

Forecasting Covid-19 New Cases in Armenia

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Abstract - In this paper, the ANN technique was applied to analyze daily COVID-19 case volumes in Armenia. This study is based on daily new cases of COVID-19 in Armenia 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 suggest that the model is stable for forecasting COVID-19 cases in Armenia. The forecasts of this research suggest that daily COVID-19 cases in Armenia are likely to remain very high over the out-of-sample period. We encourage the government of Armenia to continue enforcing and implementing control and preventive measures in order to avoid a possibility of a second wave of infections.

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

COVID-19 has wrecked havoc on a global scale (Pacheco *et al.*, 2020). Its first outbreak occurred in the city of Wuhan, China, in the tail end of 2019 (Wang *et al.*, 2020). COVID-19 is mainly transmitted by person-to-person contact (Ma *et al.*, 2020). In order to mitigate the spread of the virus, affected countries around the world have been enforcing and implementing social distancing and lockdown measures (Lau *et al.*, 2020). Armenia's first COVID-19 case was officially recorded on April 7, 2020. Despite the fact that there is vast literature on COVID-19, studies focusing on Armenia are scanty. In order to reduce uncertainty and increase efficiency in decision making by the government of Armenia, this study seeks to model and forecast daily COVID-19 cases in the country.

II. METHODOLOGY

The Artificial Neural Network (ANN) model; which is flexible and capable of nonlinear modeling, will be applied in this study. The ANN is a data processing system made up 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 Armenia.

Data Issues

This study is based on daily new cases of COVID-19 in Armenia 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	A
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	0.0787
MSE	11719.449004
MAE	80.550926

