

Forecasting Covid-19 Deaths in Nepal

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Abstract - In this study, the ANN approach was applied to analyze COVID-19 deaths in Nepal. 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 daily COVID-19 deaths in Nepal are likely to remain low over the out-of-sample period. Therefore there is need for the government of Nepal to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic and scale up COVID-19 vaccination.

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The entire World is currently experiencing one of the worst health crisis of the 21st century. By the 6th of May 2020, 213 countries and territories had reported approximately 3.8 million confirmed cases of COVID-19 and close to 265 000 deaths (White, 2020; WHO, 2020). At the same time Nepal had recorded 99 positive cases with no death (WHO, 2020). As of 18 June 2021 the country had recorded 615 984 confirmed cases, 8 597 deaths and 545 662 recoveries (Worldometer, 2021). By the 16th of June 2021 a total of 246 925 people had received at least one dose of the COVID-19 vaccine (8.6% of the population) and 691 494 people were fully vaccinated against COVID-19 representing 2.4 % of the population (Our world in data, 2021). Nepal's initial interventions mainly focused on health education, self-isolation, quarantine, social distancing, hygiene and wearing masks (White, 2020). The country is at high risk of COVID-19 complications due to the high prevalence of non-communicable diseases (NCDs) which are the leading cause of deaths in the country (Soneji et al, 2020). In this paper we aim to predict daily COVID mortality in Nepal using an artificial intelligence technique. The results of the study are expected to provide highlights of the likely future trends of COVID-19 deaths in the country and assist in decision making to control the COVID-19 epidemic.

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 Nepal.

Data Issues

This study is based on daily COVID-19 deaths in Nepal 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	N
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	0.084719
MSE	848.792306
MAE	7.353099

