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Forecasting Covid-19 New Cases in Tajikistan

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***Abstract* - The COVID-19 pandemic has triggered a global public health response. In this research paper, the ANN approach was applied to analyze COVID-19 cases in Tajikistan. This study is based on monthly new cases of COVID-19 in Tajikistan 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 applied in this paper indicate that the model is stable. The COVID-19 pandemic, as revealed by our forecasts is still and will remain significantly low in Tajikistan, for the next 4 months (that is, April 2021 – July 2021). The government should continue to implement control and preventive measures including vaccinations in order to save as many lives as possible.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

In late December 2019, COVID-19 cases were officially reported in Wuhan, China. On March 11, 2020, the WHO declared the COVID-19 outbreak a pandemic, indicating the global spread of a new disease (Holmes *et al*., 2020; Hui *et al*., 2020). No study has specifically forecasted daily COVID-19 case volumes in Tajikistan and yet such information is critical for planning purposes, especially with regards to optimal resource allocations in the fight against the pandemic. It is this research gap that this study attempts to fill. Therefore, we apply an Artificial Neural Network (ANN) model to forecast daily confirmed COVID-19 cases in Tajikistan.

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 Tajikistan.

Data Issues

This study is based on daily new cases of COVID-19 in Tajikistan 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
Activation Function	Hyperbolic Tangent Function
Back Propagation Learning:	

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Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	0.109902
MSE	165.971672
MAE	8.350002

