Comparative Model Profiles of Covid-19 Occurrence In Nigeria

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Abstract:

In this article, we studied the comparative model profile of COVID-19 occurrence in Nigeria. The model was analyzed using Simple Regression Model in GRETL. The data adopted a non-stationary time series forecasting approach. We used the Mean Error (ME), Mean Square Error (MSE) and Root Mean Square Error (RMSE) to determine the performance measures that fit the COVID-19 confirmed cases Nigeria. The model was used Linear, Quadratic and Exponential Model to determine the best performing model for predicting COVID-19 cases. The findings showed that the RMSE value (84.60) for the linear model is the smallest compared to the RMSE of quadratic and exponential models with values 32492.29 and 136.32 respectively. This showed that the linear model was the best model that fitted COVID-19 cases in Nigeria both in terms of data fit and for prediction purposes. Moreover, the results also showed that the figure of the actual cases were above the predicted cases in all the three models, which could be as a result of some parameters like infectious contact rate or inaccurate COVID-19 cases data.

Keywords: *COVID-19, Mean Square Error (MSE), Root Mean Square Error (RMSE), Linear Model, Quadratic Model, Exponential Model*

I. INTRODUCTION

Coronaviruses popularly known as COVID-19 are minute size viruses with diameter ranges from 65–125 nm that contain a single-stranded RNA ranging from 26 to 32kbs [1, 2]. The viruses are a large family of zoonotic viruses that consist of alpha (α), beta (β), gamma (γ) and delta (δ) coronavirus. The virus was discovered by Chinese researchers in Wuhan, Hubei Province, China, in December 2009 [2, 3]. The virus is zoonotic in the sense that it can be transmitted from animals to humans and was confirmed as a member of the Beta-coronavirus subgroup and was named SARS CoV [2, 6, 7].

The novel virus was named as Wuhan coronavirus or 2019 novel coronavirus (2019-nCov) by the Chinese researchers, which later named by International Committee on Taxonomy of Viruses (ICTV) as SARS-CoV-2 also called COVID-19 [1, 3–5]. The outbreak started from the Hunan seafood market in Wuhan city of China and rapidly infected more than 50 peoples. The live animals are frequently sold at the Hunan seafood market such as bats, frogs, snakes, birds, marmots and rabbits [7]. The human to the human spreading of the Covid-19 pandemic occurs due to close contact with an infected person, exposed to coughing, sneezing, respiratory droplets or aerosols. These aerosols can penetrate the human body (lungs) via inhalation through the nose or mouth [9–11].

History has shown that SRAS-CoV (2003) has infected 8098 individuals with mortality rate of 9%, across 26 countries globally; on the other hand, Covid-19 has infected over 7 million people as at June 10, 2020, with death rate of 5.64%, across 214 countries[1,4]. This shows that the transmission rate of SARS-CoV-2 is higher than SRAS-Co which could because of genetic recombination event at S protein in the RBD region of SARS-CoV-2 may have enhanced its transmission ability [1]. Covid-19 was declared by WHO as a pandemic on 11th March, 2020 as a result of infected individuals [9].

In severe cases, the acute respiratory syndrome coronavirus (SARS-CoV), H5N1 influenza A, H1N1 2009 and Middle East respiratory syndrome coronavirus (MERS-CoV) cause acute lung injury (ALI) and acute respiratory distress syndrome (ARDS) which leads to pulmonary failure and result to death. Common signs of COVID-19 infection are similar to the common cold and include respiratory symptoms such as dry cough, fever, shortness of breath, and breathing difficulties. In more severe cases, infection can cause pneumonia, severe acute respiratory syndrome, kidney failure, and death [2, 3, 6].

In Africa, the first COVID-19 case was recorded in Egypt on 14 February 2020. This was as a result travellers returning from hotspots in Asia, Europe and the United States. Since then a total of 52 countries have reported cases of 202,864 with 5,539 deaths and 90,813 recoveries [12]

Nigeria with the population of over 200 million recorded its first case on 28 February, 2020. The case was discovered from an Italian citizen who arrived in Nigeria via the Murtala Muhammed International Airport, Lagos at 10pm aboard Turkish airline from Milan, Italy. Since then, the numbers of infected cases continue to rise on daily basis. As at 10 June, Nigeria recorded 13464 cases with 365 deaths, 8893 active cases and 4206 recoveries. This constitutes 2.7% mortality rate and 31.2% recovery rate [6, 12].

Several studies have been conducted since the discovery of this pandemic. These studies focused on epidemiology, trend analysis and forecasting for different cities and countries using different models such as ARIMA model, Exponential Smoothing methods, SEIR model and Regression Model.

Yang et al., [14] applied simple regression model to estimate the case fatality rate (CFR) for COVID- 19 in three clusters. These include Wuhan city, other cities of Hubei province, and other provinces of mainland China. The results conclusively indicate CFR of COVID-19 is lower than the previous coronavirus epidemics caused by SARS-CoV and Middle East respiratory syndrome coronavirus (MERS-CoV).

Fanelli & Piazza [15] analyzed the temporal dynamics of COVID-19 outbreak in China, Italy and France with the timeframe of January 22 to March 15 2020. The model shows that Italy has peak number of infected individuals of about 26000 (not including recovered and dead) and a number of deaths at the end of the epidemics of about 18,000.

