

# Forecasting Covid-19 Deaths Cases in Indonesia

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**Abstract - In this study, the ANN approach was applied to analyze COVID-19 deaths in Indonesia. 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 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 mortality cases in Indonesia are likely to continue to rise and finally hover around an equilibrium case volume of about 408 deaths per day over the out-of-sample period. Therefore there is need for the government of Indonesia to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.**

**Keywords:** ANN, COVID-19, Forecasting.

## I. INTRODUCTION

The beginning of the global COVID-19 pandemic has drastically changed the way people used to live with many countries implementing lockdowns and restricting movement of people and certain commodities, closure of non-essential businesses and temporary ban on public gatherings. Millions of people have lost their sources of income with vulnerable groups of the society suffering the most from the negative impact of the pandemic. The new coronavirus, SARS-COV2 was first discovered in Wuhan, China in December 2019 and the virus later spread to most regions of the world with high speed due to movement of people (Leon et al, 2019). According to John Hopkins University data, by November 2020, COVID-19 had spread to 219 countries in the world with total confirmed cases of about 53 6699 160 and 1 308 261 deaths. Indonesia reported the first case of COVID-19 on the 2nd of March 2020 and by November 2020 the country had reported 457 735 positive cases and 15 037 fatalities (Kemenkes, 2020). Many researchers in Indonesia have applied machine learning models to predict COVID-19 cases and deaths in real time datasets (Zakiyyah & Suyanto, 2021). They have used techniques such as Gaussian Naïve Bayes (GNB), Support vector machine and Decision trees with relative high accuracy (Zakiyyah & Suyanto, 2021). In this study we applied the artificial neural network approach to predict daily COVID-19 deaths in Indonesia because of its prominence and high predictive accuracy (Nyoni et al, 2020; Zhao et al, 2020). The results of the study are expected to reveal the future trends of COVID-19 mortality in the country and will assist in the evaluation of intervention activities.

## II. LITERATURE REVIEW

The prediction of infected cases, cases of recovery from COVID-19, and mortality for each province in Indonesia using the Long Short-Term Memory (LSTM) machine learning method was done by Wibowo & Wihayati (2021). The results of the model evaluation of this method used the root mean squared error (RMSE) approach. The study revealed that the smallest RMSE value of the LSTM model that uses five hidden neurons, 1000 epochs, a learning rate of 0.001, and Adam's optimizer for cases of infection, recovery, and death from COVID-19 patients are found in the provinces of Jawa Barat, DKI Jakarta, and Jawa Tengah, respectively. Zakiyyah & Suyanto (2021) investigated three prediction models: Gaussian Naive Bayes (GNB), and Support Vector Machine (SVM), and Decision Tree (DT) in predicting total cases and total deaths of Covid-19 in Indonesia. First, a preprocessing was applied to change the string data to the numerical dataset using a label encoder. Second, the models were trained using the Covid-19 Indonesia Time Series All Dataset (CITSAD) with 90% and 10% train/test split. The three models are then investigated to predict new cases and new deaths. The evaluation using the CITSAD of ten provinces in Indonesia showed that DT gives the highest accuracy of 93% and provides the fastest processing time of 48.4 seconds. In another study, Kirana & Bhawiyuga (2020) provided a detailed reporting and analysis of the COVID-19 case overview and forecasting that had hit Indonesia. Time-series dataset from March 2020 to January 2021 were used. Summary of cases studied included the number of positive cases and deaths due to COVID-19 on a daily or monthly basis. They used time series and forecasting analysis using the Naïve Forecast method. The study revealed that the highest monthly average case prediction would be in June 2020, which is 35,662 cases. Wirawan & Januraga (2020) predicted the future trajectory of the epidemic under current conditions, projected the impact of policy

interventions, and analyzed the implications for healthcare capacity. The study was based on the first month of publicly accessible data on new confirmed daily cases. A susceptible, exposed, infected, recovered (SEIR) model for COVID-19 was employed to compare the current dynamics of the disease with those predicted under various scenarios. The study concluded that the healthcare system in Bali was in danger of collapse; thus, serious efforts were needed to improve COVID-19 interventions.

### 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 COVID-19 mortality cases Indonesia.

#### Data Issues

This study is based on daily COVID-19 mortality cases in Indonesia 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).

### IV. FINDINGS OF THE STUDY

#### ANN Model Summary

Table 1: ANN model summary

Variable	CL
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	0.128550
MSE	1155.607245
MAE	23.221457

