MODELLING AND FORECASTING DAILY MORTALITY RATE OF COVID-19 IN ECOWAS: EVIDENCE FROM ARIMA MODEL

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Abstract

The Coronavirus Disease 2019 (COVID-19) pandemic which has claimed thousands of lives over the past 6 months and counting, has resulted in great panic by many worldwide, as the number of death cases is now monotonically growing by the day. This paper is aimed at developing a suitable Autoregressive integrated moving average (ARIMA) model, which shall be used to fit a most appropriate model for the daily number of total deaths recorded in ECOWAS that are traceable to the COVID-19 pandemic. We discovered that ARIMA (2, 1, 0) was the most appropriate model for forecasting the number of COVID-19 related deaths recorded in ECOWAS. A forecast of 234 days from 11th May, 2020 to 31st December, 2020, was carried out and we discovered that, the COVID-19 mortality in ECOWAS may likely take a daily upward trend for the next 6 months.

Keywords: ARIMA, COVID-19, Forecasting, Mortality, Time Series.

INTRODUCTION

Corona virus disease 2019 (COVID-19) an illness caused by novel coronavirus now called Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) which was first identified amid an outbreak of respiratory illness cases in Wuhan City, Hubei Province, China.

The World Health Organisation (WHO) on March 11, 2020, has declared the novel coronavirus (Covid-19) as a pandemic, as the virus moved from China to almost every part of the world now, with number of cases as at April 20, 2020, of about two million, four hundred and seventy two thousand, and sixty two (2,472,062) with over one hundred and seventy thousand (170,000) deaths recorded worldwide (WHO Publication 2020).

In the Economic Community of West African States which includes African countries like: Benin, Burkina Faso, Cabo Verde, Cote D'Ivoire, Gambia, Ghana, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, and Sierra Lone, the story is not different as the number of confirmed cases as well as death cases is on the increase by the day. As at 10th May 2020, the total number of confirmed cases of COVID-19 in ECOWAS was about fifteen thousand, six hundred and ninety one thousand persons (15,691), with an average of three hundred and eight cases per day, while the total number of deaths recorded was about three hundred and seventy three (373) cases, with an average of twenty eight deaths per day, in ECOWAS countries (Johns Hopkins University Coronavirus Resource Centre, May, 2020).

This paper aims to fit a suitable Autoregressive Integrated Moving Average (ARIMA) model for the sum of daily death cases of COVID-19 in ECOWAS as a whole.

Several types of ARIMA models have been proposed by different scholars over the years. The Autoregressive Moving Average (ARMA) approach was introduced by Box G., et al. (1970) 1976, in their work on Time series analysis: forecasting and control. This approach is well tested and efficaciously applied by many scholars. For instance, Masukawa et al. (2014) studied the impact of the introduction of a rotavirus vaccine on rates of hospitalization of children less than 5 years old for acute diarrhea. Michael et al. (2004) studied the impact of illicit drug supply reduction on health and social outcomes: the heroin shortage in the Australian Capital Territory. They observed that a sustainable decline in the supply of heroin, as measured by indicators such as drug purity, is related to changes in drug-related health indicator such as ambulance callouts to heroin overdoses.

In further studies, ARIMA models have been fitted to economic variable. For instance Nwaju K., et al. (2019), used Box-Jenkins ARMA model in their work on intervention analysis of daily South African Rand/Nigerian Naira exchange rates. In their work they carried out a time series plot of a realization of daily exchange rates of South African Rand and Nigerian Naira from April 2017 to December, 2017 which showed the occurrence of an intervention on 4th August, 2017. They fitted ARMA (12, 2) model to their data and concluded that management of these exchange rates may be made on the basis of their proposed model. Etuk E. H., et al. (2012) proposed a seasonal Box-Jenkins Model for Nigerian Inflation rate series. They obtained a seasonal difference as well as a non-sessional difference. The correlogram of the differenced

series they obtained, revealed a seasonal nature. It also revealed a seasonal autoregressive component which was shown to be adequate for the data studied.

Materials and Method

Data

The data used in this work are of secondary sources. The data analyzed in this work are daily sum of cases and deaths recorded from COVID-19 in ECOWAS as a whole from 21st March, 2020 to 10th May, 2020. These were obtained from European Centre for Disease Prevention and Control (ECDC) with link: <http://www.ecdc.europa.eu/en/publications-data/download-todays-data-geographical-distribution-covid-19-cases-worldwide>, The used data is listed in the appendix.

