

Forecasting Covid-19 New Cases in Liechtenstein

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 Liechtenstein. 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 Liechtenstein are likely to rise up to around 55 cases per day over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Liechtenstein 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 epidemic in China was reported to WHO following cases of pneumonia of unknown origin (WHO, 2019). On the 11th of March 2020 WHO declared the disease as a global health threat due to its rapid spread and associated morbidity and high mortality (WHO, 2020; CDC, 2020; Wolf et al, 2020). Predictive modeling is one of the important tools required to predict epidemiological incidences such as confirmed COVID-19 cases, recoveries and deaths (Mazen, 2020). The prediction of daily COVID-19 cases helps health authorities to update their precautionary measures and prepare resources which will be used in hospitals such as equipment and human resources. Machine learning methods have been applied by many researchers to model and forecast daily coronavirus cases (Nyoni et al, 2021; Nyoni et al, 2020; Rustan et al, 2020; Zheng et al, 2020; Li et al, 2020; Silver et al, 2020; Yan et al, 2020) and the results have shown high forecasting accuracy. In this paper we apply the artificial neural network approach to predict daily COVID-19 cases in Liechtenstein and the findings of the study are expected to highlight future trends of SARS-COV2 infections to facilitate planning and allocation of resources to curb the spread of the virus.

II. LITERATURE REVIEW

Yang et al (2020) applied a Simple linear regression model to analyze COVID-19 cases. The findings of the study showed that the case fatality rate (CFR) of COVID-19 is lower than the previous corona virus epidemics caused by SARS COV and MERS COVS. An artificial intelligence technique was applied by Hu et al (2020) to predict the evolution of the COVID-19 epidemic in China. The results showed that the model predicted that the epidemic of COVID-19 will be over by mid-April 2020. Lakman et al (2020) evaluated the effectiveness of the ARIMA, SIRD, and Holt's exponential smoothing models to predict COVID-19 morbidity, mortality and survival in Russia. The study concluded that prediction of short term morbidity and mortality and survival of patients with an accuracy of 90% in Russia Federation in general. Moscow and Moscow region have maximum spread of the corona virus and other regions lagging behind in the dynamics of the incidence by 1-3 weeks. Qi et al (2020) examined the dynamics of the disease in Sweden using the SI, SIR and SID models. The findings indicated that all models reproduced well the number of infected cases and gave similar predictions.

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 in Liechtenstein.

Data Issues

This study is based on daily new cases of COVID-19 in Liechtenstein 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	0.110782
MSE	14.560563
MAE	2.654032

