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Forecasting Covid-19 New Cases in Sao Tome

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***Abstract* - The Artificial Neural Network (ANN) approach was applied in this piece of work, to analyze COVID-19 daily cases in Sao Tome. This study is based on monthly new cases of COVID-19 in Sao Tome for the period 1 January 2020 – 25 March 2021. The out-of-sample forecast covers the period 26 March 2021 – 31 July 2021. The residuals and forecast evaluation statistics (Error, MSE and MAE) of the applied model indicate that the model is adequate. The predictions show that daily COVID-19 cases in Sao Tome are generally likely to hover around an equilibrium case volume of about 24 cases per day over the out-of-sample period. However, the government of Sao Tome should ensure the continued compliance to control and preventive COVID-19 measures such as social distancing, quarantine, isolation, face-mask wearing as well as vaccinations.**

Keywords: ANN, COVID-19, Forecasting,

I. INTRODUCTION

The outbreak in Wuhan, Hubei province, People's Republic of China, in December last year, of a pandemic (dubbed subsequently as COVID-19) that in the next months spread around the world and in some geographical regions was characterized by an abrupt increase in the number of infected individuals, triggered drastic and unprecedented measures of containment since WW2 that affected the life of hundreds of millions of people as well as the normal functioning of numerous national economies (Misucu *et al*., 2020). While a number of COVID-19 related studies have been done in other countries, no study has specifically applied Artificial Neural Networks to forecast COVID-19 daily cases in the country. In an attempt to help government in taking the most appropriate prevention and control measures for the outbreak, this study seeks to model and forecast confirmed daily COVID-19 cases in Sao Tome.

II. 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 in Sao Tome.

Data Issues

This study is based on daily new cases of COVID-19 in Sao Tome 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).

III. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	ST
Observations	438 (After Adjusting Endpoints)
Neural Network Architecture:	
Input Layer Neurons	12
Hidden Layer Neurons	12

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Output Layer Neurons	1
Activation Function	Hyperbolic Tangent Function
Back Propagation Learning:	
Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	0.153376
MSE	165.548754
MAE	6.087939

