COVID 19 Pandemic: A Real-time Forecasts & Prediction of Confirmed Cases, Active Cases using the ARIMA model & Public Health in West Bengal, India.

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Research Article

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Abstract

Background: COVID-19 is an emerging infectious disease which has been declared a Pandemic by the World Health Organization (WHO) on March 11 2020. This pandemic has spread over the world in more than 200 countries. India is also adversely affected by this pandemic, and there are no signs of slowing down of the virus in coming time. The absence of a vaccine for COVID-19 is making the situation worse for the already overstretched Indian public health care system. As economic burden makes it increasingly difficult for our country to continue imposing control measures, it is vital for states like West Bengal to make predictions using time series forecasting for the upcoming cases , test kits , health care and estimated the requirement of Quarantine centers, isolation beds, ICU beds and ventilators for COVID-19 patients .

Objective: This study is forecasting the confirmed and active cases for COVID-19 until August, using time series ARIMA model & Public Health in West Bengal, India.

Methods: We used ARIMA model, and Auto ARIMA model for forecasting confirmed and active cases till the end of August month using time series data of COVID-19 cases in West Bengal, India from March 1, 2020, to June 4, 2020.

Discussion and Conclusion: This forecasts show a very crucial situation for West Bengal in coming days and, the actual numbers can go higher than our estimates of confirmed case as Lockdown 5.0 & Unlock 1.0 will be implemented from 1st June 2020 in India, West Bengal will be observing a partial lift of the lockdown and in that case, there will be a surge in the number of daily confirmed and active cases. The requirement of Health care sector needs to be further improved isolation beds, ICUs and ventilators will also be needed to increase in that scenario. Inter State & Intra State Movement restrictions are lifted. Hence, Migrants returning to their homes due to loss of livelihood and income in the lockdown period may lead to a rise in the number of cases, which could not be accounted for in our projections. We suggest more of Public-Private Partnership (PPP) model in the health sector to accommodate COVID-19 patients adequately and reduce the burden of the already overstretched Indian public health care system, which will directly or indirectly affect the States in the time of crisis.

Introduction

Coronavirus disease (COVID–19) is one of the greatest challenges the world has encountered in recent times. Since the initial reports of outbreak in late December, 2019, It is caused by severe acute respiratory syndrome Corona Virus 2 (SARS-CoV–2). The origin of the virus is yet to be confirmed, but the first person tested positive is from Wuhan, China. It is spreading very quickly throughout the world & the numbers have been consistently rising with the disease affecting 6.54 million people in 181 countries worldwide as of 6th June, 2020. In India, the first positive case of COVID–19 was detected on January 30th 2020, in Kerala. The frailty of a multitude of health care systems across the globe has been exposed by COVID–19. With the surfacing negative socioeconomic consequences of community mitigation strategies like

lockdown affecting the vulnerable, especially in developing countries like India, Governments are eyeing at easing the restrictions that have long been in place by recent Lockdown 5.0. It is imperative to understand that lifting the control measures for economic salvage, without thoroughly preparing for the possible consequences, may only result in further economic decline and health crisis.

WHO in its strategic advice for countries looking to lift the control measures illustrated six criteria in a sequential manner to be considered: control of transmission; preparation of health systems for active contact tracing and optimum care provision; careful management of health facilities to prevent outbreaks; adherence to preventive measures as the essential services resume; management of importation risks; indoctrination of the 'new norm' among communities by active engagement. According to the report of World Population prospects (2019), India has a population of more than 1.36 billion and most of the population of urban areas and cities are under the risk of contracting the virus. So, it is important to forecast numbers of confirmed and active cases. In this scenario, it is vital for every state to make predictions using time series forecasting, the study aims to draw comparative account of the progression of COVID-19 in near future in the state of West Bengal.

Data And Methodology

Data:

For our study, the required data of daily total confirmed cases and total active cases of COVID-19 infection collected for India as well as its state West Bengal from the (<https://www.covid19india.org/>), and excel of the patient database is used to build a time-series database for confirmed and active cases Using the Data Science Software called R. In this study, forecasting is done based on the data from March 1, 2020, to June 4 2020. This data is being used to build Forecast which includes all the Statistics and Graphs for mentioned model.

