

Forecasting Covid-19 New Cases in Latvia

¹Dr. Smartson. P. NYONI, ²Mr. Thabani NYONI, ³Mr. Tatenda. A. CHIHOHO

¹ZICHIRE Project, University of Zimbabwe, Harare, Zimbabwe

²SAGIT Innovation Center, Harare, Zimbabwe

³Independent Health Economist, Harare, Zimbabwe

Abstract - In this study, the ANN approach was applied to analyze COVID-19 new cases in Latvia. 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 Latvia are likely to fall to zero around early May 2021. Amongst other suggested policy directions, there is need for the government of Latvia to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The COVID-19 pandemic struck the whole world at a time when most governments were seized with improving the lives of their citizens in order to achieve the Sustainable development goals by 2035 especially developing nations have a mandate to deal with the TB and HIV epidemics, poverty, hunger and political instability. The emergence of the SARS-COV2 virus in Wuhan, China in December 2019 (Wang et al, 2020; CDC, 2020; Feng et al, 2020) aggravated the situation as this increased the vulnerability of developing nations mainly in Sub-Saharan Africa. In the developed world the pandemic increased the vulnerability of migrant workers, the elderly and disabled persons just like in the developing world. The SARS-COV2 virus is highly infectious and the disease has a variable course, multiple organ failure in severe cases and a mortality risk (Feng et al, 2020). Many studies have revealed that severe COVID-19 disease is seen in 12.6 % to 23.5% of the patients with increased risk in patients with pre-existing chronic medical conditions (45%). Mortality is high in patients with Diabetes, and hypertension (Zhang et al, 2020). The first COVID-19 case in Latvia was detected on the 3rd of March 2020 (WHO, 2020). On the 14th of March 2020 the government encountered a national lockdown that was effected on the 17th of March 2020. There was closure of borders, temporary ban on public gatherings and closure of non-essential business operations. The government announced a package of measures that included financing of the sickness benefit (Zasova, 2020). The purpose of this study is to model and predict daily COVID-19 cases in Latvia using the artificial neural network approach. The method has been widely used in time series forecasting in recent times (Maradze et al, 2021; Nyoni et al, 2021; Nyoni & Nyoni, 2021; Nyoni et al, 2020; Zhao et al, 2020). The results of the study are envisioned to highlight the likely future trends of COVID-19 in the country and assist authorities in allocating resources towards the fight against the COVID-19 epidemic.

II. LITERATURE REVIEW

Assimakis et al (2020) investigated the behavior of various time varying measurement driven models. They implemented time varying Kalman filters. Preliminary results from Greece and Latvia showed that Kalman Filters can be used for short term forecasting of COVID-19 cases. Viksna et al (2020) investigated the clinical features of COVID-19 patients in Latvia and differences in blood tests in groups with different disease severity. The retrospective study included 100 patients hospitalized in Riga East Clinical University Hospital in Spring 2020. The severity of the disease course was classified by the presence of pneumonia and its combination with respiratory failure. They assessed blood cells' count, hemoglobin, hematocrit, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), alanine aminotransferase, lactate dehydrogenase (LDH), troponin T, electrolytes, creatinine, glomerular filtration rate (GFR), D-dimer, prothrombin time, prothrombin index, oxygen saturation, and temperature on admission to the hospital. The study concluded that COVID-19 severity associates with lower renal function and a higher level of inflammation and tissue damage. Singh et al (2020) forecasted daily confirmed COVID-19 cases in Malaysia using ARIMA models. The study was conducted using daily confirmed cases of COVID-19 collected from the official Ministry of Health, Malaysia (MOH) and John Hopkins University websites. An Autoregressive Integrated Moving Average (ARIMA) model was fitted to the training data of observed cases from 22 January to 31 March 2020, and subsequently validated using data on

cases from 1 April to 17 April 2020. The ARIMA (0, 1, 0) was found to be the optimal model. The forecasted values showed a downward trend of COVID-19 cases until 1 May 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 Latvia.