Li et al. [16] presented a mathematical modeling and epidemic prediction of COVID-19 and its significance to epidemic prevention and control measures. The results based on time series analysis and kinetic model analysis show that the cumulative diagnosis of pneumonia of COVID-19 in mainland China can reach 36,343 after one week (February 8, 2020) and the number of basic regeneration can reach 4.01. The cumulative number of confirmed diagnoses will reach a peak of 87,701 on March 15, 2020; the number of basic regeneration in Wuhan will reach 4.3, and the cumulative number of confirmed cases in Wuhan will reach peak at 76,982 on March 20. Whether in Mainland China or Wuhan, both the infection rate and the basic regeneration number of COVID-19 continue to decline, and the results of the sensitivity analysis show that the time it takes for a suspected population to be diagnosed as a confirmed population can have a significant impact on the peak size and duration of the cumulative number of diagnoses. Increased mortality leads to additional cases of pneumonia, while increased cure rates are not sensitive to the cumulative number of confirmed cases.

In Nigeria, Rauf, & Hannah [13] forecast the spread of COVID-19 in Nigeria using Box-Jenkins Modeling Procedure. Their study shows was focused on the analysis of the spread of Covid-19 in Nigeria, applying statistical models and available data from the NCDC [13].
In similar vein, Victor [17] applied mathematical modeling to predict COVID-19 as a global pandemic. The results show that unless there is a dedicated effort from government, decision makers and stakeholders, the world would hardly be reed of the COVID-19 coronavirus and further spread is eminent and the rate of infection will continue to increase despite the increased rate of recovery because of the absence of vaccine at the moment.

Despite the several studies conducted, the spread COVID-19 is alarming, especially in Nigeria. There is speculation that the data being published by NCDC are inaccurate and this has made many individuals to doubt the existence of COVID-19 in Nigeria. In this study, we shall use regression model to study the trend and sensitivity of the COVID-19 in Nigeria. This study will be significant in that it will aid in predicting the COVID-19 cases and also provide the insight in the data published by NCDC.

II. METHOD

This paper focuses on simple linear regression model techniques for predicting the trend of COVID-19 cases in Nigeria. The data were collected from Diseases Control (NCDC) official COVID-19 and Statistica Official on COVID-19 [18, 20] confirmed, recovered and death cases. But our model focuses on the confirmed cases. The time series regression model is use to predict the number of infected individuals starting from 7 June, 2202 to 31 December, 2020. Our interest is on the trend data of the confirmed cases. We used the Mean Error (ME), Mean Square Error (MSE) and Root Mean Square Error (RMSE) to determine which performance measure is best. Measures like ME, MSE and RMSE were used to compare the performance of predictive models [19].

Predictive COVID-19 Models are designed to help us understand the trend of the data. Therefore, the tools use the description of the useful information to find similar examples of hidden information in the database and use the information learned from the data being published to develop a predictive model of what will happen in the future.

III. MODEL FORMULATION

The data collected is time series data hence we choose multiple regression models. The model was design on the fact that only the infected individuals were considered. This allowed us to adopt a non-stationary time series forecasting approach.

"Regression analysis is a statistical technique for modeling and investigating the relationships between an outcome or response variable and one or more predictor or regressor variables. The end result of a regression analysis study is often to generate a model that can be used to forecast or predict future values of the response variable given specified values of the predictor variables" [20].

The general form of regression model is given explicitly as

$$y_i = f(x_i \quad \alpha_i) + \varepsilon_i \qquad (1)$$

where, y_i's are the predictor, x_i's are the regressors, α_i's are called regression coefficients that give some information about the predictor and ε_i's are the random error term or additive error term that may stand in for un-modeled determinants.

The simple linear regression, quadratic regression and exponential regression models are given as

$$y(x) = \alpha_0 + \alpha_1 x + \varepsilon \qquad (2)$$

$$y(x) = \alpha_0 + \alpha_1 x + \alpha_2 x^2 + \varepsilon \qquad (3)$$

and

$$y(x) = \alpha_0 e^{\alpha_1 x} + \varepsilon \qquad (4)$$

A. COVID-19 Regression Model

The time-series regression model to predict the COVID-19 cases makes use of the three parameters which include contact rate, α_0, recovery rate, α_2 and death rates and α_3. Therefore, the multiple regressions model that depict such scenario is given explicitly as

$$y_c = f(\mu_i \quad \gamma_i \quad \alpha_i) + \varepsilon_i \qquad (5)$$

where,y_c is the predicted confirmed cases and α_i's are the parameters, γ_i's are the recoveries and μ_i's are the deaths.

The regression model relating the COVID-19 data is obtained using the data of months February 28–June 7. The regression technique is first used to compare the three the model based on linear, quadratic and exponential regression model using ME, MSE and RMSE and secondly for prediction of COVID-19 cases Nigeria.

B. Performance Comparison

After fitting a time series model, one can evaluate the model in order to predict feature occurrence and it fit measures. In our model we use more than one forecasting technique, which seems reasonable for a particular application. The accuracy of predicted model was measured in order to distinguish between competing models. One can subtract the forecast value from the observed value of the data at that time point and obtain a measure of error. To evaluate the amount of this forecast error, the researcher may employ the mean error or the mean absolute error.
Let A_i t is the actual data and P_i represents the predicted and n denotes the number of predictions made. Then the mean error (ME) is merely the average error

$$ME = \frac{1}{n}\sum_{i=1}^{n}(A_i - P_i) \qquad (6)$$

The mean squared error (MSE) simply measures the variability in prediction errors. Apparently, the variability in forecast errors must be small. The ME, MAE and MSE are all scale dependent measures of prediction accuracy, that is, their values are expressed in terms of the original units of measurement.

