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

ISSN (online): 2581-3048

Volume 5, Issue 6, pp 675-679, June-2021

https://doi.org/10.47001/IRJIET/2021.506118

Forecasting Covid-19 New Cases in Tunisia

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***Abstract* - Understanding the trend of COVID-19 is important for purposes of formulating and implementing appropriate precautionary measures to mitigate the spread of the epidemic. In this study, the ANN approach was applied to analyze daily COVID-19 cases in Tunisia. This study is based on monthly new cases of COVID-19 in Tunisia 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 criteria (Error, MSE and MAE) of the model used in this study indicate that the model is stable in forecasting daily COVID-19 cases in the country. The results of the study indicate that daily COVID-19 cases in Tunisia are likely to will continue to decline and reach zero cases per day around mid April 2021.The government of Tunisia should continue to enforce adherence to the WHO sanitary rules and guidelines in order to suppress any further increase in the number of cases.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The first case of COVID-19 originated from Wuhan, China, after which the disease spread to the rest of the world (Alharbi *et al*., 2020) including Tunisia. Patients with COVID-19 can develop mild to severe symptoms following infection, for instance; signs of fever, cough, dyspnea, myalgia, and fatigue can arise in patients mildly affected. The virus can also lead to severe pneumonia, acute respiratory distress syndrome (ARDS), or multi-organ failure in some patients (Huang *et al*., 2020). The main purpose of this paper is to forecast COVID-19 daily cases in Tunisia in order to explain the future dynamic spread of the disease and to support the allocation of scarce COVID-19-related resources throughout the country.

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 Tunisia.

Data Issues

This study is based on daily new cases of COVID-19 in Tunisia 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	T
Observations	438 (After Adjusting Endpoints)
Neural Network Architecture:	
Input Layer Neurons	12
Hidden Layer Neurons	12
Output Layer Neurons	1

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Activation Function	Hyperbolic Tangent Function
Back Propagation Learning:	
Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	0.106682
MSE	116217.928040
MAE	218.859281

