Predictive Models and Analysis of Peak and Flatten Curve Values of CoVID-19 Cases in India

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Predictive Models and Analysis of Peak and Flatten Curve Values of CoVID-19 Cases in India

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Abstract: Worldwide increasing cases of COVID-19 are putting high pressure on healthcare services. The coronavirus epidemic caused announcing emergency cases in India. The virus started with one infected case by 30th January, 2020, in Kerala, where the first death due to corona in Karnataka and 73 announced cases were reported by 12th March, 2020. 1024 announced cases were reported by 29th March, 2020.This indicates that the number of confirmed cases is increasing rapidly, causing national crises for India. This study aims is to fill a gap between previous studies and the current development of COVID-19 spreading, by extracting a relationship between corona positives as independent and corresponding deaths as a dependent variable. This research statistically analyses the mortality in 10 days of every month. A mathematical model to predict the new deceased cases corresponding infected cases in a practical scenario is proposed. An approximate prediction of mortality corresponding to new predicted cases can be easily performed using the proposed model. As most of the other countries have reached their peaks, confirmed cases start decreasing. By analyzing these countries' data considering the lockdown, the peak ratio is identified using all countries' population and the decreasing rate of confirmed cases after the peak has been achieved. The same calculation has been done for death and recovered cases. This average peak ratio is used to identify India's COVID patients' peak value. The decreasing rate is also used to define the rate of confirmed cases and mortality after the peak has occurred. The model has also been verified in different countries to identify the significance of the model.

Keywords: COVID-19, Correlation, regression, a test of significance, Machine Learning.

1. Introduction

Saudi Arabia faced a novel virus called Middle East Respiratory Syndrome Coronavirus (MERS-CoV) in 2012, which belongs to the Coronavirus family. Infection with MERS-COV leaded to fatal complications. In[1] the authors developed several models to predict the cases' stability and chances of recovery in MERS-COV infected cases. The reports on COVID-19 indicated that it is a pneumonia like SARS, in which 26 to 33 per cent of patients required intensive care and the mortality rate 4 to 15 % [2,3]. China[4,5], Lombardy, Italy[6] and New York, USA[7] has described clinical presentation and early outcomes on the characteristics of COVID-19 patients.

Outbreaks of the COVID-19 epidemic have been causing worldwide health concerns since December 2019. The virus causes fever, cough, fatigue and mild to severe respiratory complications, which, if very severe, can lead the patient to death. On 6th March, there were 98,192 cumulated cases of infection across the world and 3,045 deaths had been reported. On 11th March, the virus outbreak was declared a pandemic by the World Health Organization[8]. So far, it has been reported that 13.8–19.1% of COVID-19-infected patients in Wuhan, China, became severely ill[9,10]. Furthermore, recent reports have exposed an astonishing case fatality rate of 61.5% for critical cases and increasing sharply with age. The severity of cases puts great pressure on medical services, leading to a shortage of intensive care resources. Unfortunately, there is no currently available prognostic biomarker to distinguish patients that require immediate medical attention and to estimate their associated mortality rate. The capacity to identify cases that are at imminent risk of death has thus become an urgent yet challenging necessity.

The first case of Coronavirus CoVID-19 disease in India was announced on 30th January 2020[11]. India is considered as the largest country having confirmed cases in Asia. As of 11th June 2020, the Ministry of Health and Family Welfare[12] have confirmed a total of 286,579 cases, 141,029 recoveries (including 1 migration) and 8,102 deaths in India[13], while the global number of infected cases is 7255960 and number of confirmed deaths is 412583, referring to World Health Organization (WHO)[14]. In India, 1024 confirmed cases and 27 numbers of confirmed deaths were reported by 29th March, 2020. By the time, the number of confirmed infected cases has been rapidly increased in India. The growth rate of confirmed cases was rapid until 29th May, 2020, while India's fatality rate is relatively lower at 2.80%, against the global 6.13% as of 3rd June 2020[15]. People with low immunity, old age, and medical problems, specially related to lungs, are more prone to such cases. The rate of increasing cases in six cities

Mumbai, Delhi, Ahmedabad, Chennai, Pune and Kol kata is higher in India's reported cases in India.

Lakshadweep is reported as the only region without any confirmed cases on 24th May, 2020.

This research statistically analyses the mortality rate in 10 days of every month. A new mathematical model to predict mortality rate corresponding to the new cases in the current scenario is proposed.