Methodology:

In the past few months, an increasing number of research related to forecasting the trend of pandemic COVID-19 cases are being published using different approaches in various part of the world. (Gupta and Pal 2020; Fanelli and Piazza 2020; Giordano et al. 2020; Tandon et al., 2020; Kumar et al. 2020; Benvenuto et al. 2020; Batista, 2020). The ARIMA model is one of them and nowadays used for forecasting case count for the prediction of epidemic diseases based on the time series modeling (Rios et al. 2000; Li et al. 2012; Zhang et al. 2014; Benvenuto et al., 2020).

In this study, the well-known Autoregressive Integrated Moving Average (ARIMA) time-series model used for the further forecasting purpose. ARIMA model is one of the generalized forms of an autoregressive moving average (ARMA) model among the time series forecasting. We fit both models to understand the data better or to predict future points in the series (Forecasting). ARIMA model depends or always

represented with the help of some parameters, and the model has expressed as ARIMA (p, d, q): p, d and q are non-negative integers.

The parameters have their usual meaning, here, p stands for the order of auto-regression, d represents the degree of trend difference (the number of times the data have had past values subtracted) for the stationary of the trend and q signifies the order of moving average. This model combines auto regression lags under the stationary trend and moving average and predict better future values based on past and recent data. For this model, the degree of parameters p , d and q determine based on the partial Auto-correlation function (PACF) graph, The Augmented Dickey-Fuller Test to test the stationary of the time series observations and Complete Auto-Correlation Function (ACF) graph respectively (Forecasting COVID-19 cases in India)

We have applied the ARIMA model and Auto ARIMA model using R, to our considered time series data of COVID-19 cases in West Bengal for the forecasting the total confirmed and active cases for West Bengal and its majorly affected Districts. We selected Districts based on the criterion that chosen Districts should have at least 2 confirmed cases till June 2nd 2020. By using this selection criterion, West Bengal and its 24 Districts Alipurduar, Bankura, Birbhum, Cooch Behar,

Dakshin Dinajpur (South Dinajpur), Darjeeling, Hooghly, Howrah, Jalpaiguri, Jhargram, Kalimpong, Kolkata, Malda, Murshidabad, Nadia, North 24 Parganas, Paschim Medinipur (West Medinipur), Paschim (West) Burdwan (Bardhaman), Purba Burdwan (Bardhaman),

Purba Medinipur (East Medinipur), Purulia, South 24 Parganas, Uttar Dinajpur (North Dinajpur),

The cases are forecasted under the assumption that people will be maintaining condition similar to the partial lockdown situation and maintain physical distancing with self quarantine. After fitting the model, the built model is used to forecast confirmed and active cases COVID-19 cases for the next 80 days, *i.e.* from June 6rd, 2020, to August 3rd 2020.

The model for forecasting future confirmed and active cases of COVID-19 cases is represented as,

$$ARIMA(p, d, q): X_t = \alpha_1 X_{t-1} + \alpha_2 X_{t-2} + \beta_1 Z_{t-1} + \beta_2 Z_{t-2} + Z_t(i)$$

Where, $Z_t = X_t - X_{t-1}(ii)$

Here, X_t is the predicted number of confirmed and active COVID-19 cases at t^{th} day; α_1 , α_2 , β_1 and β_2 are parameters whereas Z_t is the residual term for t^{th} day.

The trend of forthcoming incidences can be estimated from the previous cases, and a time series analysis is performed for this purpose

(Tandon et. al., 2020).

In our study, the forecasted cases are mainly used for preparing the government of West Bengal for the health infrastructure such as the number of isolation beds, ICU beds and ventilators, Quarantine centers etc. across the State. In further analysis, based on predicted active cases, we estimated the hike in number of cases by COVID–19 patients in the coming days. Based on this theory we can maximize the requirement of Quarantine centers, Alcohol based Sanitizers, Public sanitizing materials, ICUs and ventilators as the infection hit its peak, which the state may get in the month of July-August according to the forecast.