Residual Analysis for the Applied Model

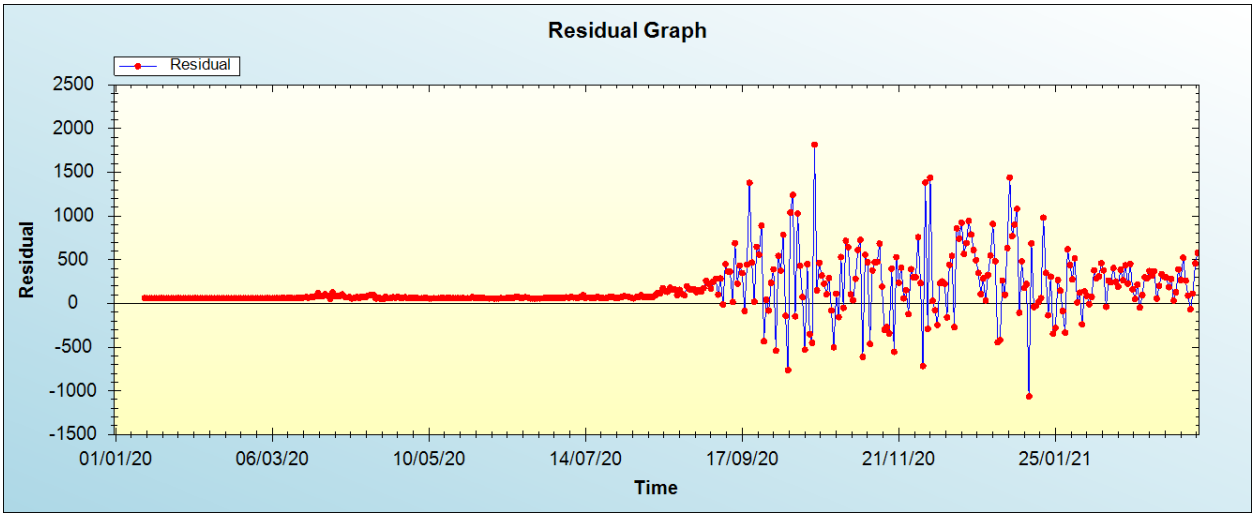

Figure 1: Residual analysis

In-sample Forecast for T

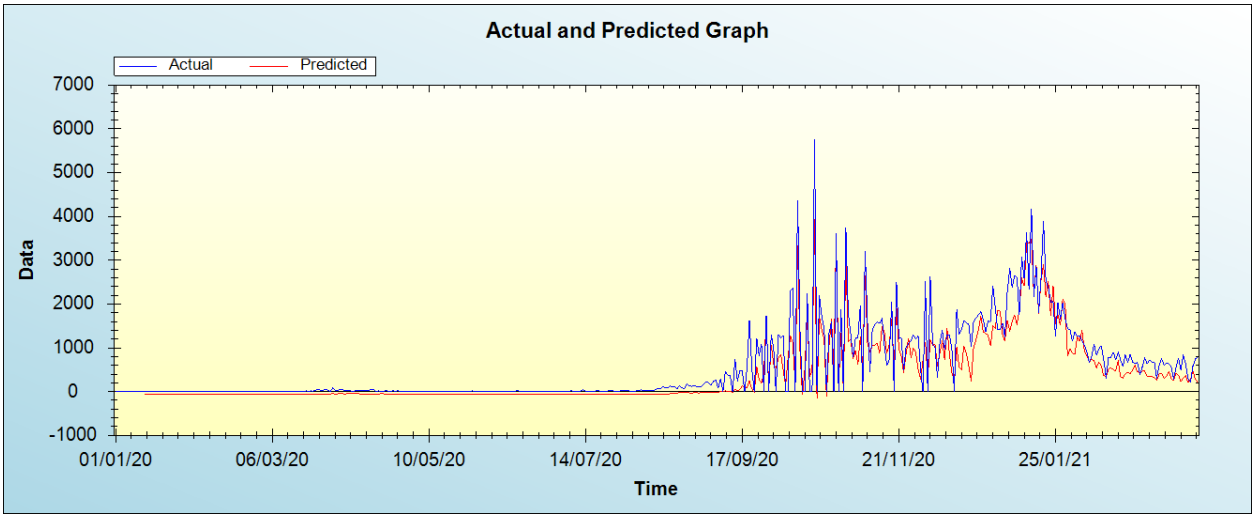

Figure 2: In-sample forecast for the T series

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

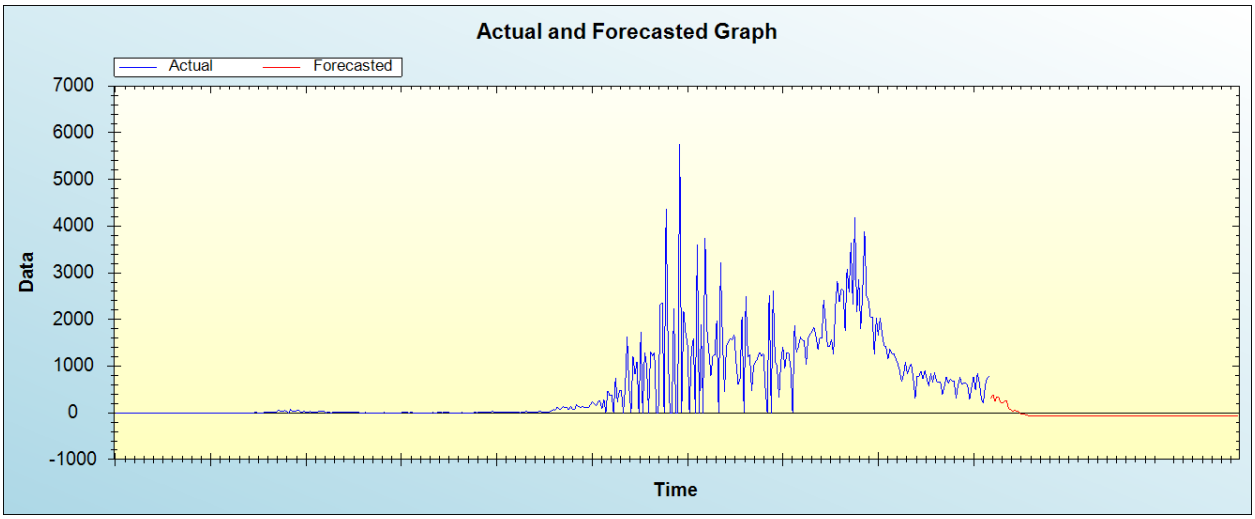

Figure 3: Out-of-sample forecast for T: actual and forecasted graph

Out-of-Sample Forecast for T: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
26/03/21	308.7675
27/03/21	390.5635
28/03/21	239.3334
29/03/21	346.0836
30/03/21	327.2730
31/03/21	208.7930
01/04/21	204.3516
02/04/21	245.5455
03/04/21	252.6423
04/04/21	86.9944
05/04/21	66.1337
06/04/21	37.4390
07/04/21	49.0214
08/04/21	35.3170
09/04/21	27.8652
10/04/21	-22.3221
11/04/21	-34.6119
12/04/21	-23.3272
13/04/21	-44.6586
14/04/21	-62.0447
15/04/21	-67.1550
16/04/21	-60.9570
17/04/21	-65.8254
18/04/21	-65.9205
19/04/21	-72.9086
20/04/21	-76.1735
21/04/21	-76.2154
22/04/21	-73.5348
23/04/21	-75.1097
24/04/21	-76.8971
25/04/21	-75.6504
26/04/21	-74.9985
27/04/21	-75.0395
28/04/21	-75.8218
29/04/21	-75.7780

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30/04/21	-75.8984
01/05/21	-75.1242
02/05/21	-74.9241
03/05/21	-75.0799
04/05/21	-75.2896
05/05/21	-75.0684
06/05/21	-74.9322
07/05/21	-75.0179
08/05/21	-75.0433
09/05/21	-75.0292
10/05/21	-74.9352
11/05/21	-74.9053
12/05/21	-74.8959
13/05/21	-74.9725
14/05/21	-74.9707
15/05/21	-74.9407
16/05/21	-74.9203
17/05/21	-74.9398
18/05/21	-74.9468
19/05/21	-74.9388
20/05/21	-74.9344
21/05/21	-74.9339
22/05/21	-74.9436
23/05/21	-74.9472
24/05/21	-74.9458
25/05/21	-74.9379
26/05/21	-74.9395
27/05/21	-74.9428
28/05/21	-74.9445
29/05/21	-74.9427
30/05/21	-74.9422
31/05/21	-74.9429
01/06/21	-74.9437
02/06/21	-74.9438
03/06/21	-74.9427
04/06/21	-74.9424
05/06/21	-74.9428
06/06/21	-74.9436
07/06/21	-74.9434
08/06/21	-74.9431
09/06/21	-74.9429
10/06/21	-74.9431
11/06/21	-74.9432
12/06/21	-74.9431
13/06/21	-74.9430
14/06/21	-74.9430
