

Forecasting Covid-19 New Cases in Lithuania

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Abstract - In this study, the ANN approach was applied to analyze COVID-19 new cases in Lithuania. 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 the pandemic will disappear in the country around early April 2021. Amongst other suggested policy directions, there is need for the government of Lithuania 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 was initially identified in Wuhan City, China in December 2019 before spreading fast to all the corners of the Earth (Kriancioniene et al, 2020). The first case of COVID-19 in Lithuania was reported on the 28th of February 2020. The government responded by imposing a national lockdown from 16-30 March 2020 following an alarming increase in the daily COVID-19 cases (Lithuania, 2020). The state also directed closure of schools and non-essential businesses, temporary ban of public gatherings and enforcement of public health measures to mitigate COVID-19 spread. The country succeeded in controlling the first wave of COVID-19. By the 30th of June 2020 the country had a few confirmed cases and deaths (Roser et al, 2020). The purpose of this study is to model and predict daily COVID-19 cases in Lithuania using the Multilayer perceptron. This machine learning algorithm has gained wide spread popularity and acceptance because of its capability to model nonlinear data and demonstrated by recent researches (Maradze et al, 2021; Nyoni et al, 2021; Nyoni & Nyoni, 2021; Nyoni et al, 2020; Zhao et al, 2020). The findings of this piece of work are expected to highlight the likely future trends of COVID-19 in the country and help in the allocation of resources to fight the epidemic.

II. LITERATURE REVIEW

Šmigelskas et al (2021) estimated the sero prevalence of SARS-CoV-2 infection in Lithuanian population. The study was conducted during August–September 2020 in 6 municipalities of Lithuania. The sample comprised 3087 adult participants from the general population (mean age 53.7 years, 64% female). SARS-CoV-2 antibodies were assessed using AMP IgM/IgG Rapid Test, other data were based on self-report. Seroprevalence was assessed as a crude estimate and as adjusted by sensitivity-specificity of the test. The authors concluded that The SARS-CoV-2 seroprevalence in Lithuanian sample in August–September 2020 was 1.4%, ranging from 0.8% to 2.4% across municipalities. Pais & Taveira applied a mathematical model to estimate the strength of Government-Imposed Measures (GIM) and predicted the impact of the degree of compliance on the number of infected cases and peak of infection. The estimated peak was around 650 thousand infected cases with 53 thousand requiring hospital care by the beginning of May if no measures were taken. Ahmad & Asad (2020) applied an artificial neural network with rectifying linear unit based technique 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 study concluded that the model is 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 Lithuania.

Data Issues

This study is based on daily new cases of COVID-19 in Lithuania 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	0.093677
MSE	58714.863964
MAE	149.217886

