

Forecasting Covid-19 New Cases in Chad

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Abstract - In this study, the ANN approach was applied to analyze COVID-19 new cases in Chad. 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 COVID-19 cases are likely to increase up to around 70 cases per day over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Chad to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The SARS-COV2 is an emerging virus that causes coronavirus disease 19 (COVID-19) and it was initially detected in Wuhan, China following reports of a pneumonia like disease which was highly infectious and associated with high morbidity and mortality (Wang et al, 2020; Wang et al, 2020; Read et al, 2020; Wang, 2020; Tang et al, 2020; CDC, 2020). The World Health Organization declared the viral disease a global health problem on January 30, 2020 (WHO, 2020). The first case of SARS-COV2 infection was detected in Chad on the 15th of March, 2020. By the 12th of September 2020 the country had reported 1084 positive cases with 80 fatalities in 16 Provinces (Nodjikoambaye et al, 2020). The country reported to the pandemic by enforcing wearing of face masks, regular hand washing, social distancing, isolation or quarantine, contact tracing and treatment of cases, temporary ban on social gatherings, closure of non-essential businesses and public transport limitations (Dzomo et al, 2020). By the 15th of December 2020 the country had reported 1655 positive COVID-19 cases and 102 fatalities (WHO, 2020). The aim of this study is to forecast daily COVID-19 cases in Chad using the multilayer perceptron neural network. The applied neural network approach has been widely used in time series forecasting including prediction of COVID-19 cases (Maradze et al, 2021; Nyoni et al, 2021, Nyoni et al, 2020, Zhao et al, 2020). The results of this piece of work are envisioned to reveal the likely future trends of SARS-COV 2 virus daily infections in Chad and trigger an appropriate national response to the epidemic.

II. LITERATURE REVIEW

Nodjikoambaye et al (2020) discussed the importance of mitigating COVID-19 spread in Ndjamenia focused on specific target population in Chad. The authors concluded that the global COVID-19 burden continues to increase in Chad and it was possible that countries in the southern hemisphere such as South Africa, Brazil and Australia would experience increased intensities of infection during their months of winter between May and September 2020. Car et al (2020) modelled the Spread of COVID-19 Infection Using a Multilayer Perceptron in Croatia. The authors used a publicly available dataset, containing information on infected, recovered, and deceased patients in 406 locations over 51 days (22nd January 2020 to 12th March 2020). This dataset, intended to be a time-series dataset, was transformed into a regression dataset and used in training a multilayer perceptron (MLP) artificial neural network (ANN). Best models achieved consisted of 4 hidden layers with 4 neurons in each of those layers, and use a ReLU activation function, with R2 scores of 0.98599 for confirmed, 0.99429 for deceased, and 0.97941 for recovered patient models. Tamang et al (2020) employed artificial neural network-based curve fitting techniques in prediction and forecasting of the Covid-19 number of rising cases and death cases in India, USA, France, and UK, considering the progressive trends of China and South Korea. The study concluded that ANN can efficiently forecast the future cases of COVID 19 outbreak of any country.

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 Chad.

Data Issues

This study is based on daily new cases of COVID-19 in Chad 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	C
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	0.150
MSE	57.916472
MAE	5.117254