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(A_i - P_i)^2 \qquad (7)$$

The root mean square error (RMSE) measures the average magnitude of the error. It is the square root of the MSE. The RMSE gives a relatively high weight to large errors. This means the RMSE is most useful when large errors are particularly undesirable

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(A_i - P_i)^2} \qquad (8)$$

Despite the fact that Mean Average Percentage Error (MAPE) is the more objective statistic indicator because the measure is in relative percentage and will not be affected by the unit of the forecasting series. The researchers did not consider the MAPE due to the fact that some observed data are zero and dividing by zero produces an error result. In our case, the RMSE is the best indicator, hence produces best results.

IV. RESULTS AND DISCUSSION

A. Results

The GRETL 2020B-64 Version is used to analyzed the regression model in equation (5) and the measured data set for days 28/02/2020-7/06/2020 [18]. The model three models were tested using ME, MSE and RMSE for comparison in order to determine the best fit; and determine which model is best for predicting COVID-19 cases.

The results for the three models are given explicitly as follows:

$$y_{cL} = -82.2126 - 24.3115\mu - 1.6658\gamma + \varepsilon \quad (9)$$

$$y_{cQ} = -30902.6 - 15859.7\mu - 548.771\gamma + \varepsilon \quad (10)$$

and

$$y_{cE} = -133.780 + 2.10053\mu - 4.88923\gamma + \varepsilon \quad (11)$$

Table 1: Comparison of all Models Performance through ME, MSE and RMSE

Model	**ME**	**MSE**	**RMSE**	**Percentage**
Linear Model	51.27872	4227.495	84.599	0.85
Quadratic Model	25176.47	1.32E+09	32492.29	324.92
Exponential Model	41.47526	3472.014	136.319	1.36

Following observations are made from the performance measures:

1. It is usually best to report the root mean squared error (RMSE) rather than mean squared error (MSE), because the RMSE is measured in the same units as the data, rather than in squared units, and is representative of the size of a "typical" error.

2. The mean error (ME) is measure that shows the biasness of the forecasts, i.e., whether they tend to be disproportionately positive or negative. It is clearly shown in Table 1 that there is inconsistency in the measurement using ME, which maybe as a result of the bias.

3. Comparing the percentage of the three statistical measures, it is noticed that the RMSE value (84.60) for the linear model is the smallest compare to the RMSE values of quadratic and exponential models with values 32492.29 and 136.32 respectively.

The Figures below depict the comparisons of the COVID-19 cases and the predicted cases using linear, quadratic and exponential models

