

Forecasting Covid-19 Deaths in Ukraine

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Abstract - COVID-19 has already brought unprecedented challenges for public health and resulted in huge numbers of cases and deaths across the globe. In this study, the ANN approach was applied to analyze COVID-19 deaths in Ukraine. This study is based on daily COVID-19 deaths in Ukraine 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. It is projected that daily COVID-19 deaths in Ukraine are likely to remain high over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Ukraine to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic as well as scaling up vaccinations.

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The COVID-19 pandemic was initially reported as a localized epidemic that was causing unexplained pneumonia cases in the city of Wuhan in China in late December 2019 and was later declared on the 11th of March 2020 as a global health threat by WHO (Phan, 2020; Yu et al, 2020; WHO, 2020; Wong et al, 2019). Several countries adopted recommendations by WHO which include social distancing, regular hand washing, contact tracing, quarantine or isolation, management of positive cases and health education (Ferguson et al, 2020; He et al, 2020). The COVID-19 pandemic has severely impacted the lives of people living in Ukraine since the first case was officially reported on March 3, 2020. Essential services such as vaccinations, women's health, mental health and care of chronic medical conditions continued to be under threat in the country. The purpose of this study is to model and predict daily COVID-19 deaths in Ukraine using the multilayer perceptron neural network. The artificial neural technique has gained prominence in forecasting COVID-19 cases & deaths and other health conditions (Maradze et al, 2021; Nyoni et al, 2021; Nyoni & Nyoni, 2021; Nyoni et al, 2020; Zhao, 2020). The outcome of this study is expected to provide an insight of the likely future trends of COVID-19 deaths in Ukraine to facilitate decision making and allocation of resources towards prevention and control of COVID-19.

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 Ukraine.

Data Issues

This study is based on daily COVID-19 deaths in Ukraine 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	A
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	0.083973
MSE	514.046326
MAE	16.108359