ARIMA Modelling

Autoregressive Moving-Average (ARMA) Model

A time series $\{X_t\}$ is said to follow an autoregressive moving-average process of order p and q , i.e. $ARMA(p, q)$, process if:

$$X_t = c + \alpha_1 X_{t-1} + \alpha_2 X_{t-2} + \dots + \alpha_p X_{t-p} + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} - \dots - \theta_q \varepsilon_{t-q}. \quad 1$$

In summation form we have

$$X_t = \sum_{k=1}^p \alpha_k X_{t-k} - \sum_{k=1}^q \theta_k \varepsilon_{t-k} + \varepsilon_t + c \quad 2$$

That ARMA models can be extended to non-stationary series by allowing the differencing of the data series resulting to $ARIMA(p, d, q)$: where with three parameters; p is the order of autoregressive, d is the degree of differencing, and q is the order of moving-average.

Thus an $ARIMA(p, d, q)$ model is given by:

$$\nabla^d X_t = \alpha_1 \nabla^d X_{t-1} + \alpha_2 \nabla^d X_{t-2} + \dots + \alpha_p \nabla^d X_{t-p} + \varepsilon_t + \beta_1 \varepsilon_{t-1} + \beta_2 \varepsilon_{t-2} + \beta_p \varepsilon_{t-p} \quad 3$$

where $\{\varepsilon_t\}$ is the error term in the equation; a white noise process, a sequence of independently and identically distributed (iid) random variables with $E(\varepsilon_t) = 0$ and $var(\varepsilon_t) = \sigma^2$; i.e. $\varepsilon_t \sim iidN(0, \sigma^2)$, and the α 's and β 's are the model parameters.

Distinction between ARMA and ARIMA is the integrated **component** which brings us back to the subject of stationarity. In reality, most economic variables are non-stationary, hence they have to go through a transformation process called differencing before they become stationary.

The autoregressive (AR) order may be determined by the lap at which the partial autocorrelation function (PACF) cuts off. The moving average (MA) order may be estimated as the lap at which the autocorrelation function (ACF) cuts off. Estimation of α 's and β 's may be done by the method of least squares.

Box-Jenkins Model Selection Approach

Figure 1: Flowchart of Stages in the Box-Jenkins iterative approach

All plots and numerical computations will be carried out using E-views version 10 on a Windows 10 personal computer with the following specifications.

Processor: Intel® Core i5-3230M CPU @ 2.60GHz

Installed Memory (Ram): 4.00GB

System type: 64-bits Operating System.

RESULTS AND DISCUSSION

The time plot of the realization of the time series used in this work is shown in Figure 1. This plot shows that the number of death cases of COVID-19 in ECOWAS countries, follows an irregular upward-downward pattern, showing both upward and downward movement over 51 days. They are adjudged stationary by the Augmented Dickey Fuller Test (See Table 1, Table 2, Table 3 and Table 4).

Figure 1: Time plot of daily death cases of Covid-19 in ECOWAS

Figure 2: Correlogram of actual death cases data showing a nonstationary behaviour of the data.

Figure 3: Time plot of 1st difference of the actual death case data.

Table 1: Augmented Dickey-Fuller Test Result of differenced Death cases data showing a stationary behaviour.

Null Hypothesis: D(DEATH) has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-10.09050	0.0000
Test critical values:		
1% level	-3.574446	
5% level	-2.923780	
10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(DEATH,2)

Method: Least Squares

Date: 05/13/20 Time: 07:32

Sample (adjusted): 4 51

Included observations: 48 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DEATH(-1))	-2.268733	0.224839	-10.09050	0.0000
D(DEATH(-1),2)	0.525408	0.129877	4.045432	0.0002
C	0.765629	0.594203	1.288498	0.2042
R-squared	0.807303	Mean dependent var		0.187500
Adjusted R-squared	0.798739	S.D. dependent var		9.131792
S.E. of regression	4.096714	Akaike info criterion		5.718709
Sum squared resid	755.2378	Schwarz criterion		5.835659
Log likelihood	-134.2490	Hannan-Quinn criter.		5.762904
F-statistic	94.26392	Durbin-Watson stat		1.989604
Prob(F-statistic)	0.000000			

ADF of 1st difference of actual death case data showing a stationary behaviour.

