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

ISSN (online): 2581-3048

Volume 5, Issue 6, pp 686-691, June-2021

https://doi.org/10.47001/IRJIET/2021.506120

Forecasting Covid-19 New Cases in West Bank & Gaza

[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* - As COVID-19 rages throughout the globe, reliable modeling and forecasting of the dynamics thereof is fundamental. In this research work, the ANN technique was applied to forecast daily COVID-19 cases in West Bank & Gaza. This study is based on daily new cases of COVID-19 in West Bank and Gaza for the period 1 January 2020 – 25 March 2021. The out-of-sample forecast covers the period 26 March 2021 – 31 July 2021. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the employed model suggest that the model is stable. It is projected that daily COVID-19 cases in West Bank & Gaza are likely to remain very high over the out-of-sample period. We strongly recommend that the government should continue to ensure vaccine uptake and strict adherence to lock-down measures while creating awareness about the COVID-19 pandemic.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

In mid to late December 2019, Chinese authorities in Wuhan reported a novel pneumonia caused by a corona virus disease (now COVID-19) which has spread domestically and internationally since then (Huang *et al*., 2020; Zhu et al., 2020). COVID-19 is highly infectious and its main clinical symptoms fever, fatigue or myalgia, dry cough and shortness of breath or difficulty breathing (Sohrabi *et al*., 2020; Nicola *et al*., 2020; Tian *et al*., 2020; Wang *et al*., 2020). Due to fast transmission of COVID-19, the incidence and mortality rates are rapidly growing worldwide (Guan *et al*., 2020). With the rapid spread of the COVID-19 outbreak, people have been highly concerned by it spread, severity and tremendous negative effects on public health and society (Yildirim & Guler, 2020). Therefore, it is necessary to come up with forecasting and control models for the pandemic. The purpose of this study is to analyze the trends of daily COVID-19 cases in West Bank & Gaza and consequently make predictions for the future trends.

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 new COVID-19 cases in West Bank and Gaza.

Data Issues

This study is based on daily new cases of COVID-19 in West Bank and Gaza 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).

III. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	W
Observations	438 (After Adjusting Endpoints)
Neural Network Architecture:	

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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	0.096310
MSE	18122.499210
MAE	93.088803

