Modeling of COVID-19 Epidemic In The State Of Maharashtra – INDIA

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Abstract- *In this paper, we discuss an explicit model function that can estimate the total number of infected patients and total number of deaths in the population, and particularly, estimate the cumulative number of infected patients in one of the states in India – Maharashtra due to the current Covid-19 virus. We compare the modeling results to the existing condition. The results show the proposed model fits significantly taking in consideration the actual values of Covid-19 infected patients and death data. We observe that the errors of the fitted data and the predicted data points on the total number of infections and deaths in Maharashtra. The results show very encouraging predictability for the model. The new model predicts that the maximum total number of infected people will be approximately 11225 across the Maharashtra due to the Covid-19 virus based on the data until 1st May, 2020. If there is a significant change in the coming days due to various testing strategies, social-distancing policies, the reopening of community strategies, or a stay-home policy, the predicted death tolls will definitely change. Future work can be explored further to apply the proposed model to global Covid-19 data and to other applications, including human population mortality, the spread of disease, and different topics such as movie reviews in recommender systems.*

Keywords- *model prediction; model selection; number of death estimation; model criteria; Covid-19; Maharashtra.*

I. INTRODUCTION

Coronaviruses consist of viruses that cause illness ranging from mild common cold, to more severe diseases, to severe illness and death. Recent Covid-19, known as Coronavirus disease 2019, has spread through people, first identified in Wuhan City, China, in Dec-19. Covid-19 is a new respiratory disease. It has rapidly spread across many countries around the world, including India. The virus is spreading through people who are in contact with one another by touching an infected surface or object and then touching their mouth or nose or by sneezing and coughing. Symptoms of infected persons with Covid-19 may include mild fever, cough, runny nose, sore throat, headache, shortness of breath, severe illness, or death. According to the World Health Organization, people can prevent the spread of viruses by staying home when they are sick, not touching their nose and mouth and covering their sneeze, and washing their hands more often with soap, hand wash and sanitizers before eating or after touching objects from outside. The outbreak of Covid-19 has rapidly spread to countries around the world, including India which is closest to China. As of 1st May 2020, more than 11500 people in the state of Maharashtra have infected of coronavirus and there are at least 3,478,000worldwide reported patients, according to a tally by WHO.

In this study, we are interested in developing a model that can estimate the cumulative number of infected people due to the ongoing Covid-19 virus pandemic occurring during the writing of this paper. The preliminary analysis based on the Covid-19 global and Maharashtra state data appears to be that the cumulative number of infected people seem to follow an exponential curve.

II.MODEL DEVELOPMENT ON EXPECTED NUMBER OF CASES AND DEATHS IN MAHARASHTRA.

2.1 Assumptions in this study [1].

1. There are a few people in the state who have been infected with Covid-19, and are spreading the virus into the locality but do not know that they are infected with the virus. The virus is spreading through people who are in contact with each other. An infected person may cough or sneeze, spreading the virus coming in contact with the mouths or noses of other people who are nearby.

2. The virus is spreading throughout the areas at infection rate per person in which it will spread at a very slow rate from the beginning due to a small number of infected people and will spread exponentially much faster due to a higher number of people who have been infected with the virus and who are in close contact with non-infected individuals as time progresses. The growth rate will then continue to grow slowly until it reaches the maximum total number of Covid-19 deaths.

3. A person can get Covid-19 by coming in contact with an infected surface or object and then touching their own mouth, nose, or possibly their eyes.

2.2 Development of Model.

➤   Total Number of cases.

The Covid-19 virus is an epidemic which is growing at a large scale in many countries. In this model we will consider the cases in Maharashtra – India which is a red zone area for the spread of Covid-19. The maximum cases found in India are from this state. This is because the population in the state is highest because of the metropolitan cities like Mumbai and Pune.

So, we can say that the spread of Covid-19 is based on the factor population density which of Maharashtra where population is about 116,000,000 counts to 950 people / square mile.

Therefore, to calculate the total number of expected cases[4] can be calculated using a model which was obtain during the plotting of the graph on spreadsheet.

Total number of Cases = Po x e^ (r x t) *1000

Let Po denote the Principal number of cases, that is the initial cases.
't' be the number of weeks since spread of virus.
'r' is the rate of weekly growth rate cases (R/100).

• This model is called exponential growth or decay depending on whether r is positive or negative respectively.
• A continuous time model for the initial stages of an epidemic states that the number of cases at week t can be given as **Po x e^ (r x t) *1000.**

➤   The new model as shown in Figure 1 and Table 1 indicates that it provides the best fit based on the current number of cases. The proposed model fits significantly better to give a picture of current number of cases.