This research aims to study the mortality rate in an interval of 10 days of every month and develop a model to identify the COVID-19 spread in India by analyzing the data and ratios defined from the various fields available in different countries considering the complete lockdown or partial lockdown respectively. Based on real collected data and published reports this model can approximately predict the number of deaths due to Covid19. The study would give an overview of India's current situation besides, it may show the main parameters used to build a forecasting model.

COVID-19 cure and prediction are becoming a problem for almost all countries. The prediction of cases, their cure, mortality and recovery is becoming a hitch for us. Most of the countries are seeking for the peak, trying to flatten the curve. The top 15 countries are taking in our paper having maximum COVID-19 cases till 2nd June 2020 (Refer Figure: 1). It has also seen that besides lockdown, some countries like Italy, Spain, Germany, France, Korea[16,17] etc. are successful in achieving this. However some countries like India, Brazil, Chile, Peru, and Mexico are still looking for a peak point and reduction in cases to see the graph to be flattened. Also, it has been seen that top countries have the same trend as compared to each other, and lockdown is also having an approximately equal effect on the daily cases if we consider the population into account. When we compare the peak of these countries those achieved the flatten curve with their population, then some wonderful parameters came into consideration. By encountered these parameters in the prediction of COVID cases a graph has been prepared, a model & graph has been built. After comparing the model R-Square, its relevance was established. The model has been built for daily confirmed cases, total cases, mortality & recovery using the parameter developed, and graphs are plotted. Let us see how the model is predicting the cases.

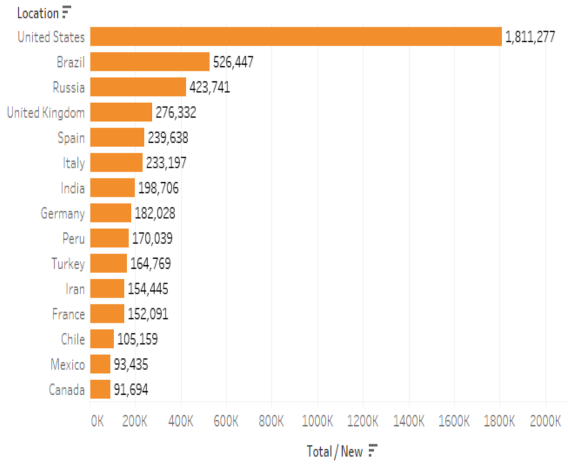


Figure. 1: Top 15 Countries with COVID Cases

2. Dataset description

We obtained our data set in table 1 from the data published by the Ministry of Health and Family Welfare on their website. We used the data on COVID-19 cases reported between 1st March, 2020 and 8th June, 2020. The data is published in the category of State/Union Territory wise per day new cases and deaths[18]. A sample of the original dataset is given table no. 1. The dataset was published in different formats. Some of the records are available in text files some in the image and some tabulated form. Therefore, first we prepare data in a unified format appropriate for the regression model. To find our prediction model, we take the data (COVID-19 cases) in a sum of every 10 days of Months March, April, May and June respectively. The reason for taking 10 days is that if a person is infected in a particular day then he may recover or he may cause death within this duration. Suppose if all the persons infected in this duration recovered, then the recovery rate may be considered as 100 %. Similarly, if all the COVID-19 patients cause death, mortality can be considered 100% during this interval.

3. Methodology

We have taken the number of confirmed cases as an independent variable and number of deaths as a dependent variable. Both statistical analysis and t-test are used to analyze the collected data and ensure the impact of COVID-19 on mortality. First, we find the correlation coefficient between these two variables. In statistics, Correlation is a method used to appraise an approximate linear association between two continuous variables. Correlation is measured by Karl Pearson's coefficient r that takes value in the range −1 to +1 which is a dimensionless quantity and represents the strength of linear association between two variables.

Then we use Student's t-test to confirm the average number of mortality rates with the previous number of cases. T-test also called the Student's t-test, is often used as a statistical method to assess whether the mean value of the data from an independent sample which follows a normal distribution is consistent with or depart significantly from the mean value of a null hypothesis, or whether the difference between the means of two independent samples which follow a normal distribution is statistically significant.

