

Forecasting Covid-19 New Cases in Fiji Islands

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Abstract - In this study, the ANN approach was applied to analyze COVID-19 new cases in Fiji Islands. 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 no cases of COVID-19 are likely to be experienced over the out-of-sample period. Amongst other suggested policy directions, there is need for the authorities in Fiji Islands 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 has disrupted several economic activities around the world and many people have lost their sources of income in addition to high morbidity and mortality associated with the deadly SARS-COV2 virus (Wang et al, 2020; Wang et al, 2020; Read et al, 2020; Wang, 2020; Tang et al, 2020; CDC, 2020; Nyoni et al, 2020). The indirect effects of the pandemic in Fiji Islands include social, economic and political issues (Dean, 2020). The closure of the borders and ships stopping to sail disrupted Fiji's supply chains and thereby increasing food insecurity (Dean, 2020). The first case of COVID-19 in Fiji was reported in March 2020 (Singh et al, 2020). The country implemented several measures such as lockdowns, contact tracing, social distancing, isolation and treatment of cases, wearing face masks and hygiene practices (UN, 2020; Gardaworld, 2020). The purpose of this paper is to predict daily COVID-19 cases in Fiji Islands using the multilayer perceptron neural network. The artificial intelligence technique is gaining massive popularity in modelling and forecasting infectious diseases such COVID-19 (Nyoni et al, 2021, Nyoni et al, 2020; Dengue fever (Zhao et al, 2020) and TB (Nyoni et al, 2021). Recently some researchers have applied the technique in modeling and forecasting ART coverage and immunization coverage (Maradze et al, 2021; Nyoni et al, 2021). The findings of this study are expected to highlight likely future trends of COVID-19 daily new cases in Fiji and trigger an early response to the highly infectious disease.

II. LITERATURE REVIEW

Iese et al (2020) conducted an exploratory analysis of immediate impacts of both COVID-19 mitigation measures and interventions on households and communities in PICs. The aim was to better understand the implications of COVID-19 for PICs and identify knowledge gaps requiring further research and policy attention. 13 communities were studied in Fiji and Solomon Islands in July-August 2020. In these communities, 46 focus group discussions were carried out and 425 households were interviewed. Insights were also derived from a series of online discussion sessions with local experts of Pacific Island food and agricultural systems in August and September 2020. To complement these discussions, an online search was conducted for available literature. The research concluded that National COVID-19 mitigation measures have been effective so far in reducing the spread of COVID-19 in Fiji and PNG and preventing the arrival of COVID-19 in other PICs. Ala'raj et al (2020) modelled the COVID-19 transmission dynamics in United Arab Emirates using a hybrid model. The proposed model consisted of two parts: the modified SEIRD dynamic model and ARIMA models. The study revealed a great model ability to make accurate predictions of infected, recovered, and deceased patients. Singh et al (2020) forecasted confirmed COVID-19 cases in Malaysia using ARIMA models. This study was conducted using daily confirmed cases of COVID-19 collected from the official Ministry of Health, Malaysia (MOH) and John Hopkins University websites. An Autoregressive Integrated Moving Average (ARIMA) model was fitted to the training data of observed cases from 22 January to 31 March 2020, and subsequently validated using data on cases from 1 April to 17 April 2020. The best model ARIMA (0, 1, 0) predicted a downward trend of COVID-19 cases until 1 May 2020.

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 Fiji.

Data Issues

This study is based on daily new cases of COVID-19 in Fiji 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	F
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	0.192448
MSE	0.285773
MAE	0.214884

