Journal of Mathematics and Statistics Studies (JMSS)
www. al-kindipublisher.com/index.php/jmss

Stochastic Modelling and Simulation of SIR Model for COVID-2019 Epidemic Outbreak in India

Umamaheswari. P
Assistant Professor of Statistics, Sona College of Arts and Science, Salem-5, India
Corresponding Author: Umamaheswari. P, E-mail: uma_m2485@yahoo.com

ARTICLE INFORMATION

Received: September 21, 2020
Accepted: October 01, 2020
Volume: 1
Issue: 1

KEYWORDS

COVID-19, Coronavirus, Pandemics, Prediction, SIR model

ABSTRACT

Coronavirus disease 2019 (COVID-19) emerged in Wuhan city, China, at the end of December 2019. As of July 26, 2020, 16258353 COVID-19 cases were confirmed worldwide, including 649848 deaths. The spread of COVID-19 is currently very high. Under the classical SIR (Susceptible-Infected-Recovered) model, epidemiological data for India up to 26th July 2020 were used to forecast the COVID-19 outbreak. For controlling the spreading of the virus, we have to prepare for precaution and futuristic calculation for infection spreading. We used the data from the COVID-2019 Outbreak of India on July 26th, 2020 in this report. In these results, for the initial level of experimental intent, we used 16291331 susceptible cases, 481248 infectious cases, and 910298 rewards / removed cases. Through the aid of the SIR model, data on a wide range of infectious diseases have been analyzed. SIR model is one of the most effective models which can predict the spreading rate of the virus. The findings of the SIR model can be used to forecast transmission and avoid the outbreak of COVID-2019 in India. The results of the study will shed light on understanding the outbreak patterns and indicate those regions epidemiological points. Finally, from this study, we have found that the outbreak of the COVID-2019 epidemic in India will be at its peak on 09 August 2020 and after that, it will work slowly and on the verge of ending in the second or third week of November 2020.

1. Introduction

COVID-19 (Coronavirus disease 2019) is a disease caused by a novel virus called SARSCoV-2 (severe acute respiratory syndrome coronavirus 2) which has spread to more than 200 countries worldwide (as of May 12, 2020) infecting more than 40 lakh people (World Health Organization, 2020). World Health Organization (WHO) confirmed the outbreak of this disease after one month from the first case recording on Dec. 31, 2019, in Wuhan, China, and later as a pandemic on March 11, 2020 (Singhal 2020). Virtually the entire world's population is using lockdowns, social distancing, and masks to combat this outbreak.

The disease has a very complex structure and is easy to spread. Sadly, 649848 deaths and roughly 16258353 cases were confirmed worldwide as of July 26, 2020. The number of confirmed cases varies from country to country because of variations in epidemiological monitoring and detection capacities. This can however be said that as of today the disease has spread across the world. Since there is no method of treatment for this form of the virus yet known, it requires careful preparation of the health system and facilities where the risk of spread of disease can be managed. Of this purpose, it is important to predict the total reported cases and potential new cases in the future to handle and guide demand to the health system. To cope with the outbreak, mathematical and statistical modeling methods that can be used to make short- and long-term case predictions are required to schedule the number of additional materials and resources. Estimating the projected burden of disease is important for public health authorities to coordinate medical services and other resources that are required to resolve the epidemic efficiently and in time. These estimates can also guide the strength and form of interventions needed to ease the outbreak (Wu

& McGoogan 2020). For this analysis, we presumed from the time of spread to India the impact of social distancing interventions, lockdown, and face cover.