Residual Analysis for the Applied Model

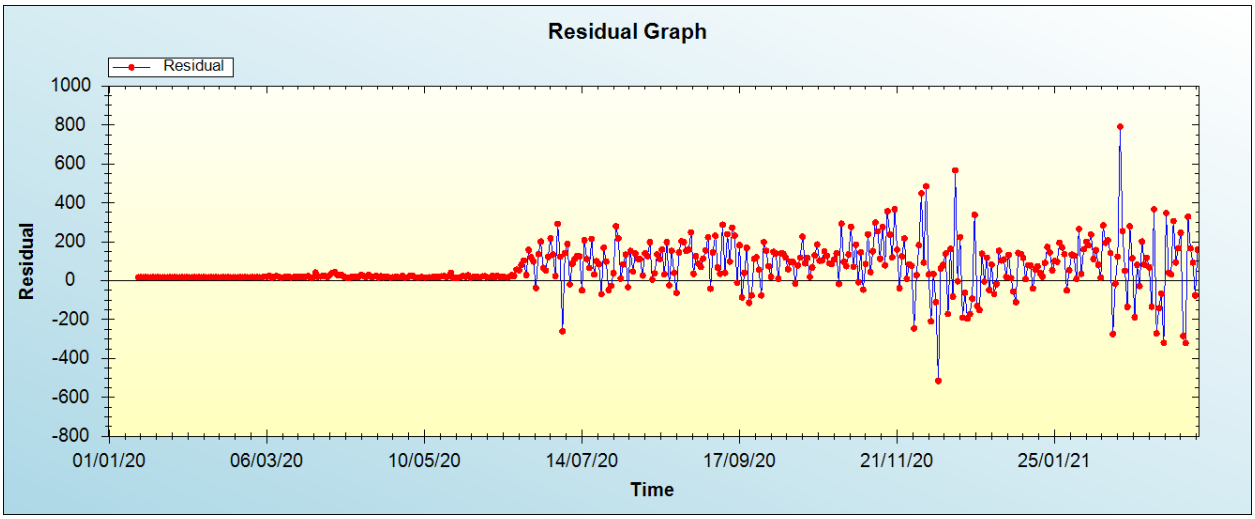

Figure 1: Residual analysis

In-sample Forecast for W

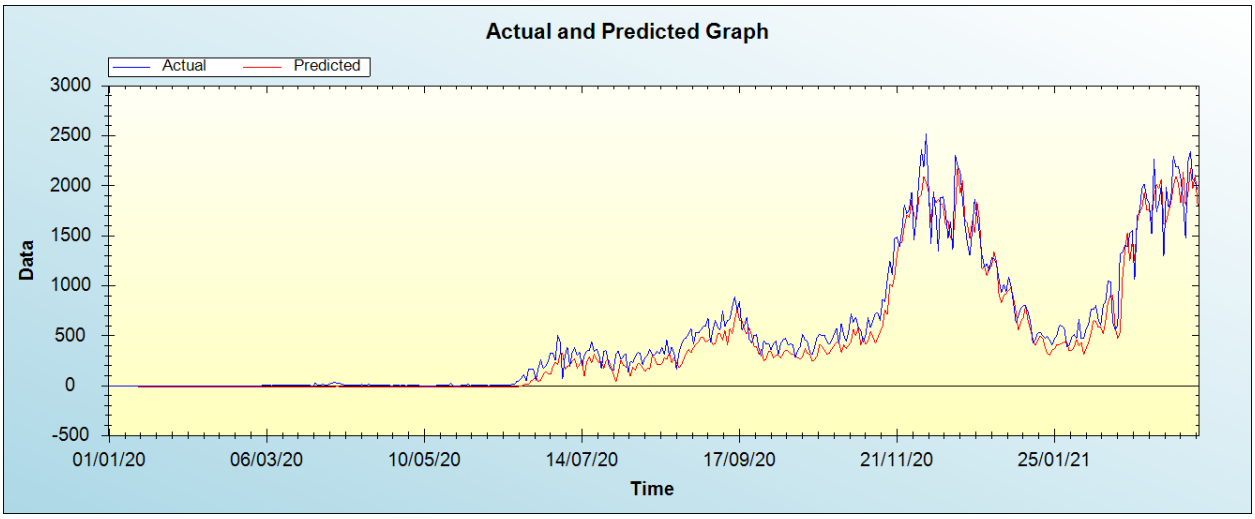

Figure 2: In-sample forecast for the W series

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

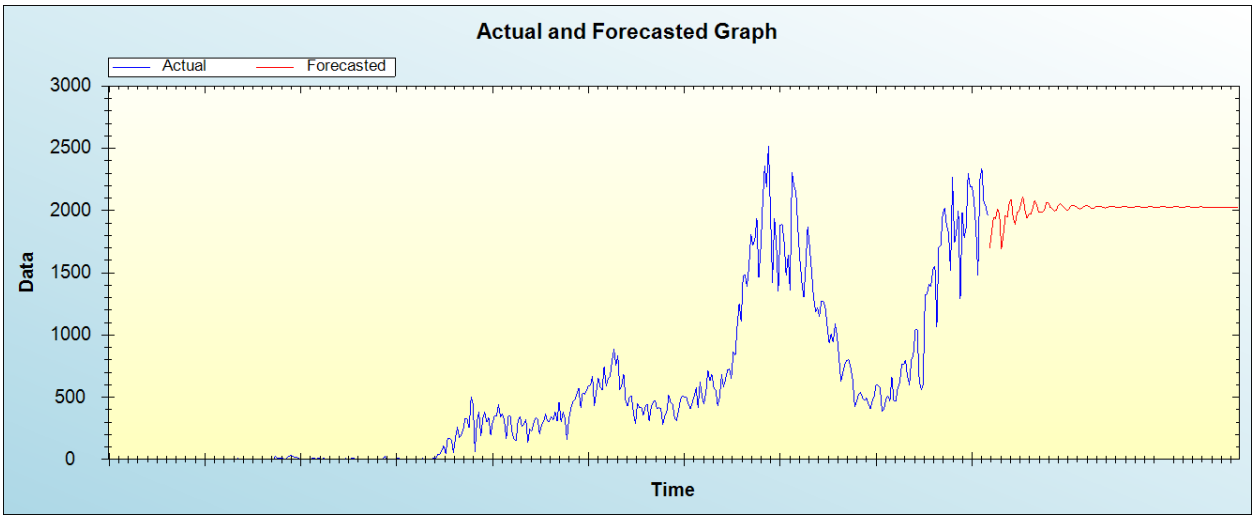

Figure 3: Out-of-sample forecast for W: actual and forecasted graph

Out-of-Sample Forecast for W: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
26/03/21	1698.6529
27/03/21	1822.9056
28/03/21	1945.3112
29/03/21	1937.5024
30/03/21	2012.8968
31/03/21	1970.3493
01/04/21	1693.8516
02/04/21	1803.5511
03/04/21	1958.3897
04/04/21	1949.3520
05/04/21	2062.9445
06/04/21	2090.0217
07/04/21	1941.3095
08/04/21	1890.1588
09/04/21	1984.6075
10/04/21	1992.6273
11/04/21	2060.0212
12/04/21	2111.2017
13/04/21	2005.0790
14/04/21	1940.8214
15/04/21	1970.4374
16/04/21	1970.5889
17/04/21	2017.6646
18/04/21	2080.0151
19/04/21	2047.3251
20/04/21	1986.3218
21/04/21	1988.4208
22/04/21	1983.3855
23/04/21	2006.6953
24/04/21	2064.2340
25/04/21	2061.1854
26/04/21	2025.2595
27/04/21	2010.2976
28/04/21	1996.9523
29/04/21	2001.1084

