Forecasting Covid-19 New Cases in Syria

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Abstract - **In this research paper, the ANN model was applied to forecast COVID-19 confirmed cases in Syria. This study is based on monthly new cases of COVID-19 in the country 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 applied model indicate that the model is stable and adequate in forecasting daily confirmed cases of COVID-19 in Syria. The results of the study indicate that daily COVID-19 cases in Syria are likely to remain high, although characterized by recurrent downward trends over the out-of-sample period. We encourage relevant authorities to continue to implement preventive and control measures such as wearing of masks, banning of unnecessary travel, social distancing, and proper washing of hands and vaccinations.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

Since the COVID-19 case was recorded in Wuhan in China in the tail end of December 2019, the virus has quickly spread to the rest of the world, mostly facilitated by the global air travel to the major cities in Europe, the US and elsewhere (Zhang et al., 2020a & b). By September 4, 2020; there were 26331492 confirmed cases of COVID-19 and continuing to grow by the day and 869290 deaths have been reported worldwide with more than 185 countries being affected by the pandemic (Johns Hopkins University, 2020). Although governments around the world, including the government of Syria; impose numerous containment and social distancing measures, the need for the healthcare systems has dramatically increased and the effective management of infected patients becomes a challenging problem for hospitals. Therefore, accurate forecasting of the number of new COVID-19 cases is crucial for optimizing the available resources and arresting or slowing down the progression of the pandemic (Zeroual et al., 2020). In this endeavor, we attempt to model and forecast daily confirmed COVID-19 cases in Syria.

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 Syria.

Data Issues

This study is based on daily new cases of COVID-19 in Syria 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	S
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	0.100082
MSE	91.457647
MAE	7.572258

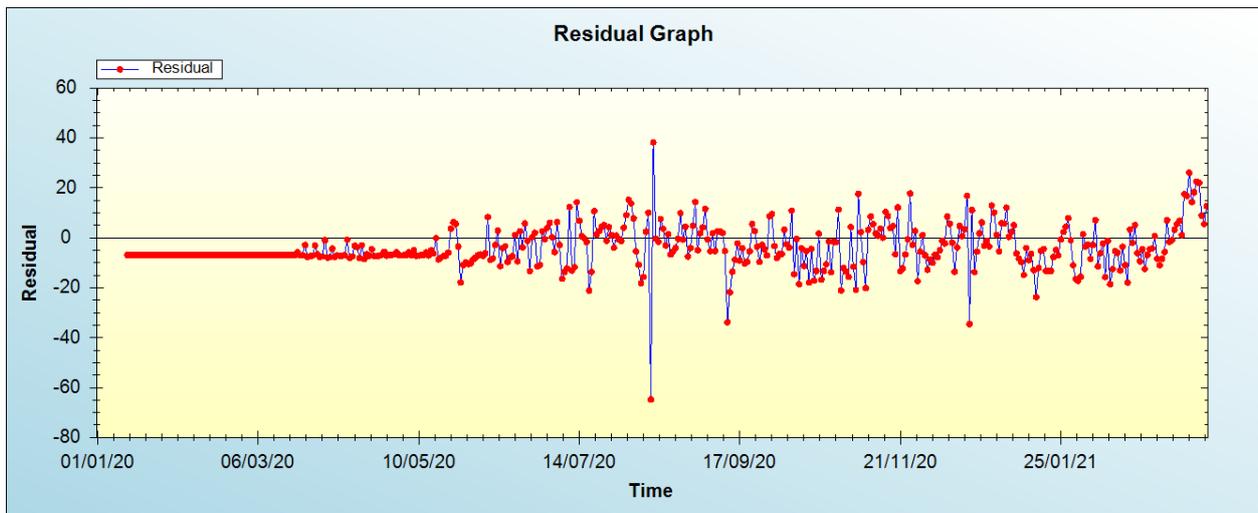*Residual Analysis for the Applied Model*