So COVID-2019 needs to be reviewed with more data now. In this proposed report, we presented an epidemic model based on COVID-19 spreading to India by the SIR method. There are three differential equations to the proposed SIR model. This type of differential equation is difficult to solve and time-consuming. Most epidemics have an initial exponential curve and then flatten out slowly. The objectives of these studies are given below:

1. Finding the rate of disease transmission using the SIR model.
2. SIR architecture model for exposed outbreak COVID-2019 at a peak in India.
3. Nation outbreak forecast COVID-2019, India with the next days, months, even a year for better management for doctors and different governmental organizations.
4. To find out whether the COVID-2019 outbreak in India is ending

2. SIR Model

We have considered an epidemic model in this proposed study which was developed by Kermack and McKendrick (1991). This epidemic model is also known as the epidemic model SIR (Susceptible, Infective, and Recover / Removed). Many infectious outbreaks such as avian influenza, cholera, SARS, Aids, Plague, Yellow Fever, Meningitis, MERS, influenza, Zika, Rift Valley Fever, Lassa Fever, Leptospirosis (Fred Brauer & Carlos Castillo-Chávez, 2000; Hethcote ,2000; Murray, 1993; Anderson & May, 1991; West & Thompson, 1997) have also been widely used in this model. The SIR model is very useful for future prediction, ending, and the peak of infectious disease and other outbreak-related activity.

This research aims to quantify the prevalence of COVID-19 in India, where the virus spreads more quickly and causes disastrous outcomes. Here, on July 26, 2020, we selected all of India's population checked by COVID-2019.

We have complete COVID-2020 population evaluated in this proposed study is divided into three parts:

1. S(t): number of vulnerable population t at the time t, i.e. number of total population checked by COVID2019 till July 26, 2020.
2. I(t): the number of people infected at the time t, i.e. the number of people infected with COVID2019 in India until 26 July 2020.
3. R(t): Number of population recovered at the time t, i.e. number of people rescued or died or spontaneously resistant to the disease COVID-2019 Indian population until July 26, 2020.

For this proposed study we took R(t) is equivalent to the recovered population plus died population from India's COVID-2019 outbreak on July 26, 2020, for the sake of this study's simplicity (Zhang et al., 2020). Figure 1 gives an overview of the theoretical SIR model for not understanding the evolution of viruses.

Unlike most diseases, this model does not recognize COVID-2019 growth. In comparison, however, my proposed SIR model seen in Figure 2 takes into account the nature of India's COVID-2019 outbreak. This model also predicts high growth in India from the COVID-2019 outbreak. This model also predicts maximum growth in India from the COVID-2019 outbreak. Figure 2 highlights the definition of the SIR model for recovered re-tuning as susceptible since India's COVID-2019 outbreak has developed into one that can re-infect.

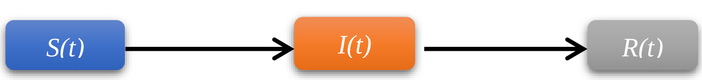

Figure 1: Description of the SIR model not considering COVID-2019 outbreak virus evolution

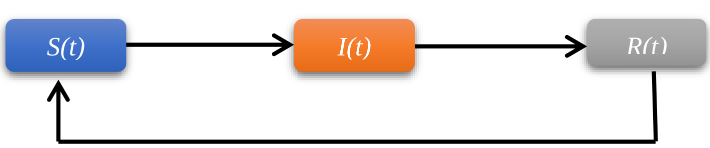

Figure 2: Description of SIR model considering COVID-2019 outbreak virus evolution.

3. Methodology of SIR Model

Let us find the following three differential equations being used for Indian COVID-2019 experimental studies and experimental debate. The definition is given below for these three differential equations:

$$S'(t) = -rSI \quad (1)$$

$$I'(t) = rSI - aI \quad (2)$$

$$R'(t) = aI \quad (3)$$

The parameters r and an of the above differential equations are known as Indian countries' infection rate and COVID-2019 recovery/removal rate. For this proposed study India 's average outbreak time for COVID-2019 is around 14 days. This numerical r and a values are very useful in the initial stage for resolving India 's three differential COVID-2019 outbreak equations.