Residual Analysis for the Applied Model

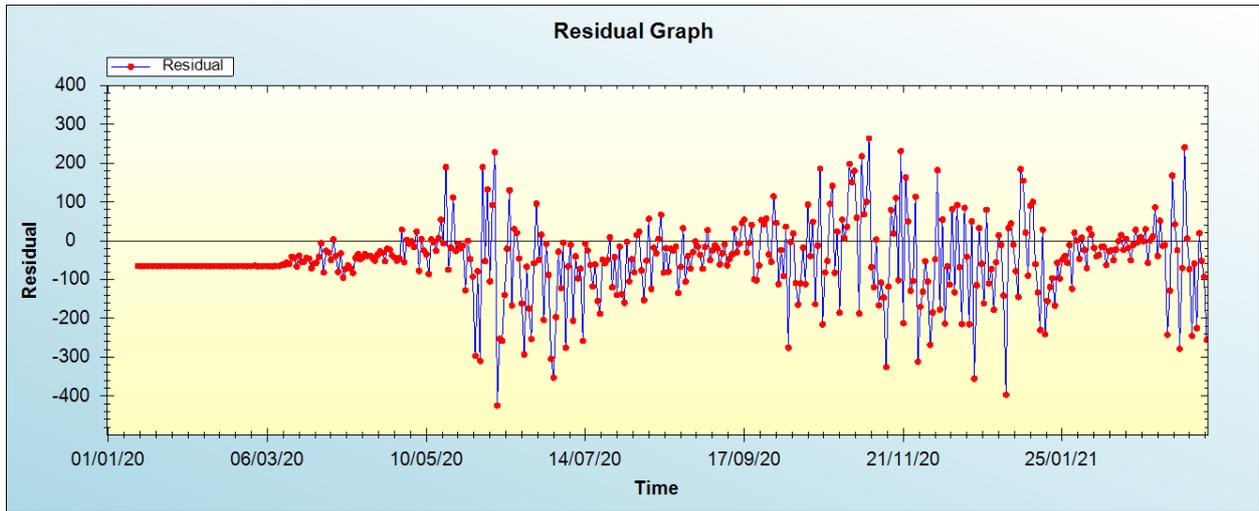


Figure 1: Residual analysis

In-sample Forecast for A

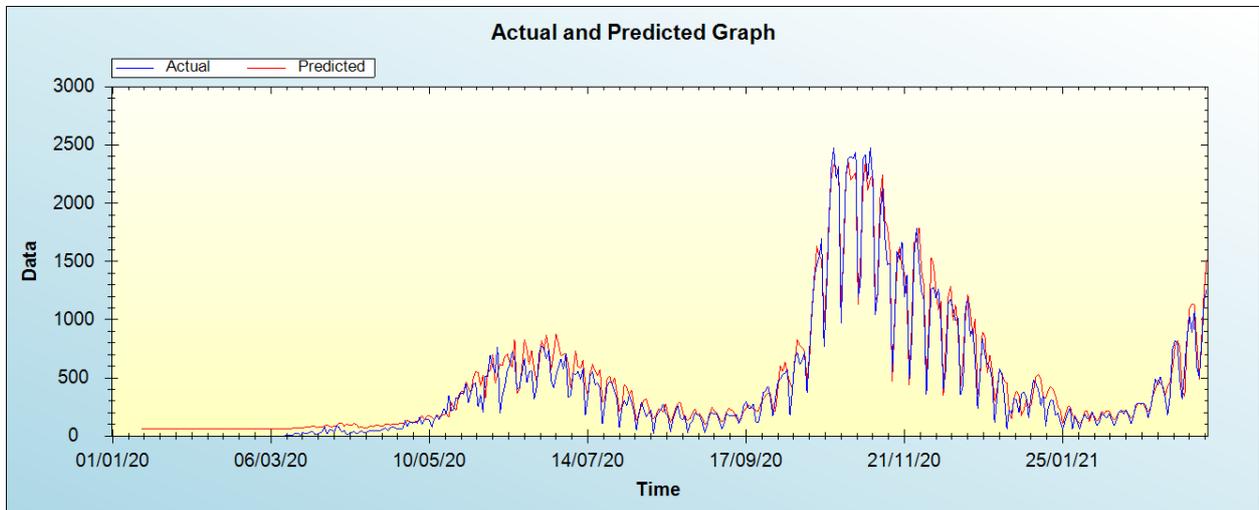


Figure 2: In-sample forecast for the A series

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

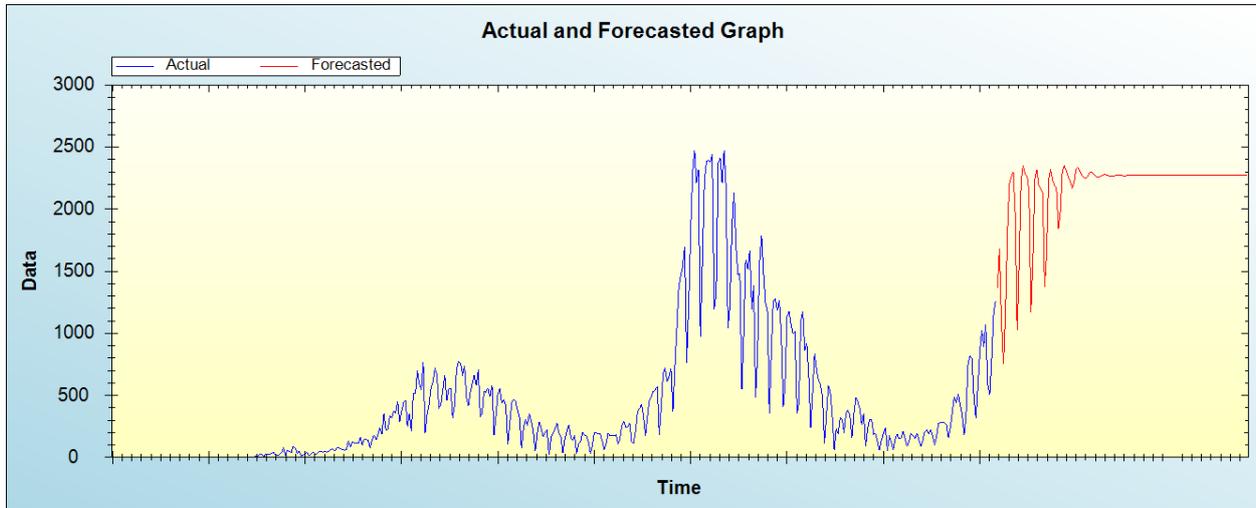


Figure 3: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	1364.0897
27/03/21	1679.8660
28/03/21	1105.9033
29/03/21	755.4732
30/03/21	1143.6738
31/03/21	1800.4708
01/04/21	2208.7157
02/04/21	2258.5461
03/04/21	2302.0771
04/04/21	1969.7032
05/04/21	1023.1957
06/04/21	1572.4334
07/04/21	2233.1168
08/04/21	2350.9273
09/04/21	2282.8997
10/04/21	2268.0862
11/04/21	2154.5061
12/04/21	1170.8137
13/04/21	1583.8961
14/04/21	2245.6478
15/04/21	2316.0488
16/04/21	2189.6798
17/04/21	2166.6922
18/04/21	2129.5202
19/04/21	1378.7780
20/04/21	1635.1778
21/04/21	2232.5289
22/04/21	2320.5377
23/04/21	2235.0557
24/04/21	2192.9379
25/04/21	2164.2133
26/04/21	1840.8424
27/04/21	1976.3857
28/04/21	2305.0070
29/04/21	2348.6406
30/04/21	2306.4183
01/05/21	2260.3018

02/05/21	2228.4019
03/05/21	2170.9182
04/05/21	2219.0834
05/05/21	2321.1457
06/05/21	2333.1095
07/05/21	2304.7908
08/05/21	2273.2497
09/05/21	2252.9709
10/05/21	2248.7189
11/05/21	2267.0619
12/05/21	2294.4613
13/05/21	2296.0483
14/05/21	2280.0592
15/05/21	2264.4159
16/05/21	2257.3796
17/05/21	2260.9892
18/05/21	2270.1801
19/05/21	2278.2794
20/05/21	2277.8150
21/05/21	2270.9772
22/05/21	2265.1391
23/05/21	2264.1768
24/05/21	2267.6355
25/05/21	2272.0346
26/05/21	2274.4296
27/05/21	2273.5442
28/05/21	2270.7215
29/05/21	2268.7497
30/05/21	2269.0097
31/05/21	2270.8019
01/06/21	2272.4558
02/06/21	2272.8870
03/06/21	2272.0816
04/06/21	2270.8502
05/06/21	2270.2012
06/06/21	2270.4897
07/06/21	2271.2540
08/06/21	2271.7849
09/06/21	2271.7394
10/06/21	2271.2730