Figure 4: Correlogram of first difference of actual death cases data.

Table 2: Estimation of parsimonious Models for the Death Cases data.

Dependent Variable: DIFDEATH

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 10/05/20 Time: 21:04

Sample: 2 51

Included observations: 50

Failure to improve objective (non-zero gradients) after 25 iterations

Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.285817	0.065807	4.343266	0.0001
AR(1)	-1.052442	0.079310	-13.26996	0.0000
AR(2)	-0.949022	0.163784	-5.794369	0.0000
AR(5)	-0.002283	0.196019	-0.011647	0.9908
MA(1)	0.177642	0.603931	0.294143	0.7701
MA(3)	-0.931366	3.786159	-0.245992	0.8069
MA(5)	-0.232400	2.182132	-0.106501	0.9157
SIGMASQ	9.640604	43.29980	0.222648	0.8249
R-squared	0.644043	Mean dependent var		0.420000
Adjusted R-squared	0.584717	S.D. dependent var		5.257026
S.E. of regression	3.387759	Akaike info criterion		5.580402
Sum squared resid	482.0302	Schwarz criterion		5.886326
Log likelihood	-131.5101	Hannan-Quinn criter.		5.696900
F-statistic	10.85596	Durbin-Watson stat		1.878135
Prob(F-statistic)	0.000000			
Inverted AR Roots	.07-.11i -.53-.82i	.07+.11i	-.14	-.53+.82i
Inverted MA Roots	1.00 -.61-.79i	.03-.48i	.03+.48i	-.61+.79i

From the parsimonious models estimation following the significant lags of the PACF for the $AR(p)$ and ACF for the $MA(q)$ of the correlogram of the first differenced data above, only $AR(1)$ and $AR(2)$ are significant at a 0.05 confidence level.

Thus for the death cases data, ARIMA (2, 1, 0) is chosen as the best fitted model.

The equation representing the model is:

$$\nabla X_t = 0.2858170 - 1.052442 \nabla X_{t-1} - 0.949022 \nabla X_{t-2} + \varepsilon_t \quad 4$$

Future forecast for 234 (May 11 2020 to December 31 2020) days was carried out using the on E-views using the model in (5) above.

Figure 5: Actual and fitted death case plot using ARIMA (2, 1, 0).

Residual Diagnostics

Date: 10/05/20 Time: 21:30

Sample: 151

Included observations: 50

Q-statistic probabilities adjusted for 6 ARMA terms

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
		1 -0.011	-0.011	0.0068	
		2 -0.043	-0.043	0.1081	
		3 -0.038	-0.039	0.1886	
		4 -0.030	-0.033	0.2402	
		5 -0.146	-0.151	1.4778	
		6 -0.041	-0.052	1.5794	
		7 0.051	0.033	1.7387	0.187
		8 0.081	0.067	2.1430	0.342
		9 0.076	0.073	2.5096	0.474
		10 -0.057	-0.070	2.7182	0.606
		11 0.090	0.092	3.2564	0.661
		12 0.019	0.041	3.2820	0.773
		13 0.030	0.069	3.3469	0.851
		14 0.067	0.108	3.6682	0.886
		15 0.049	0.052	3.8502	0.921
		16 -0.085	-0.061	4.4051	0.927
		17 -0.144	-0.135	6.0478	0.870
		18 -0.160	-0.174	8.1199	0.776
		19 -0.059	-0.082	8.4143	0.816
		20 -0.031	-0.090	8.4960	0.862
		21 0.024	-0.046	8.5480	0.900
		22 -0.029	-0.148	8.6268	0.928
		23 -0.012	-0.130	8.6398	0.951
		24 0.016	-0.037	8.6644	0.967

Figure 6: Correlogram of residuals from the fitted ARIMA (5, 1, 5) model showing no significant lag spike.

Figure 7: Actual, fitted and residual plot for the death case.