Residual Analysis for the Applied Model

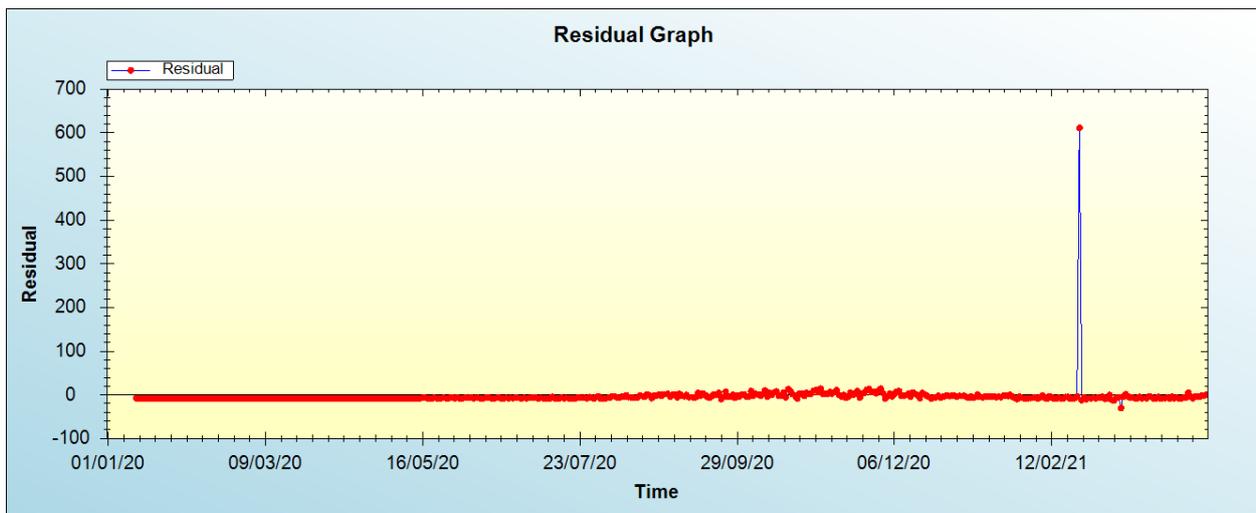


Figure 1: Residual analysis

In-sample Forecast for N

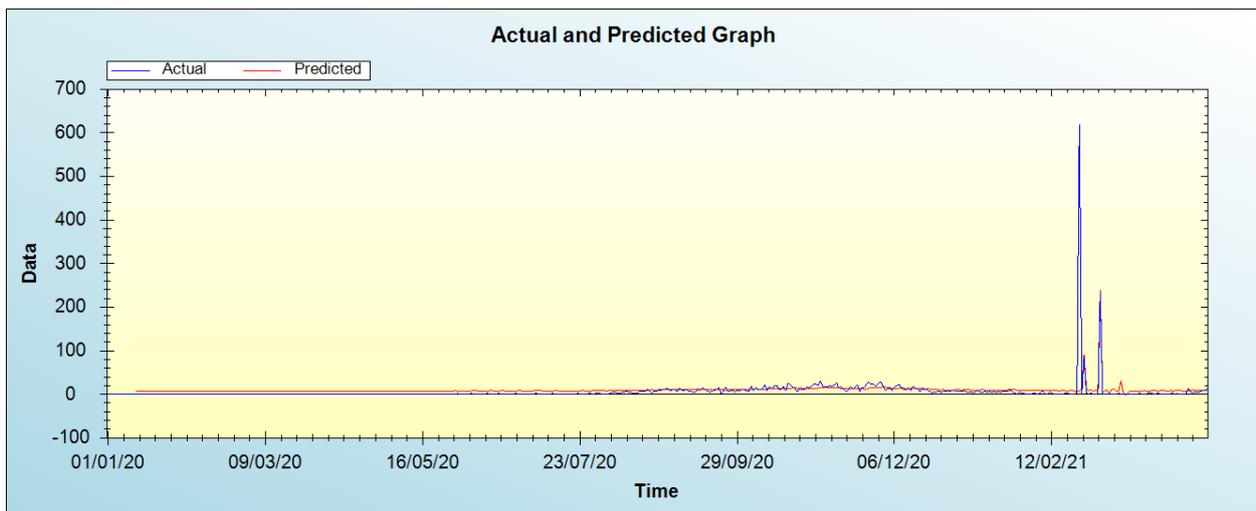


Figure 2: In-sample forecast for the N series

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

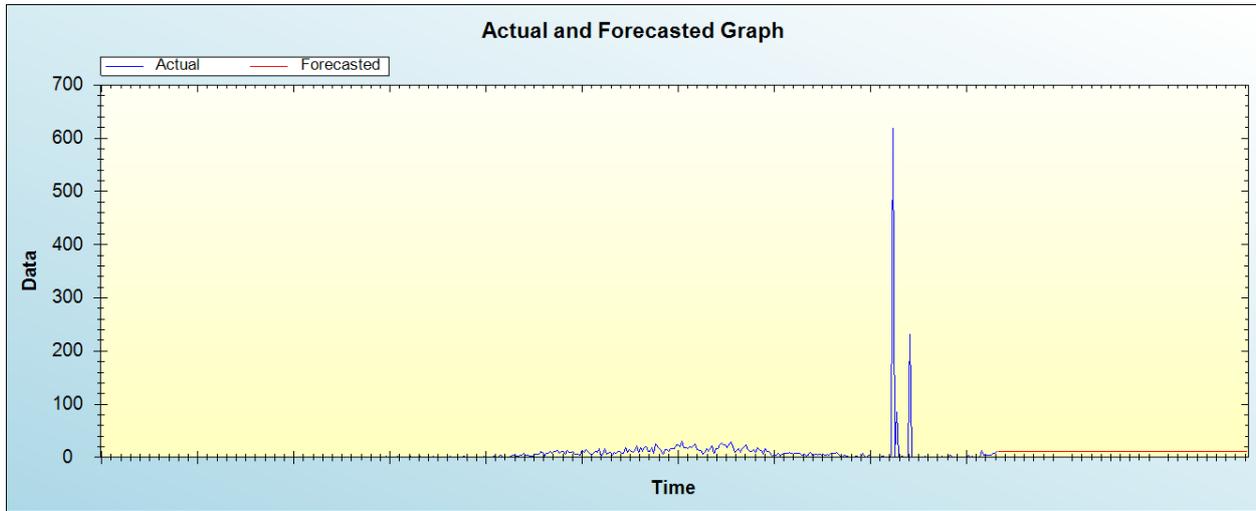


Figure 3: Out-of-sample forecast for N: actual and forecasted graph

Out-of-Sample Forecast for N: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
21/04/21	11.0233
22/04/21	10.9272
23/04/21	10.4940
24/04/21	10.9473
25/04/21	10.9934
26/04/21	11.2536
27/04/21	11.5857
28/04/21	11.6420
29/04/21	11.8668
30/04/21	11.9026
01/05/21	11.8426
02/05/21	11.8208
03/05/21	11.8666
04/05/21	11.8975
05/05/21	11.9305
06/05/21	11.9675
07/05/21	11.9715
08/05/21	11.9871
09/05/21	11.9907
10/05/21	11.9824
11/05/21	11.9815
12/05/21	11.9878
13/05/21	11.9930
14/05/21	11.9971
15/05/21	12.0005
16/05/21	12.0004
17/05/21	12.0012
18/05/21	12.0016
19/05/21	12.0007
20/05/21	12.0008
21/05/21	12.0017
22/05/21	12.0024
23/05/21	12.0028
24/05/21	12.0031
25/05/21	12.0030
26/05/21	12.0030

27/05/21	12.0031
28/05/21	12.0030
29/05/21	12.0031
30/05/21	12.0032
31/05/21	12.0033
01/06/21	12.0033
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30/08/21	12.0033
31/08/21	12.0033

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 deaths in Nepal are likely to remain low over the out-of-sample period.

IV. CONCLUSION AND POLICY RECOMMENDATIONS

Many parts of the world are now characterized by repeated lockdowns and travel restrictions due to the persistency of the deadly COVID-19 pandemic. Negative impacts of the health crisis are likely to persist as long as the world continues to witness incessant waves of COVID-19. Infectious disease modeling is now the key to help governments plan and allocate resources for COVID-19 response. In this paper we apply a machine learning technique to predict daily COVID-19 deaths in Nepal and the results indicate that daily COVID-19 deaths in Nepal are likely to remain low over the out-of-sample period. Hence the Nepal authorities are encouraged to scale up COVID-19 vaccination amongst other measures.

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