Residual Analysis for the Applied Model

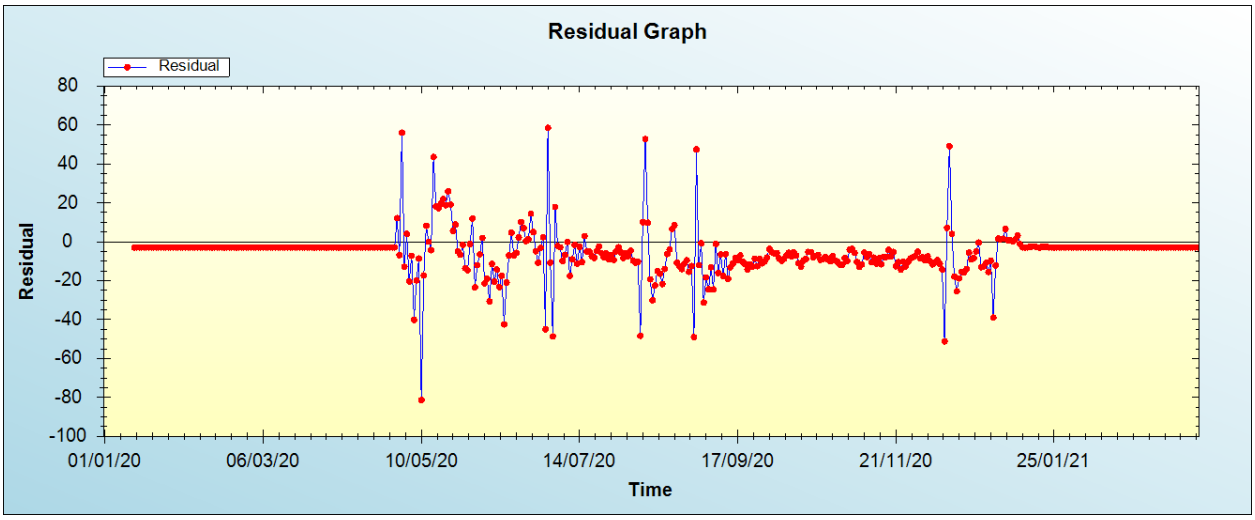

Figure 1: Residual analysis

In-sample Forecast for T

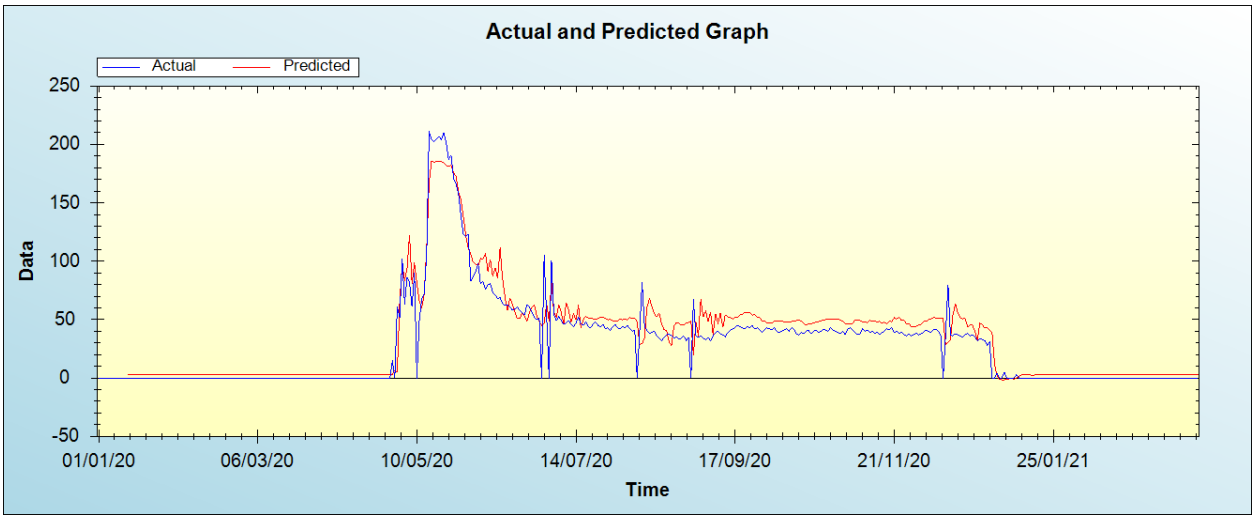

Figure 2: In-sample forecast for the T series

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

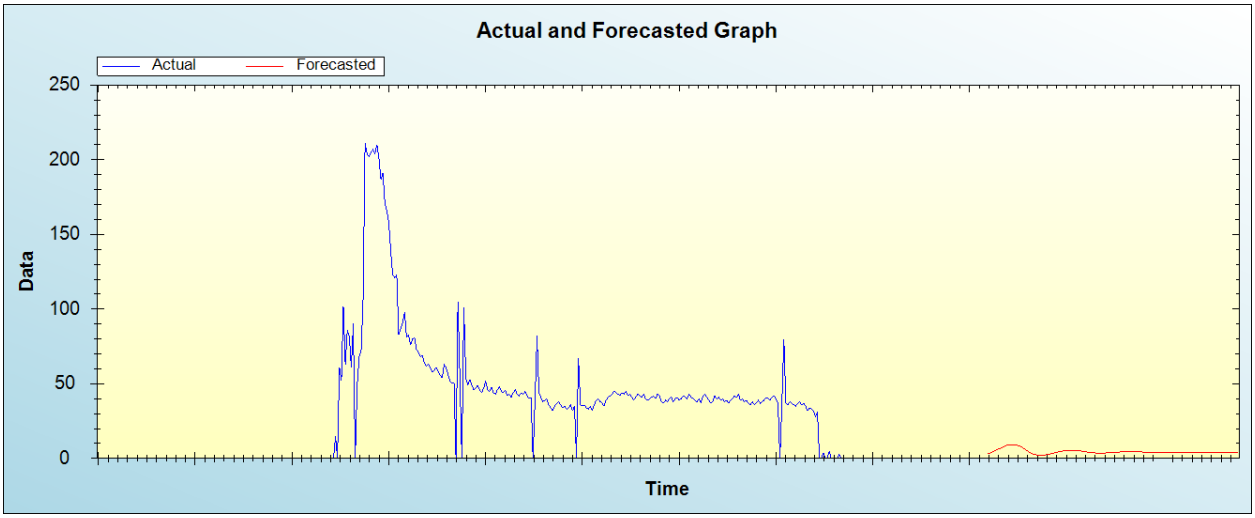

Figure 3: Out-of-sample forecast for T: actual and forecasted graph

Out-of-Sample Forecast for T: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
26/03/21	2.8904
27/03/21	3.4835
28/03/21	3.9794
29/03/21	4.7658
30/03/21	5.3799
31/03/21	5.9771
01/04/21	6.5588
02/04/21	7.1541
03/04/21	7.6806
04/04/21	8.5392
05/04/21	9.0656
06/04/21	9.2881
07/04/21	9.2155
08/04/21	9.3113
09/04/21	9.2278
10/04/21	8.8944
11/04/21	8.4528
12/04/21	7.8179
13/04/21	7.0598
14/04/21	6.1732
15/04/21	5.2283
16/04/21	4.3093
17/04/21	3.5804
18/04/21	3.0209
19/04/21	2.6066
20/04/21	2.3309
21/04/21	2.1887
22/04/21	2.1611
23/04/21	2.2193
24/04/21	2.3565
25/04/21	2.5606
26/04/21	2.8287
27/04/21	3.1400
28/04/21	3.4719
29/04/21	3.8047
30/04/21	4.1309
01/05/21	4.4414

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02/05/21	4.7249
03/05/21	4.9740
04/05/21	5.1831
05/05/21	5.3477
06/05/21	5.4609
07/05/21	5.5176
08/05/21	5.5154
09/05/21	5.4572
10/05/21	5.3488
11/05/21	5.1973
12/05/21	5.0121
13/05/21	4.8047
14/05/21	4.5878
15/05/21	4.3730
16/05/21	4.1708
17/05/21	3.9903
18/05/21	3.8385
19/05/21	3.7200
20/05/21	3.6368
21/05/21	3.5885
22/05/21	3.5735
23/05/21	3.5890
24/05/21	3.6311
25/05/21	3.6954
26/05/21	3.7769
27/05/21	3.8708
28/05/21	3.9722
29/05/21	4.0762
30/05/21	4.1781
31/05/21	4.2740
01/06/21	4.3604
02/06/21	4.4342
03/06/21	4.4934
04/06/21	4.5363
05/06/21	4.5622
06/06/21	4.5711
07/06/21	4.5636
08/06/21	4.5413
09/06/21	4.5061
10/06/21	4.4607
11/06/21	4.4078
12/06/21	4.3505
