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Forecasting Covid-19 New Cases in Mauritania

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

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

Mauritania reported her first two confirmed cases of COVID-19 on the 13th of March 2020 (UNDP, 2020) and first COVID-19 death on the 3oth March 2020 (UNICEF, 2020). The government responded to the pandemic by implementing strong restrictions for preventing the transmission of the corona virus and these included schools closure, travel bans, curfews, isolation, and closure of non-essential businesses, contact tracing and treatment cases. By the 28th of December 2020 the country had reported 13,778 confirmed cases and 330 deaths. About 867,593 children had been affected by COVID-19 school closures (UNICEF, 2020). The purpose of this study is to model and predict daily COVID-19 cases in Mauritania using the multilayer perceptron. The model is made up of 3 layers of neurons namely input, hidden and output layer connected by acyclic links called connection weights (Nyoni et al, 2020; Kaushik & Sahi, 2018; Fojnica et al, 2016; Zhang, 2003; Kishan, 1997; Patterson, 1995).The results of the study are expected to provide an insight of the likely future trends of COVID-19 in Mauritania and stimulate an appropriate health response to curb the spread of the virus.

II. LITERATURE REVIEW

Kriston et al (2020) modelled cumulative coronavirus disease 2019 (COVID-19) case growth in various regions. Publicly available time series data of cumulative COVID-19 cases form the John Hopkins University were used including reports up to 29 March 2020. A Bayesian hierarchical fiveparameter logistic model was fit to observed data to estimate and project the cumulative number of cases in all regions and countries listed in the John Hopkins University dataset with at least one case. Projections for six regions (Hubei in China, South Korea, Germany, United States, Brazil, and South Africa) were investigated in detail. The study concluded that,although the model's predictive validity needs further confirmation, the presented approach is likely to offer valuable insights into understanding and managing COVID-19. COVID-19 incidence was forecasted using the ARIMA and Expert Modeler by Edre et al (2020). Publicly available data was utilized, they performed a forecast of Malaysia COVID-19 new cases using Expert Modeler Method in SPSS and ARIMA model in R to predict COVID-19 cases in Malaysia and then compared 3 different time frames based on different Movement Control Order (MCO) period. The study findings revealed that MCO models have shown to stabilize the rate of new cases.

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 Mauritania.

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Data Issues

This study is based on daily new cases of COVID-19 in Mauritania 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	M
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	0.101409
MSE	278.091220
MAE	12.043021