The three differential equations (1) , (2), and (3) of the proposed epidemic SIR model for India's COVID-2020 outbreak can also be written as [12]:

$$\frac{dS}{dt} = -rSI \quad (4)$$

$$\frac{dI}{dt} = rSI - aI \quad (5)$$

$$\frac{dR}{dt} = aI \quad (6)$$

Such three differential SIR function equations are known as the Kermack-McKendrick model. Currently, this model is very useful for COVID-2019 data analysis in India. Again by adding the equation (4), (5), and (6), we can get another expression for the data analysis COVID-2019. Below is this expression

$$:\frac{dS}{dt} + \frac{dI}{dt} + \frac{dR}{dt} = -rSI + rSI - aI + aI = 0$$

$$dS + dI + dR = 0 \quad (7)$$

Using the integration of equation number (7), we can get the following relationship for estimating the total COVID-2019 population:

S' + I' + R' = N, regarded as the convergence constant comparing the overall population size for COVID-2019 at the original level and after the COVID-2019 epidemic in India It is a constant population at all COVID-2019 outbreak rates. The expression above can also be denoted in the following form:

$$S(t) + I(t) + R(t) = N \quad (8)$$

We will take the following initial values of the proposed SIR model, i.e., for the experimental reason of data analysis of the COVID-2019 outbreak of India

$$S(0) = S_0, I(t) = I_0, \text{ and } R(0) = R_0$$

Here the size of the Indian population is constant. We can quantify India's recovered COVID-2019 outbreak population, which is given by the following formulation:

$$R(t) = N - (S(t) + I(t)) \quad (9)$$

The three differential equations (4), (5), and (5) above the proposed SIR model can be translated into the number of differential equations (9). Such two differential equations are very difficult to solve and time-intensive. But of these two differential equations, the solution is very important for data analysis of India's COOVID-2019 epidemic. We have used a quantitative approach in this proposed study to solve these two differential equations of the model SIR. Now, here we will conclude that if S' for all t is less than zero then I'm greater than zero as long as the original population (say the number of susceptible cases in India on 26 July 2020) is greater than the $\frac{a}{r}$ ratio.

In other words, if the original population S_0 is greater than the ratio $\frac{a}{r}$, we can assume that we should initially increase to a limit, but gradually it will decrease and reach zero as S_0 is decreasing. We have incorporated some cases for India's COVID-2019 outbreak in this proposed study which is given below:

Case-1: If S_0 is less than the ratio, $\frac{a}{r}$, then India's COVID-2020 epidemic infection I should decrease or be zero after a few days.

Case-2: If S_0 is greater than the percentage then India's COVID-2020 outbreak I infection will be the COVID-2019 epidemic. These are the SIR model's conclusions on India's COVID-2019 outbreak. Hence we can conclude from the above two premises that the conduct of India's COVID-2019 outbreak depends on the values of the following expression:

$$R_n = \frac{S_0 r}{a} \qquad (10)$$

The quantity is known as the number threshold. In this present analysis, we have defined another quantity called the reproductive number that is denoted by R_n and defined by the expression (10). That is the number of secondary COVID-2019 outbreak infections in susceptible populations created by one primary infective. Here are two cases from India's COVID-2019 concerning reproductive number:

Case-1: If Rn is less than one, the outbreak of COVID-2019 from India will occur.

Case-2: If Rn is more than one, then the COVID-2019 outbreak in India is still in epidemic mode.

3.1. Step planning and experimental findings for COVID-2019 Indian outbreak

The differential equation of the proposed SIR model for the study of the Indian COVID-2019 outbreak is completely important to be solved. Find a COVID-2019 epidemic-prone population, with a limited number of infected species. Is the of COVID-2019 infectives populations increase substantially in India? The answer to this question will get after solving differential equations of (4), (5), and (6). The differential equations (4), (5) and (6) is the system of the differential equation and these equations have three unknown. Such differential equation schemes are very hard to solve. While we get the single differential equation with an unknown one for the proposed SIR model after combining the equation (4) and (5) then. The method will be as follows:

