

Forecasting Covid-19 Mortality in Algeria

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Abstract - In this study, the ANN approach was applied to analyze COVID-19 deaths in Algeria. The employed data covers the period 1 January 2020 - 20 April 2021 and the out-of-sample period ranges over the period 21 April-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 Algeria are likely to be around 4 deaths per day over the out-of-sample period. Therefore there is need for the government of Algeria to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic and roll out extensive COVID-19 vaccination in order to achieve herd immunity.

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

In December 2019 the Chinese city, Wuhan became popularly known as the origin of the deadly SARS-COV2 virus, the microorganism which causes COVID-19 disease (WHO,2020; Wang et al, 2020; Tang et al, 2020). Many people continue to bear the negative impact of the pandemic with vulnerable groups of the society at high risk. The rapid spread of the virus sent shock waves to every person all over the world (Guan et al, 2020). By April 2020, the world had reported 162 956 COVID-19 deaths and 2 397 217 confirmed cases (WHO, 2020). On the 30th of January 2020 WHO announced the listing of this new coronavirus infected pneumonia as a global health emergency (WHO, 2020). The COVID-19 pandemic has significantly affected the world especially health systems, economy, education and the transport system (Shereen et al, 2020). Forecasting is an important part of surveillance. Several models have been used in previous studies to model and predict infectious diseases. The widely used time series forecasting models are ARIMA, Long short term memory networks (LSM), support vector machine (SVM), artificial neural networks (ANNs) and Bayesian networks (Duarte &Faerman, 2019; Letham, 2018; Hochreiter & Schmidhuber, 1997; Box & Pierce, 1970). In this study we aim to predict daily COVID-19 mortality in Algeria. The results of the study are expected to provide an insight of the likely future trends of COVID-19 deaths in the country and facilitate resource mobilization for the COVID-19 response.

II. LITERATURE REVIEW

Belkacem et al (2020) applied a time series Prophet model to analyze and forecast the number of COVID-19 cases and deaths in Algeria based on the previously reported numbers. Then, to understand the spread and the properties of the COVID-19, authors included external factors that may contribute to increase/ reduce the spread of the virus, constructed a dataset from reliable sources, and conducted a large-scale data analysis considering 82 countries worldwide. The evaluation results showed that the time series Prophet model accurately predicted the number of cases and deaths in Algeria with low RMSE scores of 218.87 and 4.79 respectively, while the forecast suggested that the total number of cases and deaths were likely to increase in the coming weeks. The worldwide data-driven analysis revealed several correlations between the increase/decrease in the number of cases and deaths and external factors that may contribute to accelerate/slow the spread of the virus such as geographic, climatic, health, economic, and demographic factors. The Double Exponential Smoothing Method and an Autoregressive Integrated Moving Average (ARIMA) model were proposed by Abdelaziz et al (2020) to identify the COVID-19 cases (positive, recovery and death) and forecasting COVID-19 cases in Algeria respectively. The data for the study were obtained from March 21st, 2020 to November 26th, 2020. The daily Algerian COVID-19 confirmed cases were sourced from The Ministry of Health, Population and Hospital Reform of Algeria. The results indicated that observed cases during the forecast period were accurately predicted with ARIMA (0, 1, 1) optimal model and were placed within the prediction intervals generated by the fitted model. Moussaoui & Auger(2020) utilized SEIR modeling to forecast COVID-19 outbreak in Algeria under two scenarios by using the real-time data from March 01 to April 10, 2020. The study revealed that the final size of the epidemic depended strongly on the cumulative number of cases at the date when the intervention was implemented and on the fraction of the population in confinement and that

the longer people waited, the worse the situation would be. The Alg-COVID-19 Model was applied by Hamidouche (2020) to predict the incidence and the reproduction number R_0 in the coming months in order to help decision makers. The model predicted that the number of cases would exceed 5000 on the 42th day (April 7th) and it would double to 10000 on 46th day of the epidemic (April 11th), thus, exponential phase would begin and increase continuously until reaching a herd immunity of 61%.

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 Algeria.

Data Issues

This study is based on daily COVID-19 deaths in Algeria 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	A
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	1.286564
MSE	5.146431
MAE	1.674116

