International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 5, Issue 6, pp 860-865, June-2021

https://doi.org/10.47001/IRJIET/2021.506150

Forecasting Covid-19 Deaths in the Czech Republic

[1]Dr. Smartson. P. NYONI, [2]Mr. Thabani NYONI, [3]Mr. Tatenda. A. CHIHOHO

[1]ZICHIRe Project, University of Zimbabwe, Harare, Zimbabwe
[2]SAGIT Innovation Center, Harare, Zimbabwe
[3]Independent Health Economist, Harare, Zimbabwe

***Abstract* - In this study, the ANN approach was applied to analyze COVID-19 deaths in the Czech Republic. The employed data covers the period 1 January 2020 to 20 April 2021 and the out-of-sample period ranges over the period 21 April 2021 to 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 Czech Republic likely to remain high over the out-of-sample period. Therefore there is need for the Czech Republic to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic and to also speed up COVID-19 vaccination.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

At the tail end of 2019 in Wuhan city of China there were several unusual pneumonia cases which were then discovered to be caused by the SARS-COV2 virus which causes COVID-19 disease (Chan et al, 2020; WHO, 2020). The novel coronavirus has 88-96% sequence similarity with the bat coronaviruses in its genome (Gralinski&Menachery, 2020; Wu et al, 2020). The rapid spread of the virus and the severity of the outbreak triggered WHO to declare a public health emergency of international concern on the 30th of January 2020 (WHO, 2020). As of 20 June 2021 the Czech Republic had reported 1 666 025 positive cases, 30 280 deaths and 1 632 840 recoveries (Worldometer, 2021). By the 18th of June 2021, a total of 4 736 275 people had received at least one covid-19 vaccine dose (44.5 % of the population) and a total of 2 479 001 people were fully vaccinated representing 23.3% of the population (Our world in data, 2021). This means that the country still has a long way towards achieving herd immunity and winning the war against COVID-19. The purpose of this study is to forecast daily COVID-19 deaths in the Czech Republic using an artificial intelligence technique. The findings of this piece of work will reveal the likely future trends of COVID-19 mortality in the country and trigger an evidence based response to the epidemic.

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 Czech Republic.

Data Issues

This study is based on daily COVID-19 deaths in Czech Republic 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	C
Observations	464 (After Adjusting Endpoints)

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 5, Issue 6, pp 860-865, June-2021
https://doi.org/10.47001/IRJIET/2021.506150

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	0.086667
MSE	205.872758
MAE	9.549295