According to mathematics for chain rule:

$$\frac{dI}{dS} = \frac{dI/dt}{dS/dt} = \frac{rSI-aI}{-rSI} = \frac{rSI}{-rSI} - \left(\frac{aI}{-rSI}\right) = \frac{a}{rS} - 1$$

$$\frac{dI}{dS} = \frac{a}{rS} - 1$$

$$dI = \left(\frac{a}{rS} - 1\right) dS$$

$$I = \frac{a}{r} \ln(S) - S + C \qquad (11)$$

Where, C is the arbitrary constant.

$$\text{And } R = N - I - S \qquad (12)$$

The initial conditions are given for this Karmack-Mchendrick SIR model. We consider the initial conditions as set out below:

$S(0) = S_0$ and $I(0) = I_0$ then the equation (11) becomes:

$$I_0 = \frac{a}{r} \ln(S_0) - S_0 + C \qquad (13)$$

$$C = I_0 + S_0 - \frac{a}{r} \ln(S_0) \qquad (14)$$

Consider the Indian population size of vulnerable COVID-2019 outbreak is K. This is approximately equivalent to India 's initial population. Here, we must add a limited number of people with infections.

Accordingly, $S_0 = K$, $I_0 = 0$ and $R_n = \frac{rK}{a}$

If $I(t) = 0$ as $t \to \infty$ and $S_0 < \frac{a}{r}$ then $V(S_0, I_0) = V(S_0)$ gives the following expression:

$$K - \frac{a}{r}\ln(S_0) = S_\infty - \frac{a}{r}\ln(S_\infty)$$

Where S_∞ is India's vulnerable population if the case for infectious diseases is negative. After the above expression has been condensed we can get the following expression

$$:K - S_\infty = -\frac{a}{r}\ln(S_\infty) + \frac{a}{r}\ln(S_0)$$

$$K - S_\infty = \frac{a}{r}\ln(S_0) - \frac{a}{r}\ln(S_\infty)$$

$$K - S_\infty = \frac{a}{r}[\ln(S_0) - \ln(S_\infty)]$$

$$K - S_\infty = \frac{a}{r}\ln[S_0/S_\infty]$$

$$\frac{r}{a} = \frac{\ln[S_0/S_\infty]}{K - S_\infty} \tag{15}$$

Here $0 < S_\infty < K$ that is past of the population of India escapes the COVID-2019 infective. In this proposed study, it is very difficult to estimate the parameters of r and because these depend on the disease being studied and on social and behavioral factors of that country. The population S_0 and S_∞ can be estimated by serological studies before and after of the COVID2019 outbreak and using this data, the basic reproduction number is given by the following formula:

$$R_n = \frac{rk}{a} \tag{16}$$

This expression can be calculated using expression (15). The maximum number of COVID2019 outbreak infective at any time in India can be obtained by substantially using the following calculation: Putting $S = \frac{r}{a}$

and $I = I_{max}$ in equation (11), We have the highest number of COVID-2019 infectious cases in India at any given time.

$$I = \frac{a}{r}\ln(S) - S + C$$

Where,

$$C = I_0 + S_0 - \frac{a}{r}\ln(S_0)$$

Therefore the maximum number of infectious cases $I = I_{max}$ COVID-2019 outbreak of India can calculate with the help of the following expression:

$$I_{max} = I_0 + S - \frac{a}{r} + - \frac{a}{r}\ln(S_0) + \frac{a}{r}\ln(\frac{a}{r}) \tag{17}$$

For this proposed thesis we solve the differential equation using the values of the above initial conditions S_0, I_0, R_0, a and r. Table 1 displays the experimental effects of model SIR.

We used COVID-2019 data collection from India as of July 26, 2020 in this proposed report. Here, we took the total number of COVID-2019 population confirmed as the total number of infected population and the total number of recovered/removed cases as at the initial stage to examine India's COVID-2019 outbreak on 26 July 2020. These three initial populations S_0, I_0, R_0, a and r are represented as:

$S_0 = 162.91331$ $I_0 = 4.81248$ $R_0 = 9.10298$

The recovery rate/elimination rate and infection rate of India's COVID-2019 outbreak can be determined using the following expression:

$$r = \frac{\text{Infected Population}}{\text{Susceptible Population}} = \frac{481248}{16291331}$$

$r = 0.02954$

$\frac{1}{a} = 14$ (Because the incubation time of COVID-2019 outbreak of India is 14 day)

$a = \frac{1}{14} \approx 0.07142$

Putting the values of r, a, S_0, I_0, and R_0 in equation (4), (5) and (6) to get the next cohort values Susceptible population S_1, I_1, and R_1,

Likewise, we will calculate another repeat. Table displaying empirical effects of the SIR model 1.