Table 1: Maharashtra Covid-19 cases and deaths from 09/03-01/05.

Date	Sum of No.of cases	Sum of Deaths
09-Mar	2	0
10-Mar	5	0
11-Mar	11	0
12-Mar	14	0
13-Mar	17	0
14-Mar	26	0
15-Mar	32	0
16-Mar	39	0
17-Mar	41	1
18-Mar	42	1
19-Mar	48	1
20-Mar	52	1
21-Mar	64	1
22-Mar	74	2
23-Mar	89	2
24-Mar	107	3
25-Mar	122	3
26-Mar	125	4
27-Mar	153	5
28-Mar	181	6
29-Mar	203	8
30-Mar	220	10
31-Mar	302	10
01-Apr	335	16
02-Apr	423	20
03-Apr	490	26
04-Apr	635	32
05-Apr	748	45
06-Apr	868	52
07-Apr	1018	64
08-Apr	1135	72
09-Apr	1364	97
10-Apr	1574	110
11-Apr	1761	127
12-Apr	1982	149
13-Apr	2334	160
14-Apr	2684	178
15-Apr	2916	187
16-Apr	3320	194
17-Apr	3515	201
18-Apr	3648	211
19-Apr	4200	223
20-Apr	4666	232
21-Apr	5218	251
22-Apr	5649	269
23-Apr	6427	283
24-Apr	6817	301
25-Apr	7628	323
26-Apr	8068	342
27-Apr	8590	369
28-Apr	9318	400
29-Apr	9915	432
30-Apr	10498	459
01-May	11506	485
Grand Total	**131219**	**6368**

We observe that the actual number of the cases fitted and predicted data points on the toll in the Maharashtra on the last available data point and the next coming day are less than 0.48% and 2.2%, respectively [6]. Our model fits significantly well based on the Maharashtra infected cases data. The results show very encouraging predictability for the model. The new model predicts that the maximum total number of cases will be approximately 31600 across Maharashtra due to the Covid-19 virus till the 31st of May. If there is a significant change in the coming days due to various testing strategies, social-distancing policies, reopening the community, lockdown, vaccine development the predicted death tolls will definitely change [3]. If the rate of spread continuous to be the same then it may take entire August to finish this pandemic in Maharashtra.
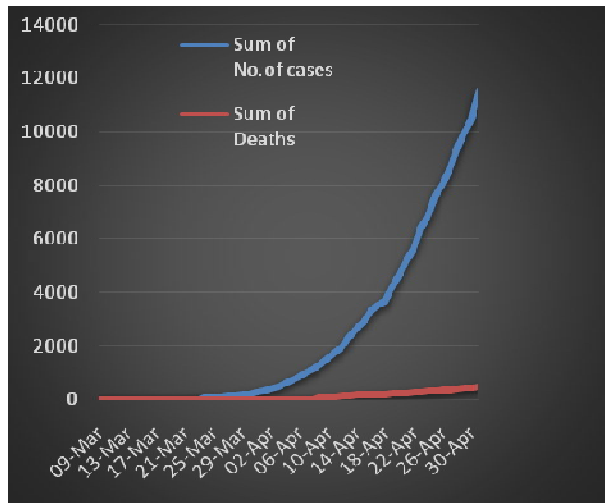
Figure 1:The actual cumulative number of cases infected in Maharashtra.

The mentioned model can only be used to forecast the cases in upcoming weeks as the R – rate depends on various factors. The rate used during the calculation of 31st May cases was taken 0.23. This model is called exponential growth or decay depending on whether r is positive or negative respectively.

III. CONCLUSION

In this paper, a model function to predict the total number of cases of Covid-19 in the population is presented. The results of the model parameter estimate of the proposed model for the Covid-19 death data in the state of Maharashtra are presented. The results show very good predictability for the model by entering various rates at that specific time. Further work can be done to apply the proposed model to Covid-19 Maharashtra death data as well as any other state such as Kerala where there is a large cumulative number of deaths due to Covid-19. In the future, we intend to use the model in applications of population death rate, the spread of disease, in various parts of the world and help countries like the United States. One can also say that if the above precautions are not taken carefully and if people in Maharashtra don't co-operate with the government the exponential graph will keep on increasing with increase in rate of spread.

Disclaimer

I am not an epidemiologist and analysis are based on an elementary mathematical modelling. This paper predicts the pattern and indicators based on the past data and a few assumptions. Prediction of the peak of the active cases is made using the model; these dates and numbers must not be taken for any administrative decisions.

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