Residual Analysis for the Applied Model

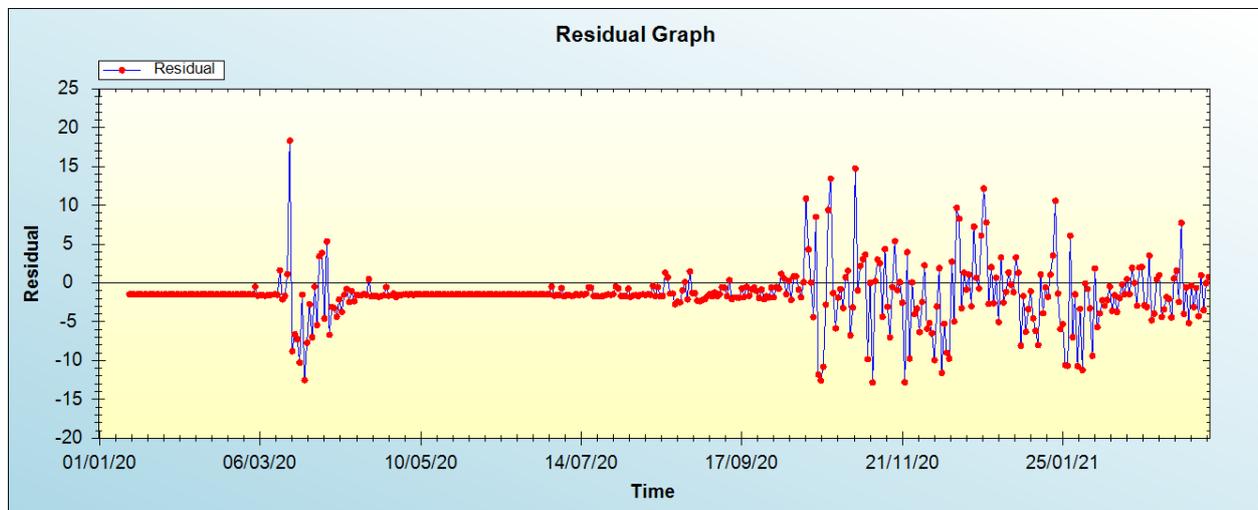


Figure 1: Residual analysis

In-sample Forecast for L

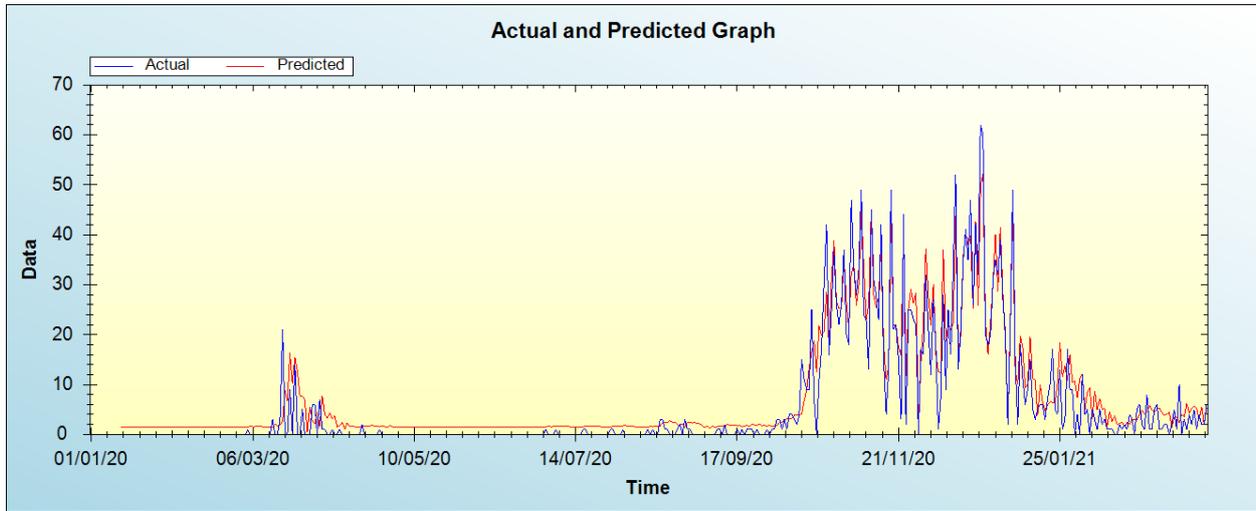


Figure 2: In-sample forecast for the L series

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

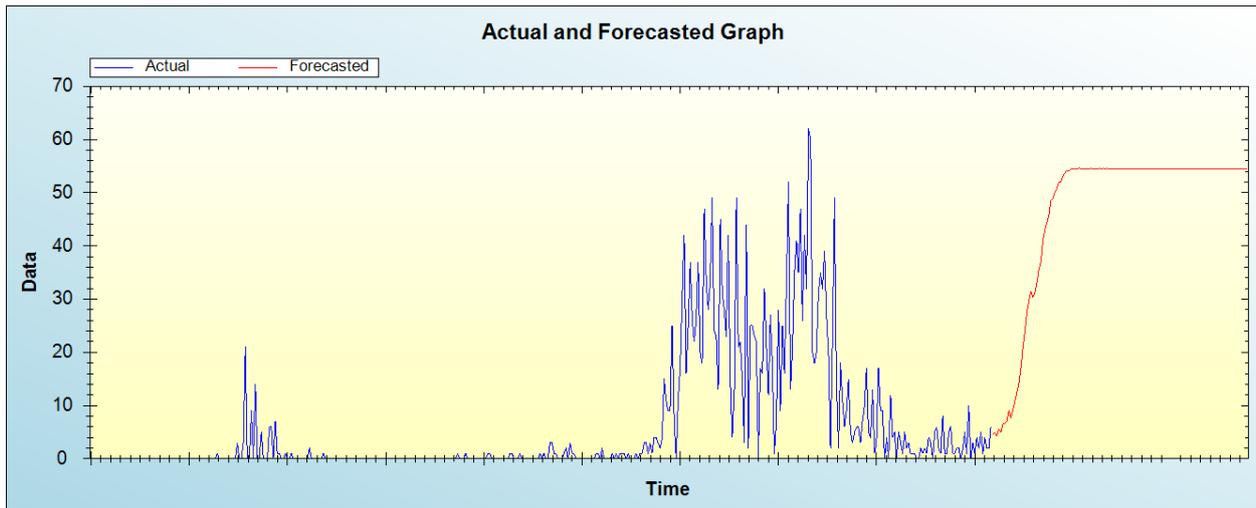


Figure 3: Out-of-sample forecast for L: actual and forecasted graph

Out-of-Sample Forecast for L: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	4.6283
27/03/21	4.8555
28/03/21	4.2780
29/03/21	5.5983
30/03/21	4.9397
31/03/21	6.4718
01/04/21	6.6084
02/04/21	7.0469
03/04/21	9.1300
04/04/21	7.5644
05/04/21	9.1117
06/04/21	10.7120
07/04/21	12.4699
08/04/21	14.1314
09/04/21	17.0388

10/04/21	20.8374
11/04/21	23.7159
12/04/21	27.5193
13/04/21	29.6325
14/04/21	31.4849
15/04/21	30.2929
16/04/21	31.2064
17/04/21	33.0517
18/04/21	35.5902
19/04/21	36.8923
20/04/21	40.9091