Table no. 1**:** Sample of the original dataset

SN	Date	Cases (x)	Deaths(y)	Death rate (d) (%)
1	March-01-March-10	50	0	0
2	March-11-March-20	173	4	2.312138728
3	March-21-March-30	1028	28	2.723735409
4	March-31- April-9	4614	137	2.969224101
5	April-10- April-19	10251	350	3.414301044
6	April-20 - April-29	15671	489	3.120413503
7	April-30- May-09	27875	973	3.49058296
8	May-10- May-19	41477	1182	2.849772163
9	May-20- May-29	64660	1543	2.386328487
10	May-30- June-08	90812	2494	2.746333084

4. Results and Discussion

The formula can calculate Karl Pearson's coefficient of Correlation

$$r(x,y)=\frac{n\sum xy-\sum x\sum y}{\sqrt{n\sum x^2-\left(\sum x\right)^2}\sqrt{n\sum y^2-\left(\sum y\right)^2}} \qquad (1)$$

using table 1 we get the values from following table 2:

Table 2: Calculation for $r(x,y)$

SN	Cases (x)	Deaths (y)	xy	x^2	y^2
1	50	0	0	2500	0
2	173	4	692	29929	16
3	1028	28	28784	1056784	784
4	4614	137	632118	21288996	18769
5	10251	350	3587850	105083001	122500
6	15671	489	7663119	245580241	239121
7	27875	973	27122375	777015625	946729
8	41477	1182	49025814	1720341529	1397124
9	64660	1543	99770380	4180915600	2380849
10	90812	2494	226485128	8246819344	6220036
	$\sum x$	$\sum y$	$\sum xy$	$\sum x^2$	$\sum y^2$
	256611	7200	414316260	1529813354 9	1132592 8

Using (1) and table 2, $r(x,y)=0.992310908$. This value of $r(x,y)$ shows the high degree positive correlation between x and y. It indicates that the mortality rate will linearly increase with the increase of infected corona cases.

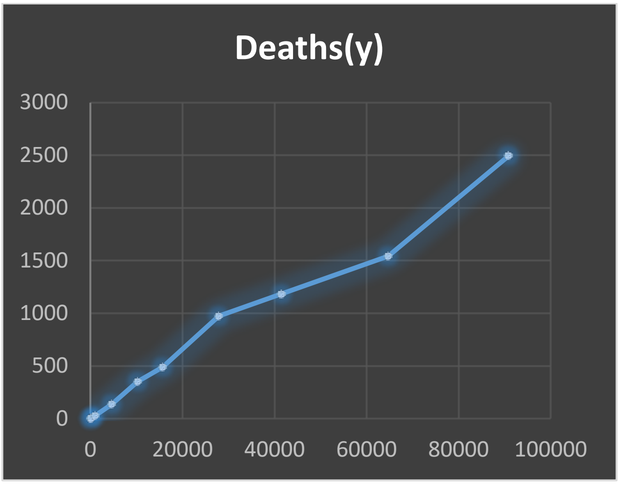


Figure 2: Curve of Distribution of death[18]

It can be observed from the figure-2 that the total number of cases increases rapidly with a small increase in death rate. For example, if infected cases increase from 4614 to 10251 cases, the total number of deaths increases from 137 to 350.

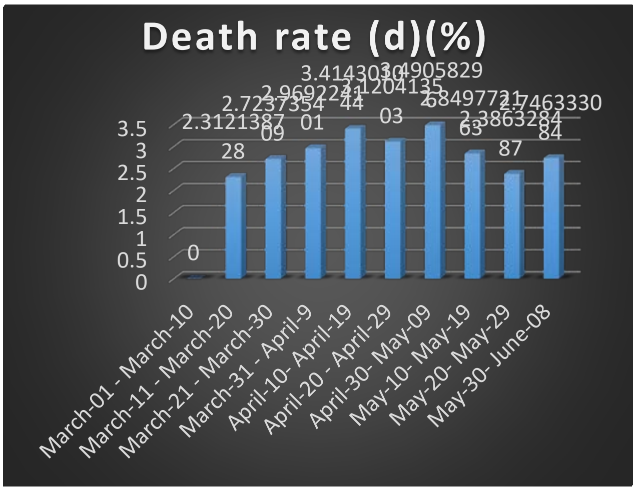


Figure 3: Mortality rate in India for different cases[23]

Figure 3 shows the if we take the data in the group of 10-10 days of the month; the average death rate is 2.% approximately.

Hypothesis testing

We test a null hypothesis that the maximum average fatality rate in India could be 3.49% (on behalf of table 1). A significant test can be done in order to determine whether the data is significant or not.

T-test: *T*-test is suitable for the small samples (such as $n < 30$), in which the statistics follow a normal distribution but the standard deviation (SD) of the population is unknown. The test statistic is given by[21]

$$t = \frac{\bar{d} - \mu}{S / \sqrt{n}} \qquad (2)$$

Where $S = \sqrt{\frac{\sum (d - \bar{d})^2}{n-1}}$, $\bar{d}$ is the mean of n sample death rate and μ the average death rate in India, is taken as 3.49.