Our health infrastructure requirement is estimated based on the active cases as our projections are made on the basis on data till June 2nd when our country was observing the complete lockdown and starting of Lookdown 5.0. However, India is observing partial lockdown in Containment Zones currently and has removed lockdown in the Red, Yellow & Green Zones, so for being prudent, we will estimate the amount of active cases which are to be increased and also look into the Public Health Infrastructure of West Bengal.

Results

Allegations against West Bengal Government: A Case Study

Chief Minister of West Bengal Mamata Banerjee and her government was widely criticized of the handling of the *coronavirus pandemic* and was accused of concealing facts by the opposition and critics. The opposition accused Mamata of playing “appeasement politics” amid the COVID–19 crisis. On 1 April, Banerjee claimed that the *West Bengal Government* have already traced 54 people who attended the *Tablighi Jamaat* religious gathering during the COVID–19 Outbreak, and 44 of them are foreigners. Although according to a report by central security agencies, 232 people had attended the Delhi’s Tablighi Jamaat event from West Bengal.

Of this, 123 are Indian nationals and 109 are foreigners.

Sooner she clarified that her government has acted swiftly after the Nizamuddin area was declared as a hotspot where nearly 2,300 people were staying despite the lockdown.

She further added that the government has quarantined 177 people, including 108 foreigners, who attended the Tablighi Jamaat congregation at the Nizamuddin Markaz.

The West Bengal Government has been also criticized for not sending enough samples to the *National Institute of Cholera and Enteric Diseases(NICED)* for testing.

West Bengal test numbers saw some rise after talks between government and NICED. According to them, this will be scaled up further in coming days.

The West Bengal Government has also been recommended to ensure transparency, genuine and verifiable data of COVID–19 by the West Bengal Doctors Forum (WBDF), as doctors cannot afford to send wrong signals to the world.

The doctors also hit out at the idea of the bureaucratic system to identify the death of COVID–19 patients. Their spokesperson claimed that every doctor is qualified enough and does not need a committee for such certification. On April 25, 2020,

The WB Govt admitted that 57 COVID–19 patients died but also said that 39 from comorbidities, after Inter Ministerial Central Team (IMCT) seek report.

The IMCT also pointed out flaws of the Govt in their letter to the Chief Secretary Rajiva Sinha, in which the letter read:

There were a large number of patients in the isolation wards of Chittaranjan National Cancer Institute (CNCI) as well as MR Bangur hospitals awaiting COVID test results for five days or longer.

Specifically at CNCI, there were four patients awaiting test result since April 16, 2020, two patients awaiting test result since April 17, 2020, and three since April 18, 2020.

Some of the patients have tested negative. It is not clear why the test results should take such a long time and there is a danger of COVID–19 negative patient acquiring the infection in the hospital while awaiting test result

Discussion & Conclusion

The world is going through a pandemic, and almost every country is affected by it. A country as well as the States needs to know how much burden of active and confirmed cases it will have to bear in the coming time. It will help the states in taking pre-active measures to prepare adequate health infrastructure for the coming time based on future needs. We used ARIMA model and Auto ARIMA model on the time series data of COVID–19 cases in West Bengal for forecasting the total confirmed and active cases till August end.

Based on the forecasts, confirmed cases for West Bengal at the end of June are expected to be 17838–18724 (95% CI: 128806, 227968). West Bengal will be having 27147–30616 confirmed cases (95% CI: 173917, 415800) in the mid of July from the estimates, Even West Bengal will be having 50588–55617 confirmed cases (95% CI: 198917, 525800) in the mid of August from the estimates & we expect that India will be having

Estimated Cases—62279 ± 5000 at the end of August.

These results also show that daily confirmed cases are increasing at a faster pace even at the end of June with around 400–500 daily confirmed cases, so it is likely that peak will be attained afterwards.

According to our forecasts, it is a very alarming situation for India & West Bengal in coming days. However, the actual numbers can go higher than our estimates of confirmed cases, active cases & trends

we made based on the data till June 3rd in this forecast, when West Bengal observed complete lockdown. Currently,

West Bengal has a partial lockdown or Following Unlock 1.0 with restrictions varying for three zones (red, orange and green zone) based on the current assessment of the situation in there.

