Forecasting Covid-19 New Cases in Djibouti

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Abstract - **In this study, the ANN approach was applied to analyze COVID-19 new cases in Djibouti. 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 hover around 234 cases per day over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Djibouti to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

Djibouti is a country located in the horn of Africa and by 2018 the nation had a population size of approximately 1million (World Bank, 2020; INSD, 2020). The country is strategically located at the Southern entrance to the Red sea, forming a trade link between Africa and the Middle East (Djibouti, 2016). The country hosts 30 000 refugees and some 150 000 migrants in transit from Ethiopia (UN, 2020).On the 17th of March 2020, the country reported its first case of COVID-19 (Djibouti, 2020). Since the beginning of the pandemic the government has implemented several measures to prevent and control COVID-19 such as closure of borders, the port and airport on the 18th of March 2020 (French Embassy in Djibouti, 2020), testing and treatment of cases, contact tracing , isolation or quarantine, social distancing, wearing of masks and hygiene practices (MOH Djibouti, 2020). The main challenges the nation has faced during this pandemic include poor health service delivery, human resource shortage and financial constraints (UN, 2020).The aim of this study is predict daily COVID-19 cases in Djibouti using the artificial network approach. The machine learning technique has been demonstrated its forecasting accuracy and reliability in the prediction of COVID-19 cases and mortalities (Maradze et al, 2021, Nyoni et al, 2021, Nyoni et al, 2020).Furthermore, the neural network algorithm has also been successfully applied in prediction of TB incidence (Nyoni & Nyoni,2021), ART coverage (Nyoni & Nyoni, 2021) and Immunization coverage (Maradze et al, 2021). The results of this study are expected to provide an insight of the likely future trends COVID-19 cases in Djibouti and stimulate an appropriate and timely response to the deadly virus.

II. LITERATURE REVIEW

Souleimanet al (2020) investigated the evolution of the COVID-19 epidemic in Djibouti using the compartmental SIHR model. They collected data from the Djibouti health ministry and analyzed the fit of the data in comparison with the result of the mathematical results, to validate the model and estimating the important model parameters and prediction about the disease and considered the real cases of Djibouti from 23th March to 10th June 2020. The results of the study revealed that the maximum number of reported cases was observed on 28 May-2020; which means that the number of infections was on an upward quickly trend for the next 9 days. After that day, the number of daily reported cases was observed to decrease asymptotically. The proposed model projected that the disease in Djibouti could be fully under control by after September 2020. Zoab et al (2020) developed a machine learning approach that trained on records from 51,831 tested individuals (of whom 4769 were confirmed to have COVID-19). The test set contained data from the subsequent week (47,401 tested individuals of whom 3624 were confirmed to have COVID-19). The model predicted COVID-19 test results with high accuracy using only eight binary features: sex, age ≥60 years, known contact with an infected individual, and the appearance of five initial clinical symptoms. Ahmad & Asad (2020) predicted of coronavirus COVID-19 distinct cases in Pakistan through an artificial neural network. An artificial neural network with rectifying linear unit based technique was used to predict the number of deaths, recovered and confirmed cases of COVID-19 in Pakistan by using previous data of 137 days of COVID-19 cases from the day 25 February 2020 when the first two cases were confirmed, until 10 July 2020. The collected data were divided into training and test data which were used to test the efficiency of the proposed technique. Furthermore, future predictions have been made by the proposed technique for the next 7 days while

training the model on whole available data. The study concluded that the model was well fitted with training data and can help to make predictions for the future.

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 Djibouti.

Data Issues

This study is based on daily new cases of COVID-19 in Djibouti 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	D
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	0.099641
MSE	240.242016
MAE	8.921490

