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Forecasting Covid-19 New Cases in South Sudan

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***Abstract* - When it comes to public health these days, COVID-19 is of serious concern and considered as the supreme crisis of the present era. A surge in the number patients testing positive for COVID-19 has created a lot of stress and frustration on governing bodies worldwide and they are finding it difficult to tackle the situation. In this research article, the ANN approach was applied to analyze COVID-19 case volumes in South Sudan. This study is based on daily new cases of COVID-19 in South Sudan 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 applied model reveal that the model is stable in forecasting COVID-19 cases in South Sudan. It is projected that daily COVID-19 cases in South Sudan are likely to decline to zero cases per day around early April 2021. The government of South Sudan should continue to ensure that there is compliance to control and preventive COVID-19 measures such as social distancing, quarantine, isolation, face-mask wearing and so on. There is also need to embrace the vaccination programme in the country.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The Corona Virus Disease (COVID-19) is a global pandemic that was discovered by a Chinese physician in Wuhan, the capital city of Hubei province in mainland China, in December 2019 (WHO, 2020). It then propagated worldwide, and was declared a pandemic by the World Health Organization (WHO) at the tail end of January 2020 (Butt *et al*., 2020). Symptoms of the disease include dry cough, sore throat and fever. Although, the majority of the cases are mild, some cases may lead to Acute Respiratory Distress Syndrome (ARDS), severe pneumonia, pulmonary oedema and organ failure (Chen *et al*., 2020). COVID-19 propagation is faster when people are in close proximity. Thus, travel restrictions control the spread of the disease, and frequent hand washing is always recommended to prevent potential viral infections (Alazab *et al*., 2020). Forecasting COVID-19 case volumes is very important (Medina-Mendieta *et al*., 2020). In the first place, to inform government and healthcare professionals on what to expect and which measures to impose, and secondly, to motivate the wider public to adhere to the measures that were imposed to decelerate the spreading before a regrettable scenario unfolds (McCloskey *et al*., 2020). Thirdly, forecasting models are used as a reference to make new policies and to evaluate the conditions of COVID-19 curfews (Remuzzi & Remuzzi, 2020). The motive behind this paper is to model and forecast daily confirmed cases of COVID-19 in South Sudan.

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 South Sudan.

Data Issues

This study is based on dailynew cases of COVID-19 in South Sudan 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).

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III. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	SS
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	0.158562
MSE	939.753215
MAE	13.488962