Figure 1: Residual analysis
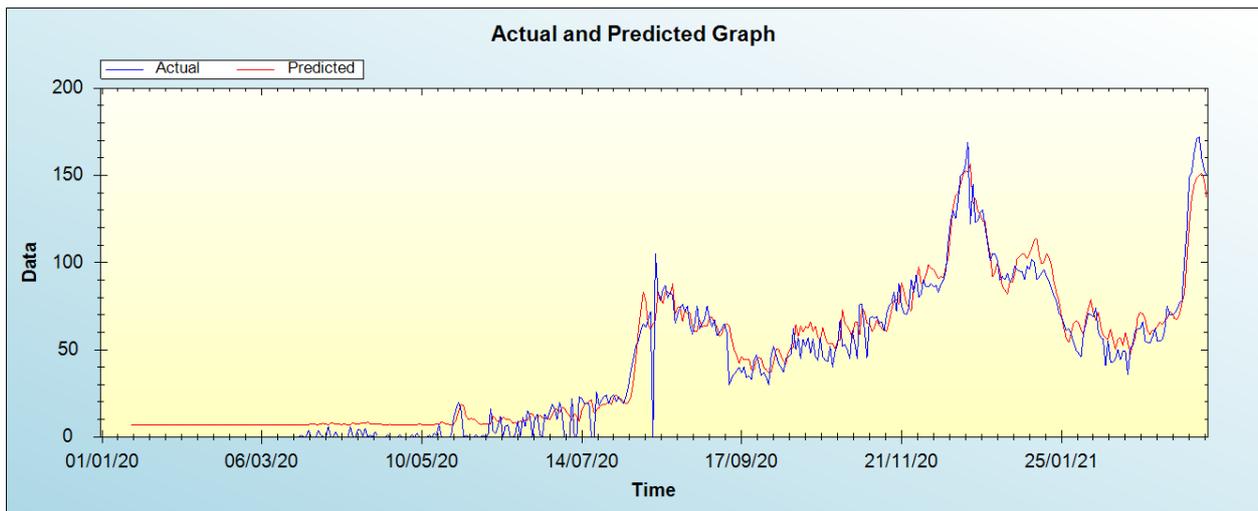
In-sample Forecast for S

Figure 2: In-sample forecast for the S series

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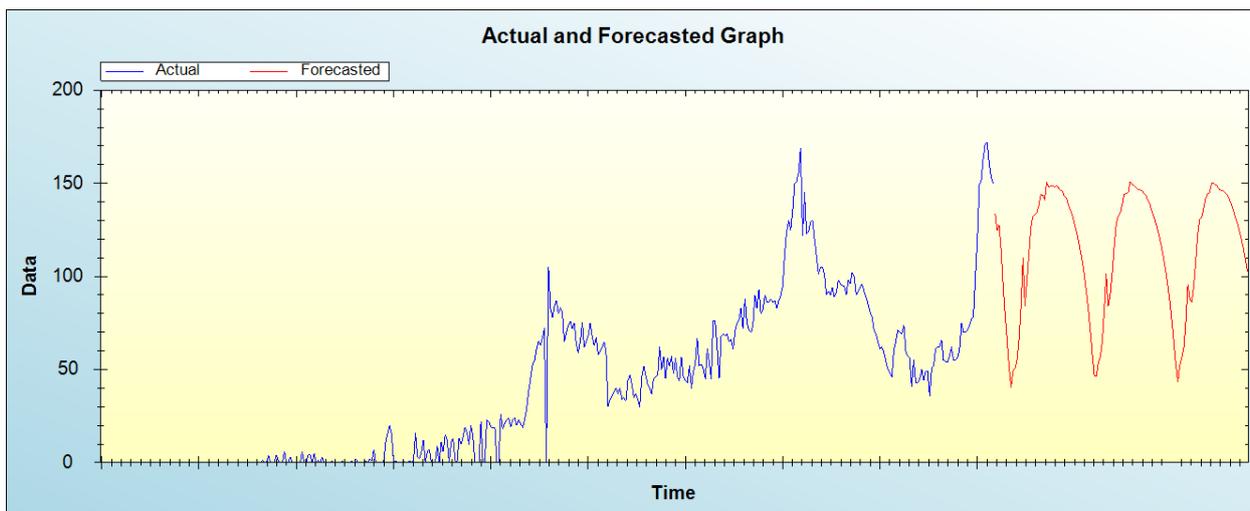
Actual and Forecasted Graph