21/04/21	43.0149
22/04/21	44.3726
23/04/21	45.6083
24/04/21	48.5048
25/04/21	48.9877
26/04/21	50.0147
27/04/21	50.7733
28/04/21	51.9626
29/04/21	52.0022
30/04/21	53.1281
01/05/21	53.7034
02/05/21	54.1760
03/05/21	54.1094
04/05/21	54.4772
05/05/21	54.4045
06/05/21	54.5102
07/05/21	54.4709
08/05/21	54.6128
09/05/21	54.4821
10/05/21	54.5395
11/05/21	54.4895
12/05/21	54.5426
13/05/21	54.4890
14/05/21	54.5542
15/05/21	54.5247
16/05/21	54.5532
17/05/21	54.5271
18/05/21	54.5589
19/05/21	54.5337
20/05/21	54.5534
21/05/21	54.5384
22/05/21	54.5527
23/05/21	54.5365
24/05/21	54.5488
25/05/21	54.5386
26/05/21	54.5469
27/05/21	54.5391
28/05/21	54.5469
29/05/21	54.5404
30/05/21	54.5457
31/05/21	54.5413
01/06/21	54.5456
02/06/21	54.5418
03/06/21	54.5451
04/06/21	54.5423
05/06/21	54.5447
06/06/21	54.5425
07/06/21	54.5444
08/06/21	54.5427
09/06/21	54.5442
10/06/21	54.5429
11/06/21	54.5440
12/06/21	54.5430