Residual Analysis for the Applied Model

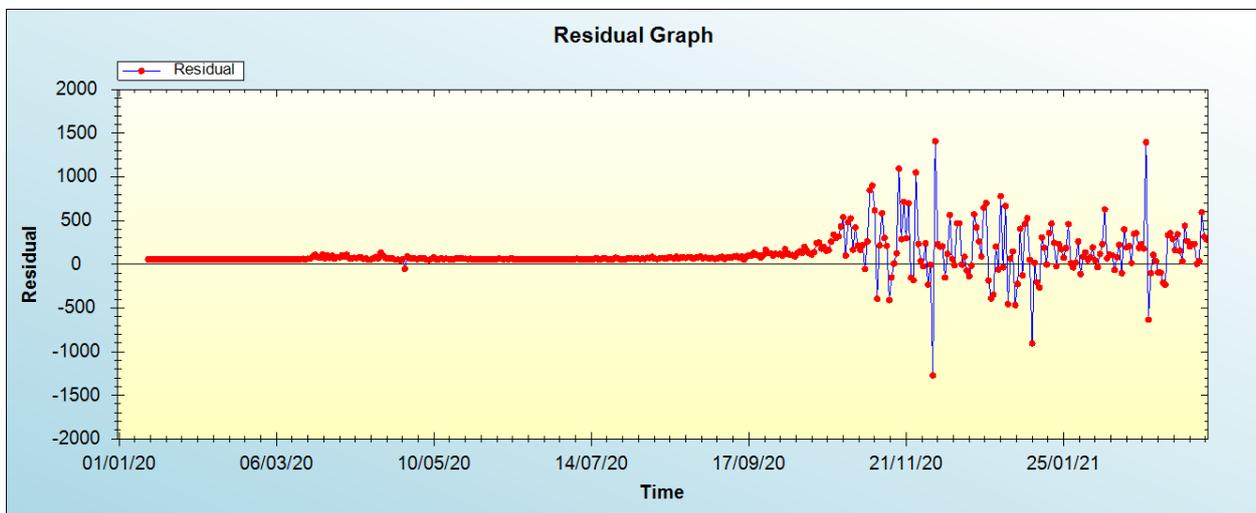


Figure 1: Residual analysis

In-sample Forecast for L

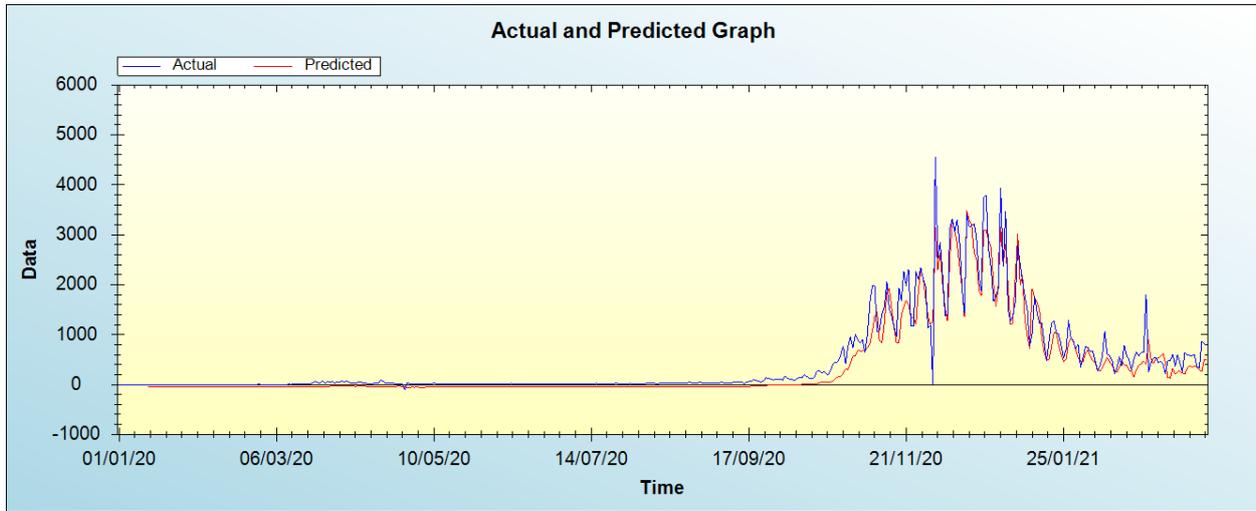


Figure 2: In-sample forecast for the L series

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

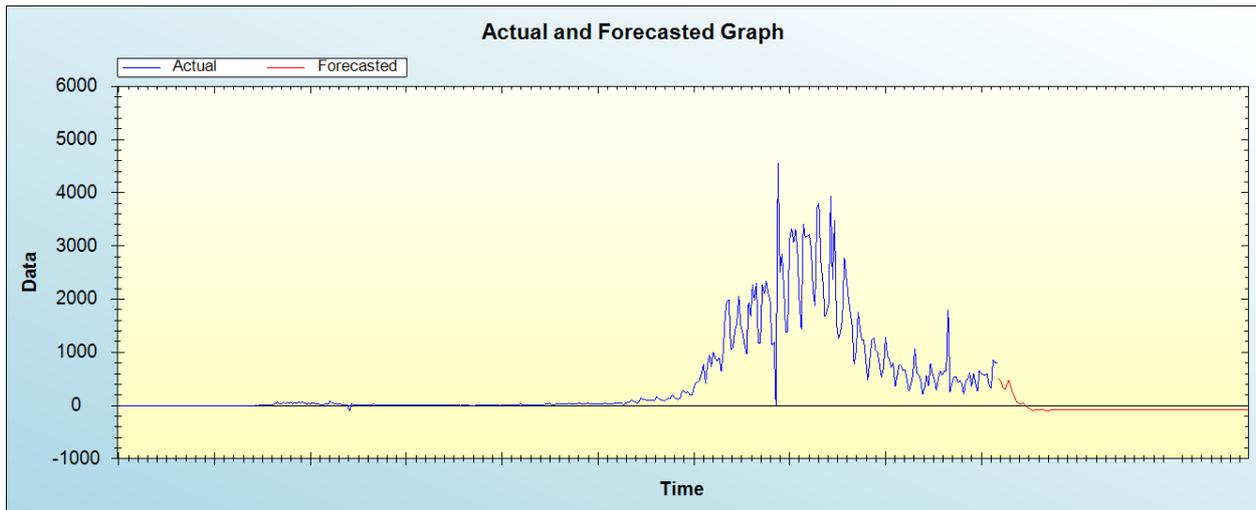


Figure 3: Out-of-sample forecast for L: actual and forecasted graph

Out-of-Sample Forecast for L: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date/Month/Year	Forecasts
26/03/21	508.2426
27/03/21	452.6665
28/03/21	337.2821
29/03/21	299.8548
30/03/21	386.7449
31/03/21	475.3886
01/04/21	359.0325
02/04/21	242.3450
03/04/21	172.5428
04/04/21	67.4037
05/04/21	41.1728
06/04/21	20.5751
07/04/21	50.2324
08/04/21	26.3732
09/04/21	14.5174

10/04/21	-45.3150
11/04/21	-66.8145
12/04/21	-88.3387
13/04/21	-85.6776
14/04/21	-77.9834
15/04/21	-75.1408
16/04/21	-76.1305
17/04/21	-83.5655
18/04/21	-86.3706
19/04/21	-90.5618
20/04/21	-90.0887
21/04/21	-86.0538
22/04/21	-82.4683
23/04/21	-81.6062
24/04/21	-81.1596
25/04/21	-82.3665
26/04/21	-83.1378
27/04/21	-83.1976
28/04/21	-82.5019
29/04/21	-81.1249
30/04/21	-80.5408
01/05/21	-80.3457
02/05/21	-80.5031
03/05/21	-80.8991
04/05/21	-81.1621
05/05/21	-81.0411
06/05/21	-80.8483
07/05/21	-80.5832
08/05/21	-80.5062
09/05/21	-80.5554
10/05/21	-80.6620
11/05/21	-80.8031
12/05/21	-80.8409
13/05/21	-80.8009
14/05/21	-80.7459
15/05/21	-80.7013
16/05/21	-80.6942
17/05/21	-80.7299
18/05/21	-80.7651
19/05/21	-80.7950
20/05/21	-80.7943
21/05/21	-80.7775
22/05/21	-80.7625
23/05/21	-80.7529
24/05/21	-80.7559