Data Issues

This study is based on daily new cases of COVID-19 in Latvia 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	L
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	0.093826
MSE	9410.031062
MAE	56.383101

Residual Analysis for the Applied Model

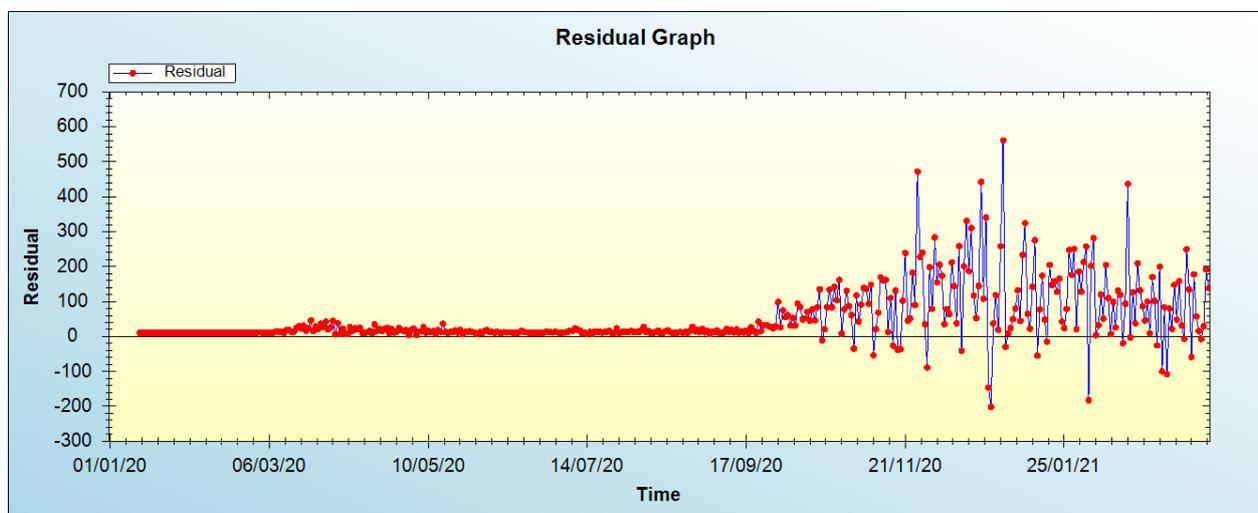


Figure 1: Residual analysis

In-sample Forecast for L

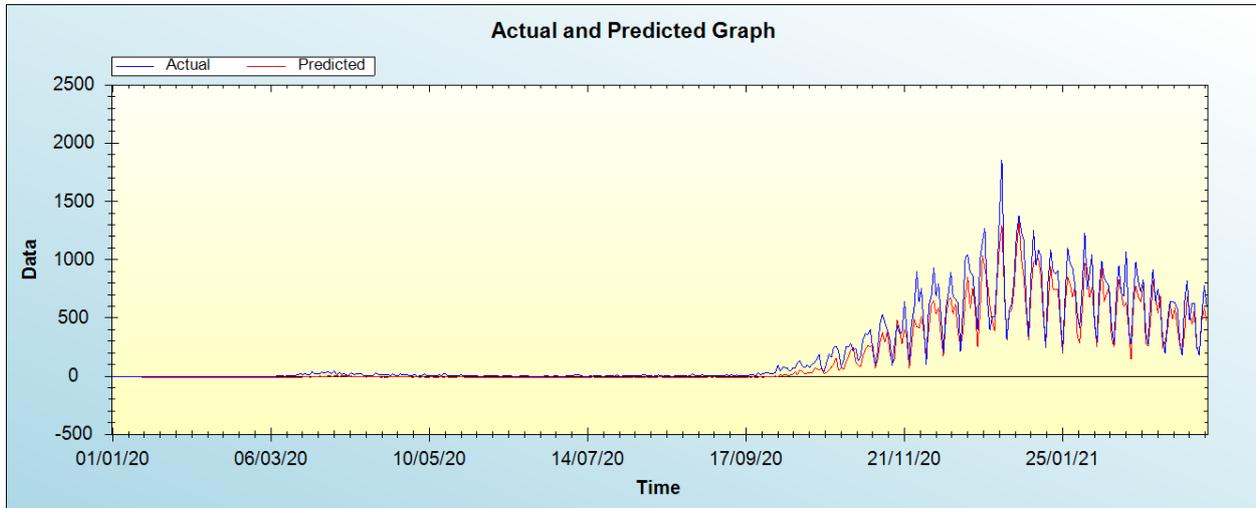


Figure 2: In-sample forecast for the L series

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

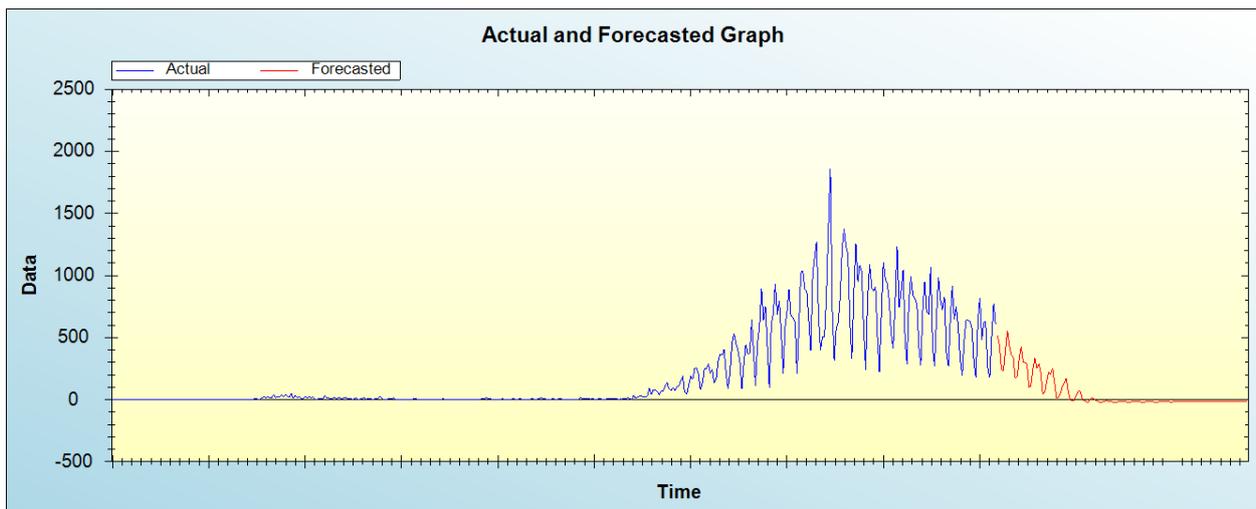


Figure 3: Out-of-sample forecast for L: actual and forecasted graph

Out-of-Sample Forecast for L: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	517.2523
27/03/21	440.6446
28/03/21	241.2704
29/03/21	235.2304
30/03/21	401.2570
31/03/21	554.7281
01/04/21	433.1690
02/04/21	365.8412
03/04/21	338.1375
04/04/21	171.7478
05/04/21	183.6915
06/04/21	329.7700
07/04/21	427.6284
08/04/21	302.2400
09/04/21	298.3246

10/04/21	285.0681
11/04/21	100.4731
12/04/21	111.2324
13/04/21	243.6854
14/04/21	333.3379