Lockdown is getting lifted, and in this case, there will be a surge in the number of daily confirmed and active cases.

The requirement of isolation beds, ICUs and ventilators will also be increased in that scenario. The migrants are returning to their homes due to loss of livelihood and income in the lockdown period, which may lead to a rise in the number of cases, and could not be accounted for, in our projections.

So, India and its majorly affected states like Maharashtra, Gujarat, Tamil Nadu and Delhi & West Bengal need to be well prepared for the pandemic challenge in coming time and focus on increasing their healthcare infrastructure, and other states should also remain alert till the pandemic completely recedes. We suggest a Public-Private Partnership (PPP) model in the health sector to accommodate COVID–19 patients adequately and reduce the burden of the already overstretched Indian public health care system.

Limitations or Errors that may occur:

The forecasting of COVID–19 cases is done based on the data under the lockdown duration and few in Unlock 1.0. So, the forecasted cases in future will be showing the same trend as India would have observed, had it been observing complete lockdown.

Since May 4, India is observing Unlock 1.0, and for that actual cases will/can/may be more than the forecasted cases. For our state it is showing hike in COVID–19 infection and increased trend in future, but the situation may not occur in future because of the nature of the previous trend-pattern is different from now.

Forecasted cases based on ARIMA model in our study for some states having lower bound for the 95% CI comes negative values which we have considered zero cases in that situation. In our study, the seasonality factor was considered but it may vary now due to Unlock 1.0, and it may affect our Forecast,

Therefore there is a Plus–Minus in the forecasted cases to avoid any Big Error, & make the Data more Reliable.

Tables

Table : Date wise number confirmed and active cases in West Bengal , Trend , Predicted

			<i>Yt</i>		<i>Yt/CMA</i>	<i>Average (respective quature)</i>	<i>De-Seasonalized Value</i>	<i>Intersept +Slope*Time Code</i>	
<i>No.</i>	<i>Months</i>	<i>Date</i>	<i>Cases</i>	<i>Moving Average (5) MA</i>	<i>St * It</i>	<i>St</i>	<i>Yt/St</i>	<i>Trend</i>	<i>Predicted (Yp)</i>
1	March	01/03/2020	0		0.00	0.00	0.00	-0.59	0
2		02/03/2020	0	0.00	0.00	0.00	0.00	0.06	0
3		03/03/2020	0	0.00	0.00	0.00	0.00	0.71	0
4		04/03/2020	0	0.00	0.00	0.00	0.00	1.35	1
5		05/03/2020	0	0.00	0.00	0.00	0.00	2.00	1
6		06/03/2020	0	0.00	0.00	0.00	0.00	2.65	2
7		07/03/2020	0	0.00	0.00	0.00	0.00	3.30	3
8		08/03/2020	0	0.00	0.00	0.00	0.00	3.95	4
9		09/03/2020	0	0.00	0.00	0.00	0.00	4.59	5
10		10/03/2020	0	0.00	0.00	0.00	0.00	5.24	6
11		11/03/2020	0	0.00	0.00	0.00	0.00	5.89	7
12		12/03/2020	0	0.00	0.00	0.00	0.00	6.54	9