11/06/21	2270.7945
12/06/21	2270.6446
13/06/21	2270.8576
14/06/21	2271.1855
15/06/21	2271.3522
16/06/21	2271.2728
17/06/21	2271.0652
18/06/21	2270.9102
19/06/21	2270.9110
20/06/21	2271.0364
21/06/21	2271.1690
22/06/21	2271.2115
23/06/21	2271.1562
24/06/21	2271.0693
25/06/21	2271.0234
26/06/21	2271.0439
27/06/21	2271.1019
28/06/21	2271.1470
29/06/21	2271.1490
30/06/21	2271.1162
01/07/21	2271.0807
02/07/21	2271.0688
03/07/21	2271.0833
04/07/21	2271.1071

05/07/21	2271.1203
06/07/21	2271.1150
07/07/21	2271.0991
08/07/21	2271.0864
09/07/21	2271.0853
10/07/21	2271.0938
11/07/21	2271.1033
12/07/21	2271.1067
13/07/21	2271.1028
14/07/21	2271.0961
15/07/21	2271.0923
16/07/21	2271.0936
17/07/21	2271.0979
18/07/21	2271.1014
19/07/21	2271.1018
20/07/21	2271.0996
21/07/21	2271.0970
22/07/21	2271.0960
23/07/21	2271.0971
24/07/21	2271.0989
25/07/21	2271.1000
26/07/21	2271.0997
27/07/21	2271.0986
28/07/21	2271.0976
29/07/21	2271.0975
30/07/21	2271.0981
31/07/21	2271.0988

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 Armenia are likely to remain very high over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

The COVID-19 pandemic has spread very quickly worldwide and Armenia, just like other countries; has not been able to escape. The government continues to be worried about the future trend of the pandemic because they need to plan ahead in order to control and or prevent the virus from further devastating the country. In an attempt to help the government of Armenia in fighting against the COVID-19 pandemic, we used a basic ANN (12, 12, 1) model to analyze COVID-19 daily cases in the country. Finally, we encourage the government of Armenia to continue enforcing and implementing control and preventive measures in order to avoid a possibility of a second wave of the pandemic.

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