15/04/21	251.2107
16/04/21	288.0452
17/04/21	218.6284
18/04/21	43.9034
19/04/21	58.6068
20/04/21	141.5056
21/04/21	218.5444
22/04/21	203.8050
23/04/21	255.7074
24/04/21	137.5531
25/04/21	10.6117
26/04/21	20.9088
27/04/21	47.3516
28/04/21	104.6435
29/04/21	138.6152
30/04/21	171.8396
01/05/21	60.2604
02/05/21	-2.6625
03/05/21	-3.5371
04/05/21	-2.7398
05/05/21	29.4696
06/05/21	64.9080
07/05/21	70.1539
08/05/21	12.4827
09/05/21	-8.5951
10/05/21	-17.1416
11/05/21	-20.0700
12/05/21	-3.6507
13/05/21	12.7479
14/05/21	9.5465
15/05/21	-7.1804
16/05/21	-13.7996
17/05/21	-21.5008
18/05/21	-22.3984
19/05/21	-14.5895
20/05/21	-9.6892
21/05/21	-10.7976
22/05/21	-13.7943
23/05/21	-16.8676
24/05/21	-20.6760
25/05/21	-20.3122
26/05/21	-17.5440
27/05/21	-16.2671
28/05/21	-15.8690
29/05/21	-16.2644
30/05/21	-17.8191
31/05/21	-19.1060
01/06/21	-18.8137
02/06/21	-18.1431
03/06/21	-17.6649
04/06/21	-17.1846
05/06/21	-17.3169
06/06/21	-17.9386
07/06/21	-18.2765
08/06/21	-18.2440
09/06/21	-18.1280
10/06/21	-17.8754
11/06/21	-17.6495
12/06/21	-17.7265