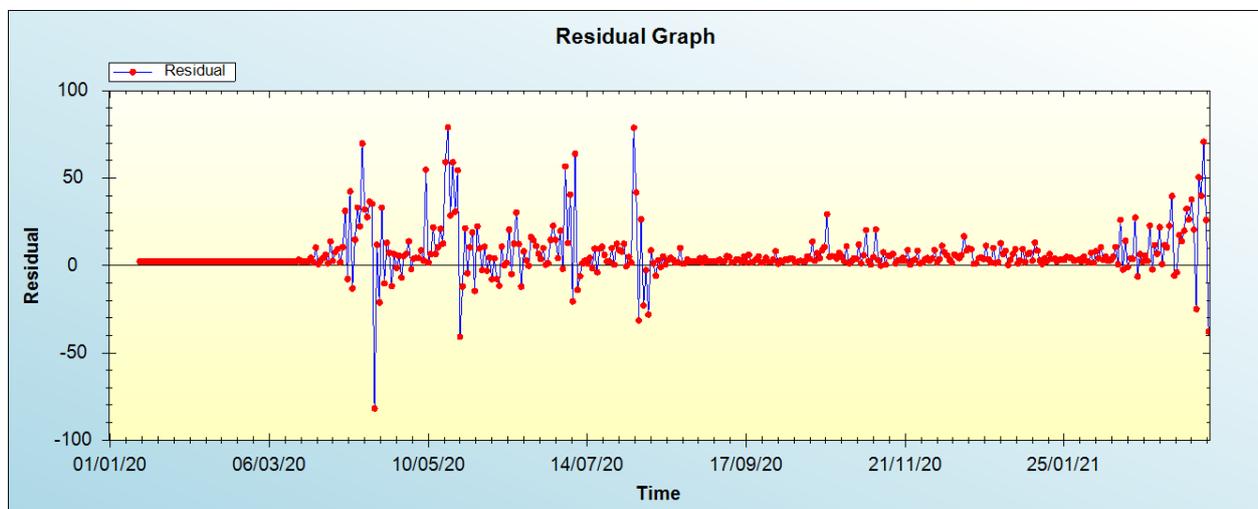*Residual Analysis for the Applied Model*

Figure 1: Residual analysis
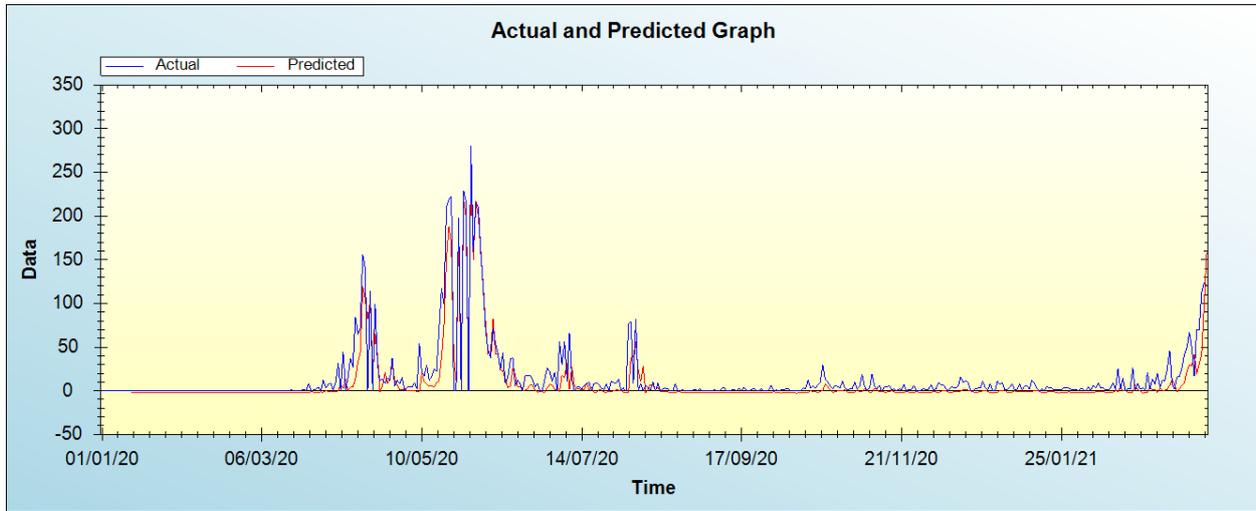
In-sample Forecast for D