Residual Analysis for the Applied Model

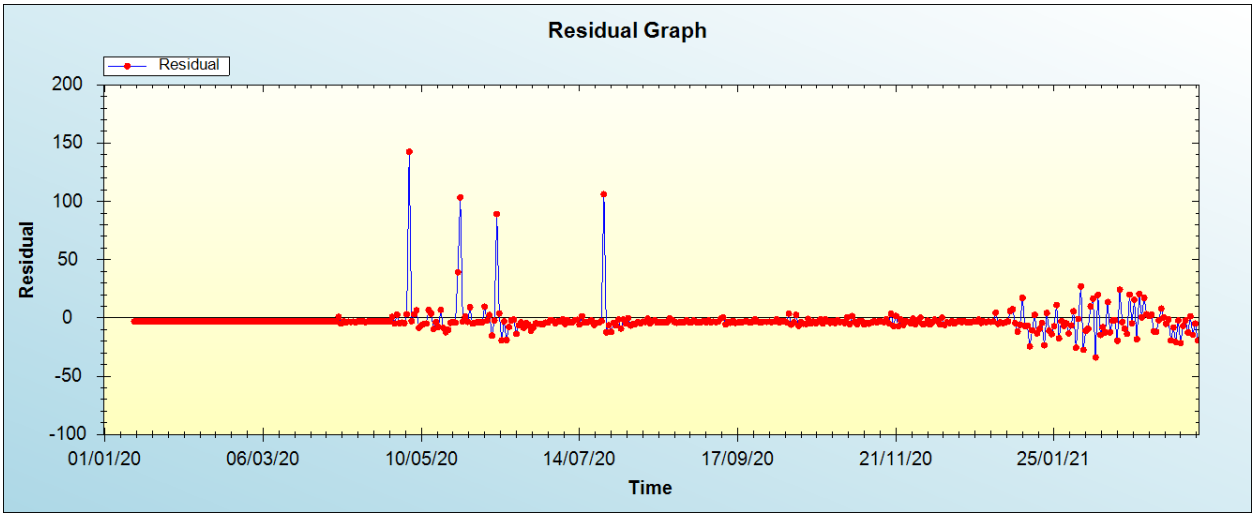

Figure 1: Residual analysis

In-sample Forecast for ST

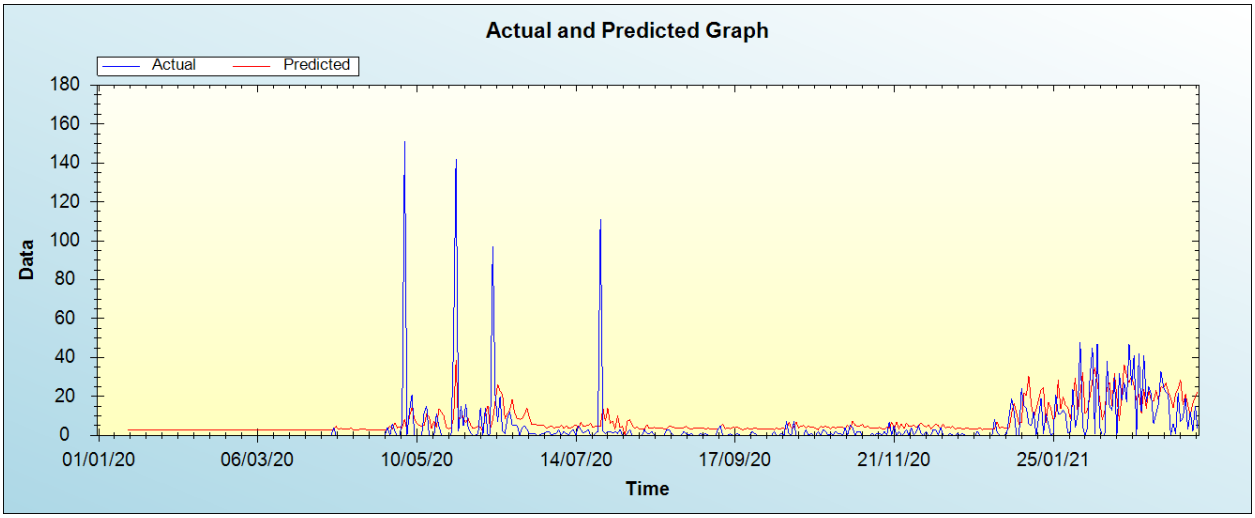

Figure 2: In-sample forecast for the ST series

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

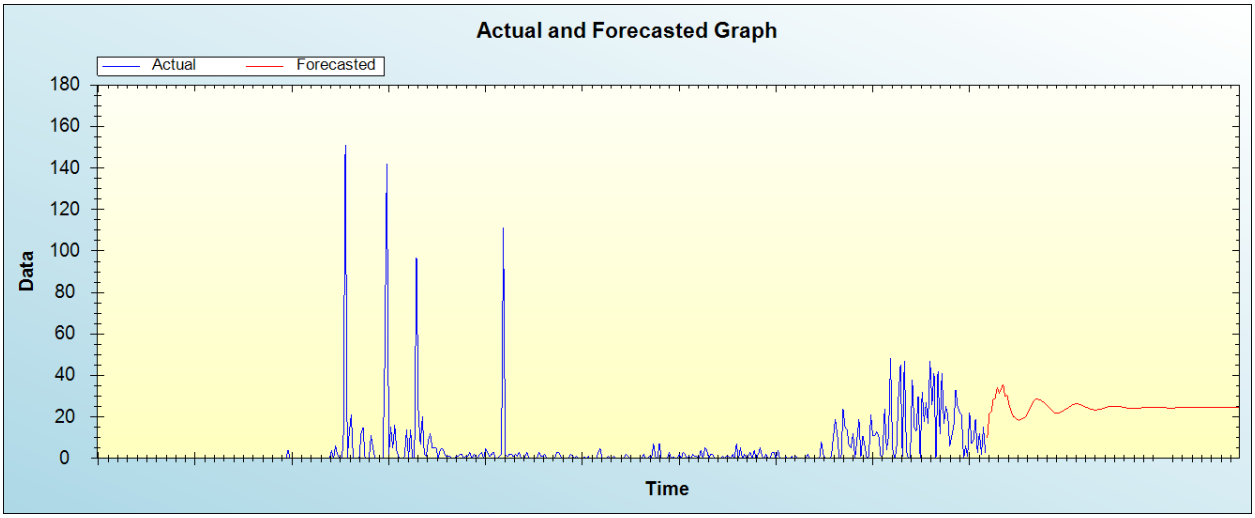

Figure 3: Out-of-sample forecast for ST: actual and forecasted graph

Out-of-Sample Forecast for ST: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
26/03/21	10.1210
27/03/21	21.7445
28/03/21	22.6983
29/03/21	28.4928
30/03/21	28.9777
31/03/21	34.4524
01/04/21	31.4413
02/04/21	33.5030
03/04/21	35.7760
04/04/21	29.7656
05/04/21	30.8850
06/04/21	26.1520
07/04/21	23.1577
08/04/21	20.3305
09/04/21	19.6514
10/04/21	18.8774
11/04/21	18.3196
12/04/21	18.9566
13/04/21	19.3729
14/04/21	19.5873
15/04/21	21.1056
16/04/21	23.1147
17/04/21	24.8529
18/04/21	26.9178
19/04/21	28.2722
20/04/21	28.6956
21/04/21	28.4175
22/04/21	28.1533
23/04/21	27.4300
24/04/21	26.5972
25/04/21	25.8154
26/04/21	24.7817
27/04/21	23.6590
28/04/21	22.7684
29/04/21	22.1131
30/04/21	21.7770
01/05/21	21.8782

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02/05/21	22.2975
03/05/21	22.7913
04/05/21	23.3479
05/05/21	23.9736
06/05/21	24.5777
07/05/21	25.1883
08/05/21	25.7699
09/05/21	26.1713
10/05/21	26.3124
11/05/21	26.2185
12/05/21	25.9197
13/05/21	25.4907
14/05/21	25.0490
15/05/21	24.6389
16/05/21	24.2581
17/05/21	23.9296
18/05/21	23.6679
19/05/21	23.4858
20/05/21	23.4221
21/05/21	23.5023
22/05/21	23.7034
23/05/21	23.9822
24/05/21	24.2922
25/05/21	24.5826
26/05/21	24.8240
27/05/21	25.0143
28/05/21	25.1504
29/05/21	25.2227
30/05/21	25.2251
31/05/21	25.1533
01/06/21	25.0117
02/06/21	24.8234
03/06/21	24.6216
04/06/21	24.4348
05/06/21	24.2835
06/06/21	24.1782
07/06/21	24.1177
08/06/21	24.0986
09/06/21	24.1201
10/06/21	24.1809
11/06/21	24.2761