Table 1: SIR Methods Simulation

S.No	Date	Day/Time	Susceptible	Infected	Recovered
1	26-07-2020	0	162.91331	4.81248	9.10298
2	27-07-2020	2	160.71806	6.23773	9.87298
3	28-07-2020	4	157.91102	8.04674	10.87101
4	29-07-2020	6	154.35314	10.31713	12.15849
5	30-07-2020	8	149.89420	13.12534	13.80923
6	31-07-2020	10	144.38544	16.53404	15.90929
7	01-08-2020	12	137.70107	20.57296	18.55473
8	02-08-2020	14	129.76890	25.21346	21.84641
9	03-08-2020	16	120.60751	30.34070	25.88056
10	04-08-2020	18	110.36143	35.73227	30.73507
11	05-08-2020	20	99.31973	41.05680	36.45224
12	06-08-2020	22	87.90203	45.90542	43.02133
13	07-08-2020	24	76.60352	49.85905	50.36619
14	08-08-2020	26	65.90926	52.57587	58.34364
15	09-08-2020	28	56.20660	53.86639	66.75578
16	10-08-2020	30	47.72919	53.72518	75.37440
17	11-08-2020	32	40.54926	52.30908	83.97043
18	12-08-2020	34	34.61020	49.87869	92.33988
19	13-08-2020	36	29.77653	46.73177	100.32047
20	14-08-2020	38	25.88030	43.15091	107.79756
21	15-08-2020	40	22.75338	39.37369	114.70170
22	16-08-2020	42	20.24490	35.58238	121.00149
23	17-08-2020	44	18.22789	31.90621	126.69467
24	18-08-2020	46	16.59946	28.42965	131.79967
25	19-08-2020	48	15.27809	25.20227	136.34841
26	20-08-2020	50	14.19997	22.24803	140.38077
27	21-08-2020	52	13.31539	19.57292	143.94046
28	22-08-2020	54	12.58565	17.17099	147.07213
29	23-08-2020	56	11.98055	15.02874	149.81948
30	24-08-2020	58	11.47640	13.12829	152.22408
31	25-08-2020	60	11.05454	11.44962	154.32461
32	26-08-2020	62	10.70014	9.97208	156.15655
33	27-08-2020	64	10.40137	8.67532	157.75208
34	28-08-2020	66	10.14871	7.53992	159.14013
35	29-08-2020	68	9.93446	6.54779	160.34652
36	30-08-2020	70	9.75232	5.68228	161.39417
37	31-08-2020	72	9.59716	4.92828	162.30333
38	01-09-2020	74	9.46472	4.27219	163.09186
39	02-09-2020	76	9.35151	3.70186	163.77541
40	03-09-2020	78	9.25458	3.20649	164.36770
41	04-09-2020	80	9.17149	2.77654	164.88074
42	05-09-2020	82	9.10018	2.40360	165.32499
43	06-09-2020	84	9.03894	2.08027	165.70956
44	07-09-2020	86	8.98629	1.80007	166.04241
45	08-09-2020	88	8.94100	1.55735	166.33042