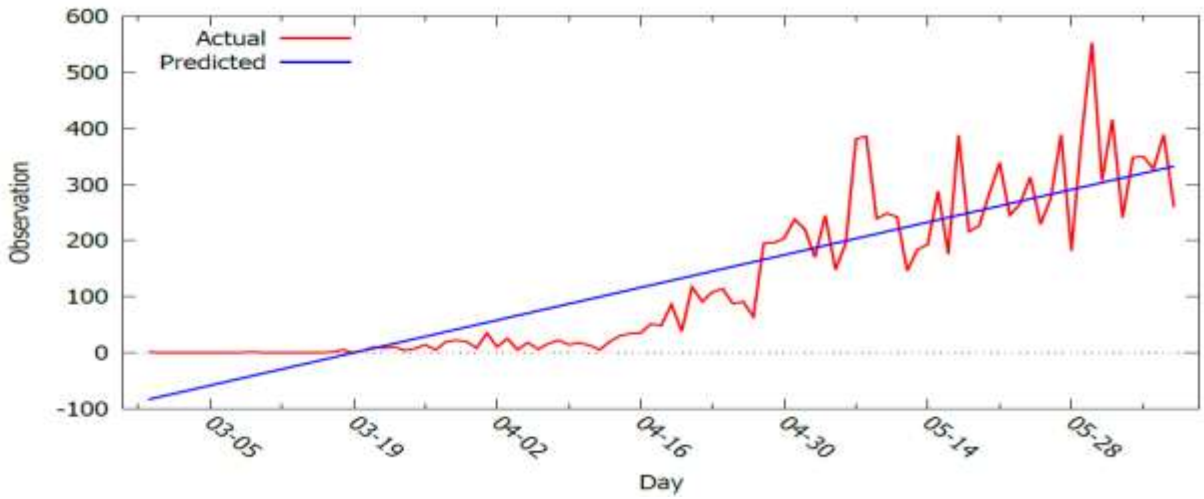

Figure 1: Comparison of Actual and Linear Model

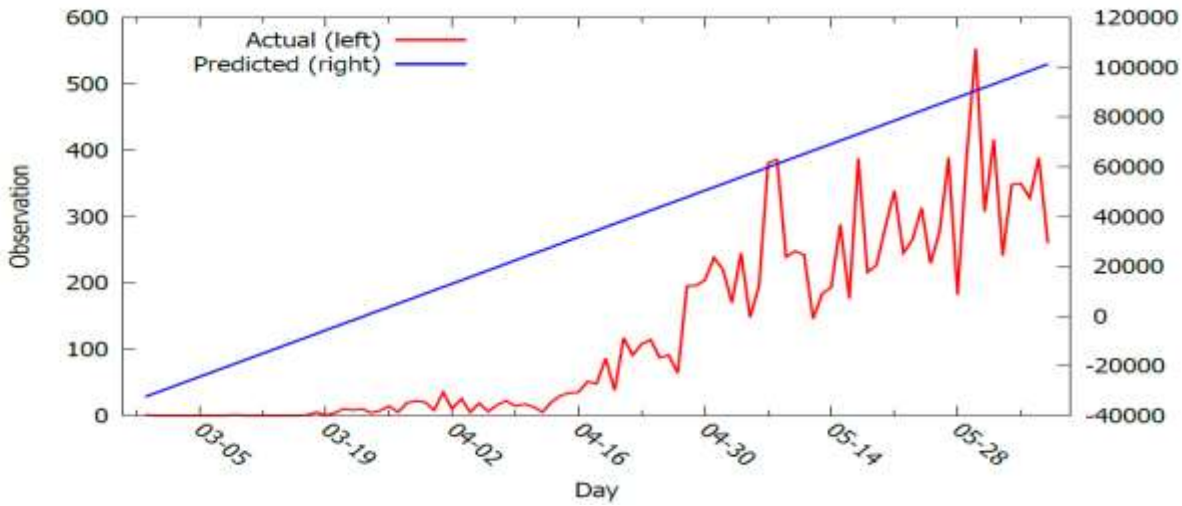

Figure 2: Comparison of Actual and Quadratic Model

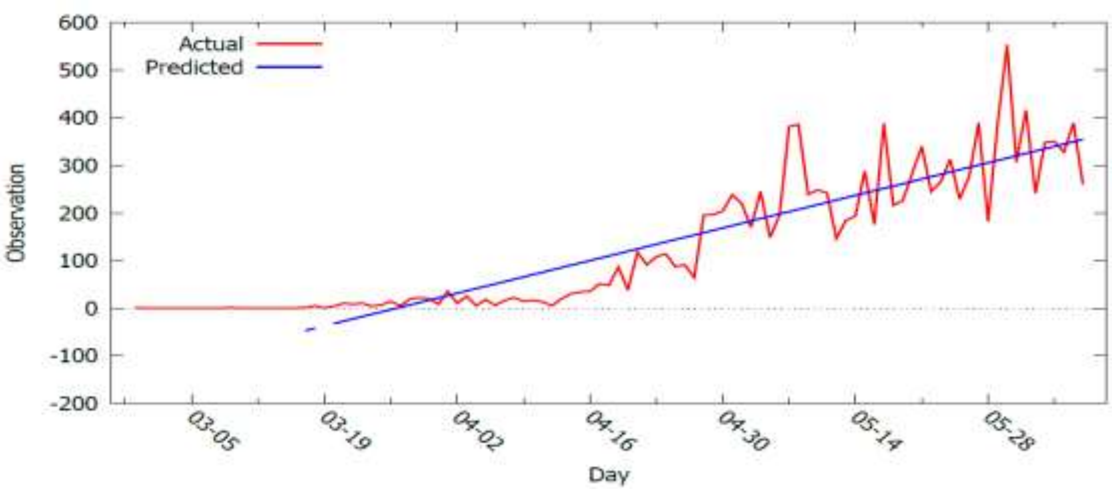

Figure 3: Comparison of Actual and Exponential Model

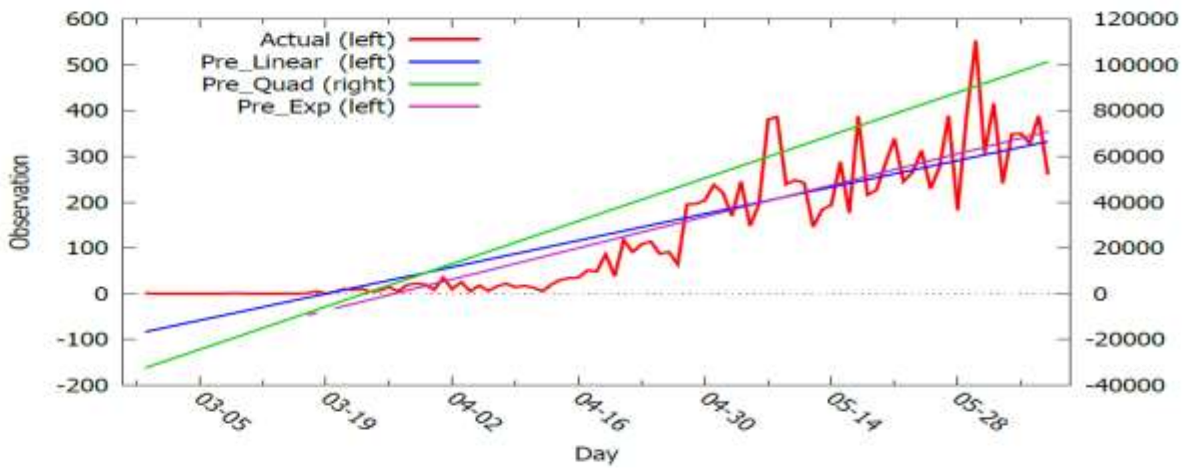

Figure 4: Comparison of Actual and the three Models

B. Discussion

Figure [1] represents graph showing comparison between actual COVID-19 cases from February 28 to June 7 (shown by blue line) and predicted COVID-19 cases (shown by red line) using Multiple Linear Regression of Dedicated Time Series Analysis in GRETL. The x-axis of the graph shows time period in days and the y-axis of the graph shows COVID-19 cases.

