

PREDICTION OF COVID-19 CASES IN THE UNITED ARAB EMIRATES (UAE) USING ARTIFICIAL NEURAL NETWORKS

*Dr. Smartson. P. NYONI¹, Thabani NYONI², Tatenda. A. CHIHOHO³

¹ZICHIRE Project, University of Zimbabwe, Harare, Zimbabwe

²Department of Economics, University of Zimbabwe, Harare, Zimbabwe

³Department of Economics, University of Zimbabwe, Harare, Zimbabwe

*Corresponding Author

ABSTRACT

In this work, the ANN approach was employed to analyze COVID-19 case volumes based on data covering the period January 29, 2020 to October 31, 2020. The out-of-sample period ranges over the period November 2020 to April 2021. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the model indicate that it is stable. The study establishes that daily COVID-19 cases in the UAE will remain as high as 1412 cases per day over the period December 18, 2020 to April 30, 2021. The government of the UAE ought to ensure the continued compliance to COVID-19 mitigation measures such as social distancing, quarantine, isolation, as well as face-mask wearing, amongst other measures.

Keywords: - ANN, COVID-19, Forecasting

INTRODUCTION

COVID-19 is a deadly viral disease quickly spreading throughout the world. Its main symptoms include fever, sore throat, coughing and difficulty in breathing. The first cases appeared in Wuhan, China, in late December 2019 and the gradually, cases started coming up in many other countries as well (Singhal *et al.*, 2020). The increasing number of new infections and death toll the virus has been a major threat and serious challenge for each and every country (Pathak *et al.*, 2020). Accurately forecasting the transmission dynamics of confirmed COVID-19 cases is vital to understand and help decision makers to slow down or arrest its spreading (Velasquez & Lara, 2020; Yousaf *et al.*, 2020; Ribeiro *et al.*, 2020). The main purpose of this study is model and forecast daily confirmed cases of COVID-19 in the UAE.

METHODOLOGY

This paper applies the multi-layer perceptron neural network type of the ANN approach in order to predict daily new COVID-19 infections in UAE. This study particularly applies the ANN (12, 12, 1) model and chooses the more efficient hyperbolic tangent function as the activation function. This study is based on daily new Covid-19 cases (referred to as UC series in this study) in all age groups in UAE. The data covers the period 29 January 2020 to 31 October 2020 while the out-of-sample forecast covers the period November 2020 to April 2021. All the data employed in this research paper was gathered from John Hopkins University (USA).

FINDINGS OF THE STUDY**DESCRIPTIVE STATISTICS**

Table 1: Descriptive statistics

Mean	Median	Minimum	Maximum
478.81	421.00	0.00000	1578.0
Std. Dev.	C.V.	Skewness	Ex. kurtosis
391.09	0.81680	0.71846	-0.038401
5% Perc.	95% Perc.	IQ range	Missing obs.
0.00000	1239.1	480.50	0

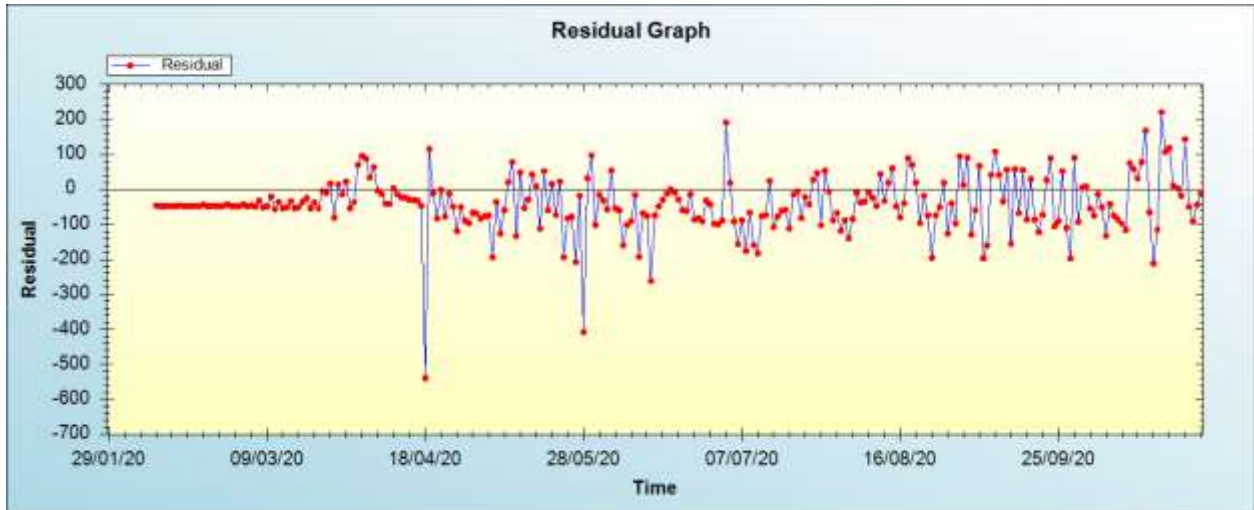
ANN MODEL SUMMARY FOR COVID-19 DAILY CASES IN UNITED ARAB EMIRATES (UAE)