Table no. 3: Calculation for test static t

SN	d %	$(d - \bar{d})^2$
1	0	6.68626338
2	2.312138728	0.07488009
3	2.723735409	0.01903142
4	2.969224101	0.14702861
5	3.414301044	0.68644546
6	3.120413503	0.28583191
7	3.49058296	0.81866659
8	2.849772163	0.06969133
9	2.386328487	0.0397813
10	2.746333084	0.02577697
	$\sum d$ = 26.01282948	$\sum (d - \bar{d})^2$ = 8.85339708

Using (2) and table 3, $|t| = 2.833542928$.

At 1% level of significance and 9 degrees of freedom, this result confirms our null hypothesis that India's maximum average death rate could be 3.49%.

Predictive Models for Covid-19 patients

We have taken several confirmed cases as an independent variable and the number of deaths as dependent variable.

Least Square approximation

If the function $y = f(x)$ is to be approximated to P(x) then by the Least square method[22)], the error function $u = \sum W(x)[f(x) - P(x)]^2$ for discrete points $x_1, x_2 \ldots . x_n$.

Where $W(x) > 0$ is the weight function, $P(x) = C_1\phi_1(x) + C_2\phi_2(x) + \ldots . C_n\phi_n(x)$, C_1, C_2, ……., C_n are constants and $\phi_i(x)$ is called the coordinate function.

$$|f(x) - P(x)| = E(f,c) = E,$$

is called error of approximation.

For u to be minimum

$$\frac{\partial u}{\partial C_i} = 0, \quad i = 0,1,2,\ldots . n.$$

These equations are called normal equations.

Consider a linear curve of regression

$$P(x) = C_1 + C_2(x) + E(f,C),$$

where $C_2 = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$,

$C_1 = \bar{y} - C_2\bar{x}$ and $W(x) = 1$.

Using table 1 we get

$$P(x) = 43.93846163 + .026345774\text{x} + E \quad (3).$$

Accuracy of the model can be calculated by

$$\text{Accuracy} = Avg\left(\frac{Absolute(Actual - Forecast)}{Absolute(Actual)}\right) \times 100$$

To find the values of C_1 and C_2, we have considered the cases from 1st March, 2020 to 8th June, 2020, given in table 1, the rest of the data is used to test this model.

Performance and evaluation of regression model

Table no. 4: Performance of the model

Date	**Actual cases**	**Actual deaths**	**Model predicted deaths**	**Error $\lvert E \rvert$**	**Actual rate (%)**	**Model predicted death rates (%)**
Jun-02	8171	204	259.209781	55.20978	2.496634439	3.172314049
Jun-03	8909	217	278.6529622	61.65296	2.43573914	3.127769247
Jun-04	9304	260	289.0595429	29.05954	2.794496991	3.106830857
Jun-05	9851	273	303.4706813	30.47068	2.771292255	3.08060787
Jun-	98	294	304.419	10.41	2.97360	3.07898

06	87		1292	913	1699	3809
Jun-07	9971	287	306.6321742	19.63217	2.878347207	3.075239938
Jun-08	9983	271	306.9483235	35.94832	2.714614845	3.074710242
Jun-09	9987	271	307.0537066	36.05371	2.713527586	3.07453396
Jun-10	9985	274	307.001015	33.00102	2.744116174	3.074622083
Total	86048	**2351**	**2662.447316**	**311.4473**	**2.744116174**	**3.074622083**

In table no. 4, the performance of the model (3) is evaluated and compared with available data. In general, the accuracy of the model is between 71.59 to 96.45. It is believed that the accuracy of the model can be enhanced with the use of more collected data of further Covid-19 cases.

A predictive model of COVID Confirmed Cases:

A data of Top 15 countries[23] having the highest COVID cases is taken for the calculation. The graphs of countries are plotted against days to see the pattern of daily COVID confirmed cases. Among them we found 10 countries have reached the peak and also reverse cycle has been achieved in decreasing the total daily cases of COVID. So from these 15 countries, 10 countries are taken in the calculation. The confirmed cases graphs of these countries are plotted (using machine learning algorithm)[24] in **figure[23] 4,5,6.**