Similarly, Figure [2] and Figure [3], depicts graph showing comparison between actual COVID-19 cases from February 28 to June 7 (shown by blue line) and predicted COVID-19 cases (shown by red line) using Quadratic and Exponential Regression of Dedicated Time Series Analysis in GRETL, respectively. The x-axis of the graph shows time period in days and the y-axis of the graph shows COVID-19 cases. While Figure [4] shows the comparisons of the actual COVID-19 cases and the three models.

It is clearly shown from the figures; especially Figure [4] shows that out of the three models the linear model is best for the COVID-19 pandemic. These results agree with the RMSE results in [Table 1], which shows that the linear model is the best model in comparison to quadratic and exponential models using the RMSE technique. Our results correspond with Saigal & Mehrotra [20], Medeiros, Veiga & Pedreira [21], Hippert, Pedreira & Souza [22] and Cărbureanu [22] results in terms using RMSE techniques to measure the performance of time series data. The predicted values from June 8, 2020 to December 31 2020 are shown in appendix D. The predicted values for linear model are closer to the actual cases compare to the quadratic and exponential model. This also shows the linear model is the best in terms of prediction.

The findings show that some periods of the actual model are slight above predicted cases while in few cases the actual models are extremely above predicted cases. These could be as a result of factors such as high increase in infectious contact rate per day or inaccurate COVID-19 data.

In conclusion, it is clear that linear model is the best model that fit the COVID-19 data and it is recommended, Nigeria Government should focus on reducing the infectious contact rate by putting strike measures on social distancing as this will reduce the infectious contact rate thereby reducing the COVID-19 cases new cases.

REFERENCES

[1] Muhammad, A. S., Suliman, Khan., Abeer, K., Nadia, Bashir. & Rabeea, S. (2020) COVID-19 infection: Origin, transmission, and characteristics of human Coronaviruses, *Journal of Advanced Research 24, 91–98*

[2] Zhong N, Zheng B, Li Y, Poon L, Xie Z, Chan K, et al. Epidemiology and cause of severe acute respiratory syndrome (SARS) in Guangdong, People's Republic of China, in February, 2003. The Lancet 2003;362(9393):1353–8.

[3] Lab Health Safety (2020). COVID-19: A History of Coronavirus. Retrieved from: https://www.labmanager.com/lab-health-and-safety/covid-19-a-history-of-coronavirus-22021

[4] Korea Covid-19 Dash Board (20200. Covid-19 Cases. https://coronaboard.kr/en/

[5] Cui J, Li F, Shi Z-L. (2019). Origin and evolution of pathogenic coronaviruses. Nat Rev Microbiol, 17(3):181–92.

[6] NCDC (2020). COVID-19 CASES. Retrieved from https://covid19.ncdc.gov.ng/

[7] Wang, C., Horby, P. W., Hayden, F.G. & Gao, G.F. (2020). A novel coronavirus outbreak of global health concern. The Lancet 2020.

[8] WHO (2020). WHO Timeline - COVID-19. Retrieved from: https://www.who.int/news-room/detail/27-04-2020-who-timeline---covid-19

[9] Phan L.T., Nguyen, T. V., Luong, Q, C., Nguyen, T. V., Nguyen, H. T & Le H. Q. (2020). Importation and human-to-human transmission of a novel coronavirus in Vietnam. N Engl J Med.

[10] Li, Q., Guan, X., Wu, P., Wang X., Zhou L. & Tong, Y. (2002). Early transmission dynamics in Wuhan, China, of novel coronavirus–infected pneumonia. N Engl J Med 2020.

[11] Riou, J., & Althaus, C. L. (2020) Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), Eurosurveillance. 2020:25(4).

[12] WHO (2020). COVID-19 cases top 10 000 in Africa. Retrieved from: https://www.afro.who.int/news/

[13] Rauf, R. I. & Hannah, O. O. (2020). Forecasting the spread of COVID-19 in Nigeria using Box-Jenkins Modeling Procedure. doi: https://doi.org/10.1101/2020.05.05.20091686

[14] Yang, S. Cao, P., Du, P., Wu, Z., Zhuang, Z., Yang, L.,Yu, X., Zhou, Q., Feng, X., Wang, X., Li, W., Liu, E., Chen, J., Chen, Y. & He, D. (2020). Early estimation of the case fatality rate of COVID-19 in mainland China: a data-driven analysis

[15] Fanelli, D. & Piazza, F. (2020) Analysis and forecast of COVID-19 spreading in China, Italy and France. Elsevier Public Health Emergency Collection

[16] Yichi, L., Bowen, W., Ruiyang, P., Chen, Z., Yonglong, Z., Zhuoxun, L., Xia, J. & Bin, Z. (2020). Mathematical Modeling and Epidemic Prediction of COVID-19 and its Significance to Epidemic Prevention and Control Measures. Annals of Infectious Disease and Epidemiology

[17] Victor A. O. (2020). Mathematical Predictions For Covid-19 As A Global Pandemic. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3555879

[18] Statistica (2020). Number of new daily coronavirus (COVID-19) cases in Nigeria as of June 8, 2020 https://www.statista.com/statistics/1110871/coronavirus-cases-in-nigeria/

[19] Han, J. & Kamber, M. (2006). Data Mining: Concepts and Techniques 2nd ed., Elsevier Inc.: Morgan Kaufmann Publish-ers.

