

Forecasting Covid-19 New Cases in Ireland

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Abstract - In this study, the ANN approach was applied to analyze COVID-19 new cases in Ireland. 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 Ireland are likely to vanish in early April 2021. Amongst other suggested policy directions, there is need for the government of Ireland 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 remains a serious public health threat in many regions of the world as many people continue to suffer the health effects of the SARS-CoV2 virus. The Republic of Ireland detected the first of COVID-19 on the 29th of February 2020 (Ali et al, 2020). By the 28th of October 2020 the country had reported 58 047 positive cases (Silva et al, 2020). The government responded by implementing measures such as wearing face masks, social distancing, regular hand washing, isolation and treatment of cases and contact tracing. The development of the COVID-19 vaccine brought hope to many people, however vaccine hesitancy has hampered efforts to effectively control the pandemic in Ireland and the UK (Rieger, 2020). In this paper we aim to predict daily COVID-19 cases in Ireland using the multilayer perceptron. The artificial neural network technique has been widely used in forecasting epidemiologic incidences of emerging infectious diseases and health related events (Maradze et al, 2021, Nyoni & Nyoni, 2020; Zhao et al, 2020).

II. LITERATURE REVIEW

Ali et al (2020) investigated the psychological impact of the COVID-19 pandemic among healthcare workers (HCWs) at acute hospital settings in the South East of Ireland, as a crucial step in guiding policies and interventions to maintain their psychological well-being. It was an observational cohort study in which 472 HCWs participated from two distinct acute hospital settings, A and B, in the South East of Ireland. The findings of the study revealed that psychological distress is prevalent among HCWs during the COVID-19 pandemic; screening for adverse mental and emotional outcomes and developing timely tailored preventative measures with effective feedback are vital to protect their psychological well-being, both in the immediate and long-term. Torres et al (2020) predicted a surge in cases in the country and concluded that the ARIMA (1, 2, 1) model was the best model for analyzing COVID-19 cases in the Philippines. Using a SEIRD model, Ghana et al (2020) found out that the COVID-19 pandemic was spreading at a faster rate and that both new cases and deaths would rise in Qatar. Tátrai & Várallyay (2020) examined how well the logistic equation can predict the outcome of COVID-19 epidemic in any regions of the World assuming that the methodology of the testing process, namely the data collection method and social behavior is not changing over the course of time. Estimations for the outcome of this epidemic in several countries was based on the logistic model and the data available on 27 March, 2020. Based on the saturated cases in China, the authors managed to find some criteria to judge the reliability of the 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 Ireland.

Data Issues

This study is based on daily new cases of COVID-19 in Ireland 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	R
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	0.045399
MSE	43055.012415
MAE	136.275874