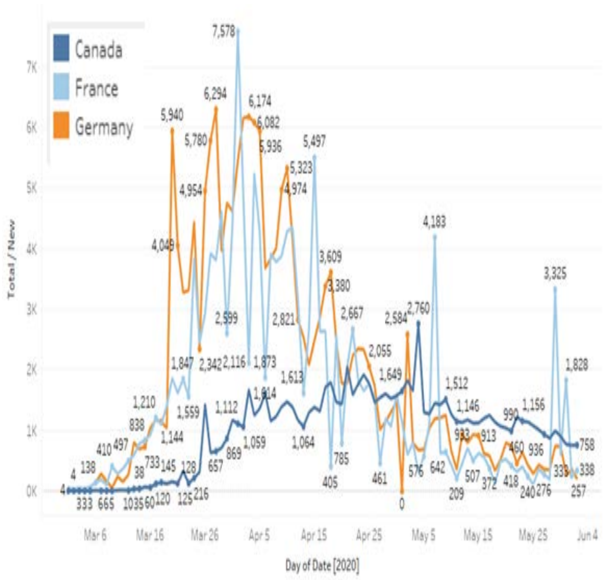


Figure. 4: COVID Daily Cases Curve of Canada, France, Germany

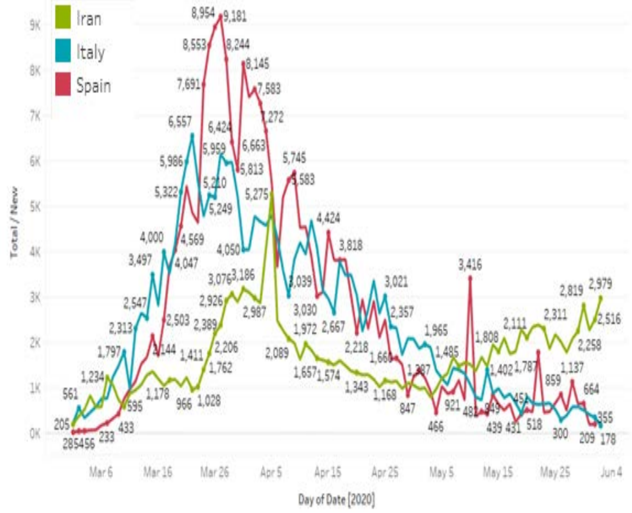


Figure. 5: COVID Daily Cases Curve of Iran, Italy, Spain

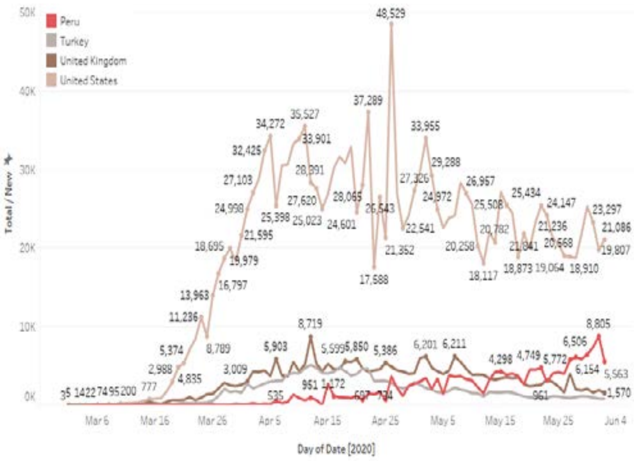


Figure. 6: COVID Daily Cases Curve of Peru, Turkey, UK, US

Almost all countries in these 10 had been gone through lockdown at the initial state except the United States. The maximum/peak points of daily confirmed cases are noted. All of these countries, curves start bending after this peak value. Now, if we compare this peak point total cases with the total population then almost the same ratio **(Table No.: 5)** has been achieved for all of these countries. It has been noted that besides lockdown this ratio (C_{PR}) is approximately the same for all of these countries[25].

So, it has seemed that the population act a major role in predicting the COVID-19 cases for any country. It is also observed despite of lockdown, any country will be having approximately cases equal to:

C_{PR} * Population of Country.

The total cases on 2nd June are also observed in the table, at this point these countries' graph came close to zero or bare minimum after the peak point achieved. A ratio T_{PR} is calculated here, i.e. the ratio of total cases to the population of the country. This ratio established a connection for total cases where the graph flattens and daily cases at its lowest values

Sr. No.	Country	Population	Confirmed Cases				
			Peak Day: Highest Cases	Total Confirmed Cases at till Peak	At Peak: % Cases of Total Population	Total Cases on 2nd June	2nd June: % Cases of Total Population
1	**United States**	331,002,647	48,529	939,053	0.2837%	1,811,277	0.5472%
2	**Russia**	145,934,460	11,656	221,344	0.1517%	414,741	0.2842%
3	**United Kingdom**	67,886,004	8,719	78,991	0.1164%	276,332	0.4071%
4	**Spain**	46,754,783	9,181	75,641	0.1618%	239,638	0.5125%
5	**Italy**	60,461,828	6,557	53,578	0.0886%	233,197	0.3857%
6	**Germany**	83,783,945	6,294	48,582	0.0580%	182,028	0.2173%
7	**Turkey**	84,339,067	5,138	52,167	0.0619%	164,769	0.1954%
8	**Iran**	83,992,953	5,275	55,743	0.0664%	154,445	0.1839%
9	**France**	65,273,512	7,578	52,128	0.0799%	152,091	0.2330%
10	**Canada**	37,742,157	2,760	59,474	0.1576%	91,694	0.2429%
	C_{PR} =				**0.1047%**	**T_{PR} =**	**0.2958%**