Table 2: ANN model summary

Variable	UC
Observations	265 (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	0.103048
MSE	8161.110981
MAE	68.694927

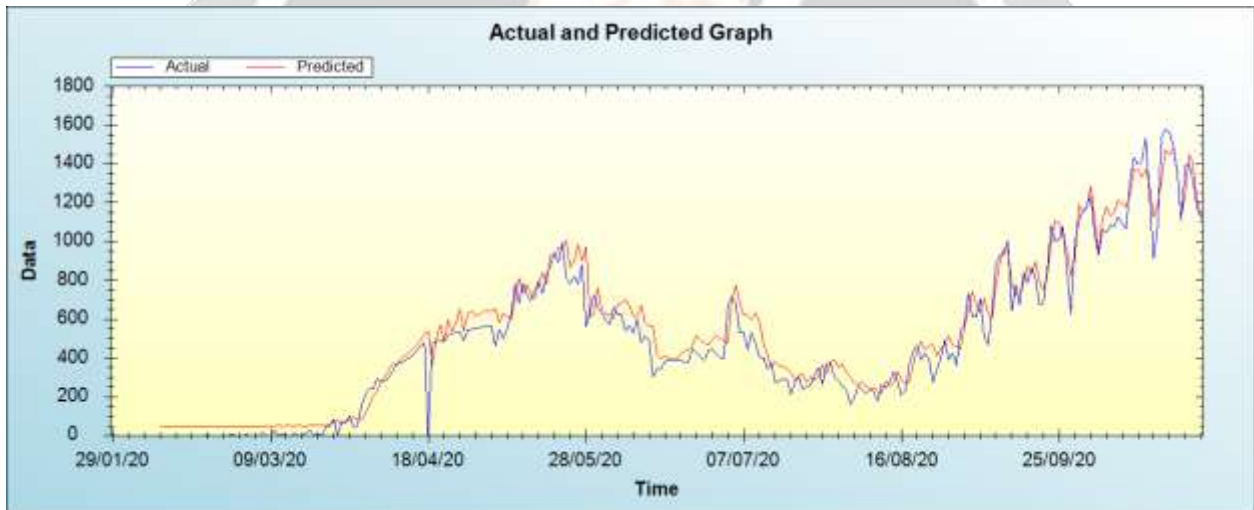
Residual Analysis for the ANN model

Figure 1: Residual analysis



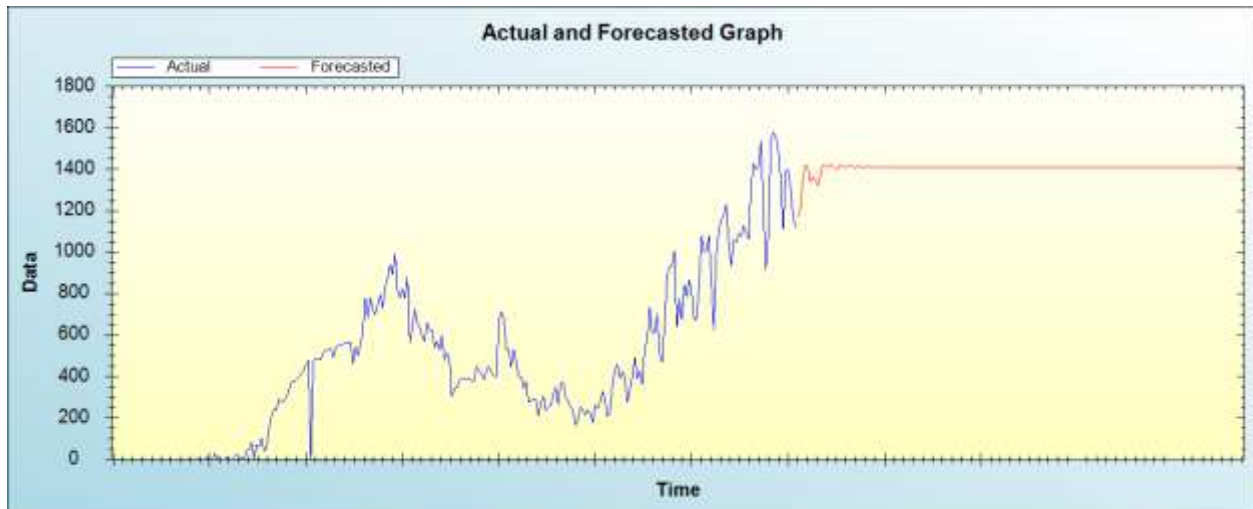
In-sample Forecast for UC

Figure 2: In-sample forecast for the UC series



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

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



Out-of-Sample Forecast for UC: Forecasts only

Table 3: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
01/11/20	1170.8644
02/11/20	1206.0821
03/11/20	1353.4720
04/11/20	1423.8250
05/11/20	1410.4115
06/11/20	1340.5474
07/11/20	1363.2335
08/11/20	1349.4203
09/11/20	1324.6953
10/11/20	1365.7182
11/11/20	1417.2928
12/11/20	1425.3633
13/11/20	1405.1728
14/11/20	1422.9994
15/11/20	1421.8444

16/11/20	1401.1566
17/11/20	1398.8199
18/11/20	1419.3134
19/11/20	1418.2186
20/11/20	1406.9693
21/11/20	1414.7483
22/11/20	1420.7895
23/11/20	1412.1552
24/11/20	1406.5966
25/11/20	1415.1358
26/11/20	1414.7249
27/11/20	1408.0007
28/11/20	1410.0304
29/11/20	1415.6622
30/11/20	1412.4984
01/12/20	1408.9000