Residual Analysis for the Applied Model

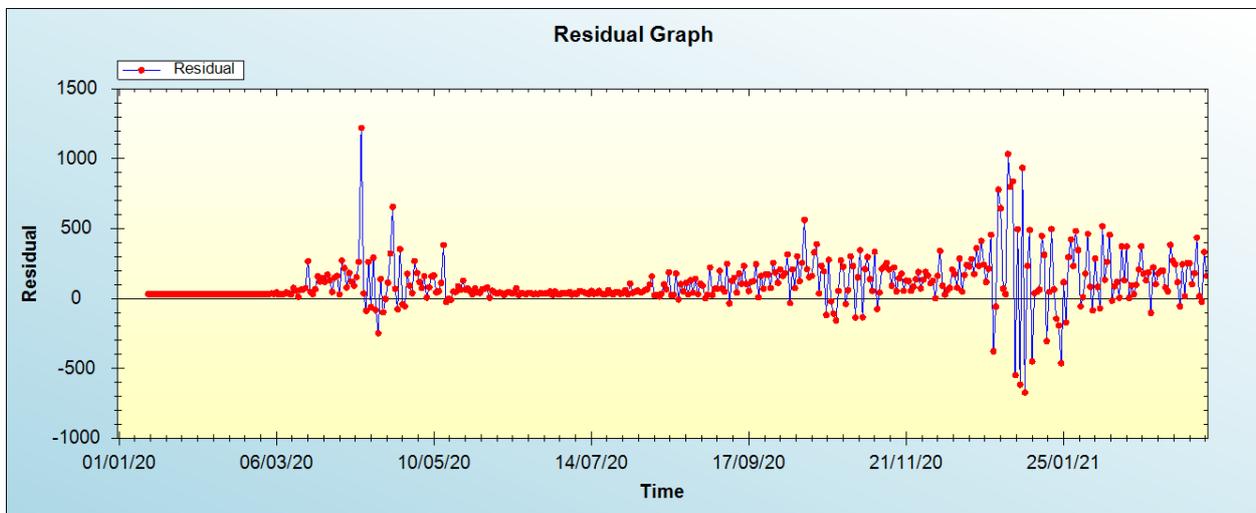


Figure 1: Residual analysis

In-sample Forecast for R

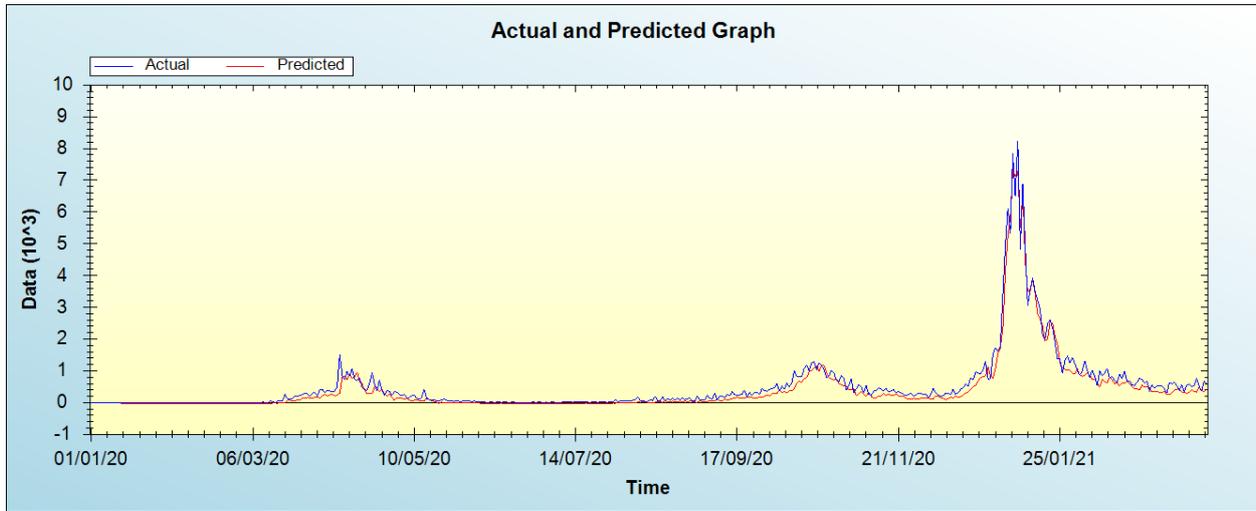


Figure 2: In-sample forecast for the R series

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

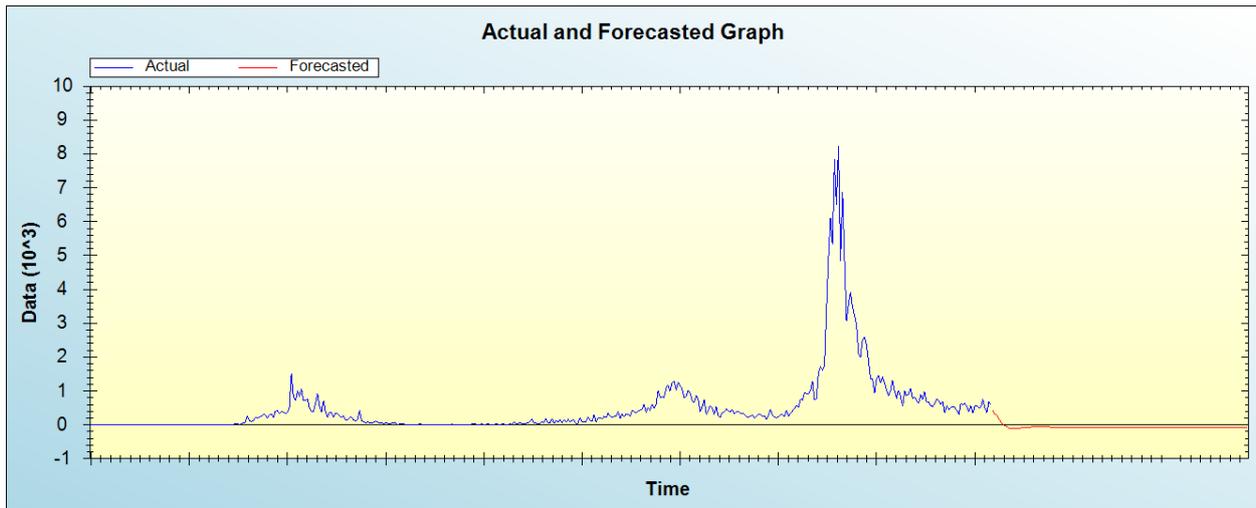


Figure 3: Out-of-sample forecast for R: actual and forecasted graph

Out-of-Sample Forecast for R: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	428.2348
27/03/21	315.6316
28/03/21	287.2532
29/03/21	188.1044
30/03/21	82.2637
31/03/21	25.7456
01/04/21	-28.2732
02/04/21	-53.5768
03/04/21	-100.3900
04/04/21	-110.5206
05/04/21	-109.0474
06/04/21	-107.9646
07/04/21	-106.9935
08/04/21	-101.6657
09/04/21	-90.7342

10/04/21	-85.6122
11/04/21	-78.5257
12/04/21	-73.2706
13/04/21	-67.1996
14/04/21	-63.7627
15/04/21	-62.0272
16/04/21	-60.2813
17/04/21	-59.5193
18/04/21	-59.1614
19/04/21	-59.8464
20/04/21	-60.1949
21/04/21	-60.8744
22/04/21	-61.6185
23/04/21	-62.3649
24/04/21	-62.9973
25/04/21	-63.4112
26/04/21	-63.8475
27/04/21	-64.1103
28/04/21	-64.3073
29/04/21	-64.3735
30/04/21	-64.4142
01/05/21	-64.4071
02/05/21	-64.3510
03/05/21	-64.2892
04/05/21	-64.2141
05/05/21	-64.1548
06/05/21	-64.0878
07/05/21	-64.0368
08/05/21	-63.9954
09/05/21	-63.9664
10/05/21	-63.9466
11/05/21	-63.9334
12/05/21	-63.9301
13/05/21	-63.9297
14/05/21	-63.9339
15/05/21	-63.9389
16/05/21	-63.9459
17/05/21	-63.9527
18/05/21	-63.9587