46	09-09-2020	90	8.90201	1.34717	166.57960
47	10-09-2020	92	8.86843	1.16520	166.79514
48	11-09-2020	94	8.83950	1.00770	166.98157
49	12-09-2020	96	8.81456	0.87141	167.14281
50	13-09-2020	98	8.79305	0.75349	167.28223
51	14-09-2020	100	8.77450	0.65148	167.40279
52	15-09-2020	102	8.75849	0.56325	167.50703
53	16-09-2020	104	8.74468	0.48694	167.59715
54	17-09-2020	106	8.73276	0.42096	167.67506
55	18-09-2020	108	8.72246	0.36390	167.74241
56	19-09-2020	110	8.71357	0.31456	167.80063
57	20-09-2020	112	8.70590	0.27191	167.85096
58	21-09-2020	114	8.69927	0.23503	167.89447
59	22-09-2020	116	8.69355	0.20315	167.93207
60	23-09-2020	118	8.68860	0.17559	167.96458
61	24-09-2020	120	8.68433	0.15177	167.99267
62	25-09-2020	122	8.68064	0.13118	168.01695
63	26-09-2020	124	8.67745	0.11338	168.03794
64	27-09-2020	126	8.67470	0.09799	168.05608
65	28-09-2020	128	8.67232	0.08469	168.07176
66	29-09-2020	130	8.67026	0.07320	168.08531
67	30-09-2020	132	8.66848	0.06326	168.09702
68	01-10-2020	134	8.66695	0.05468	168.10715
69	02-10-2020	136	8.66562	0.04726	168.11589
70	03-10-2020	138	8.66447	0.04084	168.12345
71	04-10-2020	140	8.66348	0.03530	168.12999
72	05-10-2020	142	8.66263	0.03051	168.13564
73	06-10-2020	144	8.66189	0.02636	168.14052
74	07-10-2020	146	8.66125	0.02279	168.14474
75	08-10-2020	148	8.66070	0.01969	168.14838
76	09-10-2020	150	8.66022	0.01702	168.15153
77	10-10-2020	152	8.65981	0.01471	168.15426
78	11-10-2020	154	8.65945	0.01271	168.15661
79	12-10-2020	156	8.65914	0.01099	168.15864
80	13-10-2020	158	8.65887	0.00950	168.16040
81	14-10-2020	160	8.65864	0.00821	168.16192
82	15-10-2020	162	8.65844	0.00709	168.16323
83	16-10-2020	164	8.65827	0.00613	168.16437
84	17-10-2020	166	8.65812	0.00530	168.16535
85	18-10-2020	168	8.65800	0.00458	168.16620
86	19-10-2020	170	8.65788	0.00396	168.16693
87	20-10-2020	172	8.65779	0.00342	168.16756
88	21-10-2020	174	8.65771	0.00296	168.16811
89	22-10-2020	176	8.65763	0.00255	168.16858
90	23-10-2020	178	8.65757	0.00221	168.16899
91	24-10-2020	180	8.65752	0.00191	168.16934
92	25-10-2020	182	8.65747	0.00165	168.16965
93	26-10-2020	184	8.65743	0.00142	168.16991
94	27-10-2020	186	8.65740	0.00123	168.17014
95	28-10-2020	188	8.65737	0.00106	168.17034
96	29-10-2020	190	8.65734	0.00092	168.17051
97	30-10-2020	192	8.65732	0.00079	168.17065
98	31-10-2020	194	8.65730	0.00069	168.17078
99	01-11-2020	196	8.65728	0.00059	168.17089
100	02-11-2020	198	8.65727	0.00051	168.17099
101	03-11-2020	200	8.65726	0.00044	168.17107
102	04-11-2020	202	8.65725	0.00038	168.17114

103	05-11-2020	204	8.65724	0.00033	168.17120
104	06-11-2020	206	8.65723	0.00029	168.17125
105	07-11-2020	208	8.65722	0.00025	168.17130
106	08-11-2020	210	8.65722	0.00021	168.17134
107	09-11-2020	212	8.65721	0.00018	168.17137
108	10-11-2020	214	8.65721	0.00016	168.17140
109	11-11-2020	216	8.65720	0.00014	168.17143
110	12-11-2020	218	8.65720	0.00012	168.17145
111	13-11-2020	220	8.65720	0.00010	168.17147
112	14-11-2020	222	8.65719	0.00000	168.17149
113	15-11-2020	224	8.65719	0.00000	168.17150
114	16-11-2020	226	8.65719	0.00000	168.17151
115	17-11-2020	228	8.65719	0.00000	168.17152
116	18-11-2020	230	8.65719	0.00000	168.17153
117	19-11-2020	232	8.65719	0.00000	168.17154
118	20-11-2020	234	8.65719	0.00000	168.17155
119	21-11-2020	236	8.65718	0.00000	168.17155
120	22-11-2020	238	8.65718	0.00000	168.17156
121	23-11-2020	240	8.65718	0.00000	168.17156

