Forecasting Covid-19 New Cases in Georgia

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Abstract - **In this study, the ANN approach was applied to analyze COVID-19 new cases in Georgia. 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 vanish around early April 2021 over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Georgia to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The emergence of COVID-19 in late December 2019 brought fear and panic around the World as the SARS-CoV 2 virus spread with an alarming rate characterized with many people falling sick and dying from the deadly disease (Zu et al, 2020; Tartaglione et al, 2020; Kong et al, 2020; Wang et al, 2020; Tang et al, 2020). Several economic activities wereaffected and the vulnerability of people in developing countries increased. Various researchers have applied different models to predict the evolution of the pandemic such as the compartmental models, statistical models and machine learning techniques (Hamadneh et al, 2021; Al-Qaness, 2020, Nyoni et al, 2020; Meng et al, 2017). Artificial neural networks (ANNs) are widely used in time series forecasting and have been shown to provide reliable results (Wang et al, 2018; Eriksson et al, 2017). The multilayer perceptron neural network is a type of a feed forward artificial neural network and will be applied in this study. The applied ANN (12, 12, 1) model has 12 input neurons, 12 hidden layer neurons and 1 output neuron which are connected by weights (Kaushik & Sahi, 2018; Fojnica et al, 2016; Zhang, 2003). The findings of this study are anticipated to reveal future trends of COVID-19 in Georgia and stimulate an evidence based response to the pandemic through allocation of resources to curb the spread of the SARS-CoV2 virus.

II. LITERATURE REVIEW

Short term forecasting of cases, deaths, and hospital beds occupancy in the COVID-19 pandemic at the Brazilian Amazon using artificial neural networks was done by Braga et al (2021). Six scenarios with different periods were used to identify the quality of the generated forecasting and the period in which they start to deteriorate. Results indicated that the computational model adapted capably to the training period and was able to make consistent short-term forecasts, especially for the cumulative variables and for demand hospital beds. The ARIMA model was applied by Yousaf et al (2020)to forecast confirmed cases, deaths and recoveries in Pakistan. The study results indicated that there was high exponential growth in the number of confirmed cases, deaths and recoveries in Pakistan. Nyoni et al (2020) predicted daily COVID-19 cases in Pakistan using the artificial neural approach and the authors concluded that the number of daily new COVID-19 cases would follow a downwards trend over the out-of sample period, characterized by an equilibrium level of approximately 227 cases per day. Based on the VAR model, Khan et al (2020) projected that the maximum number of new daily cases for Pakistan would be 5363 per day on July 3, 2020.

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 Georgia.

Data Issues

This study is based on daily new cases of COVID-19 in Georgia 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	G
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	0.062228
MSE	35499.096384
MAE	119.728692