13		13/03/2020	0	0.00	0.00	0.00	0.00	7.18	11
14		14/03/2020	0	0.00	0.00	0.60	0.00	7.83	12
15		15/03/2020	0	0.00	0.00	1.00	0.00	8.48	14
16		16/03/2020	0	0.00	0.00	1.36	0.00	9.13	16
17		17/03/2020	0	0.00	0.00	1.70	0.00	9.78	18
18		18/03/2020	1	0.33	3.00	2.08	0.48	10.42	21
19		19/03/2020	2	1.00	2.00	1.82	1.10	11.07	23
20		20/03/2020	3	1.67	1.80	1.72	1.74	11.72	25
21		21/03/2020	4	2.33	1.71	1.68	2.38	12.37	28
22		22/03/2020	7	3.67	1.91	1.70	4.13	13.02	31
23		23/03/2020	9	5.33	1.69	1.63	5.51	13.66	34
24		24/03/2020	9	6.00	1.50	1.62	5.56	14.31	37
25		25/03/2020	10	6.33	1.58	1.63	6.12	14.96	40
26		26/03/2020	15	8.33	1.80	1.65	9.10	15.61	43
27		27/03/2020	17	10.67	1.59	1.63	10.40	16.26	47
28		28/03/2020	20	12.33	1.62	1.63	12.29	16.90	50
29		29/03/2020	22	14.00	1.57	1.62	13.54	17.55	54
30		30/03/2020	27	16.33	1.65	1.64	16.50	18.20	58
31	April	01/04/2020	37	21.33	1.73	1.62	22.85	18.85	62
32		02/04/2020	40	25.67	1.56	1.59	25.17	19.49	66
33		03/04/2020	46	28.67	1.60	1.60	28.78	20.14	70
34		04/04/2020	55	33.67	1.63	1.58	34.79	20.79	75
35		05/04/2020	60	38.33	1.57	1.57	38.21	21.44	79
36		06/04/2020	67	42.33	1.58	1.57	42.62	22.09	84
37		07/04/2020	77	48.00	1.60	1.56	49.22	22.73	88
38		08/04/2020	79	52.00	1.52	1.55	51.08	23.38	93
39		09/04/2020	88	55.67	1.58	1.56	56.31	24.03	98
40		10/04/2020	97	61.67	1.57	1.56	62.24	24.68	103
41		11/04/2020	103	66.67	1.55	1.56	66.15	25.33	109
42		12/04/2020	105	69.33	1.51	1.56	67.17	25.97	114
43		13/04/2020	120	75.00	1.60	1.61	74.30	26.62	120
44		14/04/2020	130	83.33	1.56	1.61	80.71	27.27	125
45		15/04/2020	142	90.67	1.57	1.61	88.07	27.92	131
46		16/04/2020	157	99.67	1.58	1.63	96.57	28.56	137
47		17/04/2020	227	128.00	1.77	1.62	139.73	29.21	243
48		18/04/2020	252	159.67	1.58	1.58	159.23	29.86	249
49		19/04/2020	276	176.00	1.57	1.59	173.86	30.51	298
50		20/04/2020	330	202.00	1.63	1.59	207.45	31.16	362
51		21/04/2020	362	230.67	1.57	1.58	229.77	31.80	416
52		22/04/2020	394	252.00	1.56	1.57	250.61	32.45	471
53		23/04/2020	452	282.00	1.60	1.57	287.71	33.10	518
54		24/04/2020	506	319.33	1.58	1.56	324.89	33.75	559
55		25/04/2020	546	350.67	1.56	1.55	352.76	34.40	596
56		26/04/2020	586	377.33	1.55	1.55	378.26	35.04	603