25/05/21	-80.7672
26/05/21	-80.7760
27/05/21	-80.7795
28/05/21	-80.7769
29/05/21	-80.7707
30/05/21	-80.7669
31/05/21	-80.7655
01/06/21	-80.7674
02/06/21	-80.7706
03/06/21	-80.7722
04/06/21	-80.7723
05/06/21	-80.7710
06/06/21	-80.7693
07/06/21	-80.7685
08/06/21	-80.7686
09/06/21	-80.7693
10/06/21	-80.7702
11/06/21	-80.7704
12/06/21	-80.7702

13/06/21	-80.7698
14/06/21	-80.7694
15/06/21	-80.7693
16/06/21	-80.7694
17/06/21	-80.7697
18/06/21	-80.7699
19/06/21	-80.7699
20/06/21	-80.7698
21/06/21	-80.7696
22/06/21	-80.7696
23/06/21	-80.7696
24/06/21	-80.7696
25/06/21	-80.7697
26/06/21	-80.7697
27/06/21	-80.7697
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26/07/21	-80.7697
27/07/21	-80.7697
28/07/21	-80.7697
29/07/21	-80.7697
30/07/21	-80.7697
31/07/21	-80.7697

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 the pandemic will disappear in the country around early April 2021.

V. CONCLUSION AND POLICY RECOMMENDATIONS

In this study we proposed the artificial neural network approach to predict daily COVID-19 cases in Lithuania. This machine learning algorithm is widely used in many empirical studies across the globe especially in time series forecasting problems. The Multilayer perceptron was the chosen artificial neural framework because of its popularity and high accuracy of forecasts. The results of the study revealed that the pandemic will disappear in the country around early April 2021.. Therefore the government should continue enforcing adherence to COVID-19 public health mitigation measures.

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