Residual Analysis for the Applied Model

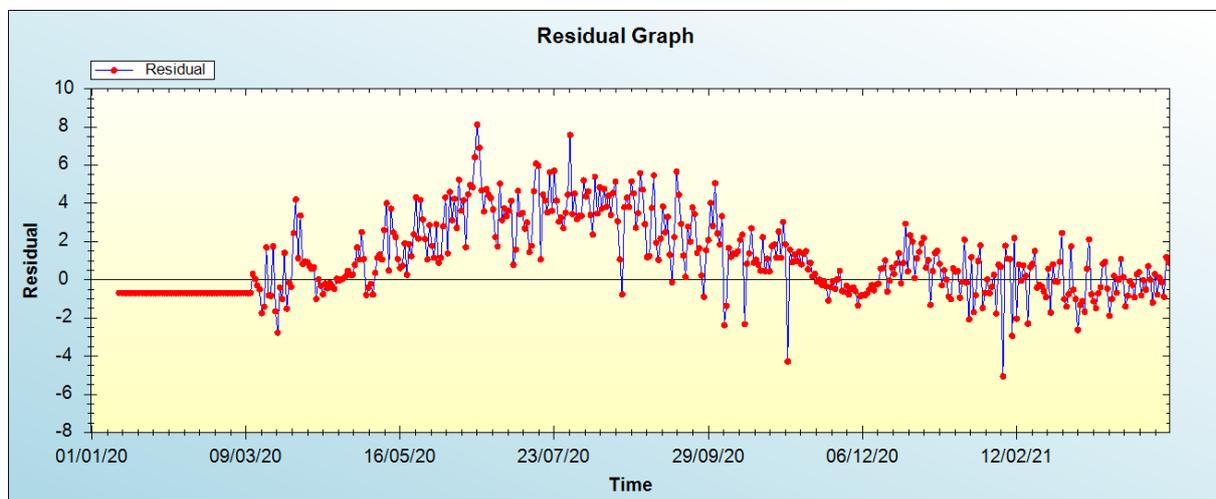


Figure 1: Residual analysis

In-sample Forecast for A

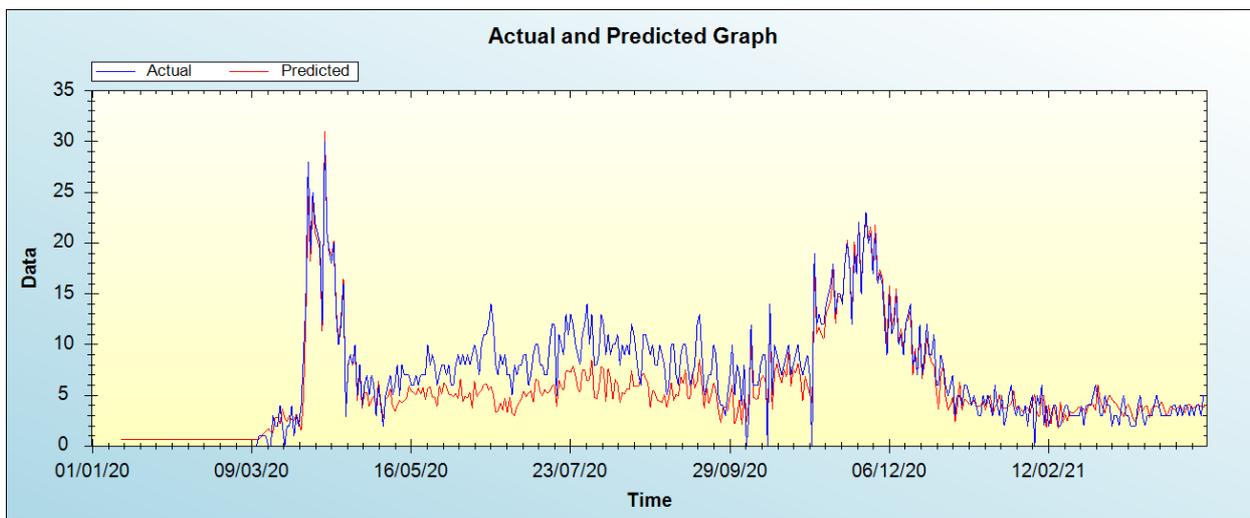


Figure 2: In-sample forecast for the A series

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

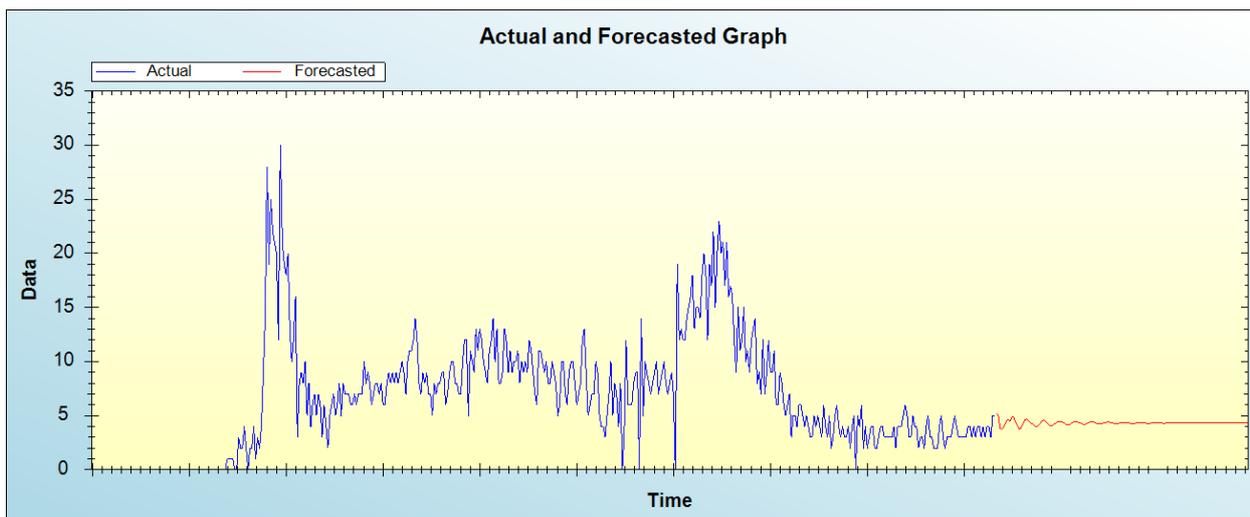


Figure 3: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Projected COVID-19 deaths
21/04/21	5.2045
22/04/21	4.9427
23/04/21	3.8149
24/04/21	3.7686
25/04/21	4.0018
26/04/21	4.4206
27/04/21	4.6542
28/04/21	4.4746
29/04/21	4.8285
30/04/21	4.8659
01/05/21	4.4080
02/05/21	4.0985
03/05/21	3.7456
04/05/21	3.8698

05/05/21	4.3094
06/05/21	4.6078
07/05/21	4.7009
08/05/21	4.5109
09/05/21	4.3619
10/05/21	4.2405
11/05/21	4.0451
12/05/21	4.0028
13/05/21	4.1046
14/05/21	4.2851
15/05/21	4.5185
16/05/21	4.6083
17/05/21	4.4842
18/05/21	4.2640
19/05/21	4.0965
20/05/21	4.0842
21/05/21	4.1635
22/05/21	4.2836
23/05/21	4.4069
24/05/21	4.4764
25/05/21	4.4893
26/05/21	4.4101
27/05/21	4.2569
28/05/21	4.1440
29/05/21	4.1438
30/05/21	4.2439
31/05/21	4.3715
01/06/21	4.4543
02/06/21	4.4649
03/06/21	4.4111
04/06/21	4.3257
05/06/21	4.2463
06/06/21	4.2054
07/06/21	4.2285
08/06/21	4.3066
09/06/21	4.3953
10/06/21	4.4467
11/06/21	4.4329
12/06/21	4.3651
13/06/21	4.2875
14/06/21	4.2426
15/06/21	4.2480
16/06/21	4.2932
17/06/21	4.3532
18/06/21	4.4020
19/06/21	4.4172
20/06/21	4.3903
21/06/21	4.3344
22/06/21	4.2806
23/06/21	4.2602
24/06/21	4.2821
25/06/21	4.3299
26/06/21	4.3760
27/06/21	4.3983
28/06/21	4.3890
29/06/21	4.3552
30/06/21	4.3141
01/07/21	4.2864
02/07/21	4.2859
03/07/21	4.3120
04/07/21	4.3500
05/07/21	4.3795
06/07/21	4.3854
07/07/21	4.3663

08/07/21	4.3339
09/07/21	4.3063
10/07/21	4.2968
11/07/21	4.3086
12/07/21	4.3341