Residual Analysis for the Applied Model

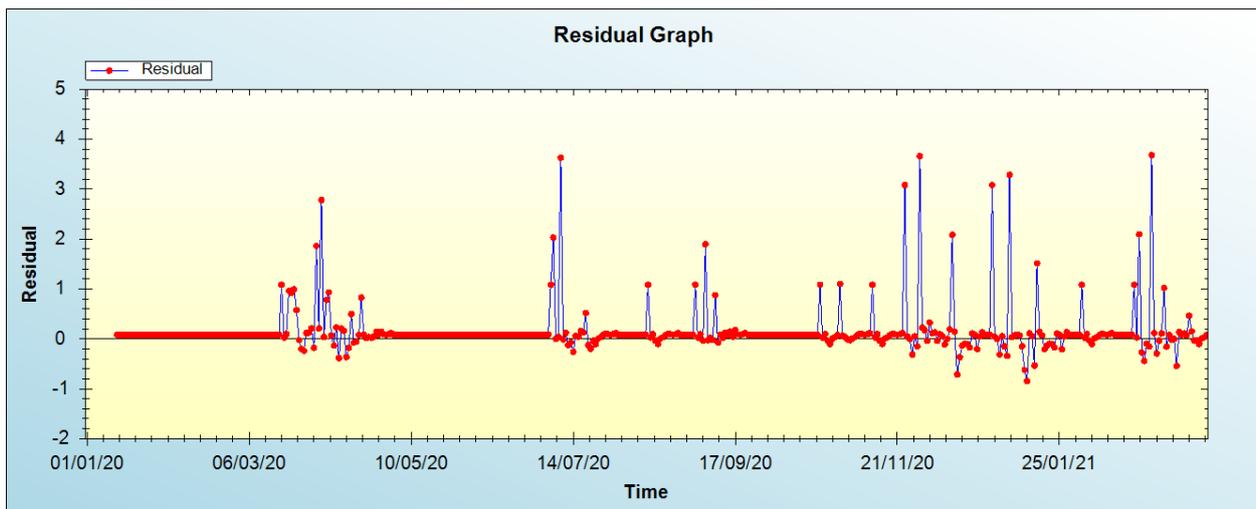


Figure 1: Residual analysis

In-sample Forecast for F

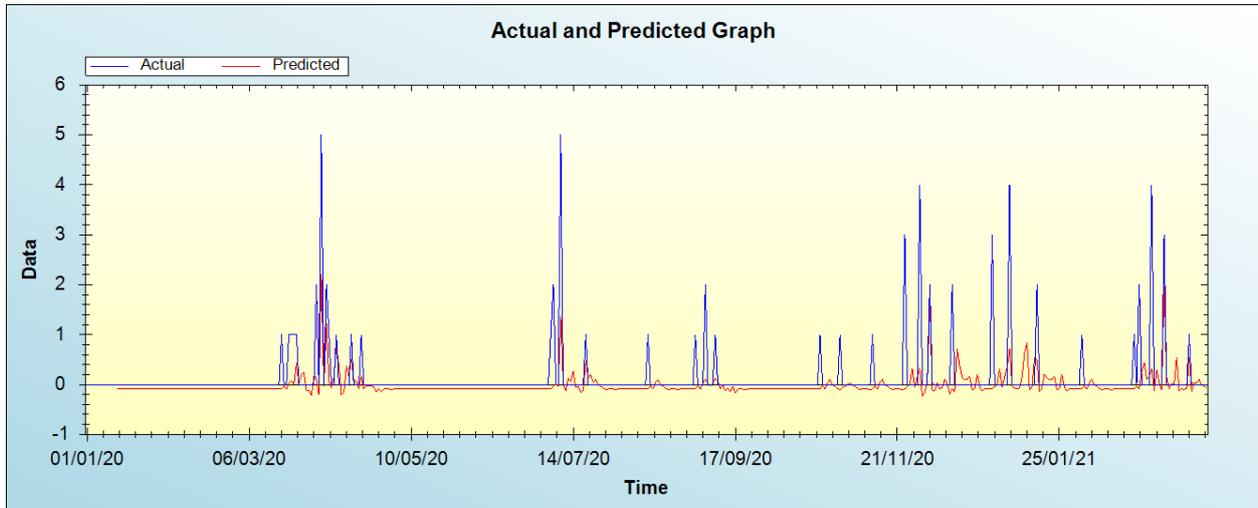


Figure 2: In-sample forecast for the F series

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

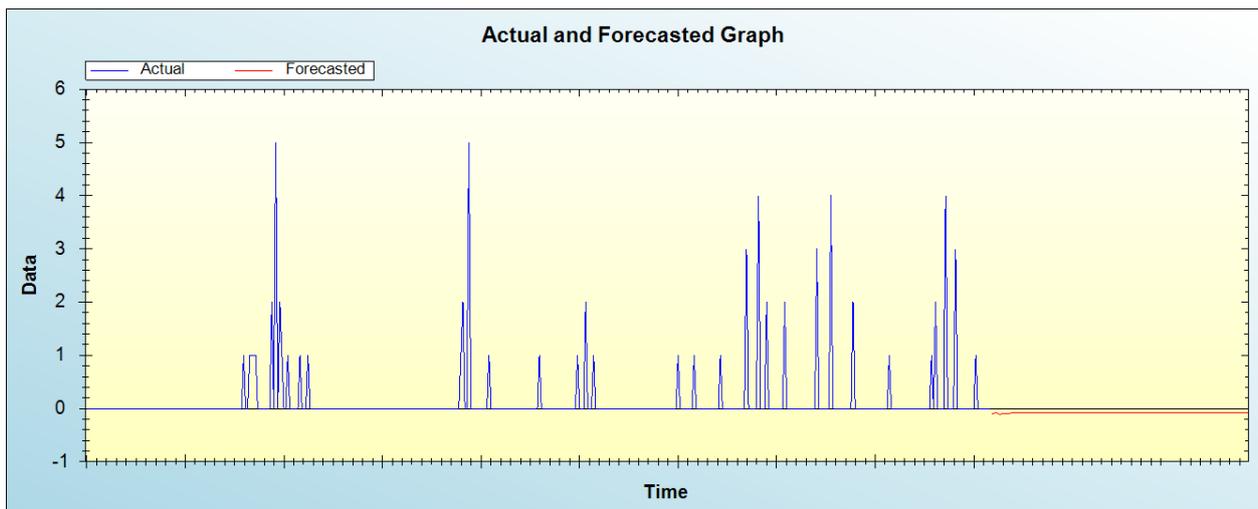


Figure 3: Out-of-sample forecast for F: actual and forecasted graph

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 Fiji are likely to be non-existent over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

Predictive modeling is a key component of public health surveillance. Several models have been employed in an attempt to understand the evolution of COVID-19. Compartmental models, traditional statistical methods and artificial intelligence (AI) techniques are used in forecasting infectious diseases. AI techniques are gaining popularity and have been recognized in the public health domain because of their ability to model complex data sets. In this study we utilized one such technique ie artificial neural network approach. The results of the study indicate that the pandemic may disappear in the out-of-sample period. Still, the government is encouraged to relentlessly follow WHO guidelines on prevention and control of COVID-19.

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