Residual Analysis for the Applied Model

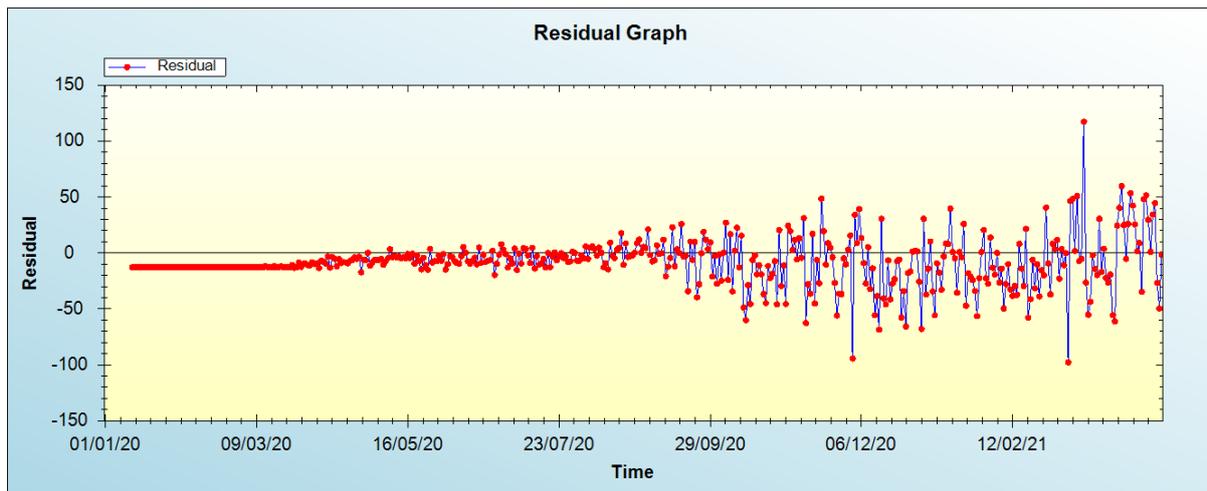


Figure 1: Residual analysis

In-sample Forecast for A

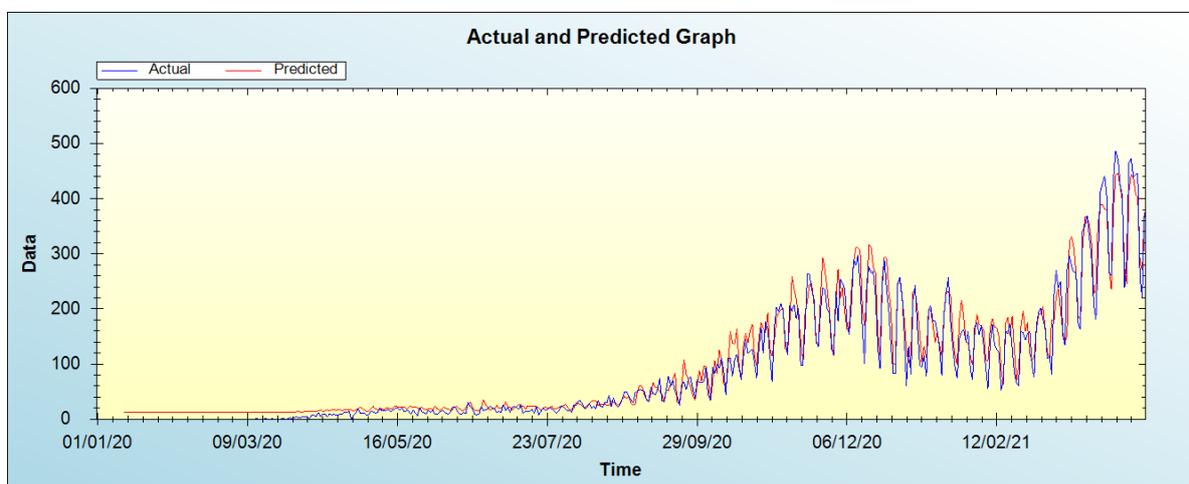


Figure 2: In-sample forecast for the A series

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

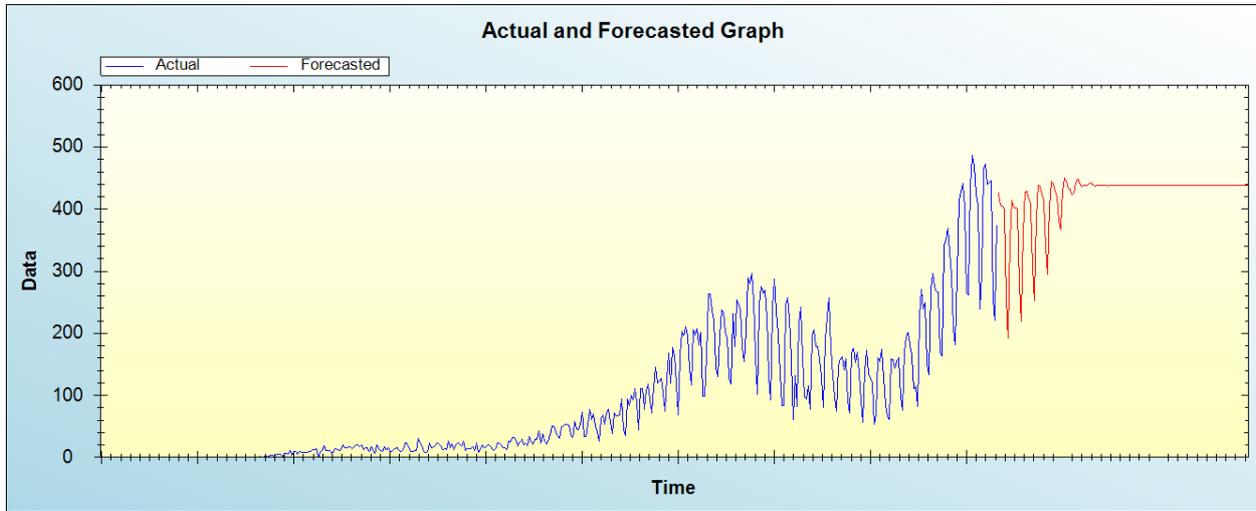


Figure 3: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
21/04/21	425.6807
22/04/21	405.8363
23/04/21	404.9075
24/04/21	400.6180
25/04/21	259.8644
26/04/21	192.5355
27/04/21	347.1100
28/04/21	413.7920
29/04/21	403.1210
30/04/21	401.7356
01/05/21	400.9286
02/05/21	280.8004
03/05/21	219.8486
04/05/21	359.1225
05/05/21	427.4717
06/05/21	428.8195
07/05/21	416.4820
08/05/21	409.3146
09/05/21	309.4399
10/05/21	251.8878
11/05/21	381.7047
12/05/21	438.5983
13/05/21	437.5420
14/05/21	423.6754
15/05/21	414.4336
16/05/21	340.4614
17/05/21	294.8122
18/05/21	400.5612
19/05/21	443.9959
20/05/21	441.8779
21/05/21	428.2512
22/05/21	421.8537
23/05/21	382.5941
24/05/21	366.5623
25/05/21	427.7924
26/05/21	450.0723

27/05/21	445.2370
28/05/21	433.3360
29/05/21	431.5653
30/05/21	422.4346
31/05/21	425.6803
01/06/21	441.9319
02/06/21	449.3334
03/06/21	442.7997
04/06/21	436.2755
05/06/21	437.8911
06/06/21	437.3747
07/06/21	438.0609
08/06/21	440.9705
09/06/21	442.3283
10/06/21	438.9934
11/06/21	436.9352
12/06/21	437.8685
13/06/21	438.4480
14/06/21	437.9209
15/06/21	438.2550
16/06/21	438.7081
17/06/21	437.7716
18/06/21	437.2220
19/06/21	437.7364
20/06/21	438.1350
21/06/21	437.8699
22/06/21	437.9062
23/06/21	438.1447
24/06/21	438.0212
25/06/21	437.8390
26/06/21	438.0487
27/06/21	438.2285
28/06/21	438.1175
29/06/21	438.0835
30/06/21	438.1789
01/07/21	438.1662
02/07/21	438.0849
03/07/21	438.1281
04/07/21	438.1849
05/07/21	438.1389
06/07/21	438.0977
07/07/21	438.1285
08/07/21	438.1302
09/07/21	438.0943
10/07/21	438.0982
11/07/21	438.1193
12/07/21	438.1058
13/07/21	438.0881
14/07/21	438.0993