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

Out-of-Sample Forecast for S: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
26/03/21	133.7982
27/03/21	124.5062
28/03/21	127.5073
29/03/21	114.4328
30/03/21	95.5799
31/03/21	79.2141
01/04/21	65.5208
02/04/21	51.3619
03/04/21	40.5836
04/04/21	49.3588
05/04/21	50.5737
06/04/21	54.8405
07/04/21	65.7033
08/04/21	83.7276
09/04/21	109.7670
10/04/21	84.3258
11/04/21	97.0752
12/04/21	112.0501
13/04/21	126.2362
14/04/21	132.3259
15/04/21	133.0509
16/04/21	134.2906
17/04/21	137.9167
18/04/21	144.1398
19/04/21	143.4076
20/04/21	141.2157
21/04/21	150.5246
22/04/21	147.9239
23/04/21	148.4615
24/04/21	148.5042
25/04/21	147.9073
26/04/21	148.6238
27/04/21	147.5249
28/04/21	146.3155
29/04/21	145.3844
30/04/21	142.8383
01/05/21	141.8368
02/05/21	138.0401
03/05/21	135.3887

04/05/21	132.2680
05/05/21	128.1364
06/05/21	124.0109
07/05/21	118.9908
08/05/21	113.3992
09/05/21	107.2055
10/05/21	99.9317
11/05/21	91.5640
12/05/21	81.7596
13/05/21	70.5661
14/05/21	58.3516
15/05/21	46.7508
16/05/21	46.2644
17/05/21	53.6458
18/05/21	57.2431
19/05/21	65.5162
20/05/21	82.8328
21/05/21	101.2829
22/05/21	83.9386
23/05/21	90.7521
24/05/21	102.1397
25/05/21	116.5137
26/05/21	128.2814
27/05/21	132.5483
28/05/21	133.8201
29/05/21	138.4833
30/05/21	143.9906
31/05/21	144.5025
01/06/21	145.1275
02/06/21	151.0544
03/06/21	149.1458
04/06/21	148.7558
05/06/21	147.7450
06/06/21	146.4785
07/06/21	146.6130
08/06/21	145.8354
09/06/21	144.5750
10/06/21	143.3094
11/06/21	140.7095
12/06/21	138.5486
13/06/21	134.7801
14/06/21	131.6164
15/06/21	128.2135
16/06/21	124.1639
17/06/21	119.8265
18/06/21	114.6505
19/06/21	108.8252
20/06/21	102.2920
21/06/21	94.7592
22/06/21	86.0110
23/06/21	75.8166
24/06/21	64.3220
25/06/21	52.3200
26/06/21	43.2551
27/06/21	52.3344
28/06/21	56.1988
29/06/21	61.5863
30/06/21	75.0077
01/07/21	95.6589
02/07/21	87.7756
03/07/21	86.2035
04/07/21	94.6982
05/07/21	107.6010
06/07/21	122.4334

07/07/21	130.6029
08/07/21	132.0205
09/07/21	136.5211
10/07/21	141.9850
11/07/21	144.2408
12/07/21	145.0165
13/07/21	149.8354
14/07/21	150.1420
15/07/21	149.2798
16/07/21	148.2398
17/07/21	146.4503
18/07/21	146.0957
19/07/21	145.8658
20/07/21	144.5938
21/07/21	143.4705
22/07/21	141.2290
23/07/21	138.8234
24/07/21	135.3531
25/07/21	131.8452
26/07/21	128.4325
27/07/21	124.5423
28/07/21	120.2549
29/07/21	115.2446
30/07/21	109.4279
31/07/21	102.9471

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 Syria are likely to remain high, mostly above 100 cases per day over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

Since the recent challenge that humanity is facing against COVID-19, several initiatives have been put forward with the goal of creating measures to help control the spread of the pandemic (Varela-Santos & Melin,2020). This piece of work is a scientific initiative whose goal is to forecast COVID-19 daily confirmed cases in Syria in order to inform policy. The applied model has been shown to be stable. The forecasts of the model are in line with reality. Basically, we establish that daily COVID-19 cases in Syria are likely to remain high, although characterized by recurrent downward trends over the out-of-sample period. We encourage relevant authorities to continue to implement preventive and control measures such as wearing of masks, banning of unnecessary travel, social distancing, and proper washing of hands and vaccinations.

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