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

ISSN (online): 2581-3048

Volume 5, Issue 6, pp 500-505, June-2021

https://doi.org/10.47001/IRJIET/2021.506087

Forecasting Covid-19 New Cases in North Macedonia

[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 new cases in North Macedonia. The employed data covers the period 1 January 2020 – 25 March 2021 and the out-of-sample period ranges over the period 26 March – 31 July 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 cases in North Macedonia are likely to decline significantly to about 13 cases per day over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of North Macedonia to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The COVID-19 pandemic started in Wuhan, China in December 2019 as a cluster of unusual pneumonia cases then unexpectedly spread rapidly all the parts of the globe characterized by high morbidity and mortality (Wang et al, 2020; Tang et al, 2020; CDC, 2020). Many health institutions began to fail to cope with the unusual high numbers of patients who needed admission and oxygen support aggravated by staff shortages as many health professionals became sick, some resigned and others died from the complications of the disease. Many countries imposed travel restrictions and this halted economic activities. On the 20th of November 2020, the government of Macedonia declared a state of crisis throughout the country whereby the laws on defense and crisis management give the government aloyal basis to mobilize the military to assist other relevant government institutions (OECD, 2021). As of 3 July 2020 the country had reported 6787 confirmed cases 2876 recoveries and 328 fatalities (WHO, 2020). The government implemented COVID-19 public health measures to mitigate the spread of the virus such as social distancing, wearing masks, regular hand washing, contact tracing, isolation and treatment of cases. The aim of this study is to predict daily COVID-19 cases in North Macedonia using the multilayer perceptron. The artificial intelligence technique is continuously gaining popularity and found its use in time series forecasting of epidemiologic incidences like TB and COVID-19 and other health related problems (Maradze et al, 2021; Nyoni et al, 2021; Nyoni & Nyoni, 2021; Nyoni et al, 2020; Zhao et al, 2020). The findings of the study are envisioned to reveal future trends of COVID-19 in North Macedonia and stimulate an evidence based health response to the COVID-19 epidemic.

II. LITERATURE REVIEW

Several models have been employed in the short term forecasting of infectious diseases like COVID-19. Compartmental models are one of the widely applied techniques to understand the spread of communicable diseases. The SIR model was applied by Khanday et al (2020) to forecast the spread of COVID-19 in Hungary. Different methods effective for short-term forecasting were applied to the dataset, and predictions were made for the next 20 days. Autoregression and other exponential smoothing methods are applied to the dataset. SIR model was used and predicted 64% of the population could be infected by the virus considering the whole population is susceptible to be infectious Autoregression, and exponential smoothing methods indicated there would be more than a 60% increase in the cases in the coming 20 days. The doubling of the number of total cases was found to be around 16 days using an effective reproduction number. Machine learning methods are now popular in time series forecasting of COVID-19 cases. One such study was carried out by Mollalo et al (2020). The study collected and prepared a database of 57 candidate explanatory variables to examine the performance of multilayer perceptron (MLP) neural network in predicting the cumulative COVID-19 incidence rates across the continental United States. The results indicated that a single-hidden-layer MLP could explain almost 65% of the correlation with ground truth for the holdout samples. In the same vein, Wieczorek et al (2020) developed a model which can work as a part of an online system as a real-time predictor to help in estimation of COVID-19 spread. The prediction model was developed using Artificial Neural Networks (ANN) to estimate the future situation by the use of geo-location and numerical data from past 2 weeks. The results of the model were confirmed by

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

ISSN (online): 2581-3048

Volume 5, Issue 6, pp 500-505, June-2021

https://doi.org/10.47001/IRJIET/2021.506087

comparing them with real data and, during research the model was correctly predicting the trend and very closely matching the numbers. In addition, Braga et al (2021) outlined in detail an approach based on artificial neural networks for the daily and cumulative forecasts of cases and deaths caused by COVID-19, and the forecast of demand for hospital beds in Brazilian Amazon. Six scenarios with different periods were used to identify the quality of the generated forecasting and the period in which they start to deteriorate. Results indicated that the computational model adapted capably to the training period and was able to make consistent short-term forecasts, especially for the cumulative variables and for demand hospital beds.

III. 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 new COVID-19 cases in North Macedonia.

Data Issues

This study is based on daily new cases of COVID-19 in North Macedonia 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).

