AN OVERVIEW: SITUATION ASSESMENT AND PREDICTION OF CORONA VIRUS IN INDIA

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Abstract:

Epidemic is a rapid and wide spread of infectious disease threatening many lives and economy damages. In January 2020, a novel corona virus was found in a India. WHO officially named this corona virus as COVID-19. Since the first patient was hospitalized on 27th January, 2020, India has reported a total of 27,892 confirmed CONID-19 cases as of 26th April; 2020.COVID-19 epidemic does great harm to people's daily life and country's economic development. It is important to fore-tell the epidemic lifetime so to decide on timely and remedy actions. These measures include closing borders, schools, suspending community services and commuters. Resuming such curfews depends on the momentum of the outbreak and its rate of decay. Being able to accurately forecast the fate of an epidemic is an extremely important but difficult task. Due to limited knowledge of the novel disease, the high uncertainty involved and the complex societal-political factors that influence the widespread of the new virus, any forecast is anything but reliable. Another factor is the insufficient amount of available data. Data samples are often scarce when an epidemic just started. With only few training samples on hand, finding a forecasting model which offers forecast at the best efforts is a big challenge. This paper adopts of mathematical models, i.e., least square fitted model. The epidemic trends of SARS were first fitted and analyzed in order to prove the validity of the existing mathematical models. The results were then used to fit and analyze the situation of COVID-19. The prediction results of the mathematical models according to the current trend, based on the data set from 30th January, 2020 to 26th April, 2020 , the total number of people expected to be infected is 50852-57449 in India. Probably COVID-19 will be under control situation in 4th week of June, 2020 in India and Second week of May, 2020 the Number of infected in peak point and fourth week of May to second week of June the number of affected will be downwards.

Keywords : Mathematic model, Forecasting, epidemic prediction.

Introduction:

A number of unexplained pneumonia cases have successively been discovered in China since December 2019, which has been confirmed to be acute respiratory infectious diseases caused by a novel corona virus. The outbreak of COVID-19 has experienced three stages since mid-December 2019: local outbreak, community transmission and large-scale transmission. The novel corona virus, COVID-19, originated in Wuhan and has spread rapidly across the globe. The World Health Organization has declared it to be a pandemic. In the absence of a vaccine, social distancing has emerged as the most widely adopted strategy for its mitigation and control. The suppression of social contact in workplaces, schools and other public spheres is the target of such measures. Since social contacts have a strong effect in India. This requires mathematical models of disease transmission that resolve social contact structures. In this paper we present a mathematical model of the spread of the novel corona virus in India. We use it to study the impact of the most common social distancing measures that have been initiated to contain the

epidemic in India: workplace non-attendance, school closure, **"Janata Curfew"** and lockdown, the latter two of which attempt, respectively, complete cessation of public contact for brief and extended periods. Infectious disease transmission is a complicated diffusion process occurring in the crowd. Models can be established for this process to analyze and study the transmission process of infectious diseases theoretically, so that we can accurately predict the future development trend of infectious diseases. Therefore, in order to control or reduce the harm of infectious diseases, the research and analysis of infectious disease prediction models have become a hot research topic. It is necessary therefore to estimate not only the total number of infections in India as well as when the situation is under control. The remainder of our study is organized as follows (I) Stop all the regional gathering (II) keep social distance with strictly probated (III) No migrating or contaminated people are not come to meet with others people. We investigate the pick point of corona virus, the saturation stage of corona virus and when the situation will be under control. We conclude with a discussion on the possibilities and limitations of our study. Our study is based on data from on 30th January 2020 to 28th April 2020. Though it is too soon to have an in-depth knowledge of the disease and its implications for public health, economies, etc., the data available allow for an initial forecast of the evolution of 2019-nCoV in India. This paper's objective is to provide a forecast on the evolution of confirmed cases in India. We hope that the information provided contributes to evaluating risks and controlling the epidemic's spread. We will now proceed to the empirical analysis of known data on the number of cases in India; the statistic model shows that transmission will soon stabilize.

Background:

The epidemic outbreak caused by corona virus COVID-19 is of great interest to researches because of the high rate of the infection spread and the significant number of fatalities. A detailed scientific analysis of the phenomenon is yet to come, but the public is already interested in the questions of the epidemic duration. Long-time predictions require complicated mathematical models that need a lot of effort to identify and calculate unknown parameters. This article will present some preliminary estimates.

Objective:

Since the short-time data are available only India, we will try to predict the epidemic characteristics only in this area. We will estimate some of the epidemic characteristics and present the dependencies for victim numbers, effect of lock down or social distancing, infected and removed persons versus time. As well as "when the situation will be under control!!!!!!"