	13/06/21	-17.9085
	14/06/21	-18.0037
	15/06/21	-18.0519
	16/06/21	-18.0241
	17/06/21	-17.9060
	18/06/21	-17.8351
	19/06/21	-17.8592
	20/06/21	-17.8985
	21/06/21	-17.9401
	22/06/21	-17.9750
	23/06/21	-17.9600
	24/06/21	-17.9183
	25/06/21	-17.8991
	26/06/21	-17.8986
	27/06/21	-17.9067
	28/06/21	-17.9275
	29/06/21	-17.9411
	30/06/21	-17.9345
	01/07/21	-17.9235
	02/07/21	-17.9166
	03/07/21	-17.9123
	04/07/21	-17.9154
	05/07/21	-17.9239
	06/07/21	-17.9278
	07/07/21	-17.9264
	08/07/21	-17.9240
	09/07/21	-17.9206
	10/07/21	-17.9182
	11/07/21	-17.9197
	12/07/21	-17.9224
	13/07/21	-17.9236
	14/07/21	-17.9238
	15/07/21	-17.9231
	16/07/21	-17.9215
	17/07/21	-17.9208
	18/07/21	-17.9213
	19/07/21	-17.9219
	20/07/21	-17.9225
	21/07/21	-17.9228
	22/07/21	-17.9225
	23/07/21	-17.9219
	24/07/21	-17.9217
	25/07/21	-17.9217
	26/07/21	-17.9219
	27/07/21	-17.9222
	28/07/21	-17.9223
	29/07/21	-17.9222
	30/07/21	-17.9220
	31/07/21	-17.9220

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 Latvia are likely to fall to zero around early May 2021.

V. CONCLUSION AND POLICY RECOMMENDATIONS

Latvia is one of the Baltic region countries, which reported the lowest total COVID-19 cases and death than in neighboring Estonia, Lithuania, Belarus, and Russia throughout the pandemic period in Spring 2020 (Viksna et al, 2020). During the first three months of pandemic, 1,066 total cases and 25 deaths were reported in Latvia (WHO, 2020). In this study we proposed an artificial intelligence technique to predict daily COVID-19 cases in Latvia so that the government can prepare resources to fight the epidemic. The results indicate that daily COVID-19 cases in Latvia are likely to fall to zero around early

May 2021. We encourage the government to make sure that people are adhering to the stimulate COVID-19 guidelines to curb the spread of the virus.

REFERENCES

- [1] Anna Zasova (2020). COVID-19 in the Region of FREE Network: The Case of Latvia, COVID-19 PAPER SERIES, pp 1-4
- [2] CDC (2020). The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. *China CDC Weekly* 2, 113–122.
- [3] Feng Y., Ling Y., & Bai T (2020). COVID-19 with Different Severities: A Multicenter Study of Clinical Features. *Am J Respir Crit Care Med*, 2020; 201(11): 1380-1388
- [4] Ludmila Viksna., Oksana Kolesova., Aleksandrs Kolesovs., Ieva Vanaga., Seda Arutjunana., Sniedze Laivacuma., Jelena Storozenko., Ieva Tolmane., Ilze Berzina., & Baiba Rozentale (2020). Clinical characteristics of COVID-19 patients in Latvia under low incidence in Spring 2020. medRxiv preprint doi: <https://doi.org/10.1101/2020.12.22.20239392>
- [5] Maradze, T. C., Nyoni, S. P., & Nyoni, T (2021). Modeling and Forecasting Child immunization against measles disease in Djibouti using artificial neural networks (ANNs). *International Journal of innovations in Engineering and Technology (IRJIET)*, 5 (3):449-452.
- [6] Nyoni, S. P., & Nyoni, T (2021). Forecasting ART coverage in Egypt using artificial neural networks. *International Journal of Innovations in Engineering and Technology (IRJIET)*, 5 (3): 161-165.
- [7] Wang D et al (2020). Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. *JAMA* 323, 1061–1069.
- [8] Wang H et al (2020). Phase-adjusted estimation of the number of coronavirus disease 2019 cases in Wuhan, China. *Cell Discovery* 6, 76.
- [9] Wang. W et al (2020). Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China. *J. Med. Virology* 92, 441–447
- [10] WHO (2020). COVID-19 situation in the WHO European Region, <https://who.maps.arcgis.com/apps/opsdashboard/index.html#/a19d5d1f86ee4d99b013eed5f637232d>
- [11] Zhang X, Tan Y, Ling Y, et al. Viral and host factors related to the clinical outcome of COVID-19. *Nature*, 2020; 583: 437-440.

Citation of this Article:

Dr. Smartson. P. NYONI, Mr. Thabani NYONI, Mr. Tatenda. A. CHIHOHO, “Forecasting Covid-19 New Cases in Latvia” Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 6, pp 425-430, June 2021. Article DOI <https://doi.org/10.47001/IRJIET/2021.506074>