Figure 2: In-sample forecast for the D series

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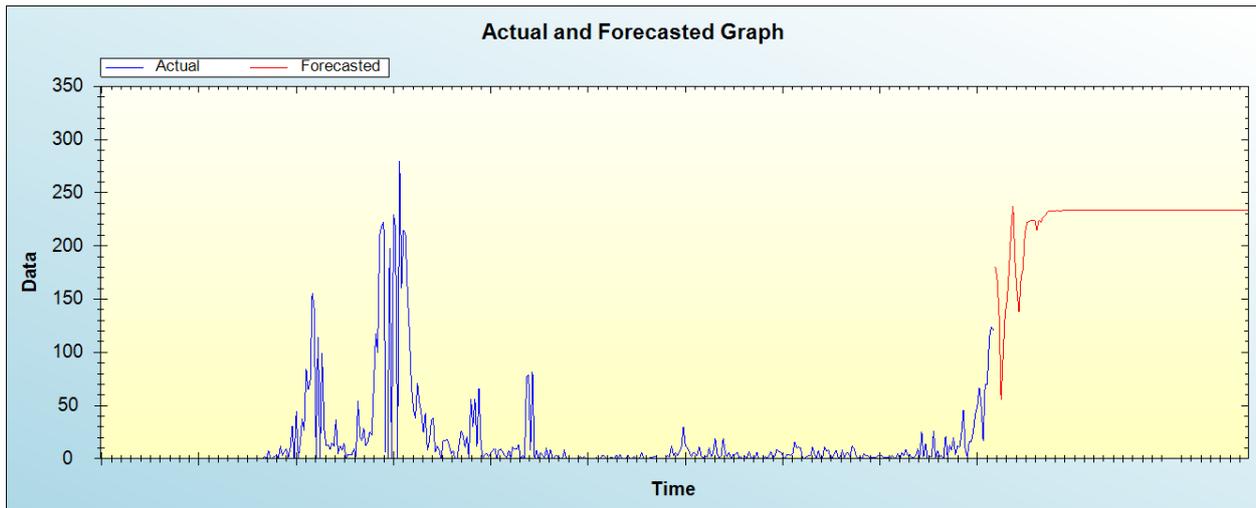

Figure 3: Out-of-sample forecast for D: actual and forecasted graph

Out-of-Sample Forecast for D: Forecasts only

Table 3: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	180.3045
27/03/21	170.5497
28/03/21	135.1026
29/03/21	55.4110
30/03/21	97.1459
31/03/21	136.8246
01/04/21	149.4655
02/04/21	178.3216
03/04/21	214.5788
04/04/21	237.6020
05/04/21	185.9153
06/04/21	158.0030
07/04/21	137.7651
08/04/21	169.9990
09/04/21	177.5823

10/04/21	211.7343
11/04/21	221.8294
12/04/21	222.7490
13/04/21	224.2585
14/04/21	223.6101
15/04/21	224.2022
16/04/21	214.9224
17/04/21	223.8159
18/04/21	222.2192
19/04/21	226.3652
20/04/21	227.9427
21/04/21	230.6485
22/04/21	232.5700
23/04/21	232.4852
24/04/21	233.1254
25/04/21	232.1459
26/04/21	233.3306
27/04/21	232.7234
28/04/21	232.7303
29/04/21	233.1268
30/04/21	233.2698
01/05/21	233.4952
02/05/21	233.4283
03/05/21	233.7497
04/05/21	233.7011
05/05/21	233.8095
06/05/21	233.7516
07/05/21	233.7435
08/05/21	233.8203
09/05/21	233.7768
10/05/21	233.7981
11/05/21	233.7964
12/05/21	233.8415
13/05/21	233.8268
14/05/21	233.8330
15/05/21	233.8461
16/05/21	233.8447
17/05/21	233.8537
18/05/21	233.8439
19/05/21	233.8500
20/05/21	233.8505
21/05/21	233.8521
22/05/21	233.8501
23/05/21	233.8513
24/05/21	233.8548
25/05/21	233.8527
26/05/21	233.8538
27/05/21	233.8536
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30/07/21	233.8547
31/07/21	233.8547

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 Djibouti are likely to hover around 234 cases per day over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

The COVID-19 pandemic is severely impacting the lives of the people living in Djibouti and slowing down the progress towards achieving the sustainable development goals (SDGs) by 2035 (UN, 2020). There is an increase in the vulnerability of citizens especially the elderly, disabled persons and migrant workers. In this study we modelled and forecasted daily COVID-19 cases in Djibouti using the artificial neural network approach. The findings of the study suggest that COVID-19 cases are likely to hover around 234 cases per day over the out-of-sample period. Therefore the government should enforce adherence to WHO guidelines on prevention and control of COVID-19.

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