13/06/21	4.2918
14/06/21	4.2346
15/06/21	4.1813
16/06/21	4.1340
17/06/21	4.0945
18/06/21	4.0638
19/06/21	4.0426
20/06/21	4.0309
21/06/21	4.0284
22/06/21	4.0344
23/06/21	4.0479
24/06/21	4.0676
25/06/21	4.0923
26/06/21	4.1202
27/06/21	4.1501
28/06/21	4.1803
29/06/21	4.2096
30/06/21	4.2368
01/07/21	4.2609
02/07/21	4.2809
03/07/21	4.2965
04/07/21	4.3072

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05/07/21	4.3129
06/07/21	4.3138
07/07/21	4.3102
08/07/21	4.3026
09/07/21	4.2916
10/07/21	4.2781
11/07/21	4.2629
12/07/21	4.2466
13/07/21	4.2303
14/07/21	4.2145
15/07/21	4.2000
16/07/21	4.1874
17/07/21	4.1770
18/07/21	4.1690
19/07/21	4.1638
20/07/21	4.1612
21/07/21	4.1612
22/07/21	4.1635
23/07/21	4.1678
24/07/21	4.1739
25/07/21	4.1812
26/07/21	4.1894
27/07/21	4.1980
28/07/21	4.2066
29/07/21	4.2149
30/07/21	4.2224
31/07/21	4.2289

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 Tajikistan are likely to remain very low over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

COVID-19 is a worldwide public health emergency with no end date in sight (Pustulka & Buler, 2020). Tajikistan, just like any other country in any part of the globe, has not been spared by the COVID-19 pandemic and hence the need for forecasting and control. Based on daily observations of COVID-19 cases in Tajikistan, this study used the ANN model to come up with daily forecasts ranging over the period late March 2020 to end of July 2021. The COVID-19 pandemic, as revealed by our forecasts is still and will remain significantly low in Tajikistan, for the next 4 months (that is, April 2021 – July 2021). The government should continue to implement control and preventive measures including vaccinations in order to save as many lives as possible.

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