

Forecasting Covid-19 Deaths in Ghana

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Abstract - In this study, the ANN approach was applied to analyze COVID-19 deaths in Ghana. 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 deaths in Ghana are likely to be close to zero over the out-of-sample period. However, there is, still, the need for the government of Ghana to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic and COVID-19 vaccination.

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The surging COVID-19 infections and deaths in some parts of the world like India and Brazil is an issue of concern in the COVID-19 response (Shet et al, 2020; Sun et al, 2020). New strains of the corona virus, SARS-COV2 have been seen to be more transmissible. The most worrisome issue is the death of young and economically productive people due to the new variants in countries like Brazil. Several previous studies have shown that the significant predictors of COVID-19 mortality are old age, hypertension and diabetes (Jordan et al, 2020; Wu et al, 2020; Becchetti & Salustvi, 2020; Ma et al, 2020; Hasan & Haque, 2020). Ghana reported the first 2 cases of COVID-19 on the 12th March 2020. By 15th of April 2020 the country had reported 641 positive cases of COVID-19 (WHO, 2020). The government managed the situation by imposing lockdowns, quarantine, isolation, contact tracing, hygiene practices, social distancing and treatment of COVID-19 cases (Ghana emergency, 2020; Zurek, 2020). In this study we propose to apply a machine learning algorithm to predict daily COVID-19 deaths in Ghana. The findings of this piece of work are envisioned to reveal the future trends of COVID-19 mortality in the country and stimulate an appropriate early response to the epidemic.

II. LITERATURE REVIEW

Dwomoh et al (2021) proposed the SEIQHRS model (susceptible-exposed-infectious-quarantine-hospitalized-recovered-susceptible) that predicts the trajectory of the epidemic to help plan an effective control strategy for COVID-19 in Ghana. A short-term forecast of the early phase of the epidemic trajectory in Ghana using the generalized growth model was done. Results showed that enhanced government and individual-level interventions and the intensity of media coverage could have a substantial effect on suppressing transmission of new COVID-19 cases and reduced death rates in Ghana until such a time that a potent vaccine or drug is discovered. Owusu et al (2020) described the socio-demographic features, pattern of COVID-19 spread and the viral load dynamics among subjects residing in northern, middle and part of the southern belt of Ghana. This was a cross-sectional retrospective study that reviewed records of samples collected from February to July, 2020. Respiratory specimens such as sputum, deep-cough saliva and nasopharyngeal swabs were collected from suspected COVID-19 subjects in 12 regions of Ghana for laboratory analysis and confirmation by real-time reverse transcription polymerase chain reaction (RT-PCR). The study concluded that males and younger individuals at greater risk of contracting the disease. In another study, Kontis et al (2020) applied an ensemble of 16 Bayesian models to vital statistics data to estimate the all-cause mortality effect of the pandemic for 21 industrialized countries. The study concluded that heterogeneous mortality effects of the COVID-19 pandemic reflect differences in how well countries have managed the pandemic and the resilience and preparedness of the health and social care system. Abdul et al (2020) investigated the effects of temperature, humidity, precipitation, wind speed and the specific government policy intervention of partial lockdown on the new cases of COVID-19 infection in Ghana. Daily data on confirmed cases of COVID-19 from March 13, 2020 to April 21, 2020 were obtained from the official website of Our World in Data (OWID) dedicated to COVID-19 while satellite climate data for the same period was obtained from the official website of the National Aeronautics and Space Administration's (NASA's) Prediction of Worldwide Energy Resources (POWER) project. A generalized linear model was

used to analyze the data. The results indicated significant effects of maximum temperature, relative humidity and precipitation in predicting new cases of the disease.

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 deaths in Ghana.

Data Issues

This study is based on daily COVID-19 deaths in Ghana 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	G
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	2.484841
MSE	2.748783
MAE	1.239782