Residual Analysis for the Applied Model

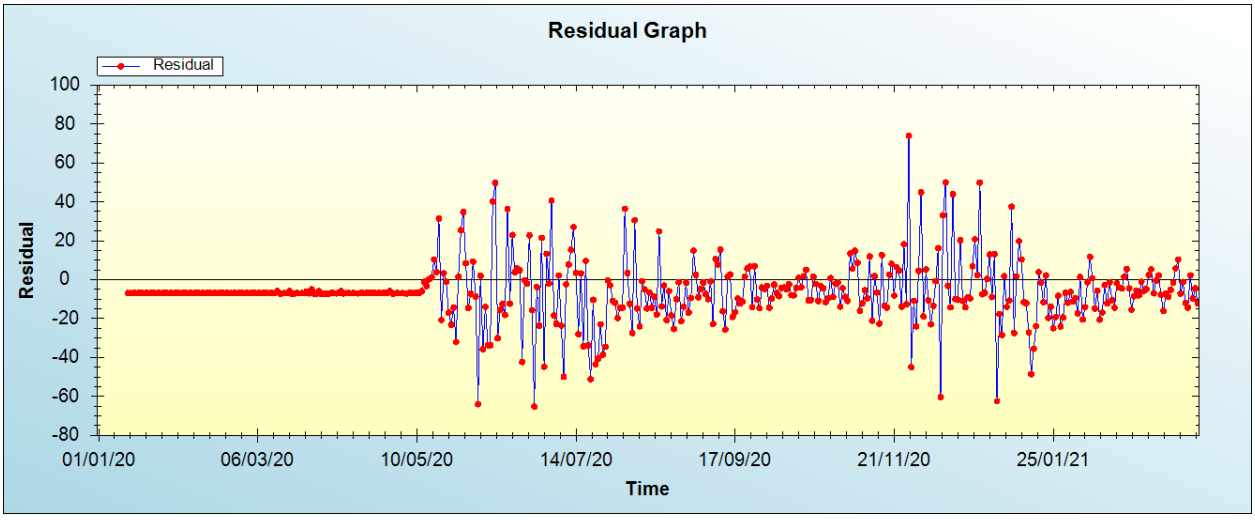

Figure 1: Residual analysis

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In-sample Forecast for M

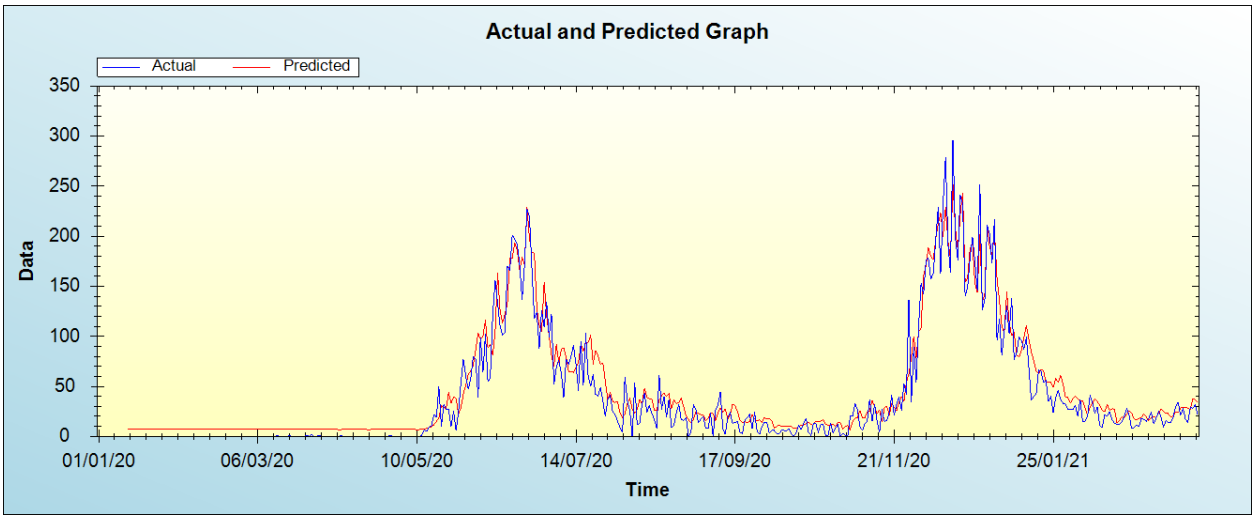

Figure 2: In-sample forecast for the M series

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

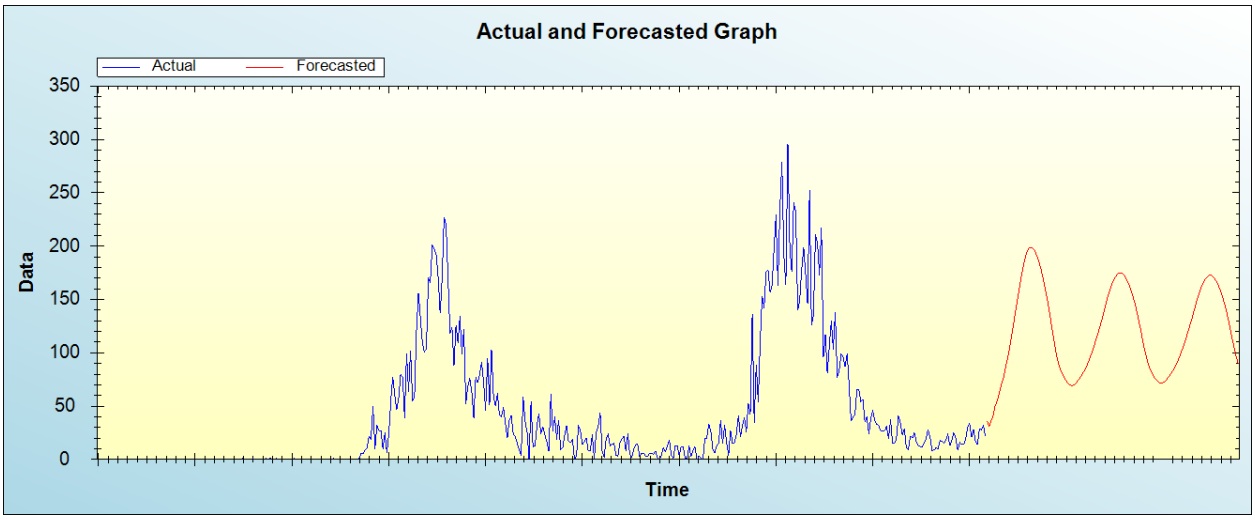

Figure 3: Out-of-sample forecast for M: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	35.7319
27/03/21	30.8242
28/03/21	36.4921
29/03/21	41.5456
30/03/21	50.3129
31/03/21	54.8814
01/04/21	62.5031
02/04/21	69.9061
03/04/21	75.0304
04/04/21	83.9717
05/04/21	92.8739
06/04/21	101.8417
07/04/21	112.6756