57		27/04/2020	633	406.33	1.56	1.55	409.51	35.69	659
58		28/04/2020	663	432.00	1.53	1.56	425.99	36.34	698
59		29/04/2020	696	453.00	1.54	1.59	438.16	36.99	708
60		30/04/2020	758	484.67	1.56	1.59	477.14	37.64	783
61	May	01/05/2020	795	517.67	1.54	1.59	501.38	38.28	841
62		02/05/2020	922	572.33	1.61	1.59	579.70	38.93	949
63		03/05/2020	1198	706.67	1.70	1.58	759.43	39.58	1257
64		04/05/2020	1259	819.00	1.54	1.55	811.98	40.23	1295
65		05/05/2020	1344	867.67	1.55	1.55	865.74	40.87	1374
66		06/05/2020	1456	933.33	1.56	1.55	936.36	41.52	1482
67		07/05/2020	1548	1001.33	1.55	1.55	997.26	42.17	1591
68		08/05/2020	1678	1075.33	1.56	1.55	1081.99	42.82	1699
69		09/05/2020	1786	1154.67	1.55	1.55	1154.77	43.47	1788
70		10/05/2020	1939	1241.67	1.56	1.54	1256.75	44.11	1887
71		11/05/2020	2063	1334.00	1.55	1.54	1343.32	44.76	2124
72		12/05/2020	2173	1412.00	1.54	1.53	1417.20	45.41	2362
73		13/05/2020	2290	1487.67	1.54	1.53	1495.48	46.06	2456
74		14/05/2020	2377	1555.67	1.53	1.53	1552.08	46.71	2552
75		15/05/2020	2461	1612.67	1.53	1.53	1605.40	47.35	2648
76		16/05/2020	2576	1679.00	1.53	1.53	1678.43	48.00	2746
77		17/05/2020	2677	1751.00	1.53	1.53	1746.94	48.65	2845
78		18/05/2020	2825	1834.00	1.54	1.53	1843.00	49.30	2946
79		19/05/2020	2961	1928.67	1.54	1.53	1934.83	49.95	3047
80		20/05/2020	3103	2021.33	1.54	1.53	2025.36	50.59	3151
81		21/05/2020	3197	2100.00	1.52	1.53	2088.15	51.24	3255
82		22/05/2020	3332	2176.33	1.53	1.53	2172.18	51.89	3361
83		23/05/2020	3459	2263.67	1.53	1.53	2254.25	52.54	3468
84		24/05/2020	3667	2375.33	1.54	1.54	2380.17	53.18	3576
85		25/05/2020	3816	2494.33	1.53	1.54	2476.67	53.83	3885
86		26/05/2020	4009	2608.33	1.54	1.54	2595.88	54.48	4096
87		27/05/2020	4192	2733.67	1.53	1.55	2696.45	55.13	4265
88		28/05/2020	4536	2909.33	1.56	1.56	2911.62	56.42	4637
89		29/05/2020	4813	3116.33	1.54	1.55	3096.94	57.72	4953
90		30/05/2020	5130	3314.33	1.55	1.55	3302.27	58.37	5247
91	June	01/06/2020	5772	3634.00	1.59	1.54	3738.56	60.96	5847
92		02/06/2020	6168	3980.00	1.55	1.53	4023.99	63.55	6332
93		03/06/2020	6508	4225.33	1.54	1.53	4261.51	68.09	6536
94		04/06/2020	6876	4461.33	1.54	1.52	4521.83	72.62	6938
95		05/06/2020	7303	4584.00	1.50	1.50	4584.00	75.38	7354

References

1. Batista M. (2020), Estimation of the final size of the COVID-19 epidemic. MedRxiv. doi:10(2020.02), 16-20023606.
2. Benvenuto D., Giovanetti M., Vassallo L., Angeletti S., Picozzi S. (2020), Application of the ARIMA model on the COVID-2019 epidemic dataset, Data in Brief, 29, 105340.

<https://doi.org/10.1016/j.dib.2020.105340>

3. Chakraborty, T., & Ghosh, I. (2020). Real-time forecasts and risk assessment of novel coronavirus (COVID-19) cases: A data-driven analysis. *Chaos, solitons, and fractals*, 135, 109850. Advance online publication. <https://doi.org/10.1016/j.chaos.2020.109850>
4. Fanelli D., Piazza F. (2020), analysis and forecast of COVID-19 spreading in China, Italy and France, *Chaos, Solitons & Fractals*, 134, 109761. <https://doi.org/10.1016/j.chaos.2020.109761>
5. Kumar P., Kalita H., Patairiya S., Sharma Y. D., Nanda C., Rani M., Rahmai J., Bhagavathula, S. (2020), Forecasting the dynamics of COVID-19 Pandemic in Top 15 countries in April 2020 through ARIMA Model with Machine Learning Approach. MedRxiv.
6. Gupta R., Pal S. K. (2020), Trend Analysis and Forecasting of COVID-19 outbreak in India. MedRxiv
7. World Population Prospects
2019 https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf
8. Tiwari, S., Kumar, S., & Guleria, K. (2020). Outbreak Trends of Coronavirus Disease-2019 in India: A Prediction. *Disaster medicine and public health preparedness*, 1–6. Advance online publication
9. COV-IND-19 Study Group. (2020, May 19). Retrieved from COVID-19 Outbreak in India: <https://umich-biostatistics.shinyapps.io/covid19/>
10. Singh, R. K., Rani, M., Bhagavathula, A. S., Sah, R., Rodriguez-Morales, A. J., Kalita, H., Nanda, C., Sharma, S., Sharma, Y. D., Rabaan, A. A., Rahmani, J., & Kumar, P. (2020). Prediction of the COVID-19 Pandemic for the Top 15 Affected Countries: Advanced Autoregressive Integrated Moving Average (ARIMA) Model. *JMIR public health and surveillance*, 6(2), e19115
11. Wikipedia COVID-19 Pandemic <https://20in%20West%20Bengal%20-%20Wikipedia.html>
12. COVID-19 India. (2020, June). Retrieved from Coronavirus Outbreak in India: <https://www.covid19india.org>
13. Public Health in West Bengal – Current Status and Ongoing Interventions <http://wbgovthealth.gov.in>
14. West Bengal COVID-19 Bulletin <http://wbgovthealth.gov.in>