02/12/20	1412.7223
03/12/20	1413.9202
04/12/20	1410.3945
05/12/20	1410.2809
06/12/20	1413.6279
07/12/20	1412.6609
08/12/20	1410.4230
09/12/20	1411.9174
10/12/20	1413.3031
11/12/20	1411.6035

12/12/20	1410.9692
13/12/20	1412.6483
14/12/20	1412.5883
15/12/20	1411.2622
16/12/20	1411.6997
17/12/20	1412.7027
18/12/20	1411.9933
19/12/20	1411.4032
20/12/20	1412.1722
21/12/20	1412.4053
22/12/20	1411.6897
23/12/20	1411.7188
24/12/20	1412.3186
25/12/20	1412.0926
26/12/20	1411.6757
27/12/20	1411.9899
28/12/20	1412.2392
29/12/20	1411.8929
30/12/20	1411.7999
31/12/20	1412.1191
01/01/21	1412.0925
02/01/21	1411.8369
03/01/21	1411.9399
04/01/21	1412.1216
05/01/21	1411.9754
06/01/21	1411.8732

07/01/21	1412.0268
08/01/21	1412.0628
09/01/21	1411.9227
10/01/21	1411.9383
11/01/21	1412.0502
12/01/21	1412.0007
13/01/21	1411.9240
14/01/21	1411.9895
15/01/21	1412.0325
16/01/21	1411.9637
17/01/21	1411.9505
18/01/21	1412.0119
19/01/21	1412.0031
20/01/21	1411.9547
21/01/21	1411.9777
22/01/21	1412.0106
23/01/21	1411.9807
24/01/21	1411.9631
25/01/21	1411.9936
26/01/21	1411.9985
27/01/21	1411.9714
28/01/21	1411.9762
29/01/21	1411.9972
30/01/21	1411.9864
31/01/21	1411.9725
01/02/21	1411.9859