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08/04/21	124.4714
09/04/21	135.8957
10/04/21	146.8347
11/04/21	158.2322
12/04/21	169.2074
13/04/21	179.2310
14/04/21	187.9448
15/04/21	194.1971
16/04/21	197.6469
17/04/21	198.9157
18/04/21	198.0264
19/04/21	195.4224
20/04/21	191.4913
21/04/21	186.1770
22/04/21	179.5528
23/04/21	171.8207
24/04/21	162.9980
25/04/21	153.3794
26/04/21	142.8200
27/04/21	131.4720
28/04/21	119.8726
29/04/21	108.4342
30/04/21	98.1529
01/05/21	90.1738
02/05/21	84.4770
03/05/21	80.2072
04/05/21	76.5963
05/05/21	73.4279
06/05/21	70.9553
07/05/21	69.4799
08/05/21	69.1971
09/05/21	70.0649
10/05/21	71.8778
11/05/21	74.2714
12/05/21	76.9152
13/05/21	79.7337
14/05/21	82.8645
15/05/21	86.4980
16/05/21	90.7313
17/05/21	95.5494
18/05/21	100.8347
19/05/21	106.4258
20/05/21	112.2104
21/05/21	118.1931
22/05/21	124.5085
23/05/21	131.2942
24/05/21	138.5053
25/05/21	145.8238
26/05/21	152.7602
27/05/21	158.8885
28/05/21	164.0248
29/05/21	168.2063
30/05/21	171.5094
31/05/21	173.8708
01/06/21	175.0722
02/06/21	174.8959
03/06/21	173.3049
04/06/21	170.4814
05/06/21	166.7057
06/06/21	162.1868
07/06/21	156.9650
08/06/21	150.9369
09/06/21	143.9710
10/06/21	136.0292

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11/06/21	127.2373
12/06/21	117.9135
13/06/21	108.5725
14/06/21	99.8735
15/06/21	92.4490
16/06/21	86.6080
17/06/21	82.1461
18/06/21	78.6069
19/06/21	75.7193
20/06/21	73.4962
21/06/21	72.0953
22/06/21	71.6512
23/06/21	72.1716
24/06/21	73.5272
25/06/21	75.5103
26/06/21	77.9067
27/06/21	80.5833
28/06/21	83.5472
29/06/21	86.8955
30/06/21	90.7218
01/07/21	95.0584
02/07/21	99.8583
03/07/21	105.0218
04/07/21	110.4554
05/07/21	116.1279
06/07/21	122.0813
07/07/21	128.3812
08/07/21	135.0185
09/07/21	141.8225
10/07/21	148.4693
11/07/21	154.5963
12/07/21	159.9438
13/07/21	164.4126
14/07/21	167.9973
15/07/21	170.6641
16/07/21	172.2903
17/07/21	172.7186
18/07/21	171.8712
19/07/21	169.8155
20/07/21	166.7284
21/07/21	162.7928
22/07/21	158.1039
23/07/21	152.6432
24/07/21	146.3308
25/07/21	139.1116
26/07/21	131.0258
27/07/21	122.2552
28/07/21	113.1560
29/07/21	104.2656
30/07/21	96.2340
31/07/21	89.6019

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 Mauritania are likely to remain high over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

Mauritania has been severely affected by the COVID-19 pandemic. Besides the health impact, the epidemic has increased the vulnerability of its citizens (UNICEF, 2020). The World Bank projected that the poverty rate could increase from 5.5% in 2019 to 6% in2020, pushing 25,000 additional people to fall into extreme poverty. Modeling and forecasting is key at this juncture to understand the future evolution of the COVID-19 epidemic. Hence in this study we applied the ANN (12, 12, 1) model

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to predict daily COVID-19 cases in Mauritania. The results of the study indicate that daily COVID-19 cases in Mauritania are likely to remain high over the out-of-sample period. Therefore the government should enforce adherence to the WHO COVID-19 guidelines and promote vaccination against the virus.

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