Forecasting Covid-19 Mortality in the United Arab Emirates (UAE)

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Abstract - **In this study, the ANN approach was applied to analyze COVID-19 daily deaths in the UAE. This study is based on daily COVID-19 deaths in the UAE for the period 1 January 2020 – 20 April 2021. The out-of-sample forecast covers the period 21 April – 31 August 2021.The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is quite stable. The results of the study indicate that daily COVID-19 deaths in the UAE are likely to range between 3 and 17 deaths per day over the out-of-sample period. There is need for the government of the UAE to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic and accelerate COVID-19 vaccination.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

December 2019 marked the beginning of the COVID-19 global health crisis with its origin being the Chinese city, Wuhan in the Hubei Province (Chen et al, 2020; Huang et al, 2020). The outbreak started as a cluster of pneumonia cases which was associated with mysterious deaths. The causative agent was then discovered to be the novel coronavirus, SARS-COV2 after genetic sequencing (Huang et al, 2020). The virus was seen to be having a transmission rate and high mortality as it spread to many parts of the world. According to previous studies around 80% of cases have mild symptoms and 5% develop severe disease (Yang et al, 2020; Wu &McGoogan, 2020). In Japan the first case of COVID-19 was reported on the 16th of January 2020 (Japan MOH, 2020). By the 7th of July 2020, the country had reported 19 816 confirmed cases and 979 deaths (Japan, 2020; MOH, 2020). It is important to highlight that the predictors of COVID-19 poor prognosis in hospitalized patients are the number of patients, resources of medical personnel, quality of infrastructure and patient background (Matsunaga et al, 2020). In this study we aim to predict daily COVID-19 mortality in the UAE using an artificial intelligence technique. The results of the study are expected to uncover the likely future trends of COVID-19 mortality in the country and assist in the allocation of resources for the COVID-19 response.

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 COVID-19 deaths in the United Arab Emirates (UAE).

Data Issues

This study is based on daily COVID-19 deaths in the UAE for the period 1 January 2020 – 20 April 2021.The out-of-sample forecast covers the period 21 April – 31 August 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	U
Observations	464 (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	0.138996
MSE	2.385164
MAE	1.186868

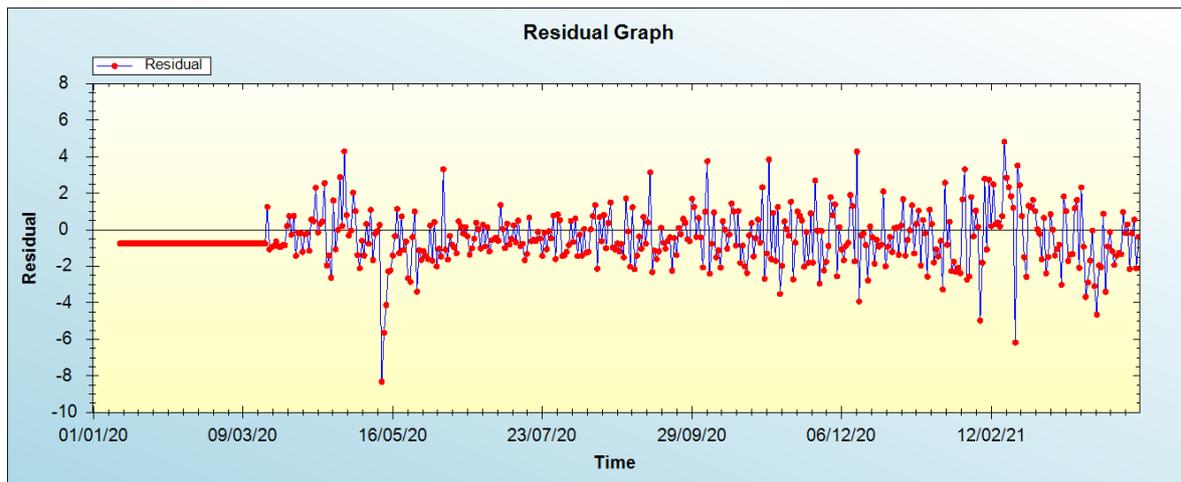*Residual Analysis for the Applied Model*