#### Residual Analysis for the Applied Model

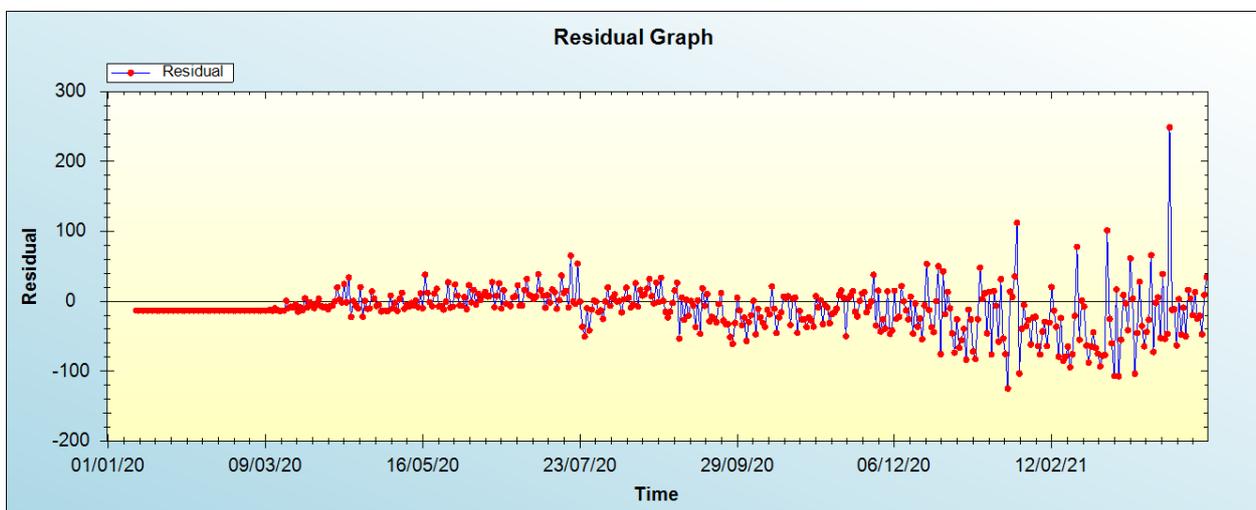


Figure 1: Residual analysis

*In-sample Forecast for CL*

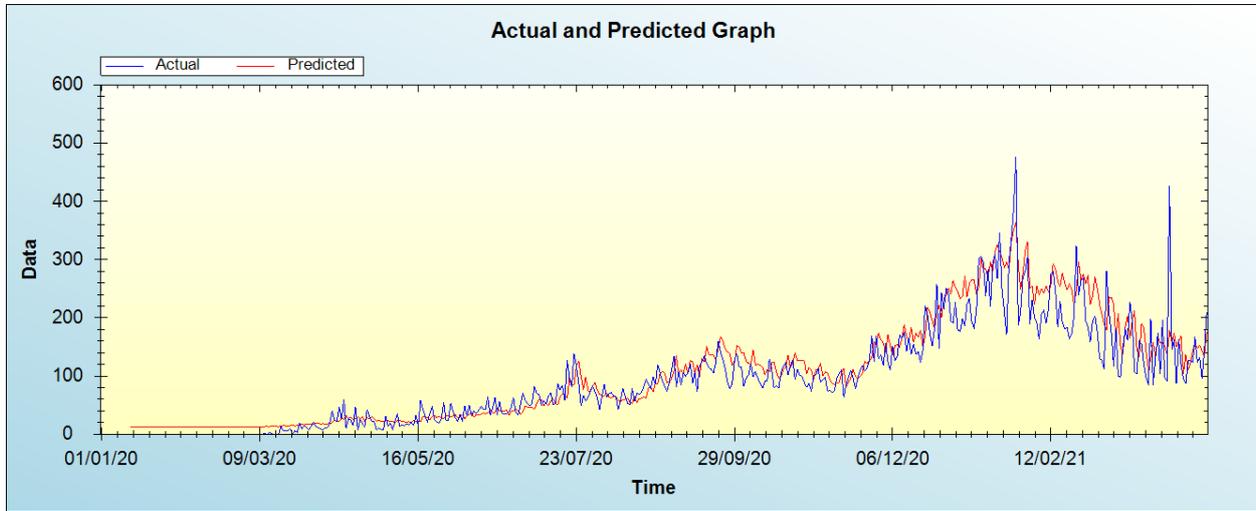


Figure 2: In-sample forecast for the CL series

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

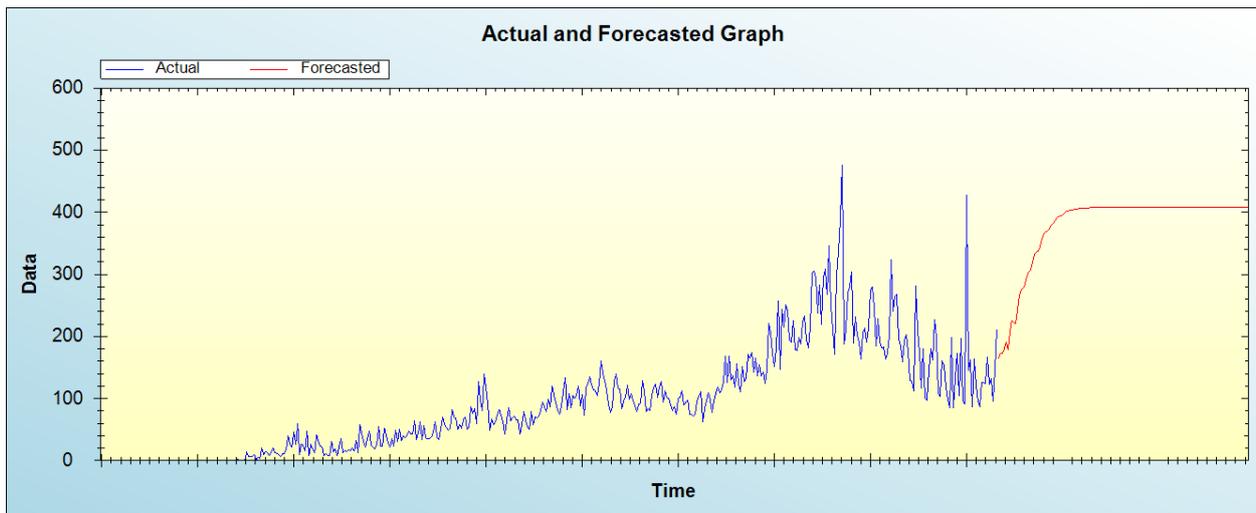


Figure 3: Out-of-sample forecast for CL: actual and forecasted graph

*Out-of-Sample Forecast for CL: Forecasts only*

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
21/04/21	165.4226
22/04/21	172.7162
23/04/21	172.3113
24/04/21	179.9756
25/04/21	191.4433
26/04/21	179.1816
27/04/21	207.1618
28/04/21	226.3129
29/04/21	222.1518
30/04/21	220.4952
01/05/21	240.4010
02/05/21	266.4763
03/05/21	274.8129

04/05/21	277.4526
05/05/21	284.2686
06/05/21	295.7290
07/05/21	304.4941
08/05/21	307.1776
09/05/21	319.2650
10/05/21	331.3703
11/05/21	335.7505
12/05/21	337.5831
13/05/21	344.4549
14/05/21	356.5606
15/05/21	365.1241
16/05/21	368.1334
17/05/21	369.6642
18/05/21	373.9253
19/05/21	379.1152
20/05/21	382.3660
21/05/21	386.9136
22/05/21	391.0168
23/05/21	393.2430
24/05/21	394.1725
25/05/21	395.5009
26/05/21	398.4287
27/05/21	401.2233
28/05/21	402.5913
29/05/21	402.8543
30/05/21	403.3577
31/05/21	404.1723
01/06/21	404.7715
02/06/21	405.5474
03/06/21	406.2527
04/06/21	406.6546
05/06/21	406.6622
06/06/21	406.5412
07/06/21	406.6930
08/06/21	407.0623
09/06/21	407.3560
10/06/21	407.3984
11/06/21	407.3662
12/06/21	407.3444
13/06/21	407.3221
14/06/21	407.3692
15/06/21	407.4628
16/06/21	407.5492
17/06/21	407.5622
18/06/21	407.5073
19/06/21	407.4588
20/06/21	407.4700
21/06/21	407.5186
22/06/21	407.5483
23/06/21	407.5557
24/06/21	407.5460
25/06/21	407.5252
26/06/21	407.5133
27/06/21	407.5190
28/06/21	407.5376
29/06/21	407.5521
30/06/21	407.5507
01/07/21	407.5376
02/07/21	407.5283
03/07/21	407.5298
04/07/21	407.5360
05/07/21	407.5424
06/07/21	407.5449

07/07/21	407.5421
08/07/21	407.5371
09/07/21	407.5341
10/07/21	407.5354
11/07/21	407.5392