Table No.: 5*: Peak points of daily confirmed cases

While calculating C_{PR} & T_{PR} United States was excluded because US did not apply the lockdown at the corona's initial stage, other countries applied it at some initial stage.

Let us have a look at India's current number of COVID-19:

	India Data till Now				
Country	**Population**	**Total Cases on 2nd June**	**Total Deaths on 2nd June**	**Total Recovered**	**Total Tests as on date**
India	1,350,000,000	198,706	5,598	104,242	3,737,027

Using these **C_{PR} and T_{PR}** values the peak value and total cases at the flattening curve can be estimated for India.

Considering the population of India let us calculate predicted values for India:

Prediction of India COVID Confirmed Cases			
Country	**Population**	**Total Confirmed Cases at till Peak (I_P)**	**Total Cases till Graph Flatten**
India	1,350,000,000	1,413,112	3,992,912

India current graph as per the data till 2nd June 2020:

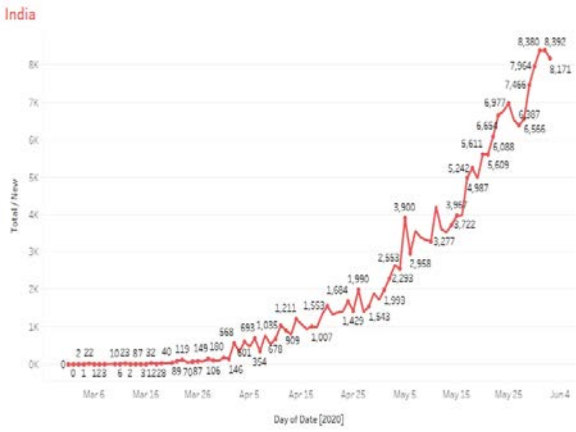


Figure. 7: India current Daily COVID Cases Curve

Now consider the average current rate of daily cases as $\mathbf{C_R}$ & applying the regression model to predict the future values of daily cases. When the cases reach the I_P (peak values) then the $\mathbf{C_R}$ for the model will start decreasing.

Daily Cases (D_C) = Total Cases* ($\mathbf{C_R}$ %)……………..…………………….…. (Till $D_C < I_P$)

Daily Cases (D_C) = Total Cases * ($\mathbf{C_{R(t-1)}}$ - ($\mathbf{C_{R(t-1)}}$ *5 %))……………… (Till $D_C > I_P$)

Where t refers to the current day, $\mathbf{C_{R(t-1)}}$ is value of $\mathbf{C_R}$ at t-1 day (i.e. previous day).

After applying the parameters to the model, the model gave the daily case values and total cases. These values are plotted (**Figure:8**, which gives a very accurate prediction of the COVID-19 cases). The R-Squared value of predicted confirmed cases is 96.67%.

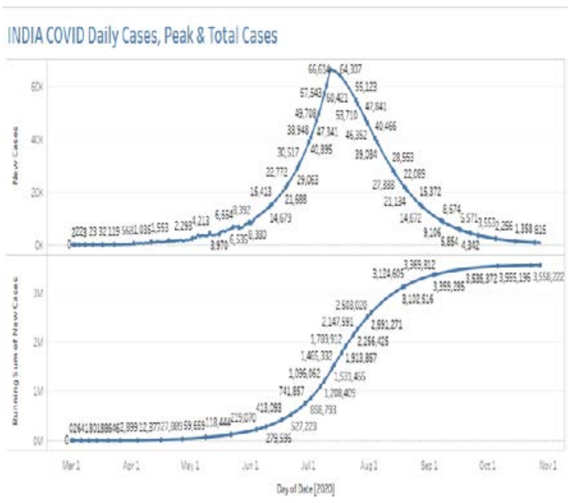


Figure. 8: India predicted Daily New and Total COVID Cases Curve (With Peak)

It is seen from the prediction model that a peak of India COVID total cases will be in 1st week of July, at this point, the daily cases are its peak i.e. C_{PR} % of the total population of India and after this week the curves start bending. The total cases curve will also start flatten in the month of August/September. So, using this, the country can plan for health care needs.