Residual Analysis for the Applied Model

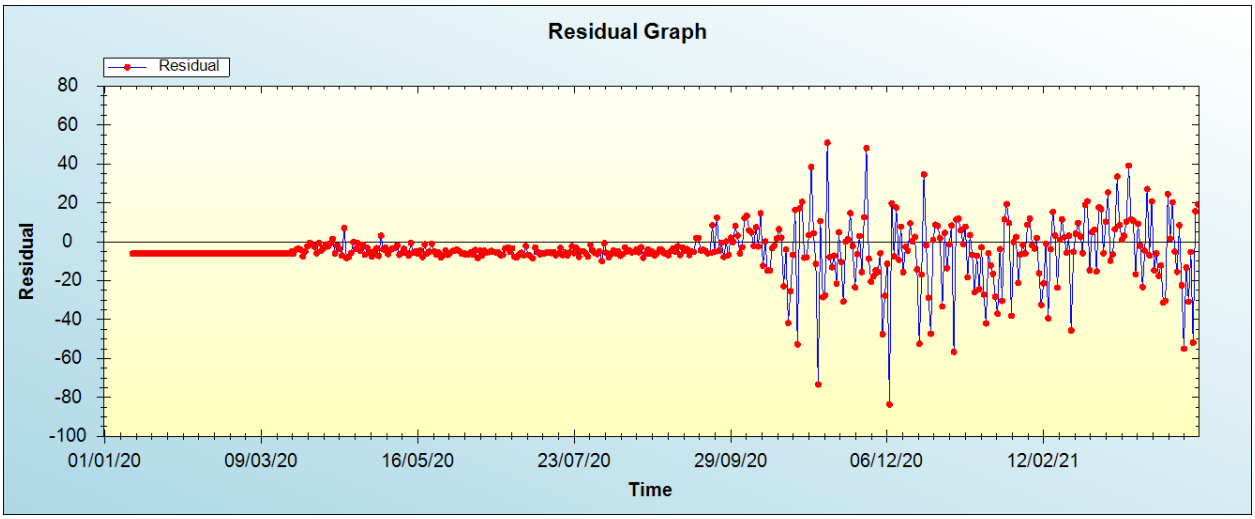

Figure 1: Residual analysis

In-sample Forecast for C

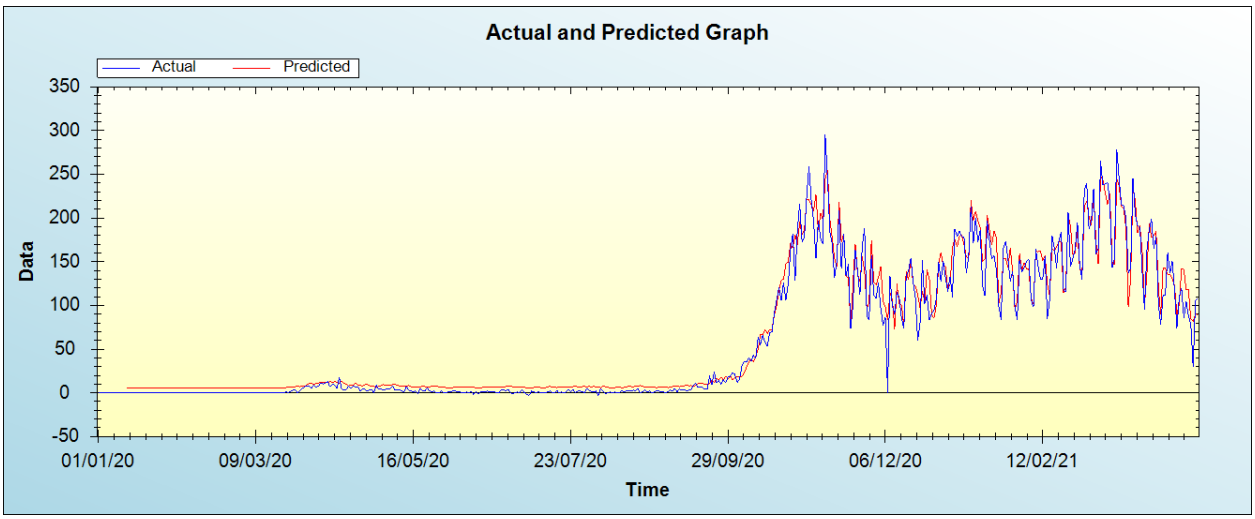

Figure 2: In-sample forecast for the C series

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 5, Issue 6, pp 860-865, June-2021
https://doi.org/10.47001/IRJIET/2021.506150