13/07/21	4.3600
14/07/21	4.3738
15/07/21	4.3689
16/07/21	4.3485
17/07/21	4.3238
18/07/21	4.3082
19/07/21	4.3094
20/07/21	4.3254
21/07/21	4.3468
22/07/21	4.3624
23/07/21	4.3650
24/07/21	4.3543
25/07/21	4.3364
26/07/21	4.3206
27/07/21	4.3149
28/07/21	4.3218
29/07/21	4.3369
30/07/21	4.3520
31/07/21	4.3594
01/08/21	4.3558
02/08/21	4.3438
03/08/21	4.3300
04/08/21	4.3217
05/08/21	4.3226
06/08/21	4.3316
07/08/21	4.3437
08/08/21	4.3526
09/08/21	4.3541
10/08/21	4.3477
11/08/21	4.3372
12/08/21	4.3282
13/08/21	4.3253
14/08/21	4.3296
15/08/21	4.3383
16/08/21	4.3467
17/08/21	4.3507
18/08/21	4.3485
19/08/21	4.3416
20/08/21	4.3338
21/08/21	4.3291
22/08/21	4.3297
23/08/21	4.3350
24/08/21	4.3420
25/08/21	4.3470
26/08/21	4.3476
27/08/21	4.3438
28/08/21	4.3378
29/08/21	4.3328
30/08/21	4.3313
31/08/21	4.3338

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 Algeria are likely to be around 4 deaths per day over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

The COVID-19 pandemic remains a global health challenge which needs adequate resource mobilization in order to effectively control the spread of the virus. As such strong guidance from public health surveillance tools like predictive modeling is critical to understand the likely future trends of mortality and new infections. In this paper we applied an artificial intelligent technique to forecast daily COVID-19 deaths in Algeria. The results of the study indicate that daily COVID-19 deaths in Algeria are likely to be around 4 deaths per day over the out-of-sample period. Therefore we implore the Algerian government to encourage citizens to get vaccinated against COVID-19 amongst other measures recommended by WHO.

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