A predictive model of COVID Deaths

The same phenomena are used while calculating the total deaths due to COVID-19 for any country. Only the difference is now the ration D_{PR} (Deaths at Peak) & TD_{PR} (Total deaths till curve flatten) are calculated over the total number of cases at peak inspite of population. **(Refer table No.6)**

Using these **D_{PR} and TD_{PR}** deaths at peak and total deaths until the curve flatten are calculated as follows:

Prediction of India COVID Deaths		
Country	**Total Deaths till Peak (D_P)**	**Total Deaths till Graph Flatten**
India	81,384	346,036

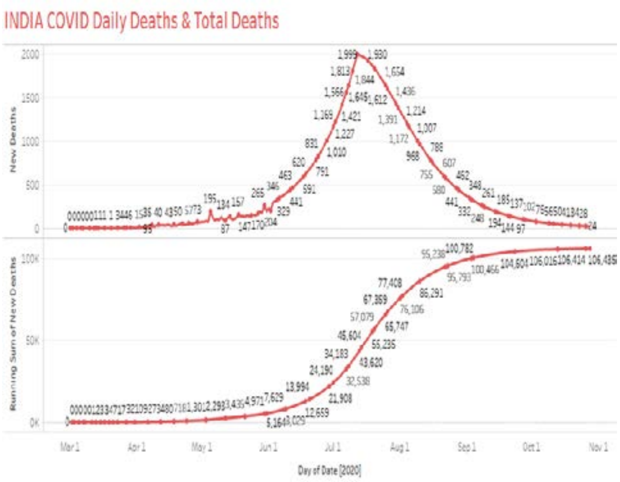
Table No: 6: Total deaths till curve flatten

Sr. No.	**Country**	**Mortality**				
		Peak Day: Highest Deaths	**Total Deaths till Peak**	**At Peak: % Deaths of Total Cases (D_{PR})**	**Total Deaths on 2nd June**	**2nd June: % Deaths of Total Cases (D_{TR})**
1	**United States**	2,172	53,189	5.66%	105,147	5.81%
2	**Russia**	94	2,009	0.91%	5,037	1.21%
3	**United Kingdom**	839	11,599	14.68 %	39,045	14.13 %
4	**Spain**	655	4,089	5.41%	27,940	11.66 %
5	**Italy**	795	4,827	9.01%	33,475	14.35 %
6	**Germany**	72	325	0.67%	8,522	4.68%
7	**Turkey**	95	1,101	2.11%	4,563	2.77%
8	**Iran**	292	3,452	6.19%	7,878	5.10%
9	**France**	499	3,523	6.76%	28,833	18.96 %
10	**Canada**	116	3,682	6.19%	7,326	7.99%
			D_{PR} =	**5.76 %**	**TD_{PR} =**	**8.67 %**

Now consider the average current rate of daily deaths as $\mathbf{D_R}$ & applying the regression model to predict the future values of daily deaths.

Daily Deaths (D_D) = Total Cases * ($\mathbf{D_R}$ %)

After applying the death parameters to the model, it gave the daily deaths and total deaths. These values are plotted (**Figure:9,** which gives a very accurate prediction of the COVID-19 deaths). The R-Squared value of predicted deaths is 92.13%.



Figure[18]. 9: India predicted Daily and Total COVID Deaths Curve (With Peak)

The predictive model of COVID Recovered Cases

A model is also formed to predict the recovery rate, total recovery until the graph flattens and total test to be conducted versus population until any country's graph started to flatten. A data is collected for the same top 10 countries and an average of percent total recovery over total confirmed cases is calculated for modelling. **(Refer Table: 7)**

Table: 7: Average of percent total recovery over total confirmed cases

S r. N o.	Country	**Recovered Cases**		**Test Conducted**		
		Total Recovered Till Date	**% Total Recovered of Total Confirmed**	**Total Tests as on date**	**% Total Tests of Population**	**% Confirmed Cases of Total Test Conducted**
1	**United States**	688,692	38.02%	16,936,891	5.12%	10.69%
2	**Russia**	204,623	49.34%	10,923,108	7.48%	3.80%
3	**United Kingdom**	Not Available	--	2,144,626	3.16%	12.88%
4	**Spain**	150,000	62.59%	2,536,234	5.42%	9.45%
5	**Italy**	160,938	69.01%	3,910,133	6.47%	5.96%
6	**Germany**	167,800	92.18%	3,952,971	4.72%	4.60%
7	**Turkey**	130,852	79.42%	2,070,719	2.46%	7.96%
8	**Iran**	127,485	82.54%	935,894	1.11%	16.50%
9	**France**	69,455	45.67%	1,384,633	2.12%	10.98%
10	**Canada**	51,048	55.67%	1,691,297	4.48%	5.42%
		$\mathbf{R_{PR}}$	**63.83%**	$\mathbf{TS_{PR}}$	**4.16%**	**8.62%**