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

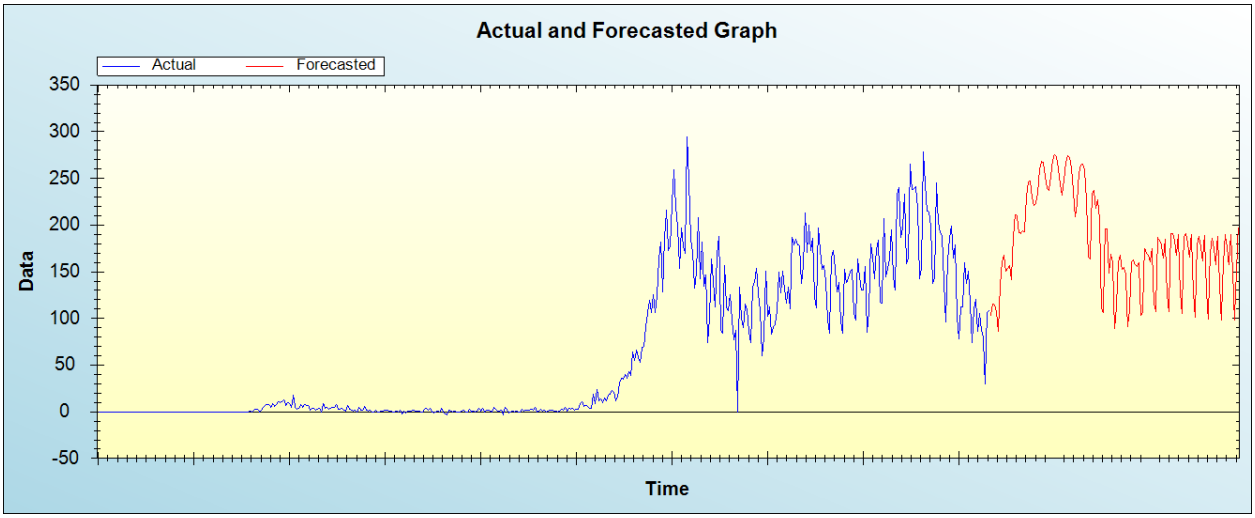

Figure 3: Out-of-sample forecast for C: actual and forecasted graph

Out-of-Sample Forecast for C: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
21/04/21	102.8165
22/04/21	115.2224
23/04/21	114.5745
24/04/21	107.5699
25/04/21	86.2024
26/04/21	134.4104
27/04/21	159.9815
28/04/21	168.1570
29/04/21	150.5939
30/04/21	153.5548
01/05/21	157.2267
02/05/21	141.3980
03/05/21	186.3227
04/05/21	211.2992
05/05/21	210.2572
06/05/21	191.9974
07/05/21	191.1758
08/05/21	193.6131
09/05/21	192.5776
10/05/21	229.9972
11/05/21	246.0753
12/05/21	247.5345
13/05/21	230.5191
14/05/21	221.0696
15/05/21	223.1951
16/05/21	233.4482
17/05/21	258.9575
18/05/21	267.8513
19/05/21	267.3370
20/05/21	252.5389
21/05/21	239.9108
22/05/21	237.0838
23/05/21	251.4818
24/05/21	269.1620
25/05/21	275.7600
26/05/21	273.4170

ISSN (online): 2581-3048
Volume 5, Issue 6, pp 860-865, June-2021
https://doi.org/10.47001/IRJIET/2021.506150

27/05/21	261.1362
28/05/21	244.0483
29/05/21	232.0130
30/05/21	247.2338
31/05/21	266.6112
01/06/21	274.0701
02/06/21	272.4952
03/06/21	262.0088
04/06/21	237.9718
05/06/21	208.9323
06/06/21	222.3319
07/06/21	255.5368
08/06/21	264.5394
09/06/21	265.4897
10/06/21	259.2465
11/06/21	228.1018
12/06/21	165.5579
13/06/21	163.7471
14/06/21	233.8104
15/06/21	237.5750
16/06/21	217.7542
17/06/21	227.3913
18/06/21	207.3287
19/06/21	111.3703
20/06/21	105.9086
21/06/21	196.1688
22/06/21	196.1950
23/06/21	148.8002
24/06/21	168.5587
25/06/21	160.1602
26/06/21	88.7186
27/06/21	111.1637
28/06/21	159.7869
29/06/21	167.5081
30/06/21	152.5804
01/07/21	154.3046
02/07/21	147.4651
03/07/21	91.5860
04/07/21	108.7886
05/07/21	160.6701
06/07/21	162.8062
07/07/21	157.3515
08/07/21	155.5171
09/07/21	160.0784
10/07/21	102.8989
11/07/21	106.5441
12/07/21	175.2244
13/07/21	170.1668
14/07/21	168.0331
15/07/21	160.8032
16/07/21	174.4099
17/07/21	117.1769
18/07/21	107.4439
19/07/21	186.6945
20/07/21	183.4228
21/07/21	178.9590
22/07/21	164.4056
23/07/21	184.6415
24/07/21	126.7151
25/07/21	107.3195
26/07/21	190.9098
27/07/21	191.1985
28/07/21	184.2684
29/07/21	167.5235