IV. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	NM
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	0.107219
MSE	6974.186868
MAE	56.655882

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 5, Issue 6, pp 500-505, June-2021
https://doi.org/10.47001/IRJIET/2021.506087

Residual Analysis for the Applied Model

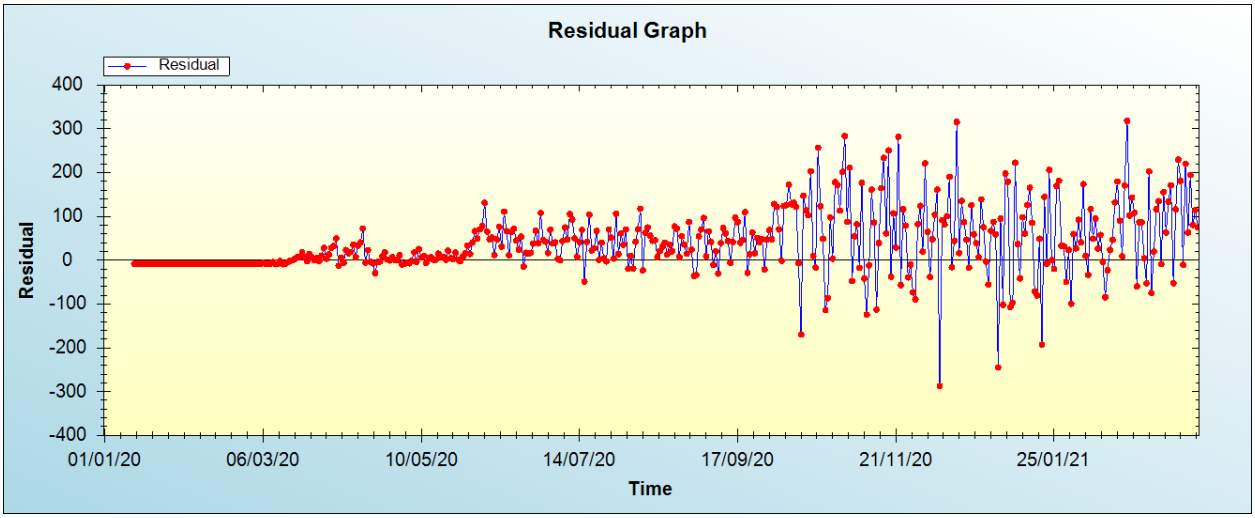


Figure 1: Residual analysis

In-sample Forecast for NM

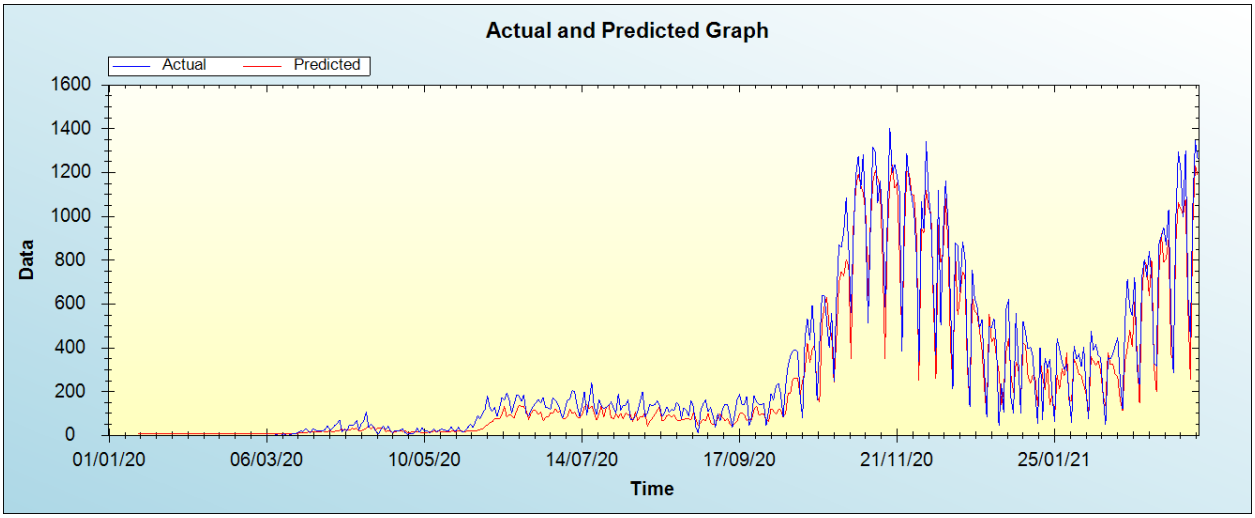
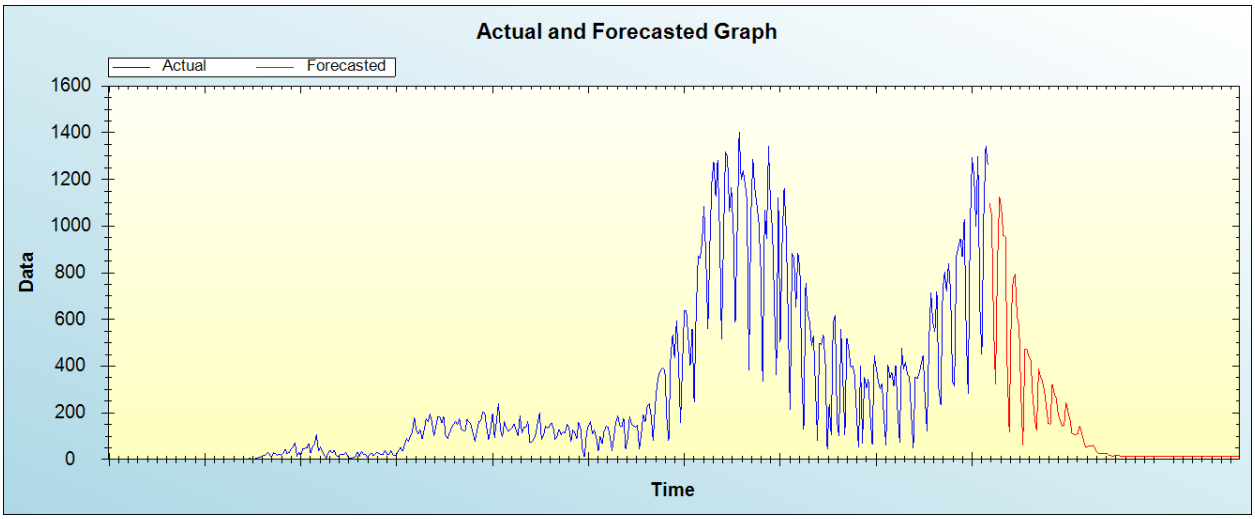


Figure 2: In-sample forecast for the NM series

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



International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 5, Issue 6, pp 500-505, June-2021
https://doi.org/10.47001/IRJIET/2021.506087

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

Out-of-Sample Forecast for NM: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	1096.2831
27/03/21	1047.7966
28/03/21	580.5650
29/03/21	324.5110
30/03/21	839.3683
31/03/21	1124.9384
01/04/21	1072.4197