[20] Saigal, S. & Mehrotra, D. (2012). Performance Comparison of Time Series Data using Predictive Data Mining Techniques. Advances in Information Mining, 4(1), 57-66.

[21] Medeiros, M. C., Veiga, A. & Pedreira, C. E. (2001). IEEE Trans-actions on Neural Networks, 12(4), 755-764.

[22] Hippert, H. S., Pedreira C.E. & Souza R.C. (2001). IEEE Trans. Power Syst., 16(1), 44-55.

[23] Cărbureanu, M. (2011) Economic Sciences Series, LXIII(3), 105-112.

APPENDIX

Appendix A: OLS using observations 2020-02-28:2020-06-07 (T = 101)
Linear Model

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	−82.2126	13.1212	−6.266	<0.0001	***
Death Rate	−24.3115	20.3984	−1.192	0.2362	
Recovery Rate	−1.66584	0.658399	−2.530	0.0130	**
Time	4.68661	0.297236	15.77	<0.0001	***

Mean dependent var	124.3960	S.D. dependent var	138.2966
Sum squared resid	394381.7	S.E. of regression	63.76355
R-squared	0.793798	Adjusted R-squared	0.787420
F(3, 97)	124.4706	P-value(F)	3.92e-33
Log-likelihood	−560.9455	Akaike criterion	1129.891
Schwarz criterion	1140.351	Hannan-Quinn	1134.126
Rho	0.289650	Durbin-Watson	1.398947

Appendix B: OLS, using observations 2020-02-28:2020-06-07 (T = 101)
Quadratic Model

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	−30902.6	7471.74	−4.136	<0.0001	***
Death Rate	−15859.7	11615.7	−1.365	0.1753	
Recovery Rate	−548.771	374.920	−1.464	0.1465	
Time	1516.21	169.258	8.958	<0.0001	***

Mean dependent var	34410.97	S.D. dependent var	53575.86
Sum squared resid	1.28e+11	S.E. of regression	36309.58
R-squared	0.554471	Adjusted R-squared	0.540692
F(3, 97)	40.23960	P-value(F)	5.55e-17
Log-likelihood	−1201.756	Akaike criterion	2411.511
Schwarz criterion	2421.972	Hannan-Quinn	2415.746
Rho	0.177643	Durbin-Watson	1.631573

Appendix C: OLS using observations 2020-02-28:2020-06-07 (T = 84)

Exponential Model

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	−133.780	17.9744	−7.443	<0.0001	***
Death Rate	2.10053	19.9353	0.1054	0.9163	
Recovery Rate	−4.88923	1.15828	−4.221	<0.0001	***
Time	6.38045	0.441386	14.46	<0.0001	***

Mean dependent var	149.5714	S.D. dependent var	138.6811
Sum squared resid	286686.1	S.E. of regression	59.86298
R-squared	0.820405	Adjusted R-squared	0.813670
F(3, 80)	121.8156	P-value(F)	9.72e-30
Log-likelihood	−460.8745	Akaike criterion	929.7491
Schwarz criterion	939.4724	Hannan-Quinn	933.6578

Appendix D: Predicted COVID-19 Cases from 8/06/2020 – 31/12/2020

Date	prediction	std. error	95% interval
2020-06-08	353.624	74.9407	(204.925, 502.322)
2020-06-09	358.004	74.9839	(209.220, 506.788)
2020-06-10	362.384	75.0279	(213.513, 511.256)
2020-06-11	366.765	75.0728	(217.804, 515.725)
2020-06-12	371.145	75.1184	(222.094, 520.196)
2020-06-13	375.525	75.1648	(226.382, 524.669)
2020-06-14	379.906	75.2121	(230.669, 529.143)
2020-06-15	384.286	75.2602	(234.953, 533.618)
2020-06-16	388.666	75.3090	(239.237, 538.096)
2020-06-17	393.047	75.3587	(243.519, 542.575)
2020-06-18	397.427	75.4092	(247.799, 547.055)
2020-06-19	401.807	75.4605	(252.077, 551.537)
2020-06-20	406.188	75.5125	(256.354, 556.021)
2020-06-21	410.568	75.5654	(260.630, 560.506)
2020-06-22	414.948	75.6190	(264.904, 564.993)
2020-06-23	419.328	75.6735	(269.176, 569.481)
2020-06-24	423.709	75.7287	(273.447, 573.971)
2020-06-25	428.089	75.7848	(277.716, 578.463)
2020-06-26	432.469	75.8416	(281.983, 582.956)
2020-06-27	436.850	75.8992	(286.249, 587.450)
2020-06-28	441.230	75.9576	(290.514, 591.946)
2020-06-29	445.610	76.0168	(294.777, 596.444)
2020-06-30	449.991	76.0767	(299.038, 600.943)
2020-07-01	454.371	76.1375	(303.298, 605.444)
2020-07-02	458.751	76.1990	(307.556, 609.947)
2020-07-03	463.132	76.2613	(311.813, 614.451)
2020-07-04	467.512	76.3243	(316.068, 618.956)
2020-07-05	471.892	76.3882	(320.322, 623.463)
2020-07-06	476.273	76.4528	(324.574, 627.971)

