Covid -19 Forecasting Using Regression Analysis

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Abstract :

Covid-19 is a viral infection started in china and became pandemic by spreading all over the world. The goal of the study is to forecast the number of confirmed, recovered, active and deaths of covid19 cases in India by December 2020 through regression analysis. According to our study the confirmed cases may rise to 43,67,580 and the active cases may rise to 14,32,583 and deaths may rise to 86,530 by 31 December of 2020.

Key words: Covid-19, Forecasting, Regression analysis

Introduction

Covid-19 is a viral disease which started in Wuhan, China in Dec 2019 and spread across the world. As of 4th Aug 2020, overall 1,81,42,718 confirmed cases are present globally.[1] In India the first case was reported on 30th Jan 2020, and the cases rapidly increased to 18,55,745 as of 4th Aug 2020.[2] The covid-19 has caused crashing of economies, and affected mental health of millions around the world.

Covid-19 is caused by virus called severe acute respiratory syndrome corona virus.[2] The virus transmits from one person to other by droplets, close contact with infected patients, fomite, and nosocomial transmission.[3] Incubation period of covid-19 is between 1-14 days. The common symptoms of covid-19 are fever, dry cough, aches, nasal congestion, runny nose, sore throat, diarrhea and difficulty in breathing. About 80% of confirmed cases recover from the disease without any serious complications. However, one out of every six persons who get covid-19 can become seriously ill and develop difficulty in breathing. In more severe cases, infection can cause severe pneumonia and other complications.[4] Infected people are capable of spreading covid-19 exponentially, if the infected person is not diagnosed or if there is delay in reporting and isolation, late recognition and treatment of the condition.

What is forecasting?

A forecast is a quantitative, probabilistic statement about an unobserved event, outcome, or trend and its surrounding uncertainty, conditional on previously observed data. Many forecasting methods are available for infectious diseases outbreak, and choice for choosing a specific method depends on the key issues of the assessment which are : (a) the scope of the system, in particular how many parallel data series are to be monitored, which can range from one to several thousand; (b) the quality of the data available, including the method of data collection, and the delay between event occurrence and reporting; (c) the spatio-temporal features of the data, such as count frequency, trend structure, seasonality, epidemicity, time step and spatial resolution; (d) the features of the outbreaks that may occur, for example explosive or gradual onset, brief or long duration, and level of severity, or a mix of these; (e) the use to which the system is to be put, including the post-signal processing protocols; (f) the availability of processing power and human resources to support the system; and (g) the choice of metric to evaluate results. The most commonly used statistical forecasting methods are regression technique, time series methodology, methods of statistical process control, methods incorporating spatial information, and multivariate outbreak detection.[5]

Forecasting targets can revolve around expected epidemic duration, size, or peak timing and incidence, or geographical distribution of risk, or short-term trends in incidence.[6] Infectious disease forecasts aid to prepare for and prevent illness, hospitalization, and death, as well as to face the economic burden experienced during infectious disease epidemics. [7]

DOI: 10.46858/vimshsj.7307

What is the purpose of forecasting?

Forecasting is a technique that uses historical data as inputs to make informed estimates that are predictive in determining the direction of future trends.[8] These methods allow the planners to prepare well in the time, for the future scenerio in advance, anticipating the forthcoming load of patients. Forecasting is used regularly in defence services to get men, money and material ready and available for the eventuality, well in time.

Types of forecasting

The three basic types of forecasting are qualitative techniques, time series analysis and projection and causal models.[2] The Qualitative technique objective is to bring qualitative information in a logical, unbiased and systematic way into quantitative estimates. Qualitative forecasting is done by Delphi method, Market Research, Panel consensus, Visionary forecast and Historical analogy. Time series analysis and projection is done by Moving average, Exponential smoothing, Box-Jenkins, X-11 and Trend projections. Causal forecasting methods include Regression Model, Econometric model, Intention to buy and anticipation surveys, Input-Output model, Economic Input-Output model, Defusion Index, Leading indicator and Life-cycle analysis. The forecasting techniques are based on the assumption that existing patterns will continue into the future. This assumption is more likely to be correct over the short term than the long term.[9]

Method followed for forecasting covid-19

In statistics, it is hard to stare at a set of random numbers in a table and try to make any sense of it. To forecast the covid-19 cases in India we used regression analysis. Regression analysis is used in stats to find trends in data. Trend in the regression analysis is the best explanation for relationship between a dependent variable and independent variable.[10,11] Forecasting via regression analysis can be done by using various software like SPSS, Tableau, Microsoft excel, NCSS software and others. For this study we used Microsoft office excel 2020.

The study data of confirmed cases, active cases, deceased, recovered and testing was collected from https://www.covid19india.org/. The data was collected in the monthly format from starting of the first case in India, from January 2020 to July 2020 and the forecast has been done up to December 2020.

