

Forecasting Covid-19 Deaths in New Zealand

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Abstract - In this study, the ANN approach was applied to analyze COVID-19 deaths in New Zealand. The employed data covers the period 1 January 2020 to 20 April 2021 and the out-of-sample period ranges over the period 21 April 2021 to 31 August 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 country may record no COVID-19 related deaths over the out-of-sample period. Therefore there is need for the government of New Zealand to ensure adherence to safety guidelines and scale up COVID-19 vaccine roll out in order to achieve herd immunity.

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

Mortality from the COVID-19 pandemic continues to be a cause for concern in many countries especially first world nations. The emergence of new COVID-19 strains which are more transmissible has made COVID-19 forecasting a difficult task. The use of artificial intelligence systems to predict COVID-19 confirmed cases and mortality is gaining ground since these technologies have proven to have high predictive accuracy. However under reporting of positive cases & deaths and lack of resources to carryout COVID-19 tests consistently is a major setback for researchers to come up with more accurate forecasts to inform policy and decision making. New Zealand did not escape the COVID-19 crisis. During the first wave of the pandemic, the country reported 22 deaths and the crude overall case fatality rate was 1.4 % (Hendy et al, 2021). The majority of the deaths were in the 62-99 year age group (Hendy et al, 2021). As of 18 June 2021, the country had reported 2 714 confirmed cases, 26 deaths and 2 665 recoveries (Worldometer, 2021)). By the 15th of June 2021, a total of 57 188 people had received at least one dose of the COVID-19 vaccine (representing 11.5 % of the total population) and a total of 324 514 people had been fully vaccinated representing 6.6 % of the population (Our world in data, 2021). These figures indicate that there is still a long way to achieve herd immunity in New Zealand. The purpose of this study is to predict daily COVID-19 deaths in New Zealand using a machine learning technique. The results of this paper are envisioned to provide an insight of the likely future trends of COVID-19 mortality in the country and trigger an appropriate COVID-19 response to curb the spread of the virus.

II. 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 COVID-19 deaths in New Zealand.

Data Issues

This study is based on daily COVID-19 deaths in New Zealand for the period 1 January 2020 – 20 April 2021. The out-of-sample forecast covers the period 21 April – 31 August 2021. All the data employed in this research paper was gathered from the Johns Hopkins University (USA).

III. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	NZ
Observations	464 (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	0.134516
MSE	0.089355
MAE	0.164964