19/05/21	-63.9641
20/05/21	-63.9683
21/05/21	-63.9717
22/05/21	-63.9738
23/05/21	-63.9753
24/05/21	-63.9759
25/05/21	-63.9760
26/05/21	-63.9758
27/05/21	-63.9753
28/05/21	-63.9747
29/05/21	-63.9740
30/05/21	-63.9734
31/05/21	-63.9728
01/06/21	-63.9724
02/06/21	-63.9721
03/06/21	-63.9718
04/06/21	-63.9717
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27/07/21	-63.9719
28/07/21	-63.9719
29/07/21	-63.9719
30/07/21	-63.9719
31/07/21	-63.9719

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 Ireland are likely to vanish in early April 2021.

V. CONCLUSION AND POLICY RECOMMENDATIONS

Artificial intelligence (AI) is an important subject in public health. AI techniques are fast overtaking the use of traditional statistical methods especially in predictive modeling of infectious diseases. AI technologies may appear to be difficult but they are fast becoming our everyday tool in public health surveillance. Their ability to analyze big data with such speed and accuracy is a great advantage indeed. In this study we applied the artificial neural network approach to predict daily COVID-19 cases in Ireland. The findings indicate that daily COVID-19 cases in Ireland are likely to vanish in early April 2021. Therefore we

encourage the authorities in Ireland to enforce adherence to COVID-19 public health mitigation measures in order to curb the spread of the deadly virus.

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