15/07/21	438.1065
16/07/21	438.0958
17/07/21	438.0951
18/07/21	438.1056
19/07/21	438.1042
20/07/21	438.0982
21/07/21	438.1024
22/07/21	438.1072
23/07/21	438.1042
24/07/21	438.1030
25/07/21	438.1067
26/07/21	438.1072
27/07/21	438.1045
28/07/21	438.1052
29/07/21	438.1071

30/07/21	438.1060
31/07/21	438.1048
01/08/21	438.1058
02/08/21	438.1061
03/08/21	438.1049
04/08/21	438.1048
05/08/21	438.1055
06/08/21	438.1052
07/08/21	438.1046
08/08/21	438.1049
09/08/21	438.1052
10/08/21	438.1048
11/08/21	438.1047
12/08/21	438.1050
13/08/21	438.1050
14/08/21	438.1048
15/08/21	438.1049
16/08/21	438.1051
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25/08/21	438.1050
26/08/21	438.1050
27/08/21	438.1051
28/08/21	438.1050
29/08/21	438.1050
30/08/21	438.1050
31/08/21	438.1050

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

IV. CONCLUSION AND POLICY RECOMMENDATIONS

The COVID-19 outbreak has severely impacted on the economic growth for Ukraine, with anticipated new waves of infections, movement and business restrictions likely to aggravate challenges for individuals, households and the country. Therefore, the researchers decided to model and forecast daily COVID-19 related deaths in Ukraine so that the authorities can understand the evolution of the epidemic and prepare adequate resources to curtail the spread of the virus. The results of the study show that daily COVID-19 deaths in Ukraine are likely to remain high over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Ukraine to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic as well as scaling up vaccinations.

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Citation of this Article:

Dr. Smartson. P. NYONI, Mr. Thabani NYONI, Mr. Tatenda. A. CHIHOHO, “Forecasting Covid-19 Deaths in Ukraine”
Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 6, pp 824-829, June 2021. Article DOI <https://doi.org/10.47001/IRJIET/2021.506144>
