Forecasting Covid-19 New Cases in Iceland

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Abstract - **In this study, the ANN approach was applied to analyze COVID-19 new cases in Iceland. 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 Iceland are likely to remain between 0 and 100 cases per day over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Iceland to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

Iceland is an island country with an estimated population size of around 364 000 people, with only one major gateway to into the country (Gudbjartsson et al, 2020). The country reported its first case of COVID-19 on the 28th of February 2020 in returnee from Northern Italy (Gudbjartsson et al, 2020). Iceland authorities responded to the pandemic by isolating all COVID-19 positive cases and systematic contact tracing (Erythorsson et al, 2020). The government rolled out mass COVID-19 testing to ensure early detection, treatment and isolation of cases (Hasell et al, 2020). In addition the authorities wearing of face masks, social distancing and hygiene practices and these measures were effective in controlling the epidemic (Directorate of Health Iceland, 2020).This paper aims to predict daily COVID-19 cases using the multilayer perceptron (MLP) neural network. The MLPis widely used in time series forecasting and has been proven to produce reliable results (Nyoni & Nyoni, 2021; Nyoni et al, 2021; Maradze et al, 2021; Nyoni et al, 2020; Zhao et al, 2020).

II. LITERATURE REVIEW

Gudbjartsson et al (2020) investigated the spread of COVID-19 in the Iceland population. The study did targeted testing of persons living in Iceland who were at high risk for infection (mainly those who were symptomatic, had recently traveled to high-risk countries, or had contact with infected persons).They also carried out population screening using two strategies: issuing an open invitation to 10,797 persons and sending random invitations to 2283 persons and sequenced SARS-CoV-2 from 643 samples. The study concluded that children under 10 years of age and females had a lower incidence of SARS-CoV-2 infection than adolescents or adults and males. The proportion of infected persons identified through population screening did not change substantially during the screening period, which was consistent with a beneficial effect of containment efforts. Ettensperger (2020) investigated thoroughly the link between poverty related indicators and case and mortality rates of the outbreak using multivariate, multilevel regression while also considering the urban-rural divide of the country. As proxies for poverty the unemployment rate, the per capita presence of general practitioners (physicians), per capita GDP, and the rate of employees with no professional job training is evaluated in relation to the accumulated case and mortality numbers on district level taken from RKI data of June and July 2020.The study found out that there was no evidence for a poverty-related effect on mortality for German districts. Furthermore, only employment in low qualification jobs approximated by the job training variable consistently affected case numbers in urban districts in the expected direction. Khanday et al (2020) forecasted the spread of COVID-19 in Hungary. Different methods effective for short-term forecasting are applied to the dataset, and predictions are made for the next 20 days. Autoregression and other exponential smoothing methods are applied to the dataset. SIR model is used and predicted 64% of the population could be infected by the virus considering the whole population is susceptible to be infectious Autoregression, and exponential smoothing methods indicated there would be more than a 60% increase in the cases in the coming 20 days. The doubling of the number of total cases is found to be around 16 days using an effective reproduction number. Eythorsson et al (2020) characterized the symptoms of coronavirus disease 2019 (covid-19). All individuals who tested positive for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by reverse transcription polymerase chain reaction (RT-PCR) between 17

March and 30 April 2020. Cases were identified by three testing strategies: targeted testing guided by clinical suspicion, open invitation population screening based on self-referral, and random population screening. All identified cases were enrolled in a tele health monitoring service, and symptoms were systematically monitored from diagnosis to recovery. The study revealed that in the setting of broad access to RT-PCR testing, most SARS-CoV-2-positive people were found to have mild symptoms.

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 Iceland.

Data Issues

This study is based on daily new cases of COVID-19 in Iceland 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	C
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	0.130019
MSE	59.736461
MAE	5.584207