Table 3: Actual, Fitted, and Residuals of the model.

obs	Actual	Fitted	Residual	Residual Plot
2	3.00000	1.31930	1.68070	
3	-3.00000	-1.62543	-1.37457	
4	3.00000	1.72929	1.27071	
5	-1.00000	-0.50630	-0.49370	
6	0.00000	0.16020	-0.16020	
7	-2.00000	0.13451	-2.13451	
8	3.00000	3.06407	-0.06407	
9	5.00000	-0.04757	5.04757	
10	-7.00000	-4.62798	-2.37202	
11	7.00000	3.79567	3.20433	
12	-8.00000	-3.40888	-4.59112	
13	6.00000	4.07604	1.92396	
14	-2.00000	-1.47701	-0.52299	
15	-3.00000	1.21319	-4.21319	
16	4.00000	2.86426	1.13574	
17	7.00000	1.38410	5.61590	
18	-11.0000	-6.34048	-4.65952	
19	4.00000	4.23235	-0.23235	
20	4.00000	3.05351	0.94649	
21	-7.00000	-3.41321	-3.58679	
22	0.00000	2.61036	-2.61036	
23	6.00000	7.08487	-1.08487	
24	-6.00000	-2.70999	-3.29001	
25	3.00000	2.92475	0.07525	
26	-1.00000	4.79650	-5.79650	
27	-1.00000	1.37544	-2.37544	
28	4.00000	2.54752	1.45248	
29	9.00000	3.90889	5.09111	
30	-9.00000	-9.37519	0.37519	
31	-1.00000	1.82140	-2.82140	
32	3.00000	5.84095	-2.84095	
33	-3.00000	-2.58101	-0.41899	
34	3.00000	2.43100	0.56900	
35	0.00000	3.00698	-3.00698	
36	-3.00000	-1.56251	-1.43749	
37	3.00000	3.81269	-0.81269	
38	4.00000	3.20674	0.79326	
39	-7.00000	-4.97884	-2.02116	
40	7.00000	5.53161	1.46839	
41	1.00000	0.02426	0.97574	
42	-1.00000	-4.54719	3.54719	
43	3.00000	0.18599	2.81401	
44	8.00000	-0.96369	8.96369	
45	-15.0000	-12.4120	-2.58800	
46	1.00000	5.75655	-4.75655	
47	4.00000	4.28786	-0.28786	
48	-5.00000	-2.77168	-2.22832	
49	4.00000	4.18095	-0.18095	
50	2.00000	2.22442	-0.22442	
51	6.00000	-1.78995	7.78995

Figure 8: Histogram: normality test of residual for fitted death cases

Forecast

Dependent Variable: DEATHFORECAST

Method: ARMA Maximum Likelihood (BFGS)

Date: 10/05/20 Time: 21:40

Sample: 6 51

Included observations: 46

Convergence achieved after 4 iterations

Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(1)	-0.207072	0.226731	-0.913293	0.0000
AR(2)	-0.222709	0.187012	-1.190877	0.0000
SIGMASQ	52.58093	11.62927	4.521431	0.0000
R-squared	0.289487	Mean dependent var		7.302895
Adjusted R-squared	0.238736	S.D. dependent var		8.697625
S.E. of regression	7.588718	Akaike info criterion		6.976988
Sum squared resid	2418.723	Schwarz criterion		7.136000
Log likelihood	-156.4707	Hannan-Quinn criter.		7.036555
Durbin-Watson stat	1.851382			
Inverted AR Roots	-.10-.46i	-.10+.46i

Figure 9: Plot of actual and forecasted values for the death cases showing an upward trend over the next 7 months.

CONCLUSION

The Coronavirus Disease 2019 (COVID-19) pandemic which has claimed thousands of lives over the past 6 months and counting, has resulted in great panic by many worldwide, as the number of death cases is now monotonically growing by the day. This paper was aimed at developing a suitable ARIMA model which was used to fit a most appropriate model for the daily number of total deaths recorded in ECOWAS traceable to the COVID-19 pandemic. We discovered that ARIMA (2, 1, 0) was the most appropriate for forecasting the number of COVID-19 related deaths recorded in ECOWAS. A forecast of 235 days from 11th May, 2020 to 31th December, 2020, was carried out and we discovered that, the COVID-19 mortality in ECOWAS may likely take a daily upward trend for the next 7 months.

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Appendix 1: Daily Total Death Cases of Covid-19 in ECOWAS from 3rd April, 2020 to 10th May, 2020.