Table 1: Actual Covid-19 cases in India up to July 2020

Month	Confirmed cases	Active cases	Recovered	Deceased	Tested
Jan-20	1	1	0	0	0
Feb-20	3	0	3	0	0
Mar-20	1944	1709	179	53	47134
Apr-20	36669	25747	9689	1229	975107
May-20	199437	97007	96790	5627	3937387
Jun-20	604048	225658	360404	17914	9044516
Jul-20	1754540	584595	1132201	37315	19884348

In India the first case of covid-19 was reported on 30 January 2020 and by 31 July 2020 17,54,540 confirmed cases were recorded and the active cases were 5,84,595, recovered cases were 11,32,201, deceased cases were 37,315 and testing was done in 1,98,84,348.

Findings

We have forecasted the confirmed cases, active cases, deceased, recovered and testing with 95% confidence interval.

Table 2: Forecast of the confirmed Covid-19 cases in India in 2020

Month of 2020	Forecasted cases	Confidence interval 95%
August	19,92,726	6,35,733
September	22,23,228	8,91,343
October	24,69,097	11,00,755
November	26,99,599	12,66,318
December	29,45,469	14,22,111

In Table 2, we have forecasted the confirmed cases from August to December 2020 by regression analysis using the data from January to July 2020 (Table 1), with a confidence interval (CI) of 95%. A confidence interval is a range around a measurement that conveys how precise the measurement is.[12] The CI provides a range +/- of the forecasted value.

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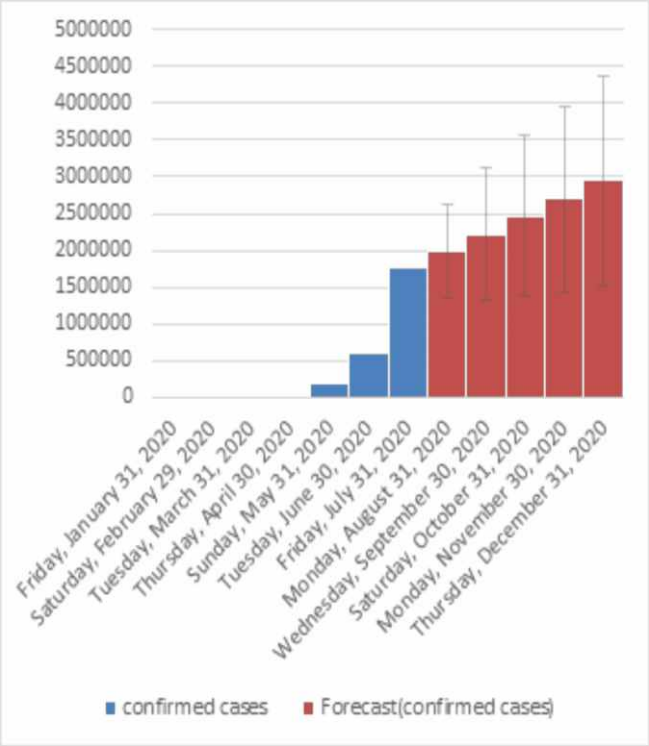

Fig 1: Forecast of confirmed cases of Covid-19 in India in 2020

In Fig 1, the forecasted confirmed cases are presented in red color with error bars which provide the range of confirmed cases of each month. According to our forecast the confirmed cases show a trend of increasing in number reaching in to 29,45,469 in December 2020

Table 3: Forecast of active cases of Covid-19 in India upto end of 2020

Month of 2020	Forecasted cases	Confidence interval 95%
August	6,66,752	1,95,445
September	7,46,259	2,74,028
October	8,31,066	3,38,408
November	9,10,573	3,89,308
December	9,95,380	4,37,203

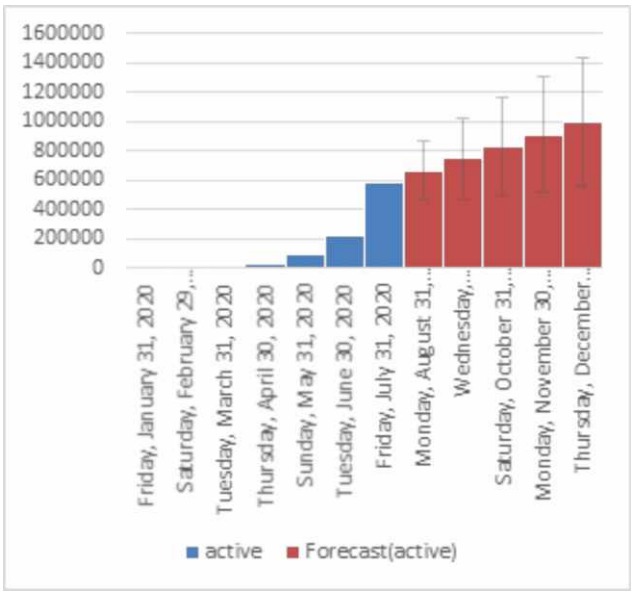

Fig 2: Forecast of active cases of Covid-19 in India

In Fig 2, the forecasted confirmed cases are presented in red color with error bars which provide the range of active cases of each month. According to our forecast the active cases may show a figure of 9,95,380 in December 2020.