Residual Analysis for the Applied Model

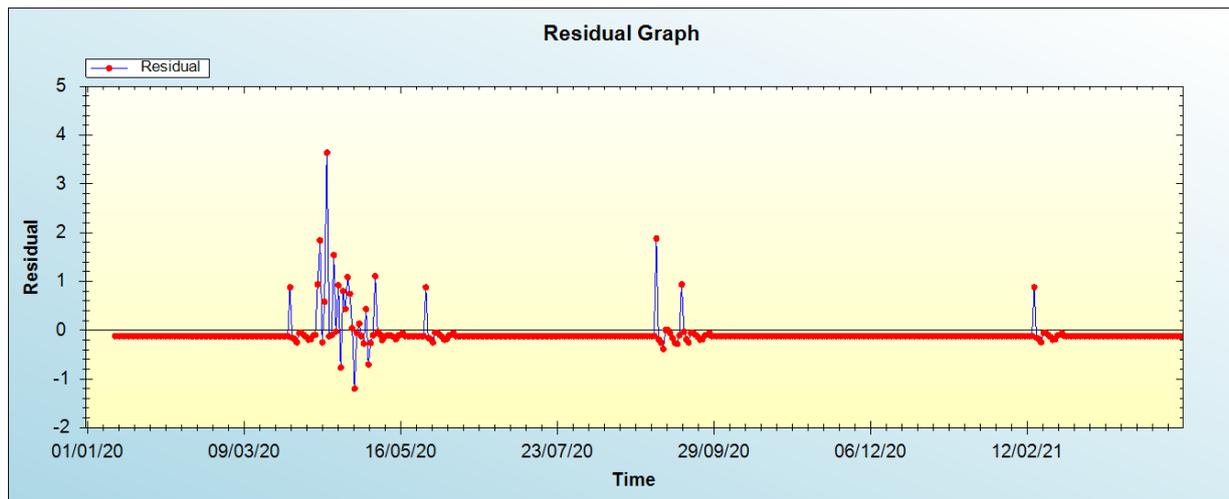


Figure 1: Residual analysis

In-sample Forecast for NZ

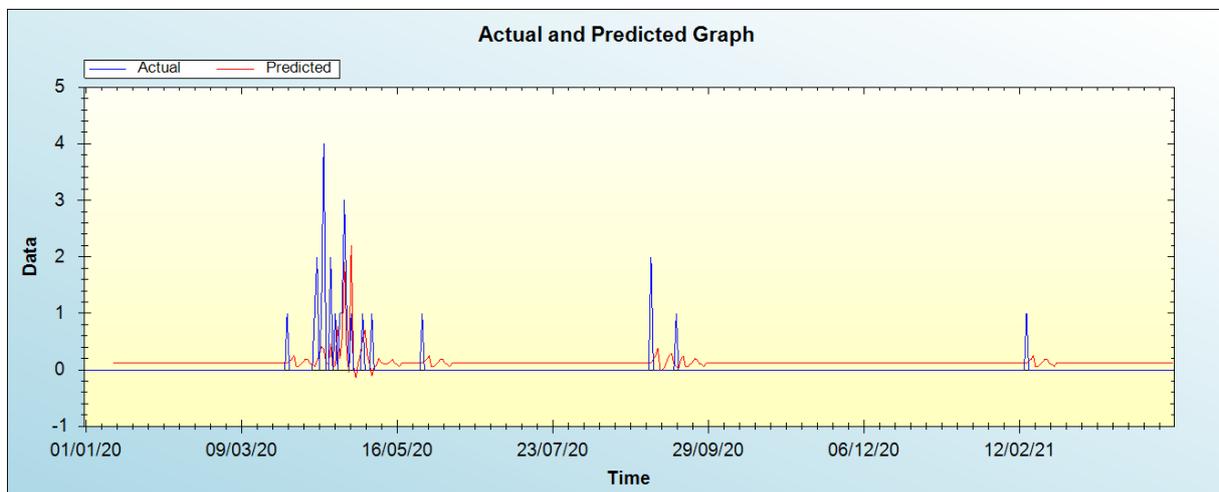


Figure 2: In-sample forecast for the NZ series

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

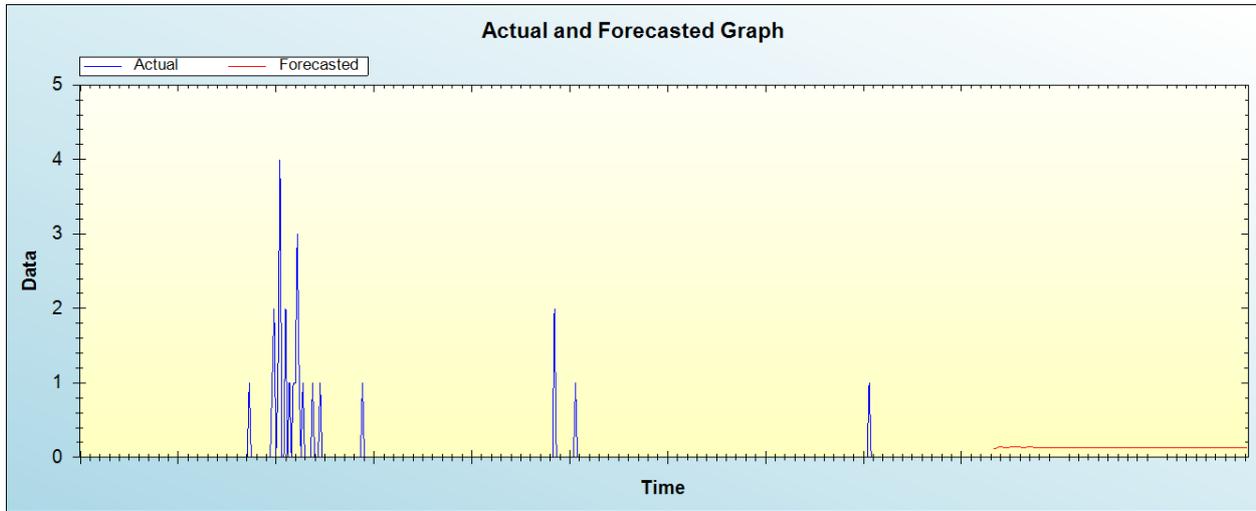


Figure 3: Out-of-sample forecast for NZ: actual and forecasted graph

Out-of-Sample Forecast for NZ: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
21/04/21	0.1197
22/04/21	0.1242
23/04/21	0.1317
24/04/21	0.1470
25/04/21	0.1402
26/04/21	0.1326
27/04/21	0.1305
28/04/21	0.1292
29/04/21	0.1365
30/04/21	0.1452
01/05/21	0.1468
02/05/21	0.1476
03/05/21	0.1413
04/05/21	0.1386
05/05/21	0.1358
06/05/21	0.1335
07/05/21	0.1345
08/05/21	0.1364
09/05/21	0.1376
10/05/21	0.1383
11/05/21	0.1376
12/05/21	0.1364
13/05/21	0.1356
14/05/21	0.1350
15/05/21	0.1352
16/05/21	0.1357
17/05/21	0.1362
18/05/21	0.1367
19/05/21	0.1367
20/05/21	0.1365
21/05/21	0.1362
22/05/21	0.1360
23/05/21	0.1359
24/05/21	0.1360
25/05/21	0.1362
26/05/21	0.1363
27/05/21	0.1364

28/05/21	0.1364
29/05/21	0.1363
30/05/21	0.1362
31/05/21	0.1362
01/06/21	0.1362
02/06/21	0.1362
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29/08/21	0.1362
30/08/21	0.1362
31/08/21	0.1362

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 country may record no COVID-19 related deaths over the out-of-sample period.

IV. CONCLUSION AND POLICY RECOMMENDATIONS

Artificial intelligence techniques are now popular in time series forecasting problems due to their high predictive accuracy and their ability to analyze big data. Artificial intelligence technologies are not only useful in prediction problems but they are also essential in screening, prognosis and diagnosis in clinical care settings. In this paper we applied a machine learning technique to forecast daily COVID-19 deaths in New Zealand and the results of the study revealed that the country may record no COVID-19 related deaths over the out-of-sample period. Therefore we encourage the New Zealand government to speed up COVID-19 vaccination amongst other measures recommended by WHO.

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