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 5, Issue 6, pp 860-865, June-2021
https://doi.org/10.47001/IRJIET/2021.506150

30/07/21	189.7130
31/07/21	130.0769
01/08/21	104.9098
02/08/21	187.2013
03/08/21	190.8923
04/08/21	181.8430
05/08/21	165.3664
06/08/21	190.1509
07/08/21	129.8336
08/08/21	101.5113
09/08/21	177.7282
10/08/21	187.8554
11/08/21	177.9283
12/08/21	161.4107
13/08/21	188.9290
14/08/21	132.0444
15/08/21	98.8387
16/08/21	167.2216
17/08/21	186.4420
18/08/21	175.8497
19/08/21	157.7671
20/08/21	188.4794
21/08/21	140.2773
22/08/21	97.7186
23/08/21	157.1921
24/08/21	189.7257
25/08/21	177.4313
26/08/21	157.0280
27/08/21	189.6889
28/08/21	155.0791
29/08/21	98.5476
30/08/21	146.7243
31/08/21	197.3725

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 Czech Republic likely to remain high over the out-of-sample period.

IV. CONCLUSION AND POLICY RECOMMENDATIONS

The world continues to face incessant COVID-19 waves with many authorities pinning their hopes on the COVID-19 vaccine. However vaccine roll out in many regions of the world has been slow due to supply and distribution challenges. Many researchers have confirmed that the COVID-19 vaccine is going to significantly reduce the number of deaths and number of patients requiring critical care services. Predictive models are useful tools for planning & resource allocation and evaluation of the impact or usefulness of mitigation measures such as vaccine rollout by predicting the likely future trends of COVID-19 mortality. In this paper we applied a machine learning technique to predict daily COVID-19 deaths in the Czech Republic and the results revealed that daily COVID-19 deaths in Czech Republic likely to remain high over the out-of-sample period. Hence the authorities in the country are encouraged to enforce WHO guidelines including COVID-19 vaccination.

REFERENCES

[1] Worldometer (2021). Austria COVID-19 update. https://www.worldometers.info.
[2] Our world in data (2021). Austria COVID-19 update. https://ourworld.in data.org.Austria
[3] Chan J F., Yuan S., Kok K H (2020). A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. Lancet; 395:514–23.
[4] World Health Organization (WHO) (2020). Statement regarding cluster of pneumonia cases in Wuhan, China. 2020. https:// www.who.int/china/news/detail/09-01-2020-whostatement-regarding-cluster-of-pneumonia-cases-inwuhan-china.
[5] GralinskiLE.,&Menachery VD (2020). Return of the coronavirus: 2019-nCoV. Viruses 2020; 12:2.

ISSN (online): 2581-3048
Volume 5, Issue 6, pp 860-865, June-2021
https://doi.org/10.47001/IRJIET/2021.506150

[6] Wu F., Zhao S., & Yu B (2020). Author Correction: A new coronavirus associated with human respiratory disease in China Nature

[7] World Health Organization (2020). WHO statement regarding the outbreak of novel coronavirus (2019- nCoV), 2020. https://www.who.int/ news-room/detail/30-01-2020-statement-on-thesecond-meeting-of-the-international-healthregulations-(2005)-emergency-committee-regardingthe-outbreak-of-novel-coronavirus-(2019-ncov).

Citation of this Article:

Dr. Smartson. P. NYONI, Mr. Thabani NYONI, Mr. Tatenda. A. CHIHOHO, "Forecasting Covid-19 Deaths in the Czech Republic" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 6, pp 860-865, June 2021. Article DOI https://doi.org/10.47001/IRJIET/2021.506150

****