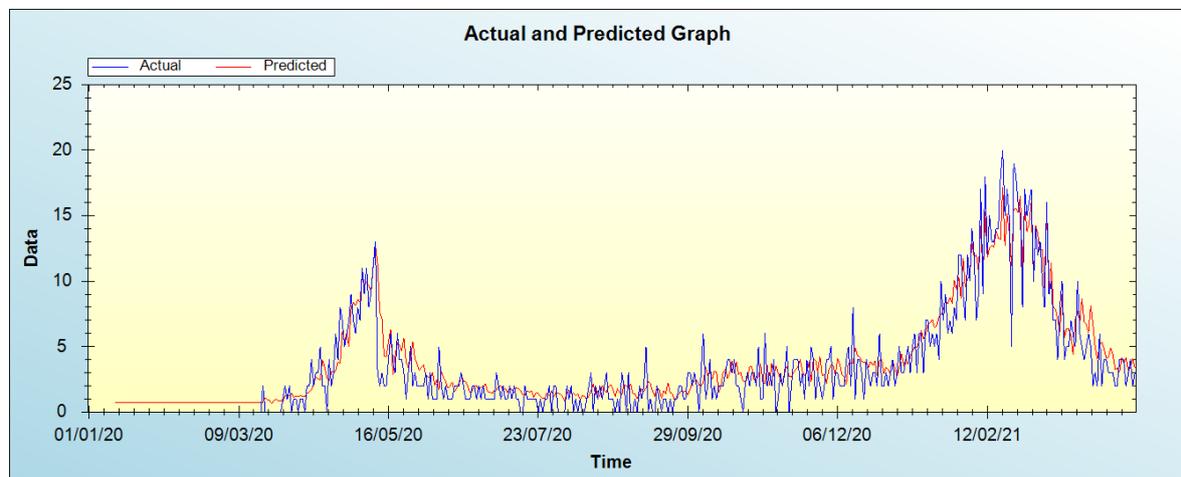**Figure 1: Residual analysis**

In-sample Forecast for U

Figure 2: In-sample forecast for the U series

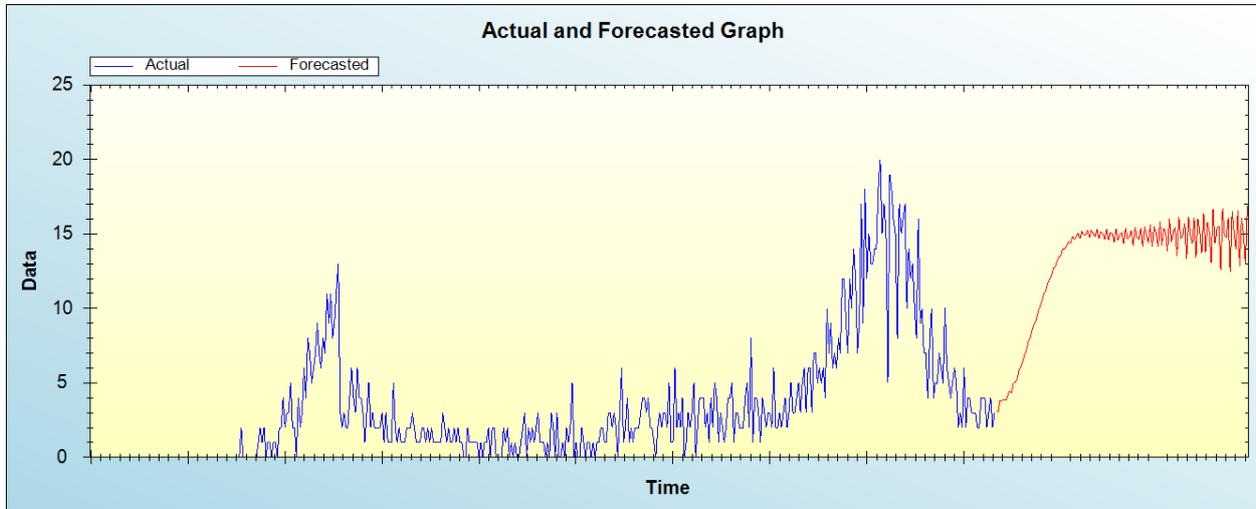*Out-of-Sample Forecast for U: Actual and Forecasted Graph*