Residual Analysis for the Applied Model
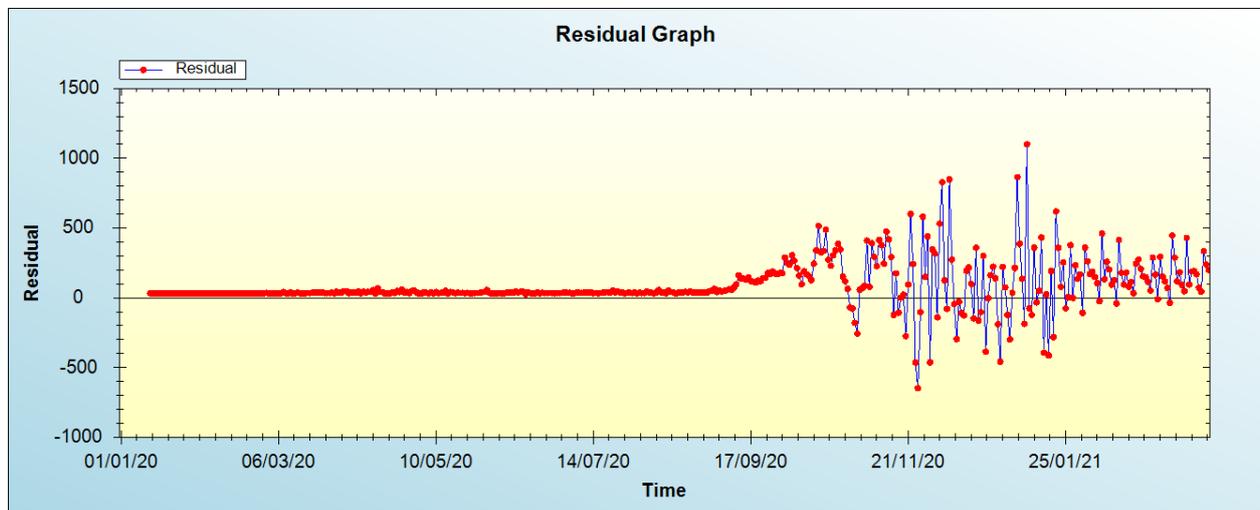
Figure 1: Residual analysis
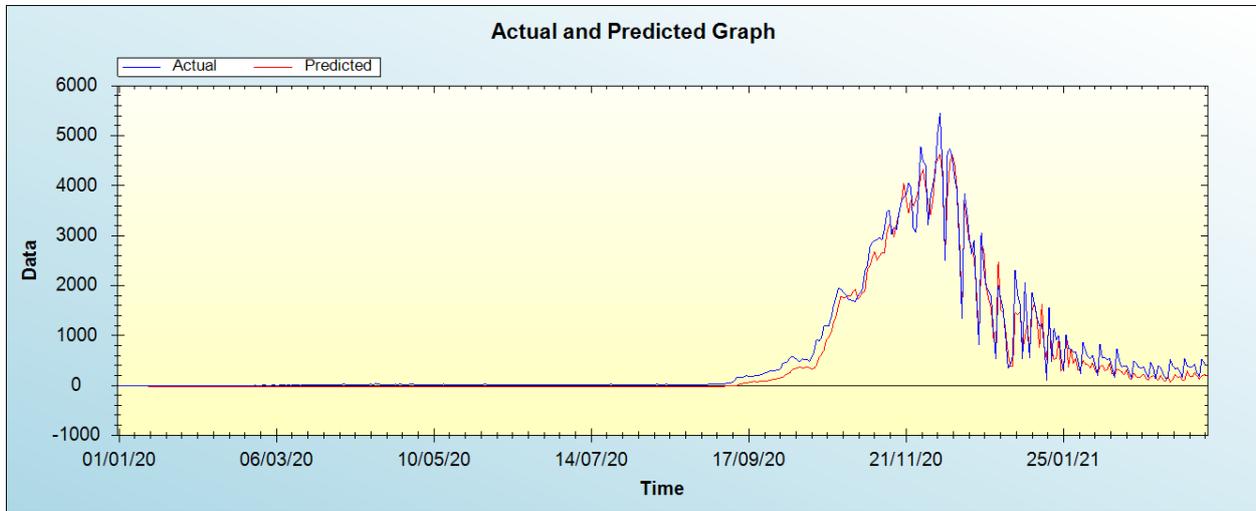
In-sample Forecast for G

Figure 2: In-sample forecast for the G series

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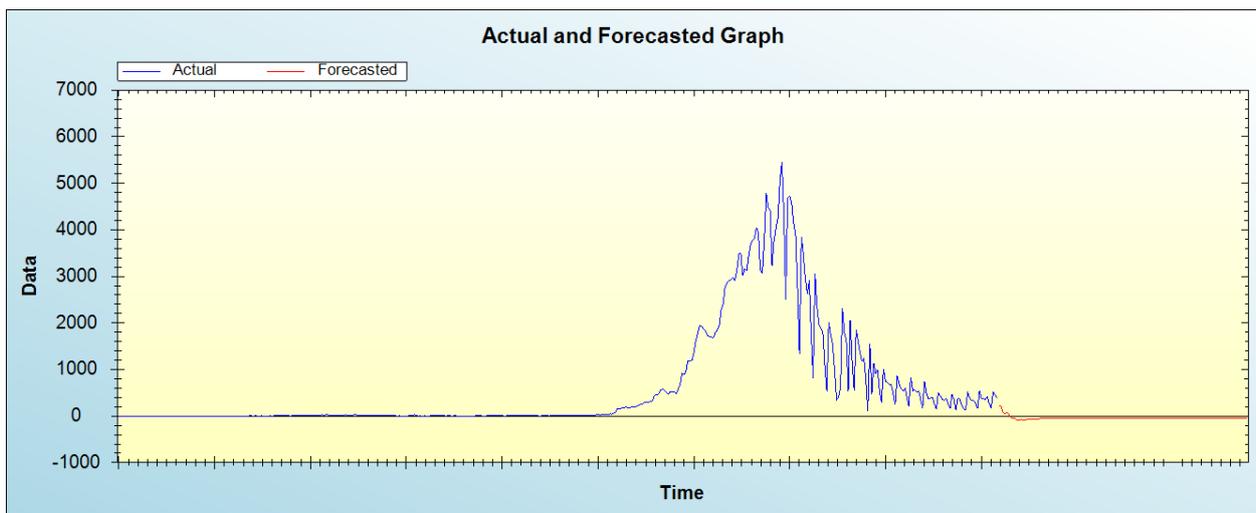