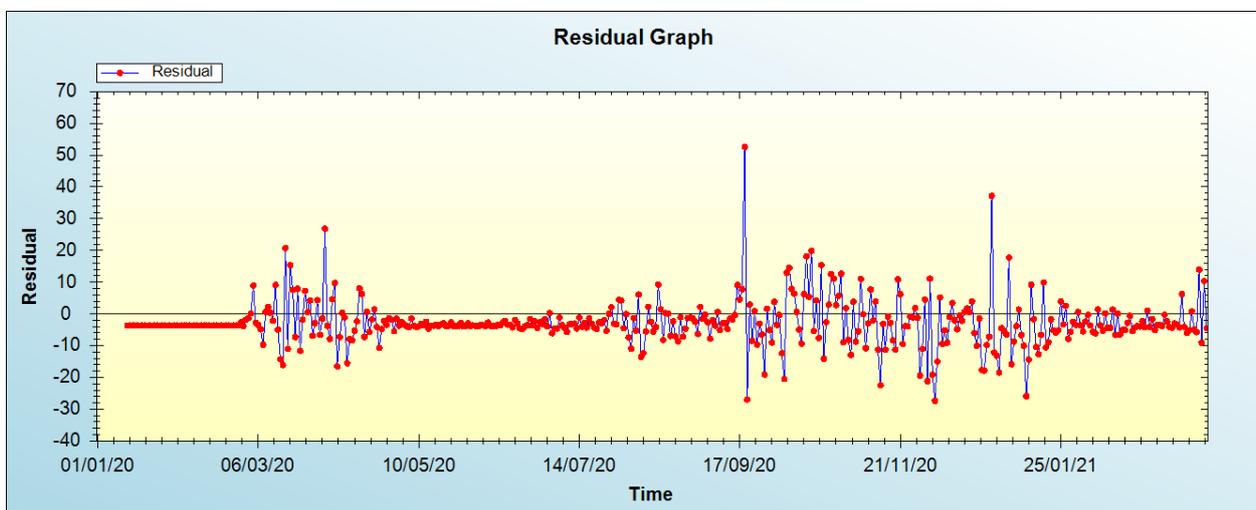*Residual Analysis for the Applied Model*

Figure 1: Residual analysis
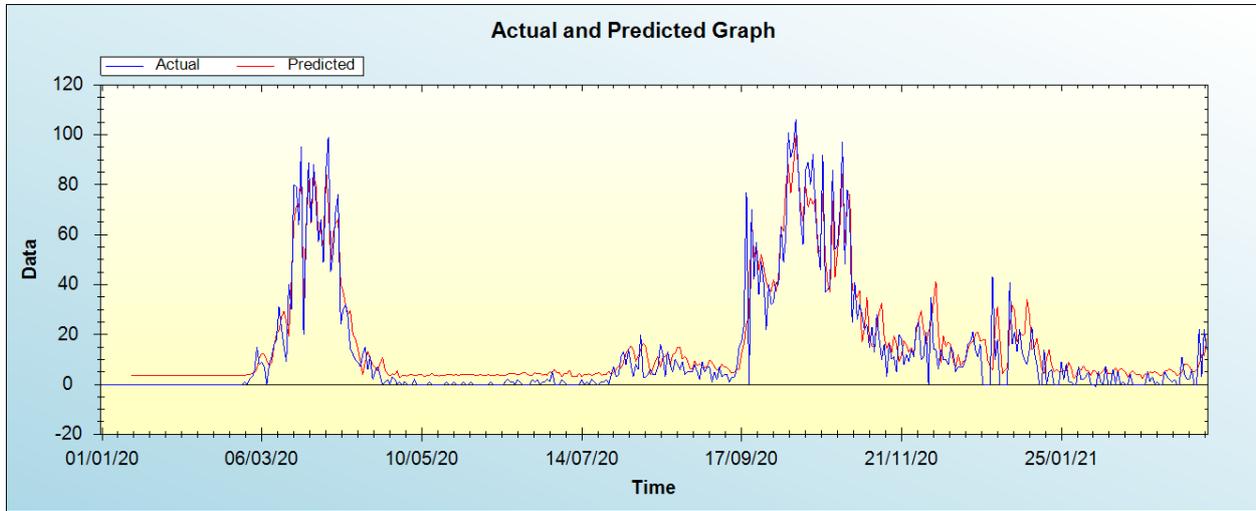
In-sample Forecast for C

Figure 2: In-sample forecast for the C series

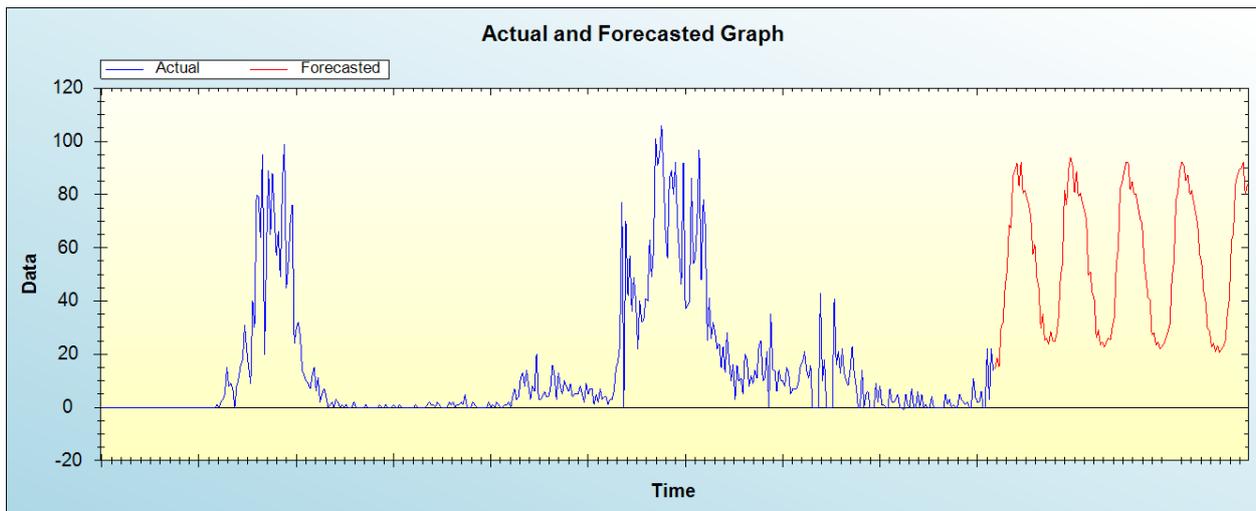*Out-of-Sample Forecast for C: Actual and Forecasted Graph*