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

Out-of-Sample Forecast for U: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
21/04/21	3.1052
22/04/21	3.0405
23/04/21	3.8078
24/04/21	3.8325
25/04/21	3.8756
26/04/21	3.8303
27/04/21	4.1776
28/04/21	4.4728
29/04/21	4.3409
30/04/21	4.9692
01/05/21	5.0602
02/05/21	5.3096
03/05/21	5.8510
04/05/21	6.1101
05/05/21	6.4974
06/05/21	6.9225
07/05/21	7.2989
08/05/21	7.8645
09/05/21	8.0936
10/05/21	8.6162
11/05/21	8.9831
12/05/21	9.2371
13/05/21	9.7915
14/05/21	10.1293
15/05/21	10.4985
16/05/21	10.9851
17/05/21	11.1578
18/05/21	11.6805
19/05/21	11.9366
20/05/21	12.2159
21/05/21	12.7103
22/05/21	12.7676
23/05/21	13.1881
24/05/21	13.4821
25/05/21	13.5270
26/05/21	14.0179

27/05/21	13.9486
28/05/21	14.2308
29/05/21	14.4737
30/05/21	14.3361
31/05/21	14.8359
01/06/21	14.6405
02/06/21	14.7669
03/06/21	15.0564
04/06/21	14.6874
05/06/21	15.1747
06/06/21	14.9511
07/06/21	14.9154
08/06/21	15.2705
09/06/21	14.7572
10/06/21	15.2612
11/06/21	15.0126
12/06/21	14.8168
13/06/21	15.3200
14/06/21	14.6795
15/06/21	15.1749
16/06/21	15.0161
17/06/21	14.6491
18/06/21	15.3054
19/06/21	14.5999
20/06/21	15.0646
21/06/21	15.0168
22/06/21	14.4641
23/06/21	15.3374
24/06/21	14.5772
25/06/21	14.9419
26/06/21	15.0964
27/06/21	14.3180
28/06/21	15.3822
29/06/21	14.6271
30/06/21	14.8221
01/07/21	15.2255
02/07/21	14.2047
03/07/21	15.4562
04/07/21	14.7274
05/07/21	14.6493
06/07/21	15.4056
07/07/21	14.1421
08/07/21	15.4872
09/07/21	14.8653
10/07/21	14.4328
11/07/21	15.6031
12/07/21	14.1444
13/07/21	15.4699
14/07/21	15.0156
15/07/21	14.1406
16/07/21	15.8193
17/07/21	14.2488
18/07/21	15.3570
19/07/21	15.1917
20/07/21	13.8186
21/07/21	16.0075
22/07/21	14.4485
23/07/21	15.1494
24/07/21	15.4145
25/07/21	13.5091
26/07/21	16.1466
27/07/21	14.7005
28/07/21	14.8101
29/07/21	15.7184

Date	Value
30/07/21	13.3314
31/07/21	16.1712
01/08/21	14.9228
02/08/21	14.3397
03/08/21	16.0818
04/08/21	13.3935
05/08/21	16.0497
06/08/21	15.0761
07/08/21	13.7221
08/08/21	16.4332
09/08/21	13.7827
10/08/21	15.7640
11/08/21	15.2249
12/08/21	13.0580
13/08/21	16.6778
14/08/21	14.3887
15/08/21	15.3524
16/08/21	15.5364
17/08/21	12.5467
18/08/21	16.7411
19/08/21	14.9000
20/08/21	14.7936
21/08/21	16.0758
22/08/21	12.4228
23/08/21	16.5334
24/08/21	15.0983
25/08/21	13.9916
26/08/21	16.5832
27/08/21	12.8143
28/08/21	16.0912
29/08/21	15.0712
30/08/21	12.9980
31/08/21	16.8666

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 deaths in the UAE are likely to range between 3 and 17 deaths per day over the out-of-sample period.

IV. CONCLUSION AND POLICY RECOMMENDATIONS

The COVID-19 outbreak is associated with high morbidity and mortality. A myriad of models have been used by various researchers to forecast COVID-19 mortality and such techniques include statistical and machine learning methods. In this study we propose a machine learning technique to predict daily COVID-19 deaths in the UAE. The results of the study indicate that daily COVID-19 deaths in the UAE are likely to range between 3 and 17 deaths per day over the out-of-sample period. There is need for the government of the UAE to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic and accelerate COVID-19 vaccination.

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