Residual Analysis for the Applied Model

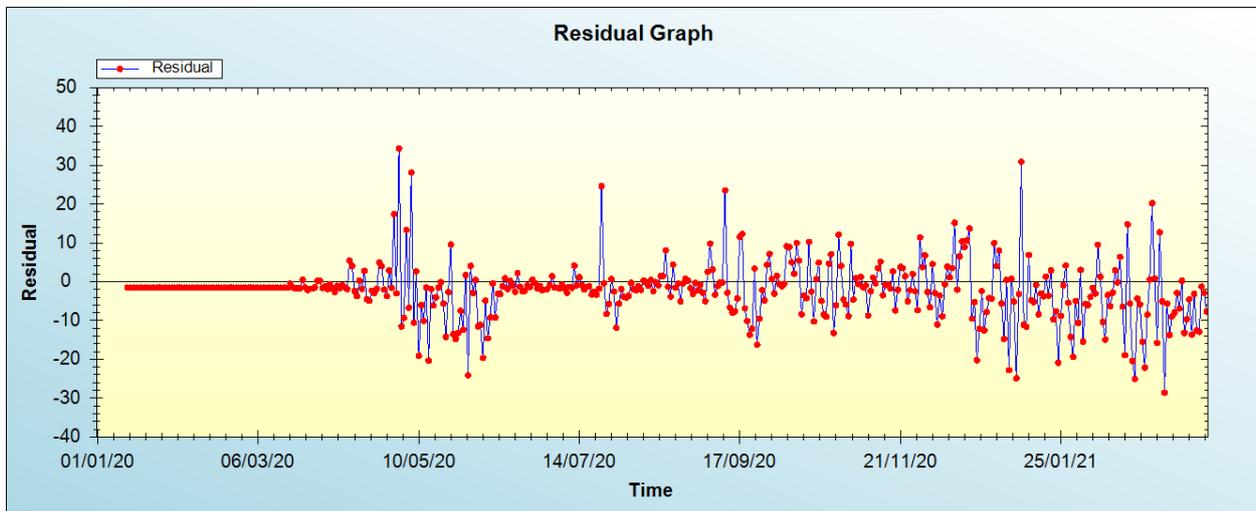


Figure 1: Residual analysis

In-sample Forecast for C

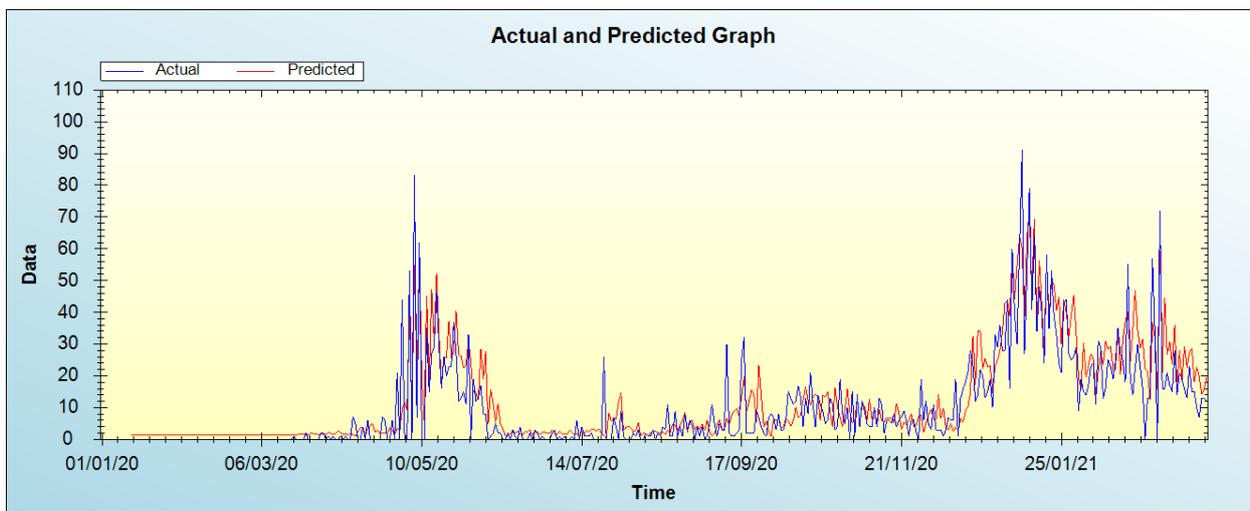


Figure 2: In-sample forecast for the C series

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

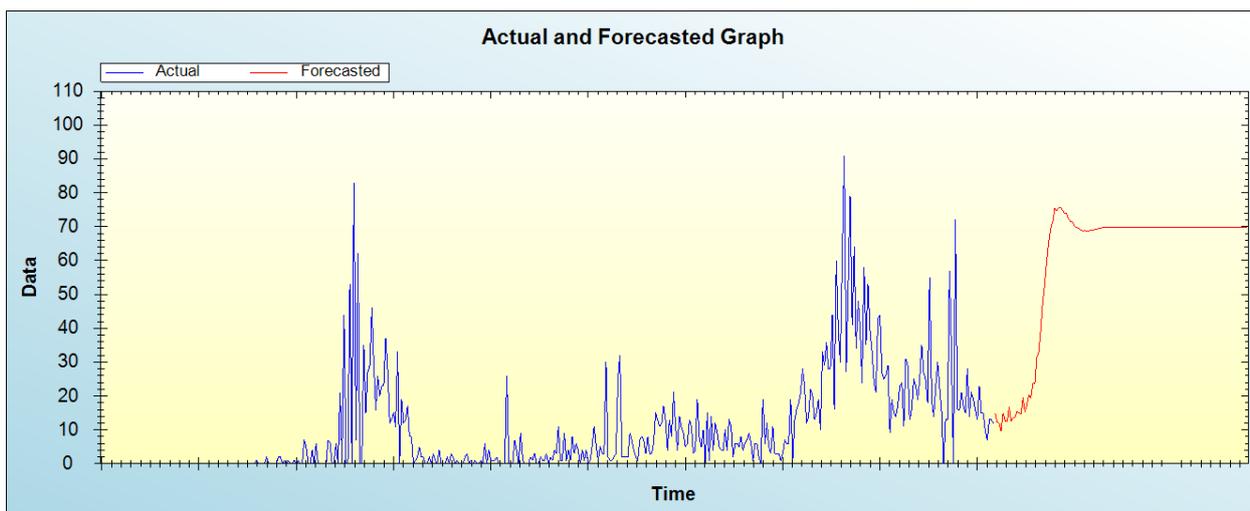


Figure 3: Out-of-sample forecast for C: actual and forecasted graph

Out-of-Sample Forecast for C: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	14.9262
27/03/21	12.2211
28/03/21	12.0261
29/03/21	9.6154
30/03/21	14.9738
31/03/21	12.6474
01/04/21	12.4586
02/04/21	16.6105
03/04/21	12.5884
04/04/21	13.4985
05/04/21	13.6518
06/04/21	15.4442
07/04/21	14.9810
08/04/21	14.7385
09/04/21	19.5177

10/04/21	15.2115
11/04/21	17.4195
12/04/21	20.3738
13/04/21	19.4665
14/04/21	23.8440
15/04/21	23.5976
16/04/21	31.3949
17/04/21	33.0179
18/04/21	39.7457
19/04/21	48.0409
20/04/21	52.9290
21/04/21	60.0589
22/04/21	65.5456
23/04/21	69.4846
24/04/21	71.4874
25/04/21	75.4508
26/04/21	74.6995
27/04/21	75.6492
28/04/21	75.7309
29/04/21	74.7820
30/04/21	73.9408
01/05/21	73.8332
02/05/21	72.3411
03/05/21	71.4985
04/05/21	71.4656
05/05/21	70.1811
06/05/21	69.7489
07/05/21	69.5120
08/05/21	69.1014
09/05/21	68.7722
10/05/21	68.9194
11/05/21	68.7460
12/05/21	68.7421
13/05/21	68.9916
14/05/21	68.9975
15/05/21	69.1003
16/05/21	69.3206
17/05/21	69.4370
18/05/21	69.4888
19/05/21	69.6830
20/05/21	69.7300
21/05/21	69.7677
22/05/21	69.8613
23/05/21	69.8731
24/05/21	69.8593
25/05/21	69.8930
26/05/21	69.8814
27/05/21	69.8372
28/05/21	69.8458
29/05/21	69.8172
30/05/21	69.7809
31/05/21	69.7737
01/06/21	69.7557
02/06/21	69.7265
03/06/21	69.7246
04/06/21	69.7164
05/06/21	69.6997
06/06/21	69.7038
07/06/21	69.7032