S/N	DATE	Daily Total Death Cases of Covid-19 in ECOWAS	S/N	DATE	Daily Total Death Cases of Covid-19 in ECOWAS
1	3/21/2020	0	26	4/15/2020	4
2	3/22/2020	3	27	4/16/2020	3
3	3/23/2020	0	28	4/17/2020	7
4	3/24/2020	3	29	4/18/2020	16
5	3/25/2020	2	30	4/19/2020	7
6	3/26/2020	2	31	4/20/2020	6
7	3/27/2020	0	32	4/21/2020	9
8	3/28/2020	3	33	4/22/2020	6
9	3/29/2020	8	34	4/23/2020	9
10	3/30/2020	1	35	4/24/2020	9
11	3/31/2020	8	36	4/25/2020	6
12	4/1/2020	0	37	4/26/2020	9
13	4/2/2020	6	38	4/27/2020	13
14	4/3/2020	4	39	4/28/2020	6
15	4/4/2020	1	40	4/29/2020	13
16	4/5/2020	5	41	4/30/2020	14
17	4/6/2020	12	42	5/1/2020	13
18	4/7/2020	1	43	5/2/2020	16
19	4/8/2020	5	44	5/3/2020	24
20	4/9/2020	9	45	5/4/2020	9
21	4/10/2020	2	46	5/5/2020	10

22	4/11/2020	2		47	5/6/2020	14
23	4/12/2020	8		48	5/7/2020	9
24	4/13/2020	2		49	5/8/2020	13
25	4/14/2020	5		50	5/9/2020	15
				51	5/10/2020	21

Appendix 1: TABLE: Forecasted daily total death cases of Covid-19 in ECOWASs.

S/N	DATE	FORECASTED TOTAL DAILY DEATH CASES IN ECOWAS STATES	S/N	DATE	FORECASTED TOTAL DAILY DEATH CASES IN ECOWAS STATES
1	5/11/2020	8	41	6/20/2020	21
2	5/12/2020	8	42	6/21/2020	21
3	5/13/2020	8	43	6/22/2020	21
4	5/16/2020	8	44	6/23/2020	21
5	5/15/2020	8	45	6/24/2020	21
6	5/16/2020	9	46	6/25/2020	21
7	5/17/2020	9	47	6/26/2020	21
8	5/18/2020	9	48	6/27/2020	21
9	5/19/2020	10	49	6/28/2020	21
10	5/20/2020	10	50	6/29/2020	21
11	5/21/2020	10	51	6/30/2020	21
12	5/22/2020	11	52	7/1/2020	21
13	5/23/2020	11	53	7/2/2020	21
14	5/24/2020	12	54	7/3/2020	21
15	5/25/2020	12	55	7/4/2020	21
16	5/26/2020	13	56	7/5/2020	21
17	5/27/2020	13	57	7/6/2020	21
18	5/28/2020	14	58	7/7/2020	21
19	5/29/2020	14	59	7/8/2020	21
20	5/30/2020	15	60	7/9/2020	22
21	5/31/2020	15	61	7/10/2020	22
22	6/1/2020	16	62	7/11/2020	22
23	6/2/2020	16	63	7/12/2020	22
24	6/3/2020	17	64	7/13/2020	22
25	6/4/2020	17	65	7/14/2020	22
26	5/5/2020	17	66	7/15/2020	23
27	6/6/2020	18	67	7/16/2020	23
28	6/7/2020	18	68	7/17/2020	23
29	6/8/2020	19	69	7/18/2020	24
30	6/9/2020	19	70	7/19/2020	24
31	6/10/2020	19	71	7/20/2020	24
32	6/11/2020	20	72	7/21/2020	24
33	6/12/2020	20	73	7/22/2020	25
34	6/13/2020	20	74	7/23/2020	25
35	6/14/2020	20	75	7/24/2020	26
36	6/15/2020	20	76	7/25/2020	26

37	6/16/2020	21	77	7/26/2020	26
38	6/17/2020	21	78	7/27/2020	27
39	6/18/2020	21	79	7/28/2020	27
40	6/19/2020	21	80	7/29/2020	27