2020-07-07	480.653	76.5181	(328.824, 632.481)
2020-07-08	485.033	76.5843	(333.073, 636.993)
2020-07-09	489.414	76.6512	(337.321, 641.506)
2020-07-10	493.794	76.7188	(341.567, 646.021)
2020-07-11	498.174	76.7872	(345.812, 650.537)
2020-07-12	502.554	76.8564	(350.055, 655.054)
2020-07-13	506.935	76.9264	(354.296, 659.573)
2020-07-14	511.315	76.9970	(358.536, 664.094)
2020-07-15	515.695	77.0685	(362.775, 668.616)
2020-07-16	520.076	77.1407	(367.012, 673.140)
2020-07-17	524.456	77.2136	(371.248, 677.665)
2020-07-18	528.836	77.2873	(375.482, 682.191)
2020-07-19	533.217	77.3617	(379.714, 686.719)
2020-07-20	537.597	77.4368	(383.945, 691.248)
2020-07-21	541.977	77.5127	(388.175, 695.779)
2020-07-22	546.358	77.5894	(392.403, 700.312)
2020-07-23	550.738	77.6667	(396.630, 704.846)
2020-07-24	555.118	77.7448	(400.856, 709.381)
2020-07-25	559.499	77.8237	(405.079, 713.918)
2020-07-26	563.879	77.9032	(409.302, 718.456)
2020-07-27	568.259	77.9835	(413.523, 722.995)
2020-07-28	572.639	78.0645	(417.743, 727.536)
2020-07-29	577.020	78.1462	(421.961, 732.079)
2020-07-30	581.400	78.2287	(426.177, 736.623)
2020-07-31	585.780	78.3119	(430.393, 741.168)
2020-08-01	590.161	78.3957	(434.607, 745.715)
2020-08-02	594.541	78.4803	(438.819, 750.263)
2020-08-03	598.921	78.5656	(443.030, 754.813)
2020-08-04	603.302	78.6516	(447.240, 759.364)
2020-08-05	607.682	78.7383	(451.448, 763.916)
2020-08-06	612.062	78.8257	(455.655, 768.470)
2020-08-07	616.443	78.9138	(459.860, 773.025)
2020-08-08	620.823	79.0027	(464.065, 777.581)
2020-08-09	625.203	79.0922	(468.267, 782.139)
2020-08-10	629.584	79.1824	(472.469, 786.699)
2020-08-11	633.964	79.2732	(476.669, 791.259)
2020-08-12	638.344	79.3648	(480.867, 795.821)
2020-08-13	642.725	79.4571	(485.064, 800.385)
2020-08-14	647.105	79.5500	(489.260, 804.949)
2020-08-15	651.485	79.6437	(493.455, 809.515)
2020-08-16	655.865	79.7380	(497.648, 814.083)
2020-08-17	660.246	79.8329	(501.840, 818.652)
2020-08-18	664.626	79.9286	(506.030, 823.222)
2020-08-19	669.006	80.0249	(510.220, 827.793)
2020-08-20	673.387	80.1219	(514.407, 832.366)
2020-08-21	677.767	80.2196	(518.594, 836.940)
2020-08-22	682.147	80.3179	(522.779, 841.516)

2020-08-23	686.528	80.4169	(526.963, 846.092)
2020-08-24	690.908	80.5166	(531.146, 850.670)
2020-08-25	695.288	80.6169	(535.327, 855.250)
2020-08-26	699.669	80.7178	(539.507, 859.830)
2020-08-27	704.049	80.8194	(543.686, 864.412)
2020-08-28	708.429	80.9217	(547.863, 868.995)
2020-08-29	712.810	81.0246	(552.039, 873.580)
2020-08-30	717.190	81.1282	(556.214, 878.166)
2020-08-31	721.570	81.2324	(560.388, 882.753)
2020-09-01	725.950	81.3372	(564.560, 887.341)
2020-09-02	730.331	81.4427	(568.731, 891.931)
2020-09-03	734.711	81.5488	(572.901, 896.522)
2020-09-04	739.091	81.6555	(577.069, 901.114)
2020-09-05	743.472	81.7629	(581.236, 905.707)
2020-09-06	747.852	81.8709	(585.402, 910.302)
2020-09-07	752.232	81.9795	(589.567, 914.897)
2020-09-08	756.613	82.0887	(593.731, 919.495)
2020-09-09	760.993	82.1986	(597.893, 924.093)
2020-09-10	765.373	82.3091	(602.054, 928.692)
2020-09-11	769.754	82.4202	(606.214, 933.293)
2020-09-12	774.134	82.5319	(610.373, 937.895)
2020-09-13	778.514	82.6442	(614.530, 942.498)
2020-09-14	782.895	82.7571	(618.686, 947.103)
2020-09-15	787.275	82.8707	(622.841, 951.708)
2020-09-16	791.655	82.9848	(626.995, 956.315)
2020-09-17	796.036	83.0995	(631.148, 960.923)
2020-09-18	800.416	83.2149	(635.299, 965.532)
2020-09-19	804.796	83.3308	(639.450, 970.143)
2020-09-20	809.176	83.4473	(643.599, 974.754)
2020-09-21	813.557	83.5644	(647.747, 979.367)
2020-09-22	817.937	83.6821	(651.894, 983.981)
2020-09-23	822.317	83.8004	(656.039, 988.596)
2020-09-24	826.698	83.9193	(660.184, 993.212)
2020-09-25	831.078	84.0387	(664.327, 997.829)
2020-09-26	835.458	84.1587	(668.469, 1002.45)
2020-09-27	839.839	84.2793	(672.610, 1007.07)
2020-09-28	844.219	84.4005	(676.750, 1011.69)
2020-09-29	848.599	84.5223	(680.889, 1016.31)
2020-09-30	852.980	84.6446	(685.026, 1020.93)
2020-10-01	857.360	84.7674	(689.163, 1025.56)
2020-10-02	861.740	84.8909	(693.298, 1030.18)
2020-10-03	866.121	85.0149	(697.433, 1034.81)
2020-10-04	870.501	85.1394	(701.566, 1039.44)
2020-10-05	874.881	85.2645	(705.698, 1044.06)
2020-10-06	879.262	85.3902	(709.829, 1048.69)
2020-10-07	883.642	85.5164	(713.959, 1053.32)
2020-10-08	888.022	85.6432	(718.087, 1057.96)