02/04/21	957.5669
03/04/21	956.7759
04/04/21	380.2459
05/04/21	117.8737
06/04/21	607.3363
07/04/21	772.1997
08/04/21	793.9704
09/04/21	615.8762
10/04/21	572.9845
11/04/21	277.1599
12/04/21	61.1996
13/04/21	475.1943
14/04/21	470.6296
15/04/21	443.4297
16/04/21	427.0830
17/04/21	271.6961
18/04/21	175.1774
19/04/21	125.5635
20/04/21	387.7331
21/04/21	354.5786
22/04/21	334.9050
23/04/21	289.8880
24/04/21	220.6304
25/04/21	154.8276
26/04/21	150.6644
27/04/21	322.6275
28/04/21	283.5330
29/04/21	261.1265
30/04/21	196.7031
01/05/21	166.1486
02/05/21	141.3403
03/05/21	148.4958
04/05/21	242.0178
05/05/21	206.2194
06/05/21	172.8564
07/05/21	114.1833
08/05/21	106.1214
09/05/21	106.3223
10/05/21	109.1720
11/05/21	145.2431
12/05/21	115.3021
13/05/21	81.2025
14/05/21	52.2309
15/05/21	55.0006
16/05/21	58.5683
17/05/21	56.6049
18/05/21	62.8525
19/05/21	45.0553
20/05/21	29.9175
21/05/21	23.4162

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 5, Issue 6, pp 500-505, June-2021
https://doi.org/10.47001/IRJIET/2021.506087

