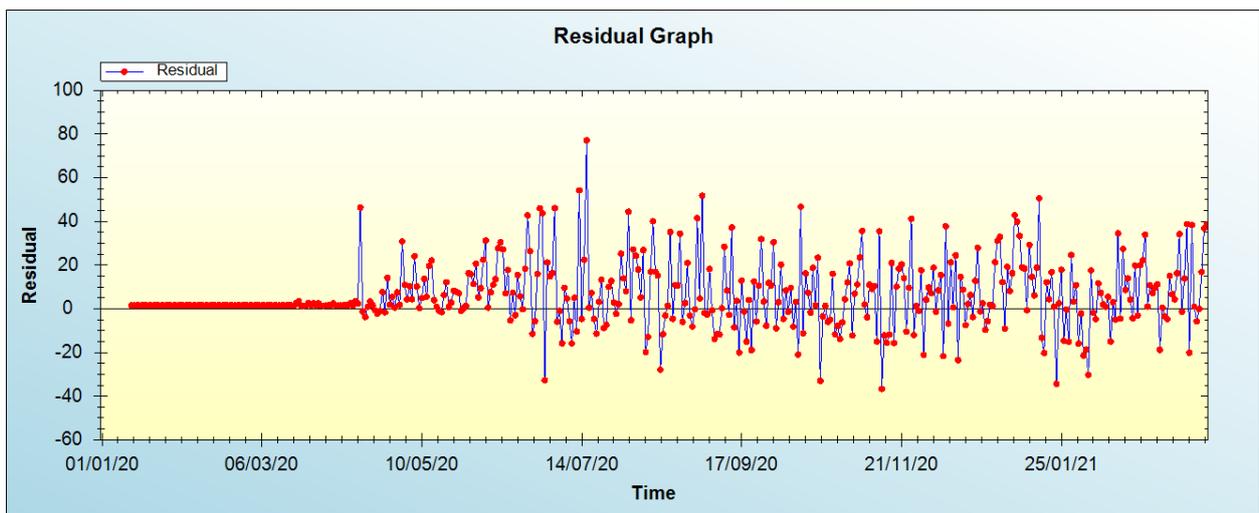


Figure 1: Residual analysis

In-sample Forecast for CV

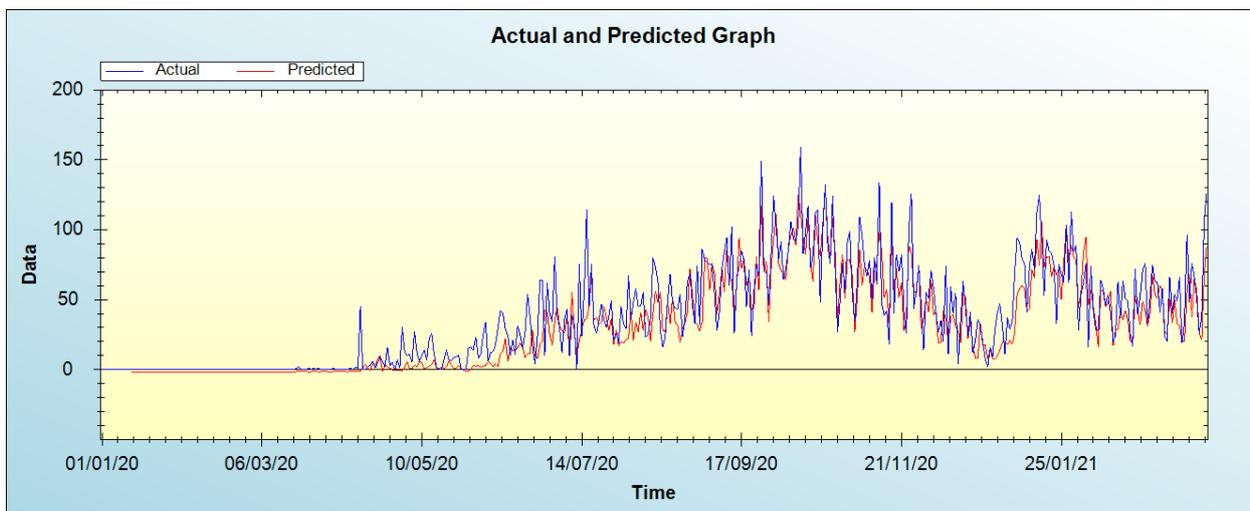


Figure 2: In-sample forecast for the CV series

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

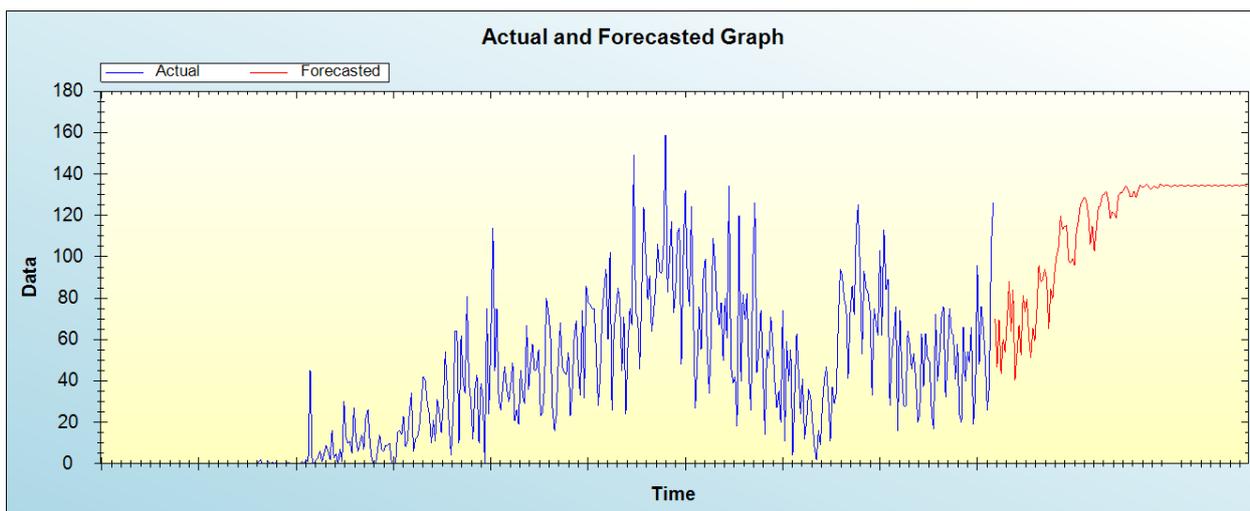


Figure 3: Out-of-sample forecast for CV: actual and forecasted graph

Out-of-Sample Forecast for CV: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	70.0867
27/03/21	46.6877
28/03/21	69.7005
29/03/21	43.5160
30/03/21	60.2749
31/03/21	54.0308
01/04/21	69.3593
02/04/21	87.9373
03/04/21	63.8037
04/04/21	83.9856
05/04/21	40.4116
06/04/21	53.0384
07/04/21	66.7267
08/04/21	52.5321
09/04/21	81.5417

10/04/21	73.5216
11/04/21	79.6161
12/04/21	60.7850
13/04/21	51.3922
14/04/21	65.5612
15/04/21	59.3866
16/04/21	74.0860
17/04/21	95.8559
18/04/21	87.8353
19/04/21	88.9178
20/04/21	93.9952
21/04/21	89.1058
22/04/21	65.3598
23/04/21	84.3974
24/04/21	79.7057
25/04/21	92.6433
26/04/21	100.7478
27/04/21	104.5453
28/04/21	119.6324
29/04/21	113.1295
30/04/21	114.6793
01/05/21	115.1599
02/05/21	98.2698
03/05/21	96.9084
04/05/21	99.1885
05/05/21	95.9161
06/05/21	112.6275
07/05/21	117.3538
08/05/21	125.3609
09/05/21	127.1226
10/05/21	128.7064
11/05/21	126.9073
12/05/21	120.2256
13/05/21	106.1279
14/05/21	114.7672
15/05/21	102.6250
16/05/21	113.9157
17/05/21	123.9665
18/05/21	124.7443
19/05/21	129.8229
20/05/21	129.9536
21/05/21	131.8167
22/05/21	127.3144
23/05/21	118.4454
24/05/21	121.6141
25/05/21	120.5347
26/05/21	118.5685
27/05/21	129.1019
28/05/21	130.8574
29/05/21	131.2092
30/05/21	132.7668
31/05/21	134.3292
01/06/21	132.3420
02/06/21	129.0882
03/06/21	129.1155
04/06/21	131.7584
05/06/21	128.6531
06/06/21	131.8981
07/06/21	134.8676
08/06/21	133.5954
09/06/21	133.6468
10/06/21	134.9944