2020-10-09	892.402	85.7705	(722.215, 1062.59)
2020-10-10	896.783	85.8984	(726.342, 1067.22)
2020-10-11	901.163	86.0267	(730.467, 1071.86)
2020-10-12	905.543	86.1557	(734.592, 1076.49)
2020-10-13	909.924	86.2852	(738.715, 1081.13)
2020-10-14	914.304	86.4152	(742.838, 1085.77)
2020-10-15	918.684	86.5457	(746.959, 1090.41)
2020-10-16	923.065	86.6768	(751.079, 1095.05)
2020-10-17	927.445	86.8083	(755.198, 1099.69)
2020-10-18	931.825	86.9405	(759.317, 1104.33)
2020-10-19	936.206	87.0731	(763.434, 1108.98)
2020-10-20	940.586	87.2062	(767.550, 1113.62)
2020-10-21	944.966	87.3399	(771.665, 1118.27)
2020-10-22	949.347	87.4741	(775.779, 1122.91)
2020-10-23	953.727	87.6088	(779.892, 1127.56)
2020-10-24	958.107	87.7440	(784.004, 1132.21)
2020-10-25	962.487	87.8797	(788.115, 1136.86)
2020-10-26	966.868	88.0160	(792.225, 1141.51)
2020-10-27	971.248	88.1527	(796.334, 1146.16)
2020-10-28	975.628	88.2899	(800.442, 1150.81)
2020-10-29	980.009	88.4276	(804.549, 1155.47)
2020-10-30	984.389	88.5659	(808.655, 1160.12)
2020-10-31	988.769	88.7046	(812.760, 1164.78)
2020-11-01	993.150	88.8438	(816.864, 1169.43)
2020-11-02	997.530	88.9835	(820.967, 1174.09)
2020-11-03	1001.91	89.1236	(825.070, 1178.75)
2020-11-04	1006.29	89.2643	(829.171, 1183.41)
2020-11-05	1010.67	89.4055	(833.271, 1188.07)
2020-11-06	1015.05	89.5471	(837.370, 1192.73)
2020-11-07	1019.43	89.6892	(841.469, 1197.39)
2020-11-08	1023.81	89.8318	(845.566, 1202.06)
2020-11-09	1028.19	89.9748	(849.663, 1206.72)
2020-11-10	1032.57	90.1183	(853.758, 1211.39)
2020-11-11	1036.95	90.2623	(857.853, 1216.05)
2020-11-12	1041.33	90.4068	(861.946, 1220.72)
2020-11-13	1045.71	90.5517	(866.039, 1225.39)
2020-11-14	1050.09	90.6971	(870.131, 1230.06)
2020-11-15	1054.47	90.8430	(874.222, 1234.73)
2020-11-16	1058.85	90.9893	(878.312, 1239.40)
2020-11-17	1063.23	91.1360	(882.401, 1244.07)
2020-11-18	1067.62	91.2832	(886.489, 1248.74)
2020-11-19	1072.00	91.4309	(890.577, 1253.41)
2020-11-20	1076.38	91.5790	(894.663, 1258.09)
2020-11-21	1080.76	91.7275	(898.749, 1262.76)
2020-11-22	1085.14	91.8765	(902.833, 1267.44)
2020-11-23	1089.52	92.0260	(906.917, 1272.12)
2020-11-24	1093.90	92.1759	(911.000, 1276.79)

2020-11-25	1098.28	92.3262	(915.082, 1281.47)
2020-11-26	1102.66	92.4769	(919.163, 1286.15)
2020-11-27	1107.04	92.6281	(923.244, 1290.83)
2020-11-28	1111.42	92.7798	(927.323, 1295.51)
2020-11-29	1115.80	92.9318	(931.402, 1300.20)
2020-11-30	1120.18	93.0843	(935.479, 1304.88)
2020-12-01	1124.56	93.2372	(939.556, 1309.56)
2020-12-02	1128.94	93.3905	(943.632, 1314.25)
2020-12-03	1133.32	93.5443	(947.708, 1318.93)
2020-12-04	1137.70	93.6984	(951.782, 1323.62)
2020-12-05	1142.08	93.8530	(955.856, 1328.31)
2020-12-06	1146.46	94.0080	(959.928, 1332.99)
2020-12-07	1150.84	94.1634	(964.000, 1337.68)
2020-12-08	1155.22	94.3192	(968.072, 1342.37)
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