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30/04/21	2040.1203
01/05/21	2055.3473
02/05/21	2037.3901
03/05/21	2024.3769
04/05/21	2008.3374
05/05/21	2001.3532
06/05/21	2024.9149
07/05/21	2043.3741
08/05/21	2041.0247
09/05/21	2033.7477
10/05/21	2020.7687
11/05/21	2008.8806
12/05/21	2018.5306
13/05/21	2034.3231
14/05/21	2038.3718
15/05/21	2037.3971
16/05/21	2029.0200
17/05/21	2016.7644
18/05/21	2017.5344
19/05/21	2027.2799
20/05/21	2033.4911
21/05/21	2036.2296
22/05/21	2032.9993
23/05/21	2023.4564
24/05/21	2019.6672
25/05/21	2024.1675
26/05/21	2029.2563
27/05/21	2033.5784
28/05/21	2033.9946
29/05/21	2028.1022
30/05/21	2023.1559
31/05/21	2023.7275
01/06/21	2026.7287
02/06/21	2030.6446
03/06/21	2033.0242
04/06/21	2030.4091
05/06/21	2026.1835
06/06/21	2024.7645
07/06/21	2025.6785
08/06/21	2028.3981
09/06/21	2031.2570
10/06/21	2030.9594
11/06/21	2028.2618
12/06/21	2026.2726
13/06/21	2025.8251
14/06/21	2027.1450
15/06/21	2029.5812
16/06/21	2030.5135
17/06/21	2029.2919
18/06/21	2027.6240
19/06/21	2026.5405
20/06/21	2026.7597
21/06/21	2028.3629
22/06/21	2029.6664
23/06/21	2029.5114
24/06/21	2028.4923
25/06/21	2027.3740
26/06/21	2026.9298
27/06/21	2027.7049
28/06/21	2028.8495
29/06/21	2029.2642
30/06/21	2028.8812
01/07/21	2028.0454
02/07/21	2027.3612

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03/07/21	2027.5101
04/07/21	2028.2699
05/07/21	2028.8526
06/07/21	2028.9094
07/07/21	2028.4532
08/07/21	2027.8139
09/07/21	2027.6050
10/07/21	2027.9662
11/07/21	2028.4690
12/07/21	2028.7427
13/07/21	2028.6106
14/07/21	2028.1604
15/07/21	2027.8236
16/07/21	2027.8863
17/07/21	2028.2070
18/07/21	2028.5195
19/07/21	2028.5959
20/07/21	2028.3605
21/07/21	2028.0481
22/07/21	2027.9428
23/07/21	2028.0798
24/07/21	2028.3277
25/07/21	2028.4943
26/07/21	2028.4319
27/07/21	2028.2152
28/07/21	2028.0537
29/07/21	2028.0574
30/07/21	2028.2040
31/07/21	2028.3746

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 West Bank & Gaza are likely to remain very high over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

COVID-19, declared as a pandemic by WHO, is currently the most dreaded disease in the world, affecting everyone in this world, in one way or the other; directly or indirectly. West Bank & Gaza, has not been spared by this deadly virus. It has become critical to forecast the daily new COVID-19 cases in West Bank & Gaza: this information is important for policy makers to be in a position to control the pandemic, particularly within the next 6 months. The study made use of a simple ANN (12, 12, 1) model, based on observations of daily new COVID-19 cases. We strongly recommend that the government should continue to ensure vaccine uptake and strict adherence to lock-down measures while creating awareness about the COVID-19 pandemic. We also urge everyone in the country to be more responsible, especially with regards to social distancing, washing of hands and wearing of masks.

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Volume 5, Issue 6, pp 686-691, June-2021
https://doi.org/10.47001/IRJIET/2021.506120

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Citation of this Article:

Dr. Smartson. P. NYONI, Mr. Thabani NYONI, Mr. Tatenda. A. CHIHOHO, "Forecasting Covid-19 New Cases in West Bank & Gaza" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 6, pp 686-691, June 2021. Article DOI https://doi.org/10.47001/IRJIET/2021.506120

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