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

Out-of-Sample Forecast for C: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	14.7024
27/03/21	18.6408
28/03/21	15.0178
29/03/21	30.1947
30/03/21	31.8993
31/03/21	45.7526
01/04/21	51.3685
02/04/21	68.7210
03/04/21	67.3788
04/04/21	87.1977
05/04/21	89.2428
06/04/21	91.7896
07/04/21	83.2011

08/04/21	92.0701
09/04/21	80.4648
10/04/21	81.6451
11/04/21	78.6097
12/04/21	76.1430
13/04/21	71.4322
14/04/21	57.4121
15/04/21	61.1628
16/04/21	48.5908
17/04/21	44.7861
18/04/21	29.8636
19/04/21	35.0091
20/04/21	25.1721
21/04/21	26.0671
22/04/21	23.6825
23/04/21	28.5406
24/04/21	24.9937
25/04/21	24.7720
26/04/21	27.7423
27/04/21	33.9763
28/04/21	49.5541
29/04/21	54.2187
30/04/21	81.5596
01/05/21	76.1420
02/05/21	89.5722
03/05/21	93.9359
04/05/21	91.1303
05/05/21	80.7709
06/05/21	88.6389
07/05/21	79.1640
08/05/21	80.4352
09/05/21	76.8281
10/05/21	73.9390
11/05/21	70.4167
12/05/21	49.7008
13/05/21	50.9086
14/05/21	43.0917
15/05/21	40.4560
16/05/21	26.0820
17/05/21	29.1563
18/05/21	23.5423
19/05/21	24.6573
20/05/21	22.7974
21/05/21	24.3443
22/05/21	26.1257
23/05/21	25.2506
24/05/21	30.0610
25/05/21	33.6048
26/05/21	53.7389
27/05/21	59.1860
28/05/21	82.2040
29/05/21	84.5056
30/05/21	88.8421
31/05/21	92.2049
01/06/21	91.9088
02/06/21	81.8535
03/06/21	84.9572
04/06/21	80.0678
05/06/21	80.1257
06/06/21	75.4797
07/06/21	70.9999
08/06/21	68.9984
09/06/21	54.5215
10/06/21	48.5752

11/06/21	41.3829
12/06/21	40.5286
13/06/21	27.3592
14/06/21	27.9489
15/06/21	23.3187
16/06/21	24.6440
17/06/21	21.9997
18/06/21	22.7901
19/06/21	23.9778
20/06/21	25.8040
21/06/21	28.2705
22/06/21	31.1430
23/06/21	48.5394
24/06/21	54.4844
25/06/21	77.6521
26/06/21	81.0062
27/06/21	88.7375
28/06/21	92.3687
29/06/21	91.2209
30/06/21	85.1688
01/07/21	87.4160
02/07/21	79.8919
03/07/21	81.4589
04/07/21	77.0648
05/07/21	73.2075
06/07/21	68.8730
07/07/21	57.4494
08/07/21	54.2746
09/07/21	43.3754
10/07/21	39.8677
11/07/21	29.3245
12/07/21	28.8327
13/07/21	22.6720
14/07/21	23.9977
15/07/21	20.8782
16/07/21	23.3137
17/07/21	20.6505
18/07/21	21.9659
19/07/21	22.8358
20/07/21	25.2127
21/07/21	35.3802
22/07/21	40.6418
23/07/21	62.7814
24/07/21	65.0732
25/07/21	83.3539
26/07/21	87.3157
27/07/21	89.3365
28/07/21	89.9735
29/07/21	92.1544
30/07/21	80.1736
31/07/21	83.6439

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 Iceland are likely to remain between 0 and 100 cases per day over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

The COVID-19 pandemic has caused numerous problems around the globe which include disruption of economic activities and increase in vulnerability of groups such as the elderly, disabled and migrant workers. In addition, many people have suffered or died from the deadly virus and others have lost their jobs. The future is still uncertain however predictive modeling can help to reveal likely future trends of the disease and facilitate adequate resource mobilization and implementation of measures to

control the pandemic. In this study we applied the artificial neural network approach to predict daily COVID-19 cases in Iceland. The results indicate that daily COVID-19 cases in Iceland are likely to remain between 0 and 100 cases per day over the out-of-sample period. Therefore we encourage the government to enforce adherence to public health mitigation measures to control the spread of the virus.