12/07/21	407.5420
13/07/21	407.5414
14/07/21	407.5389
15/07/21	407.5372
16/07/21	407.5370
17/07/21	407.5382
18/07/21	407.5397
19/07/21	407.5403
20/07/21	407.5396
21/07/21	407.5385
22/07/21	407.5379
23/07/21	407.5382
24/07/21	407.5390
25/07/21	407.5395
26/07/21	407.5394
27/07/21	407.5390
28/07/21	407.5386
29/07/21	407.5385
30/07/21	407.5387
31/07/21	407.5391
01/08/21	407.5392
02/08/21	407.5391
03/08/21	407.5388
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26/08/21	407.5389
27/08/21	407.5389
28/08/21	407.5389
29/08/21	407.5389
30/08/21	407.5389
31/08/21	407.5389

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 mortality cases in Indonesia are likely to continue to rise and finally hover around an equilibrium case volume of about 408 deaths per day over the out-of-sample period.

## V. CONCLUSION AND POLICY RECOMMENDATIONS

The world is currently in the midst of the COVID-19 health crisis and several governments are funding research projects in order to find the panacea of this prolonged health problem. The development of the vaccines which are currently in use after being recommended by the World Health Organisation has brought a moment of relief to many people. However, vaccine uptake in certain regions of the world is still poor and this is one of the setbacks in the global COVID-19 response. COVID-19 mortality continues to increase especially in countries which have a high population density and poor adherence to WHO guidelines. In this paper we utilized an artificial intelligence technique to predict COVID-19 mortality in Indonesia. The results of the study showed that daily COVID-19 mortality cases in Indonesia are likely to continue to rise and finally hover around an equilibrium case volume of about 408 deaths per day over the out-of-sample period. Therefore we strongly encourage the Indonesian government to scale up COVID-19 vaccination and continuously enforce public adherence to WHO guidelines.

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