Declarations

I Dibash Sarkar Declare No competing interests & The authors declare no competing interests

Figures

Figure 1

Forecast of confirmed and active cases by the ARIMA model for West Bengal: Correlogram and ARIMA forecast graph for the Confirmed COVID-19 Cases in West Bengal

Figure 2

Trend of COVID - 19 Cases in West Bengal.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.99997256
R Square	0.999945122
Adjusted R Square	0.999944525
Standard Error	8.377135212
Observations	94

ANOVA

	df	SS	MS	F	Significance F
Regression	1	117639803.5	117639803.5	1676344.368	8.5371E-198
Residual	92	6456.228281	70.17639436		
Total	93	117646259.7			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	Upper 95.0%
Intercept	-1.237868533	1.05322687	-1.175310437	0.242903314	-3.329667961	0.853930895	-3.32967	0.8539309
X Variable 1	0.647888191	0.000500401	1294.737181	8.5371E-198	0.646894351	0.648882032	0.646894	0.64888203

Figure 3

Regression Table for the Total Data

Figure 4

The ACF and PACF plot for the determine the value of q and p for the model.

Figure 5

COVID – 19 Forecast For the month of July & August. Estimated Cases – 62279 ± 5000

District	Cnfrmd ▲	Actv	Rcvrd	Dcsd
Jhargram	6	0	6	0
Kalimpong	9	2	6	1
Alipurduar	12	12	0	0
Jalpaiguri	18	14	4	0
Purulia	19	19	0	0
Dakshin Dinajpur	44	26	18	0
Darjeeling	60	48	10	2
Other State	60	41	16	3
Paschim Bardhaman	66	36	28	2
Paschim Medinipur	70	41	28	1
Bankura	95	62	33	0
Murshidabad	108	32	74	2
Nadia	110	87	22	1
Purba Bardhaman	112	50	62	0
Purba Medinipur	125	68	56	1
Cooch Behar	138	112	26	0
Malda	158	74	84	0
Uttar Dinajpur	173	22	151	0
Birbhum	181	74	106	1
South 24 Parganas	221	122	92	7
Hooghly	429	253	165	11
North 24 Parganas	910	545	318	47
Howrah	1,264	755	467	42
Kolkata	2,488	1,258	996	234

**** Data is taken from West Bengal Govt. COVID-19 Website (till 4th June 2020)**

Figure 6

District - wise Confirmed cases data** in West Bengal

Figure 7

Map of Districts with Confirmed Cases

Top districts

2,488 Kolkata

1,264 Howrah

910 North 24
Parganas

429 Hooghly

221 South 24
Parganas

**** Data is taken from West Bengal Govt. COVID-19 Website (till 4th June 2020)**

Figure 8

Top Districts Affected With COVID-19 in West Bengal

Kolkata's Covid-19 Figure: A Case Study

Kolkata's COVID-19 containment zones

The centre has identified 170 COVID-19 , hotspot districts in 25 states across India. The states have been asked to classify hotspot areas as red zones and focus on converting the red zones to orange and then green zones.

The West Bengal government on Monday released a list, saying four districts, including Kolkata, have been declared as red zones in the wake of the COVID-19 outbreak, and 348 areas as containment zones out of which Kolkata has 227. There are some districts in Orange & Green zones. The lockdown process will be strict in those Red Zone Containment areas. Some relaxation will be given to Orange zones and most relaxation will be given to Green Zones.