Figure 3 displays the revised SIR model for India 's disease condition COVID-2019 as of July 26, 2020. This figure also reveals that the date of COVID-2019's highest number of cases of infection in India is 15 August 2020 (see table 1).

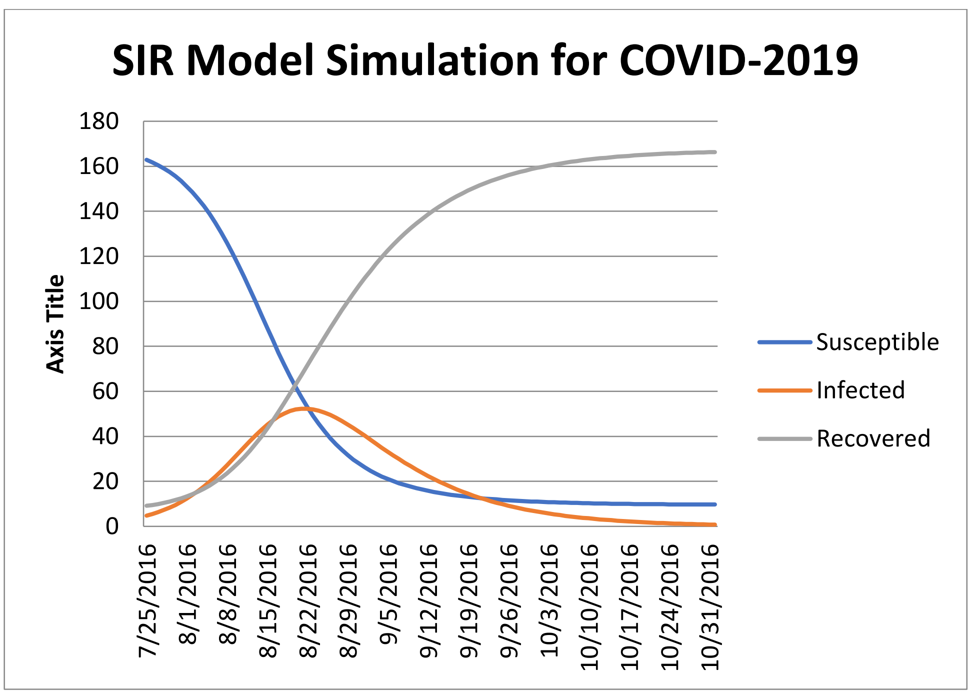

Figure 3: SIR Model Simulation for COVID-2019 epidemic state of India from July 26, 2020.

The maximum number of infective cases (I_{max}) of COVID-2019 outbreak of India can be intended consuming equation (17) is as follows:

a = 0.07142 S_0 = 162.91331 I_0 = 4.81248 S_∞ = 8.65720

Then the ratio $\frac{r}{a}$ can be calculated using equation (15) i.e. $\frac{r}{a}$ = 0.008038

Therefore r = 0.008038 × 0.07142= 0.000574

Hence I_{max} = 53.86639, Here, we have multiplied by 100000 in I_{max} to get the maximum number of infectives cases of COVID-2019 outbreak of India because 100000 is the stabilization factor of this suggested study. Therefore, I_{max} = 5386639 . From this table, we have seen that the maximum number of infectives cases of CODID-2019 is 5228520. This value is nearby the I_{max}. Therefore, we have seen that there will be a maximum outbreak of COVID-2019 in India on July 26, 2020, then it will decrease unceasingly till the Second week of November 2020.