Figure 3: Out-of-sample forecast for G: actual and forecasted graph

Out-of-Sample Forecast for G: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	208.6138
27/03/21	211.6007
28/03/21	84.9164
29/03/21	50.2701
30/03/21	88.6690
31/03/21	34.1900
01/04/21	-17.2904
02/04/21	-50.8546
03/04/21	-44.9341
04/04/21	-83.1812
05/04/21	-84.8120
06/04/21	-75.5406
07/04/21	-77.9193

08/04/21	-85.1963
09/04/21	-78.0478
10/04/21	-71.7948
11/04/21	-76.5595
12/04/21	-71.3274
13/04/21	-64.1333
14/04/21	-61.7701
15/04/21	-61.9007
16/04/21	-56.8551
17/04/21	-54.9404
18/04/21	-55.7806
19/04/21	-54.3128
20/04/21	-52.3532
21/04/21	-52.7205
22/04/21	-53.2028
23/04/21	-52.1488
24/04/21	-52.3591
25/04/21	-53.2113
26/04/21	-53.2238
27/04/21	-53.0608
28/04/21	-53.6825
29/04/21	-54.0169
30/04/21	-53.8841
01/05/21	-54.1235
02/05/21	-54.4771
03/05/21	-54.4704
04/05/21	-54.4455
05/05/21	-54.6495
06/05/21	-54.6919
07/05/21	-54.6041
08/05/21	-54.6452
09/05/21	-54.7054
10/05/21	-54.6408
11/05/21	-54.6029
12/05/21	-54.6364
13/05/21	-54.6126
14/05/21	-54.5618
15/05/21	-54.5639
16/05/21	-54.5682
17/05/21	-54.5358
18/05/21	-54.5236
19/05/21	-54.5335
20/05/21	-54.5238
21/05/21	-54.5101
22/05/21	-54.5159
23/05/21	-54.5193
24/05/21	-54.5116
25/05/21	-54.5125
26/05/21	-54.5188
27/05/21	-54.5175
28/05/21	-54.5158
29/05/21	-54.5201
30/05/21	-54.5220
31/05/21	-54.5205
01/06/21	-54.5219
02/06/21	-54.5243
03/06/21	-54.5237
04/06/21	-54.5234
05/06/21	-54.5249
06/06/21	-54.5251
07/06/21	-54.5243
08/06/21	-54.5247
09/06/21	-54.5252
10/06/21	-54.5247

11/06/21	-54.5244
12/06/21	-54.5247
13/06/21	-54.5246
14/06/21	-54.5242
15/06/21	-54.5243
16/06/21	-54.5244
17/06/21	-54.5242
18/06/21	-54.5241
19/06/21	-54.5242
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26/06/21	-54.5241
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01/07/21	-54.5241
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26/07/21	-54.5241
27/07/21	-54.5241
28/07/21	-54.5241
29/07/21	-54.5241
30/07/21	-54.5241
31/07/21	-54.5241

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 Georgia are likely to vanish around early April 2021 over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

The rapid spread of the SARS-COV2 virus and its associated high morbidity and mortality resulted in great panic around the world. Many households became more vulnerable to hunger and malnutrition due to sudden loss of income from lost jobs, disrupted business activities and restricted travel. However some businesses like the pharmaceutical industry experienced to some extent positive growth due to increased demand of medical drugs and equipment. In this study we applied the artificial neural

network approach to predict daily COVID-19 cases in Georgia. The results of the study indicate that COVID-19 cases are likely to vanish around early April 2021 over the out-of-sample period. The authorities in Georgia are, still, encouraged to continue enforcing adherence to COVID-19 public health mitigation measures.

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