02/02/21	1411.9932
03/02/21	1411.9796
04/02/21	1411.9780
05/02/21	1411.9898
06/02/21	1411.9873
07/02/21	1411.9783
08/02/21	1411.9833
09/02/21	1411.9892
10/02/21	1411.9831
11/02/21	1411.9802
12/02/21	1411.9862
13/02/21	1411.9867
14/02/21	1411.9815
15/02/21	1411.9828
16/02/21	1411.9867
17/02/21	1411.9844
18/02/21	1411.9819
19/02/21	1411.9846
20/02/21	1411.9858
21/02/21	1411.9831
22/02/21	1411.9830
23/02/21	1411.9852
24/02/21	1411.9846
25/02/21	1411.9829
26/02/21	1411.9840
27/02/21	1411.9851

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28/02/21	1411.9838
01/03/21	1411.9834
02/03/21	1411.9845
03/03/21	1411.9846
04/03/21	1411.9836
05/03/21	1411.9839
06/03/21	1411.9846
07/03/21	1411.9841
08/03/21	1411.9837
09/03/21	1411.9842
10/03/21	1411.9844
11/03/21	1411.9839
12/03/21	1411.9839
13/03/21	1411.9843
14/03/21	1411.9842
15/03/21	1411.9839
16/03/21	1411.9841
17/03/21	1411.9843
18/03/21	1411.9840
19/03/21	1411.9840
20/03/21	1411.9842
21/03/21	1411.9842
22/03/21	1411.9840
23/03/21	1411.9841
24/03/21	1411.9842
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26/03/21	1411.9840
27/03/21	1411.9841
28/03/21	1411.9841
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27/04/21	1411.9841
28/04/21	1411.9841
29/04/21	1411.9841
30/04/21	1411.9841

The descriptive statistics, summary of the applied ANN model, residual analysis, in-sample forecasts as well as out-of-sample forecasts are presented in table 1, table 2, figure 1, figure 2 and well as figures 3 and table 3, respectively. The employed predictive model is stable and acceptable as shown in the residual analysis. The forecasts show that daily COVID-19 cases are likely to remain very high, about 1412 cases per day beginning (from around) December 18, 2020, onwards. Therefore, the pandemic is far from ending in the UAE.

CONCLUSION & RECOMMENDATIONS

Based on 277 daily observations of COVID-19 cases in UAE, this study used the ANN (12, 12, 1) model to come up with forecasts ranging over the period November 2020 to April 2021. The results of the study suggest that the COVID-19 infections will remain significantly high in the country. The government of the UAE ought to ensure the continued compliance to COVID-19 mitigation measures such as social distancing, quarantine, isolation, face-mask wearing and so on.

REFERENCES

- [1] COVID-19 Repository By the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University.
- [2] Dong, E., *et al.* (2020). An Interactive Web-based Dashboard to Track COVID-19 in Real Time, *Lancet Infectious Diseases*, 20 (5): 533 – 534.
- [3] Pathak, K. P., Ranabhat, C., & Chalise, H. N. (2020). Vaccines, Temperature, Latitude and Demography Could All be Reasons for Less Infection of Coronavirus in Nepal, *Journal of Psychiatry and Mental Disorders*, 5 (2): 1 – 2.
- [4] Ribeiro, M. H. D. M., *et al.* (2020). Short-term Forecasting of COVID-19 Cumulative Confirmed Cases: Perspectives for Brazil, *Chaos, Solitons and Fractals*, 138 (2020): 1 – 13.

- [5] Singhal, A., *et al.* (2020). Modeling and Prediction of COVID-19 Pandemic Using Gaussian Mixture Model, *Chaos, Solitons and Fractals*, 138 (2020): 1 – 8.
- [6] Velasquez, R. M. A., & Lara, J. V. M. (2020). Forecast and Evaluation of COVID-19 Spreading in USA With Reduced-space Gaussian Process Regression, *Chaos, Solitons and Fractals*, 138 (2020): 1 – 9.
- [7] Yousaf, M., *et al.* (2020). Statistical Analysis of Forecasting COVID-19 for Upcoming Month in Pakistan, *Chaos, Solitons and Fractals*, 138 (2020): 1 – 15.