It is also possible to measure the reproductive number of COVID-2019 outbreak on the original, select, end of COVID-2019 outbreak, and sometime during India's COVID-2019 outbreak. Here some estimates of the reproductive number are given below:

1. The initial level of COVID-2019: $R_n = \frac{S_0 r}{a} = \frac{162.91331 \times 0.000571}{0.07142} = 1.302165$

2. Pick level (maximum of COVID-2019): $R_n = 162.91331 \times 0.007993 = 1.302165$

3. End level of COVID-2019: $R_n = 8.65720 \times 0.00799 = 0.069197$

From the latter equation, we found that if the reproductive number is greater than one, then the COVID-2019 continuously rises at the pick / maximum point Case-1 and Case-2) and if the reproductive number is less than one, the COVID-2019 will die off (case-3). However, epidemiological scientists all over the world have estimated the replication number of COVID-2019.

We get the following finding in the described study:

1. COVID-2019 outbreak is expected to peak in India on 09 August 2020, following which the spread of this disease will begin to function gradually.

2. COVID-2019 outbreak in India will last until the second or third week of November 2020, after which the epidemic ceases.

3. In the initial COVID-2019 point, India 's reproductive number for this outbreak is 1.3.

4. Conclusion

Based on the data provided in the study as of July 26, 2020, the SIR model suggests that the outbreak of COVID-2019 will hit its height in India by August 09, 2020, or by the end of August. Based on this report, we can assume that the outbreak of this epidemic will continue to function gradually by the end of August 2020 and that the outbreak of this epidemic will be near the peak by the second week of November 2020. Based on the data this model obtains, this will be misleading to say that the COVID-2019 epidemic will occur in India because people here today do not obey social distancing or add their face masks. Therefore, this disease danger in India is very strong. This research also reveals that in India, when locking, social distancing and masks, etc. are used correctly, In the second or third week of November 2020, the outbreak of the COVID-2019 epidemic may then almost be removed. This proposed research is highly useful for COVID-2019 future outbreak prediction. The new SIR model would accurately predict the number of weekly, bimonthly, monthly, and even year events. Therefore, we might assume that for next week or in the future, the Indian government and doctors should hold a watch on hospital services, the requisite medicines for new patients, medical aid, and isolation.

References

[1] Anderson, R. M., Anderson, B., & May, R. M. (1992). *Infectious diseases of humans: dynamics and control*. Oxford university press.
[2] Brauer, F., & Castillo-Chávez, C. (2001). Basic ideas of mathematical epidemiology. In *Mathematical Models in Population Biology and Epidemiology* (pp. 275-337). Springer, New York, NY.
[3] Hethcote, H. W. (2000). The mathematics of infectious diseases. *SIAM review*, *42*(4), 599-653.
[4] Kermack, W. O., & McKendrick, A. G. (1927). A contribution to the mathematical theory of epidemics. *Proceedings of the royal society of london. Series A, Containing papers of a mathematical and physical character*, *115*(772), 700-721.
[5] Murray, J. D. (1993). Mathematical Biology, Biomathematics Texts, vol. 19.
[6] Singhal, T. (2020). A review of coronavirus disease-2019 (COVID-19). *The Indian Journal of Pediatrics*, 1-6.
[7] West, R. W., & Thompson, J. R. (1997). Models for the simple epidemic. *Mathematical biosciences*, *141*(1), 29-39.
[8] World Health Organization (2020). Coronavirus disease 2019 (COVID19): situation report, 67. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports
[9] Wu, Z., & McGoogan, J. M. (2020). Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *Jama*, *323*(13), 1239-1242.
[10] Zhang, S., Diao, M., Yu, W., Pei, L., Lin, Z., & Chen, D. (2020). Estimation of the reproductive number of novel coronavirus (COVID-19) and the probable outbreak size on the Diamond Princess cruise ship: A data-driven analysis. *International journal of infectious diseases*, *93*, 201-204.