REFERENCES

[1] D.F. Gudbjartsson., A. Helgason., H. Jonsson., O.T. Magnusson, P. Melsted, G.L. Norddahl., J. Saemundsdottir., A. Sigurdsson., P. Sulem., A.B. Agustsdottir., B. Eiriksdottir., R. Fridriksdottir., E.E. Gardarsdottir., G. Georgsson, O.S. Gretarsdottir, K.R. Gudmundsson, T.R. Gunnarsdottir, A. Gylfason., H. Holm, B.O. Jensson., A. Jonasdottir, F. Jonsson, K.S. Josefsdottir, T. Kristjansson, D.N. Magnusdottir., L. le Roux, G. Sigmundsdottir., G. Sveinbjornsson., K.E. Sveinsdottir, M. Sveinsdottir., E.A. Thorarensen., B. Thorbjornsson., A. Löve., G. Masson., I. Jonsdottir., A.D. Möller., T. Gudnason., K.G. Kristinsson., U. Thorsteinsdottir., and K. Stefansson(2020). Spread of SARS-CoV-2 in the Icelandic Population, engl j med 382;24 nejm.org June 11, 2020

[2] Elias Eythorsson., Dadi Helgason., Ragnar Freyr Ingvarsson., Helgi K Bjornsson., Lovisa Bjork Olafsdottir., Valgerdur Bjarnadottir., Hrafnhildur Linnet Runolfsdottir., Solveig Bjarnadottir., Arnar Snaer Agustsson., Kristin Oskarsdottir., Hrafn Hliddal Thorvaldsson., Gudrun Kristjansdottir., Brynja Armannsdottir., Agnar Bjarnason., Birgir Johannsson., Olafur Gudlaugsson., Magnus Gottfredsson., Martin I Sigurdsson., Olafur S Indridason., & Runolfur Palsson (2020). Clinical spectrum of coronavirus disease 2019 in Iceland: population based cohort study, | BMJ 2020;371:m4529 | doi: 10.1136/bmj.m4529

[3] Hasell J., Ortiz-Ospina E., & Mathieu E (2020). Daily COVID-19 tests per thousand people. 2020. https://ourworldindata.org/grapher/full-listdaily-covid-19-tests-per-thousand?country=ECU+IND+IDN+SEN+KOR +USA+LTU+NZL+ISL

[4] 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

[5] 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

[6] Naizhuo Zhao., Katia Charland., Mabel Carabali., Elaine O., Nsoesie., Mathieu MaheuGiroux., Erin Rees., Mengru Yuan., Cesar Garcia Balaguera., Gloria Jaramillo Ramirez., & Kate Zinszer (2020). Machine learning and dengue forecasting: Comparing random forests and artificial neural networks for predicting dengue burden at national and sub-national scales in Colombia. PLOS Neglected Tropical Diseases | https://doi.org/10.1371/journal.pntd.0008056

[7] Nyoni, S. P., & Nyoni, T (2021). Forecasting ART coverage in Kenya using the Multilayer perceptron neural network. International Journal of Innovations in Engineering and Technology (IRJIET), 5 (3): 161-165.

[8] Nyoni, S. P., & Nyoni, T (2021). Forecasting ART coverage in South Africa using the Multilayer perceptron neural network. International Journal of Innovations in Engineering and Technology (IRJIET), 5 (3): 207-211.

[9] Nyoni, S. P., & Nyoni, T (2021). Forecasting infant mortality rate in Gabon using artificial neural networks, IRJIET, 5 (3): 592-596

[10] Nyoni, S. P., & Nyoni, T (2021). Predicting TB incidence in Zimbabwe: Artificial neural networks reveal TB program success, IRJIET, 5(3): 380-384

[11] Smartson. P. Nyoni., Thabani Nyoni., Tatenda. A. Chihoho (2021). Forecasting daily new Covid-19 cases in Botswana using artificial neural networks. International Journal of innovations in Engineering and Technology (IRJIET), 5 (3):177-186

[12] The Directorate of Health in Iceland and the Department of Civil Protection and Emergency Management. COVID-19 in Iceland - statistics. 2020. https://www.covid.is/data

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