15/06/21	-74.9432
16/06/21	-74.9432
17/06/21	-74.9431
18/06/21	-74.9431
19/06/21	-74.9431
20/06/21	-74.9431
21/06/21	-74.9431
22/06/21	-74.9431
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24/06/21	-74.9431
25/06/21	-74.9431
26/06/21	-74.9431
27/06/21	-74.9431
28/06/21	-74.9431
29/06/21	-74.9431
30/06/21	-74.9431
01/07/21	-74.9431
02/07/21	-74.9431

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03/07/21	-74.9431
04/07/21	-74.9431
05/07/21	-74.9431
06/07/21	-74.9431
07/07/21	-74.9431
08/07/21	-74.9431
09/07/21	-74.9431
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11/07/21	-74.9431
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24/07/21	-74.9431
25/07/21	-74.9431
26/07/21	-74.9431
27/07/21	-74.9431
28/07/21	-74.9431
29/07/21	-74.9431
30/07/21	-74.9431
31/07/21	-74.9431

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 Tunisia are likely to will continue to decline and reach zero cases per day around mid April 2021.

IV. CONCLUSION & RECOMMENDATIONS

The COVID-19 outbreak continues to spread rapidly across the world and Tunisia is among the countries that have been affected by the deadly disease. In this research endeavor, we applied the ANN (12, 12, 1) model to forecast daily COVID-19 daily cases in the country. The results of the study indicate that daily COVID-19 cases in Tunisia are likely to will continue to decline and reach zero cases per day around mid April 2021.The government of Tunisia should continue to enforce adherence to the WHO sanitary rules and guidelines in order to suppress any further increase in the number of cases. In this regard, we encourage the government to upscale the vaccination programme in the country.

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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 Tunisia" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 6, pp 675-679, June 2021. Article DOI https://doi.org/10.47001/IRJIET/2021.506118

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