22/05/21	26.4451
23/05/21	27.6150
24/05/21	25.8184
25/05/21	25.2571
26/05/21	19.0004
27/05/21	15.5268
28/05/21	15.0061
29/05/21	16.3830
30/05/21	16.6438
31/05/21	15.9338
01/06/21	15.3625
02/06/21	13.7488
03/06/21	13.2765
04/06/21	13.4922
05/06/21	13.9864
06/06/21	14.0153
07/06/21	13.7774
08/06/21	13.5680
09/06/21	13.2189
10/06/21	13.2326
11/06/21	13.3681
12/06/21	13.5111
13/06/21	13.4913
14/06/21	13.4119
15/06/21	13.3511
16/06/21	13.2891
17/06/21	13.3270
18/06/21	13.3747
19/06/21	13.4070
20/06/21	13.3900
21/06/21	13.3648
22/06/21	13.3502
23/06/21	13.3434
24/06/21	13.3606
25/06/21	13.3734
26/06/21	13.3782
27/06/21	13.3702
28/06/21	13.3630
29/06/21	13.3605
30/06/21	13.3614
01/07/21	13.3671
02/07/21	13.3698
03/07/21	13.3697
04/07/21	13.3667
05/07/21	13.3650
06/07/21	13.3649
07/07/21	13.3658
08/07/21	13.3674
09/07/21	13.3677
10/07/21	13.3673
11/07/21	13.3664
12/07/21	13.3661
13/07/21	13.3663
14/07/21	13.3667
15/07/21	13.3670
16/07/21	13.3670
17/07/21	13.3668
18/07/21	13.3665
19/07/21	13.3665
20/07/21	13.3666
21/07/21	13.3667
22/07/21	13.3668
23/07/21	13.3668
24/07/21	13.3667

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

ISSN (online): 2581-3048

Volume 5, Issue 6, pp 500-505, June-2021

https://doi.org/10.47001/IRJIET/2021.506087

25/07/21	13.3666
26/07/21	13.3667
27/07/21	13.3667
28/07/21	13.3667
29/07/21	13.3667
30/07/21	13.3667
31/07/21	13.3667

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 North Macedonia are likely to decline significantly to about 13 cases per day over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

Artificial intelligence (AI) techniques are gaining popularity in the analysis of big data. They can model nonlinear complex data with tremendous speed and high level of accuracy. The human mind cannot process certain types of information with such high speed and accuracy. In this study we applied the artificial neural network technique to predict daily COVID-19 cases in North Macedonia. The results of the study indicate that daily COVID-19 cases in North Macedonia are likely to decline significantly to about 13 cases per day over the out-of-sample period. Therefore the government should continue enforcing adherence to public health mitigation measures including vaccination against COVID-19.

REFERENCES

[1] CDC (2020). The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. China CDC Weekly 2, 113–122.

[2] Maradze, T. C., Nyoni, S. P., & Nyoni, T (2021). Modeling and Forecasting COVID-19 mortalities in the United States of America using artificial neural networks (ANN). International Journal of innovations in Engineering and Technology (IRJIET), 5 (3):533-539

[3] Naizhuo Zhao., Katia Charland., Mabel Carabali., Elaine O., Nsoesie., Mathieu MaheuGiroux., Erin Rees., Mengru Yuan., Cesar Garcia Balaguera., Gloria Jaramillo Ramirez., & Kate Zinszer (2020). Machine learning and dengue forecasting: Comparing random forests and artificial neural networks for predicting dengue burden at national and sub-national scales in Colombia. PLOS Neglected Tropical Diseases | https://doi.org/10.1371/journal.pntd.0008056

[4] Nyoni, S. P., & Nyoni, T (2021). Forecasting ART coverage in Egypt using artificial neural networks. International Journal of Innovations in Engineering and Technology (IRJIET), 5 (3): 161-165.

[5] OECD (2021). THE COVID-19 CRISIS IN NORTH MACEDONIA

[6] Tang. B et al (2020). Estimation of the transmission risk of the 2019-nCoV and its implication for public health interventions. J. Clinical Med. 9, 462.

[7] Wang D et al (2020). Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. JAMA 323, 1061–1069.

[8] WHO (2020). WHO North Macedonia COVID-19 Update – 3 JULY 2020, pp 1-14.

Citation of this Article:

Dr. Smartson. P. NYONI, Mr. Thabani NYONI, Mr. Tatenda. A. CHIHOHO, "Forecasting Covid-19 New Cases in North Macedonia" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 6, pp 500-505, June 2021. Article DOI https://doi.org/10.47001/IRJIET/2021.506087

****