The West Bengal government has been sharing regular updates of the lists of containment zones from 4th May 2020.

Figure 9

Kolkata's Covid-19 Figure: A Case Study

West Bengal

Figure 10

COVID-19 Pandemic Data in West Bengal

Figure 11

Confirmed Per Million, Active, Recovery Rate, Mortality Rate, Average Growth Rate, Tests Per Million

Spread Trends

Figure 12

Spread Trends of COVID-19 IN West Bengal

**** Data is taken from West Bengal Govt. COVID-19 Website (till 5th June 2020)**

Figure 13

COVID-19 Cases** in INDIA

Department of Health & Family Welfare Govt. of West Bengal

WEST BENGAL COVID-19 HEALTH BULLETIN

STATE GOVT.
INTERVENTIONS

- Treatment is free for all patients in all Government Hospitals
- Govt has requisitioned private hospitals as COVID hospitals
- Govt reimburses these hospitals at already notified rates
- Govt has instituted a Cabinet Committee for better management of the COVID-19 crisis, chaired by Dr. Amit Mitra, and co-chaired by Shri Partha Chatterjee
- Govt has notified Medical College and Hospital, Kolkata as a full-fledged tertiary level COVID Hospital
- Govt has also notified KPC Medical College & Hospital, Kolkata as the 69th dedicated COVID Hospital in the state for specialized COVID treatment

Figure 14

State Govt. Interventions for COVID-19.

I COVID 19 STATUS	S. No	Subject	Number
	1	Total COVID-19 Cases Confirmed till 3 rd June	6,508
	2	New COVID-19 Cases Confirmed on 4 th June	368
	3	Total COVID-19 Cases Confirmed till 4 th June (1+2)	6,876
	4	Total Discharged	2,768 (+188)
	5	Total Deaths due to COVID-19*	283 (+10)
	6	Total Deaths due to Comorbidity	72
	7	Active COVID-19 Cases as on 4 th June	3,753 (+170)
	8	Discharge Rate (4/3)	40.25%

Figure 15

COVID-19 Status in West Bengal.

II TESTING SNAPSHOT	S. No	Subject	Number
	1	Samples Tested till 3 rd June	2,32,225
	2	Samples Tested on 4 th June	9,606
	3	Total Number of Samples Tested till 4 th June (1+2)	2,41,831
	4	Tests per Million population	2,687
	5	% of Positive Cases out of Samples Tested	2.84%
	6	Total Testing Laboratories*	42
	7	Testing Laboratories added this week	2
	8	Testing Laboratories pending approval	1

Figure 16

Sample Testing Stats for COVID-19.

III INFRASTRUCTURE DETAILS	S. No	Subject	Number
	1	Total Number of Hospitals dedicated for treating COVID-19	69
	2	Total Number of Govt. Hospitals dedicated for treating COVID-19	16
	3	Total Number of Pvt. Hospitals requisitioned for treating COVID-19	53
	4	Total Number of earmarked COVID-19 Beds	8,785
	5	% Occupancy in COVID Beds	20.14%
	6	Total ICU Beds in the COVID Hospitals	920
	7	Total Number of Ventilators in the COVID Hospitals	392

Figure 17

Healthcare Infrastructure for COVID-19.

IV QUARANTINE DETAILS	Institutional Quarantine		
	1	Total Govt. Quarantine Centres	582
	2	Total number of people in Govt. Quarantine Centres	20,662
	3	Total number of people released from Govt. Quarantine Centres	57,940
	Home Quarantine		
	1	Total Home Quarantined People	2,46,981
	2	Total number of people currently in Home Quarantine	1,48,359
	3	Total number of people released from Home Quarantine Centres	98,622
	Quarantine for Migrant Returnees*		
	1	Total Quarantine Facilities	11,205
	2	Total number of returnees in Quarantine Centres	1,36,600
	3	Total number of workers released from Quarantine Centres	40,980

Figure 18

Quarantine Details for COVID-19.

Supplementary Files

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- [Trend.jpg](#)
- [Covid19CasesinWESTBENGAL.jpg](#)