S/N	DATE	FORECASTED TOTAL DAILY DEATH CASES IN ECOWAS STATES	S/N	DATE	FORECASTED TOTAL DAILY DEATH CASES IN ECOWAS STATES
81	7/30/2020	28	121	9/8/2020	35
82	7/31/2020	28	122	9/9/2020	35
83	8/1/2020	28	123	9/10/2020	35
84	8/2/2020	29	124	9/11/2020	36
85	8/3/2020	29	125	9/12/2020	36
86	8/4/2020	30	126	9/13/2020	36
87	8/5/2020	30	127	9/14/2020	36
88	8/6/2020	30	128	9/15/2020	37
89	8/7/2020	30	129	9/16/2020	37
90	8/8/2020	31	130	9/17/2020	37
91	8/9/2020	31	131	9/18/2020	37
92	8/10/2020	31	132	9/19/2020	38
93	8/11/2020	31	133	9/20/2020	38
94	8/12/2020	32	134	9/21/2020	38
95	8/13/2020	32	135	9/22/2020	39
96	8/14/2020	32	136	9/23/2020	39
97	8/15/2020	32	137	9/24/2020	39
98	8/16/2020	32	138	9/25/2020	39
99	8/17/2020	33	139	9/26/2020	40
100	8/18/2020	33	140	9/27/2020	40
101	8/19/2020	33	141	9/28/2020	40
102	8/20/2020	33	142	9/29/2020	41
103	8/21/2020	33	143	9/30/2020	41
104	8/22/2020	33	144	10/1/2020	41
105	8/23/2020	33	145	10/2/2020	42
106	8/24/2020	33	146	10/3/2020	42
107	8/25/2020	33	147	10/10/2020	42
108	8/26/2020	34	148	10/5/2020	42
109	8/27/2020	34	149	10/6/2020	43
110	8/28/2020	34	150	10/7/2020	43
111	8/29/2020	34	151	10/8/2020	43
112	8/30/2020	34	152	10/9/2020	43
113	8/31/2020	34	153	10/10/2020	44

114	9/1/2020	34	154	10/11/2020	44
115	9/2/2020	34	155	10/12/2020	44
116	9/3/2020	34	156	10/13/2020	44
117	9/4/2020	34	157	10/14/2020	44
118	9/5/2020	35	158	10/15/2020	45
119	9/6/2020	35	159	10/16/2020	45
120	9/7/2020	35	160	10/17/2020	45

S/N	DATE	FORECASTED TOTAL DAILY DEATH CASES IN ECOWAS STATES	S/N	DATE	FORECASTED TOTAL DAILY DEATH CASES IN ECOWAS STATES
161	10/18/2020	45	201	11/27/2020	53
162	10/19/2020	45	202	11/28/2020	53
163	10/20/2020	45	203	11/29/2020	53
164	10/21/2020	45	204	11/30/2020	54
165	10/22/2020	46	205	12/1/2020	54
166	10/23/2020	46	206	12/2/2020	54
167	10/24/2020	46	207	12/3/2020	54
168	10/25/2020	46	208	12/4/2020	55
169	10/26/2020	46	209	12/5/2020	55
170	10/27/2020	46	210	12/6/2020	55
171	10/28/2020	47	211	12/7/2020	55
172	10/29/2020	47	212	12/8/2020	56
173	10/30/2020	47	213	12/9/2020	56
174	10/31/2020	47	214	12/10/2020	56
175	11/1/2020	47	215	12/11/2020	56
176	11/2/2020	47	216	12/12/2020	56
177	11/3/2020	47	217	12/13/2020	57
178	11/4/2020	48	218	12/14/2020	57
179	11/5/2020	48	219	12/15/2020	57
180	11/6/2020	48	220	12/16/2020	57
181	11/7/2020	48	221	12/17/2020	57
182	11/8/2020	48	222	12/18/2020	58
183	11/9/2020	49	223	12/19/2020	58
184	11/10/2020	49	224	12/20/2020	58
185	11/11/2020	49	225	12/21/2020	58
186	11/12/2020	49	226	12/22/2020	58
187	11/13/2020	49	227	12/23/2020	58
188	11/14/2020	50	228	12/24/2020	59
189	11/15/2020	50	229	12/25/2020	59
190	11/16/2020	50	230	12/26/2020	59
191	11/17/2020	50	231	12/27/2020	59
192	11/18/2020	51	232	12/28/2020	59
193	11/19/2020	51	233	12/29/2020	60
194	11/20/2020	51	234	12/30/2020	60
195	11/21/2020	51	235	12/31/2020	60
196	11/22/2020	52	TOTAL FORECASTED CASES		8303
197	11/23/2020	52	AVERAGE		35
198	11/24/2020	52			

			DAILY FORECASTED CASES	
199	11/25/2020	52		
200	11/26/2020	53		