12/06/21	24.3961
13/06/21	24.5248
14/06/21	24.6433
15/06/21	24.7367
16/06/21	24.7973
17/06/21	24.8239
18/06/21	24.8200
19/06/21	24.7907
20/06/21	24.7404
21/06/21	24.6737
22/06/21	24.5969
23/06/21	24.5184
24/06/21	24.4476
25/06/21	24.3932
26/06/21	24.3606
27/06/21	24.3509
28/06/21	24.3617
29/06/21	24.3887
30/06/21	24.4273
01/07/21	24.4731
02/07/21	24.5221
03/07/21	24.5698
04/07/21	24.6112

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05/07/21	24.6418
06/07/21	24.6583
07/07/21	24.6600
08/07/21	24.6483
09/07/21	24.6265
10/07/21	24.5982
11/07/21	24.5670
12/07/21	24.5358
13/07/21	24.5074
14/07/21	24.4841
15/07/21	24.4680
16/07/21	24.4608
17/07/21	24.4626
18/07/21	24.4726
19/07/21	24.4888
20/07/21	24.5086
21/07/21	24.5294
22/07/21	24.5491
23/07/21	24.5660
24/07/21	24.5788
25/07/21	24.5867
26/07/21	24.5890
27/07/21	24.5859
28/07/21	24.5779
29/07/21	24.5664
30/07/21	24.5531
31/07/21	24.5396

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 Sao Tome are generally likely tohover around an equilibrium case volume of about 24 cases per day over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

There is no doubt; COVID-19 has led to excessive healthcare crisis with millions of infected people across the world often pushing infrastructures, healthcare workers and entire economies beyond their limits. Sao Tome has not been spared by this pandemic and hence the need for forecasting. The results of the study suggest that daily COVID-19 cases in Sao Tome are generally likely to hover around an equilibrium case volume of about 24 cases per day over the out-of-sample period. However, the government of Sao Tome should ensure the continued compliance to control and preventive COVID-19 measures such as social distancing, quarantine, isolation, face-mask wearing as well as vaccinations.

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