Where $\mathbf{R_{PR}}$ is the recovery rate of total confirmed cases and $\mathbf{TS_{PR}}$ is the percent total test to be conducted over population until the graph flattens of any country. Using $\mathbf{R_{PR}}$ and $\mathbf{TS_{PR}}$ values of total recovered cases and total test to be conducted till graph flatten are calculated as follows:

	Prediction Based on Tests Conduction		Prediction on Recovered Cases		
Country	**Test Conducted Till date**	**Total Tests of Population will be conducted till graph Flatten**	**Current Recovery Rate**	**Total Recovered at Graph Flatten**	**India % age of recovered cases at Graph Flatten**
India	3,737,027	56,160,000	$\mathbf{R_R}$ = **45%**	2,677,248	66.89%

It has been seen that till India graph flatten total approximate **5.62 Crore test to be conducted and the recovery rate per day will be 67% till graph flatten.** After applying the regression model, the graph was plotted for the daily recovered cases in India (**figure 10).**

Daily Recovered Cases (R_D) = Total Cases * ($R_{R(t-1)}$ + ($R_{R(t-1)}$*0.25%))

Where t refers to the current day, $R_{R(t-1)}$ is value of R_R at t-1 day (i.e. previous day). The R-Squared value of predicted recovered cases is 98.1%.

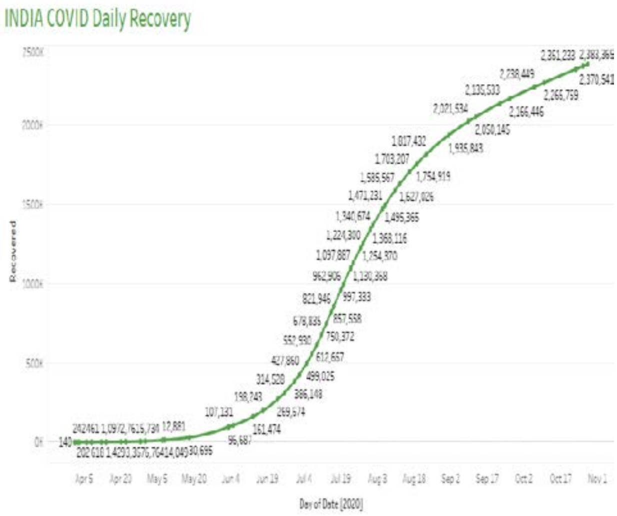


Figure. 10: India recovered Total COVID Cases Curve

The model has been built for prediction of COVID confirmed cases, peak confirmed cases, deaths, peak deaths and recovery rate. The model is self-explanatory and well established. The actual data of top 15 countries till 2nd June 2020 was used to build the model.

Conclusion

The actual data of the top 15 countries till 2nd June 2020 was used to build the model. We have analyzed the data of Covid-19 spread in India in current scenarios. A mathematical model is established following the actual data trend of Covid-19 spread in India. This model can find an approximate fatality rate in India. The performance of the model is evaluated and compared with available data. The calculated value of correlation coefficient indicating that the mortality rate will linearly increase with the increase of corona infected cases and t-test confirms our null hypothesis that the maximum average death rate in India could be 3.49%. As future work we are planning to collect the data in order to collect more information related to 3.49% death cases due to COVID-19. It has been observed that countries with lockdown are still having a total COVID case equal to $\mathbf{C_{PR}}$ percent of its population and total cases till the country graph flatten will be $\mathbf{T_{PR}}$ percent of the total population because of virus. After this much spread only any country can be in the state of bending the curve for daily cases and flatten curve for total cases. It is also found that total deaths till any country flatten the curve will approximately $\mathbf{D_{PR}}$ percent of its total population. The recovery rate is quite good for lockdown countries i.e. 67% till they reach the peak and which is further improving as soon as daily cases reach to minimum/zero. Regarding Coronavirus testing, it's found that a country will be doing an approximate 4 % test of its population till reaching the end of the pandemic/graph flattens. Sharing information can help researchers and governments to understand the mortality rate during virus transmission. The results also found that regression could give initial an indicator of the possibility of surviving or dying, based on the collected data.

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