08/06/21	69.6977
09/06/21	69.7033
10/06/21	69.7083
11/06/21	69.7066
12/06/21	69.7133

13/06/21	69.7184
14/06/21	69.7183
15/06/21	69.7230
16/06/21	69.7267
17/06/21	69.7263
18/06/21	69.7286
19/06/21	69.7307
20/06/21	69.7294
21/06/21	69.7302
22/06/21	69.7308
23/06/21	69.7293
24/06/21	69.7291
25/06/21	69.7292
26/06/21	69.7278
27/06/21	69.7273
28/06/21	69.7273
29/06/21	69.7263
30/06/21	69.7260
01/07/21	69.7260
02/07/21	69.7255
03/07/21	69.7253
04/07/21	69.7256
05/07/21	69.7253
06/07/21	69.7254
07/07/21	69.7256
08/07/21	69.7256
09/07/21	69.7256
10/07/21	69.7259
11/07/21	69.7259
12/07/21	69.7259
13/07/21	69.7261
14/07/21	69.7261
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25/07/21	69.7261
26/07/21	69.7261
27/07/21	69.7261
28/07/21	69.7261
29/07/21	69.7261
30/07/21	69.7261
31/07/21	69.7261

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 Chad are likely to increase up to around 70 cases per day over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

Utilization of artificial intelligence (AI) techniques in Africa to predict infectious diseases is lagging behind. These technologies are critical in medicine for prognosis, diagnosis, screening and prediction of diseases. Machine learning algorithms such as artificial neural networks play a key role in pattern recognition, classification, regression and prediction. In this study the ANN (12, 12, 1) was applied to predict daily COVID-19 cases in Chad. The results indicate that COVID-19 cases are likely to increase up to around 70 cases per day over the out-of-sample period. Therefore we implore the authorities to continue enforcing adherence to WHO guidelines on prevention and control of COVID-19.

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