Residual Analysis for the Applied Model

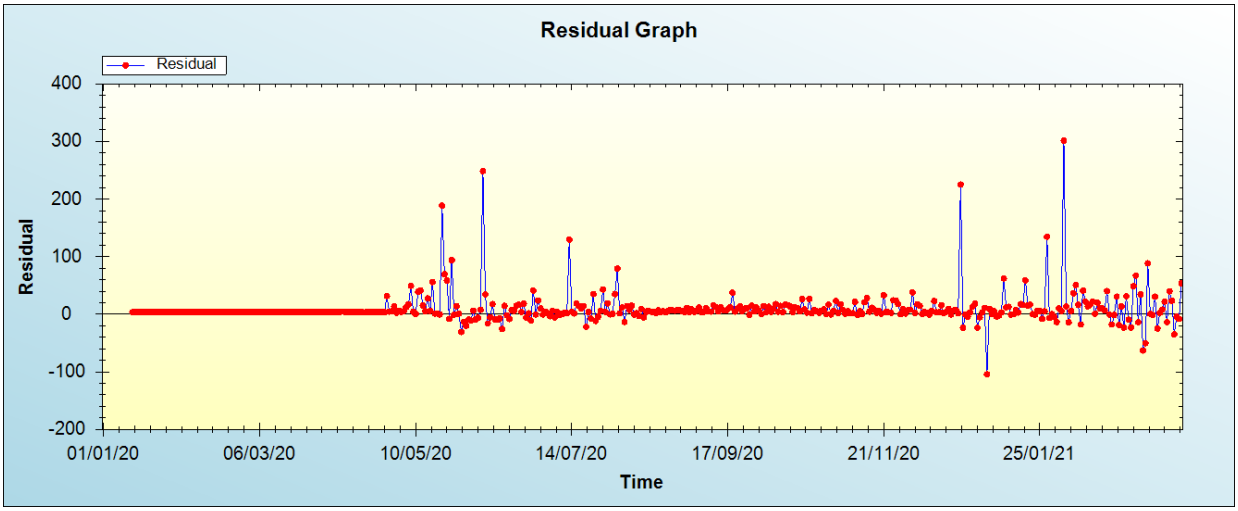

Figure 1: Residual analysis

In-sample Forecast for SS

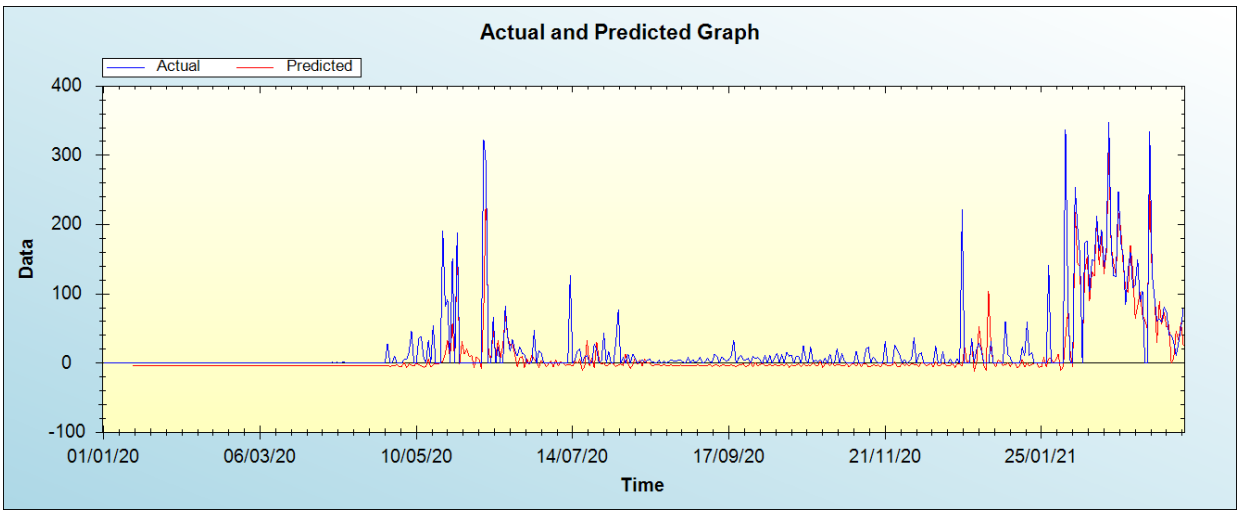

Figure 2: In-sample forecast for the SS series

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

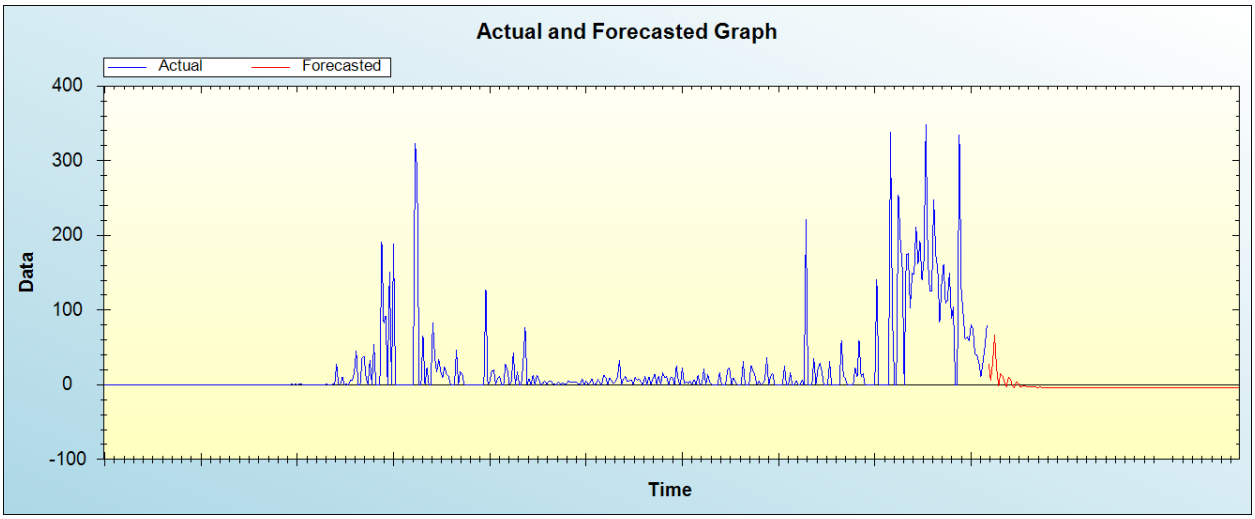

Figure 3: Out-of-sample forecast for SS: actual and forecasted graph

Out-of-Sample Forecast for SS: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
26/03/21	27.5341
27/03/21	5.6866
28/03/21	30.0518
29/03/21	66.4327
30/03/21	21.2810
31/03/21	-1.2782
01/04/21	15.0236
02/04/21	12.0249
03/04/21	3.8501
04/04/21	-2.7855
05/04/21	9.7693
06/04/21	8.1598
07/04/21	-0.5640
08/04/21	-3.7377
09/04/21	4.4467
10/04/21	2.2899
11/04/21	-2.8913
12/04/21	-2.2513
13/04/21	-1.6597
14/04/21	-2.2308
15/04/21	-3.3101
16/04/21	-2.7545
17/04/21	-2.8900
18/04/21	-2.8270
19/04/21	-3.2841
20/04/21	-3.7322
21/04/21	-3.2233
22/04/21	-3.4623
23/04/21	-3.7627
24/04/21	-3.8475
25/04/21	-3.6555
26/04/21	-3.8090
27/04/21	-3.9001
28/04/21	-3.7894
29/04/21	-3.8813

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30/04/21	-3.8630
01/05/21	-3.9066
02/05/21	-3.9176
03/05/21	-3.9307
04/05/21	-3.9255
05/05/21	-3.9439
06/05/21	-3.9724
07/05/21	-3.9378
08/05/21	-3.9630
09/05/21	-3.9654
10/05/21	-3.9628
11/05/21	-3.9644
12/05/21	-3.9697
13/05/21	-3.9732
14/05/21	-3.9687
15/05/21	-3.9779
16/05/21	-3.9727
17/05/21	-3.9759
18/05/21	-3.9776
19/05/21	-3.9761
20/05/21	-3.9773
21/05/21	-3.9774
22/05/21	-3.9789
23/05/21	-3.9770
24/05/21	-3.9791
25/05/21	-3.9787
26/05/21	-3.9785
27/05/21	-3.9793
28/05/21	-3.9789
29/05/21	-3.9793
30/05/21	-3.9791
31/05/21	-3.9795
01/06/21	-3.9792
02/06/21	-3.9794
03/06/21	-3.9796
04/06/21	-3.9793
05/06/21	-3.9796
06/06/21	-3.9795
07/06/21	-3.9796
08/06/21	-3.9795
09/06/21	-3.9796
10/06/21	-3.9796
11/06/21	-3.9796
12/06/21	-3.9796
13/06/21	-3.9796
14/06/21	-3.9796
15/06/21	-3.9796
16/06/21	-3.9796
17/06/21	-3.9796
18/06/21	-3.9796