11/06/21	134.5341
12/06/21	132.8374

13/06/21	133.0795
14/06/21	134.3168
15/06/21	133.5251
16/06/21	133.2334
17/06/21	135.1332
18/06/21	134.7579
19/06/21	133.8412
20/06/21	134.5997
21/06/21	134.8943
22/06/21	133.9432
23/06/21	133.8771
24/06/21	134.6510
25/06/21	134.4415
26/06/21	133.9200
27/06/21	134.5616
28/06/21	134.8611
29/06/21	134.1318
30/06/21	134.2666
01/07/21	134.7441
02/07/21	134.3608
03/07/21	134.0748
04/07/21	134.5239
05/07/21	134.5879
06/07/21	134.1957
07/07/21	134.3508
08/07/21	134.6681
09/07/21	134.3733
10/07/21	134.2153
11/07/21	134.5495
12/07/21	134.5019
13/07/21	134.2300
14/07/21	134.3971
15/07/21	134.5642
16/07/21	134.3470
17/07/21	134.3084
18/07/21	134.5248
19/07/21	134.4596
20/07/21	134.2885
21/07/21	134.4266
22/07/21	134.5102
23/07/21	134.3439
24/07/21	134.3527
25/07/21	134.4962
26/07/21	134.4230
27/07/21	134.3315
28/07/21	134.4411
29/07/21	134.4706
30/07/21	134.3577
31/07/21	134.3831

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 Carbo Verde are likely to increase over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

Machine learning techniques play an important role in studying disease trends in epidemiology. Artificial neural network is one such technique which is gaining popularity in short term forecasting of COVID-19 cases, recoveries and deaths. In this study the ANN (12, 12, 1) model was applied in this study to predict daily confirmed cases in Cabo Verde. The results of the study revealed that the COVID-19 cases would continue to rise in the country over the out-of-sample period. Therefore we encourage the authorities in the country to continue enforcing adherence to the COVID-19 public health mitigation measures and promote vaccination against the SARS –COV 2 virus.

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