13/06/21	54.5439
14/06/21	54.5432
15/06/21	54.5438
16/06/21	54.5432
17/06/21	54.5438
18/06/21	54.5433
19/06/21	54.5437
20/06/21	54.5433
21/06/21	54.5437
22/06/21	54.5434
23/06/21	54.5436
24/06/21	54.5434
25/06/21	54.5436
26/06/21	54.5434
27/06/21	54.5436
28/06/21	54.5435
29/06/21	54.5436
30/06/21	54.5435
01/07/21	54.5435
02/07/21	54.5435
03/07/21	54.5435
04/07/21	54.5435
05/07/21	54.5435
06/07/21	54.5435
07/07/21	54.5435
08/07/21	54.5435
09/07/21	54.5435
10/07/21	54.5435
11/07/21	54.5435
12/07/21	54.5435
13/07/21	54.5435
14/07/21	54.5435
15/07/21	54.5435
16/07/21	54.5435
17/07/21	54.5435
18/07/21	54.5435
19/07/21	54.5435
20/07/21	54.5435
21/07/21	54.5435
22/07/21	54.5435
23/07/21	54.5435
24/07/21	54.5435
25/07/21	54.5435
26/07/21	54.5435
27/07/21	54.5435
28/07/21	54.5435
29/07/21	54.5435
30/07/21	54.5435
31/07/21	54.5435

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 Liechtenstein are likely to rise up to around 55 cases per day over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

The effects of the COVID-19 pandemic have been felt in most countries. The pandemic has resulted in health, social and economic problems of which some of these problems will never find an immediate solution. However with accurate predictive modeling, governments can plan and prepare adequate resources to deal with future waves of the COVID-19 virus. Hence in this study we apply the ANN (12, 12, 1) model to predict daily COVID-19 cases in Liechtenstein. The findings of the study indicate that daily COVID-19 cases in Liechtenstein are likely to rise up to around 55 cases per day over the out-of-sample period. Based

on these findings the government should continuously enforce adherence to the WHO guidelines on prevention and control of COVID-19.

REFERENCES

- [1] 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.
- [2] F. Rustam., A. MEHMOOD., A. RESHI., S. ULLAH., B.-W. ON., W. ASLAM and G. S. CHOI(2020), "COVID-19 Future Forecasting Using Supervised Machine Learning Models," *IEEE Access* , vol. 8, pp. 101489 - 101499.
- [3] Maradze, T. C., Nyoni, S. P., & Nyoni, T (2021). Modeling and Forecasting COVID-19 mortalities in the United States of America using artificial neural networks (ANN). *International Journal of innovations in Engineering and Technology (IRJIET)*, 5 (3):533-539
- [4] N. Zheng., S. Du., J. Wang., H. Zhang., W. Cui., T. Yang., B. Lou., Y. Chi., H. Long., M. Ma., Q. Yuan & S. Zhang (2020). "Predicting COVID-19 in China Using Hybrid AI Model," *IEEE Trans Cybern.*
- [5] 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.
- [6] Tamer Sh. Mazen (2020). A Novel Machine Learning based Model for COVID-19 Prediction, (IJACSA) *International Journal of Advanced Computer Science and Applications*, Vol. 11, No. 11, 2020
- [7] Thomas Gerhard Wolf., Oliver Zeyer and Guglielmo Campus (2020), COVID-19 in Switzerland and Liechtenstein: A Cross-Sectional Survey among Dentists' Awareness, Protective Measures and Economic Effects, *Int. J. Environ. Res. Public Health* 2020, 17, 9051; doi:10.3390/ijerph17239051
- [8] World Health Organization (2020). Coronavirus Disease (COVID-19) Weekly Epidemiological Update and Weekly Operational Update. Available online: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>.
- [9] World Health Organization (2020). Rolling Updates on Coronavirus Disease (COVID-19). Available online: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline>.
- [10] Yan, L., Zhang, H., Goncalves, J (2020). "An interpretable mortality prediction model for COVID-19 patients," *Nature Machine Intelligence*, vol. 2, pp. 283-288.

Citation of this Article:

Dr. Smartson. P. NYONI, Mr. Thabani NYONI, Mr. Tatenda. A. CHIHOHO, "Forecasting Covid-19 New Cases in Liechtenstein" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 6, pp 298-303, June 2021. Article DOI <https://doi.org/10.47001/IRJIET/2021.506053>