Table 4: Forecast of deceased patients of Covid-19

Month of 2020	Forecasted Deaths	Confidence interval 95%
August	42,792	9,760
September	48,092	13,684
October	53,745	16,898
November	59,045	19,440
December	64,698	21,832

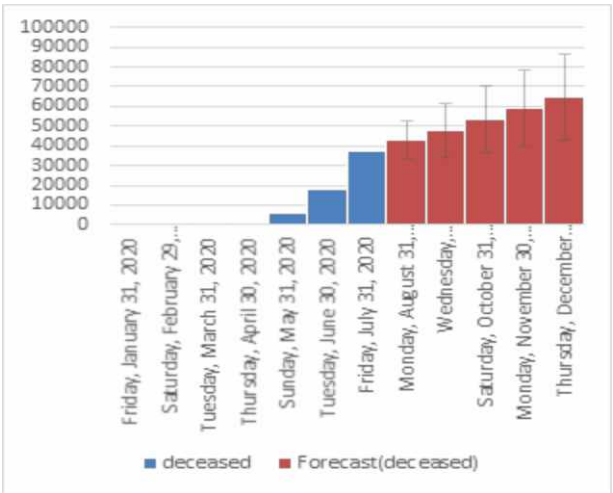

Figure 3: Forecast of deceased Covid-19 patients in 2020

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In Fig 3, the forecasted deaths are presented in red color with error bars which provide the range of deaths each month. According to our forecast the death toll may reach 64,698 in December 2020.

Table 5: Forecast of recovered Covid-19 cases for 2020

Month of 2020	Forecasted recovery	Confidence interval 95%
August	12,82,702	4,32,553
September	14,28,347	6,06,470
October	15,83,703	7,48,953
November	17,29,348	8,61,603
December	18,84,704	9,67,604

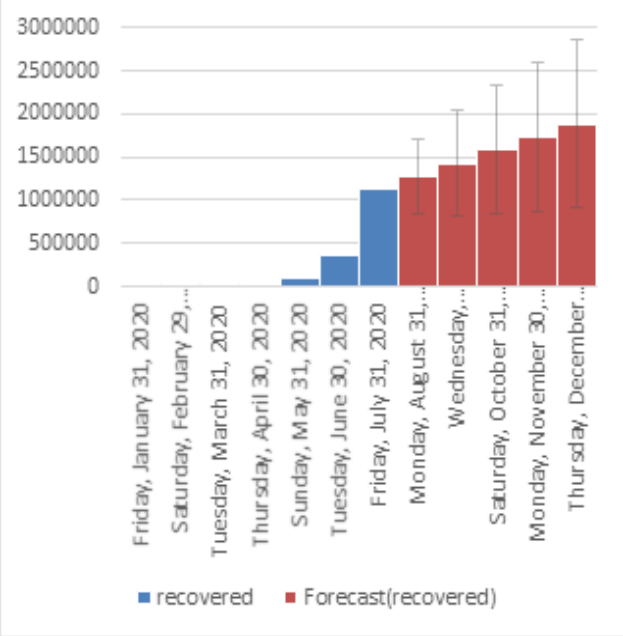

Fig 4: Forecast of recovered cases of Covid-19

In Fig 4, the forecasted recovered cases are presented in red color with error bars which provide the range of deaths each month.

Table 6: Percentage of confirmed cases against tested and other recovered, deceased and active cases against confirmed cases

	Total	Percentage
Tested	92565207	
Confirmed Cases	8786191	9.491893
Deceased	175997.9	2.00312
Recovered	5789675	65.89517
Active	2818191	32.07523

As can be seen from Table 6, the actual percentage of confirmed cases is 9.4 % of the cases tested. Out of the cases confirmed the death rate is 2.003%, which should be seen as a favorable picture.

Conclusion

According to our study, if there is no change in the transmission rate for corona virus in India, the covid-19 confirmed cases may increase upto 43,67,580, and the active cases may increase to 14,32,583 and deaths may increase to 86,530 by 31 December of 2020. If there is any change in the transmission rate, it will alter this projection of data of covid-19 cases.

Precautions should be taken to prevent spread of corona virus, by following social distance, regular hand wash, and by avoiding unwanted touching of the face.

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DOI: 10.46858/vimshsj.7307

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