Residual Analysis for the Applied Model

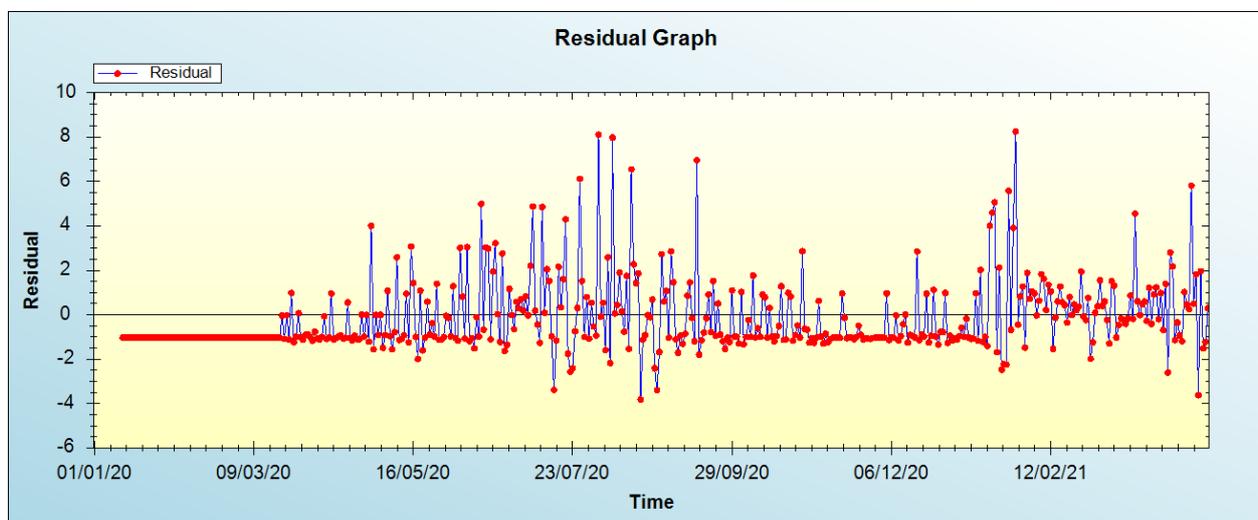


Figure 1: Residual analysis

In-sample Forecast for G

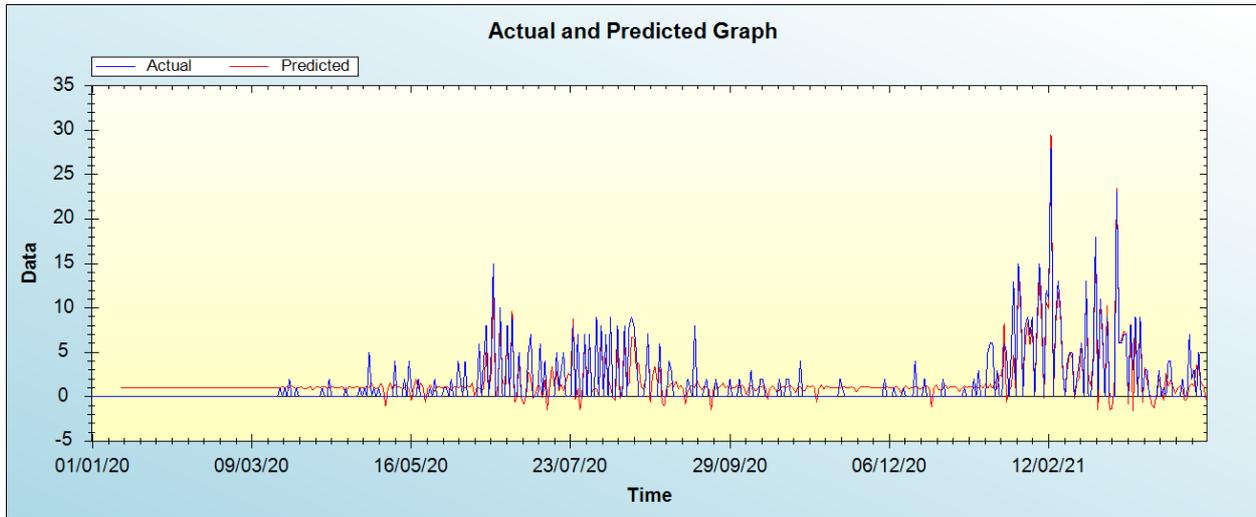


Figure 2: In-sample forecast for the G series

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

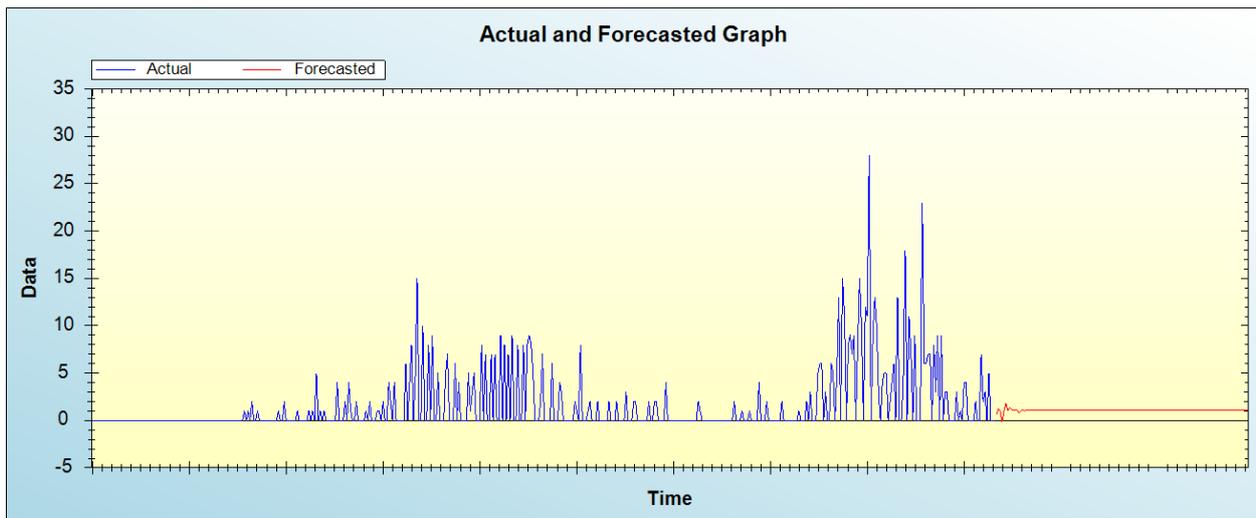


Figure 3: Out-of-sample forecast for G: actual and forecasted graph

Out-of-Sample Forecast for G: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Projected COVID-19 deaths
21/04/21	0.6390
22/04/21	1.2677
23/04/21	1.0390
24/04/21	-0.1658
25/04/21	0.9676
26/04/21	1.8439
27/04/21	1.0402
28/04/21	1.3681
29/04/21	1.1760
30/04/21	1.0527
01/05/21	1.1395
02/05/21	1.0676
03/05/21	0.7937
04/05/21	1.0526

05/05/21	1.0695
06/05/21	1.0003
07/05/21	1.1316
08/05/21	1.0669
09/05/21	1.0881
10/05/21	1.1168
11/05/21	1.0870
12/05/21	1.0582
13/05/21	1.0865
14/05/21	1.0628
15/05/21	1.0604
16/05/21	1.0797
17/05/21	1.0618
18/05/21	1.0744
19/05/21	1.0786
20/05/21	1.0738
21/05/21	1.0759
22/05/21	1.0785
23/05/21	1.0733
24/05/21	1.0748
25/05/21	1.0756
26/05/21	1.0719
27/05/21	1.0747
28/05/21	1.0740
29/05/21	1.0735
30/05/21	1.0746
31/05/21	1.0746
01/06/21	1.0742
02/06/21	1.0748
03/06/21	1.0746
04/06/21	1.0741
05/06/21	1.0746
06/06/21	1.0742
07/06/21	1.0742
08/06/21	1.0744
09/06/21	1.0743
10/06/21	1.0743
11/06/21	1.0744
12/06/21	1.0743
13/06/21	1.0743
14/06/21	1.0744
15/06/21	1.0743
16/06/21	1.0744
17/06/21	1.0744
18/06/21	1.0743
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26/08/21	1.0744
27/08/21	1.0744
28/08/21	1.0744
29/08/21	1.0744
30/08/21	1.0744
31/08/21	1.0744

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 Ghana are likely to be close to zero over the out-of-sample period.

IV. CONCLUSION AND POLICY RECOMMENDATIONS

Artificial intelligent systems are key in the prediction of COVID-19 mortality. Artificial intelligence techniques can model big data with such a high speed and high predictive accuracy. In this study we proposed the artificial neural network approach to predict daily COVID-19 deaths in Ghana. The results indicate that that daily COVID-19 deaths in Ghana are likely to be close to zero over the out-of-sample period. Hence we encourage the government to focus on mass media COVID-19 vaccine sensitization in order to tackle vaccine hesitancy and educate people on the importance of adhering to COVID-19 WHO guidelines.

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