19/06/21	-3.9796
20/06/21	-3.9796
21/06/21	-3.9796
22/06/21	-3.9796
23/06/21	-3.9796
24/06/21	-3.9796
25/06/21	-3.9796
26/06/21	-3.9796
27/06/21	-3.9796
28/06/21	-3.9796
29/06/21	-3.9796
30/06/21	-3.9796
01/07/21	-3.9796
02/07/21	-3.9796

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03/07/21	-3.9796
04/07/21	-3.9796
05/07/21	-3.9796
06/07/21	-3.9796
07/07/21	-3.9796
08/07/21	-3.9796
09/07/21	-3.9796
10/07/21	-3.9796
11/07/21	-3.9796
12/07/21	-3.9796
13/07/21	-3.9796
14/07/21	-3.9796
15/07/21	-3.9796
16/07/21	-3.9796
17/07/21	-3.9796
18/07/21	-3.9796
19/07/21	-3.9796
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22/07/21	-3.9796
23/07/21	-3.9796
24/07/21	-3.9796
25/07/21	-3.9796
26/07/21	-3.9796
27/07/21	-3.9796
28/07/21	-3.9796
29/07/21	-3.9796
30/07/21	-3.9796
31/07/21	-3.9796

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 South Sudan are likely to decline to zero cases per day around early April 2021.

IV. CONCLUSION & RECOMMENDATIONS

The rapid spread of COVID-19 across the globe as well as the increasing number of deaths requires drastic actions from all sectors. Future prediction of potential infections will enable authorities to tackle the consequences effectively (Alazab *et al*., 2020). Indeed, forecasting the number of new confirmed cases of COVID-19 is crucial in the prevention and control of the COVID-19 outbreak (Lei *et al*., 2020). This study used the ANN (12, 12, 1) model to come up with reliable predictions of the disease progression in the country. It is projected that daily COVID-19 cases in South Sudan are likely to decline to zero cases per day around early April 2021. The government of South Sudan should continue to ensure that there is compliance to control and preventive COVID-19 measures such as social distancing, quarantine, isolation, face-mask wearing and so on. There is also need to embrace the vaccination programme in the country.

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