Methods

In this study we use the known least square fitted-model for the dynamics of an epidemic, the known exact solution of the linear differential equations and statistical approach developed before for investigation of the children disease, which occurred in Chernivtsi (Ukraine) in 1988–1989.

Epidemic forecasts

Using our parameterised least square fitted model, we simulated the impact of an ongoing outbreak in India to seed infections and outbreaks in other cities of India, and to generate infection in travellers to other countries, through airline travel originating in India. We stress that these projections make strong assumptions: that no control interventions are instigated; that the key epidemiological variables driving epidemic dynamics remain constant; that travel behaviour in India and to the rest of the world continues as per our mobility estimates; finally, we only

consider travel by air, and do not include land transportation, particularly via trains. We estimate that on 26th April 2020, in India there were 27,892 currently infected individuals. We saw that daily no of positive case near about 1500.

Data:

Data were obtained from daily reports of Government of India as published in internet (www.covid19india.org).

Study and visual representation of data:

When predicting the evolution of a temporal process, it is useful to find a model generating past values in order to extrapolate said model to the future. To this effect, the model must sufficiently describe the past, be robust in its predictions, and fulfil the least square fitted technique. The temporal series we aim to predict is the number of accumulated confirmed cases (C) of virus COVID-19 in India. The temporal unit is a day and the numbers of cases are those provided by the Govertment of India. A first approach to said series confirms that the logarithmic transformation allows us to describe the phenomenon in a functionally simpler manner and with the added advantage of expressing the relative or perceptual evolution of number of cases in logarithmic form.

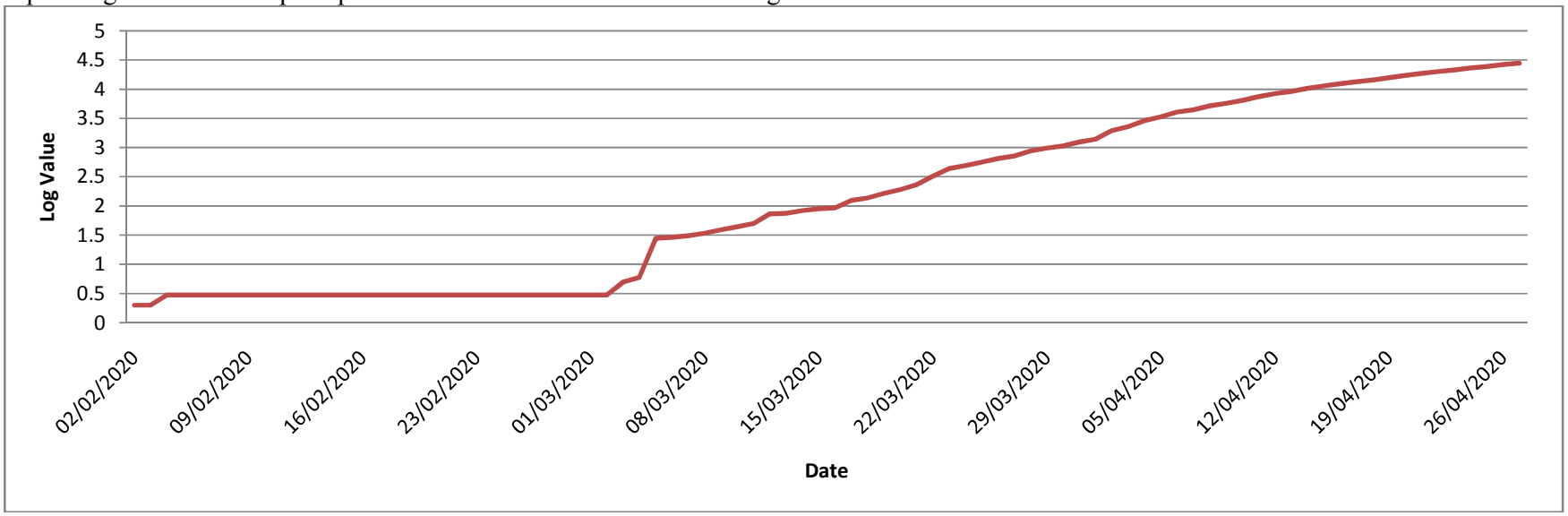


Figure 1: Logarithm of accumulated confirmed cases.

This series ln(C) appears at first glance to suggest a non-linear evolution close to the polynomial one. It should be pointed out that the quadratic evolution would only describe the phenomenon up to the peak, and following that point, would no longer be the generating model, and given that C cannot decrease. It is a lifecycle model where the maximum is generated in a finite time and not in an infinite time like a classic logistic model. Now we plot auto correlation function (ACF).

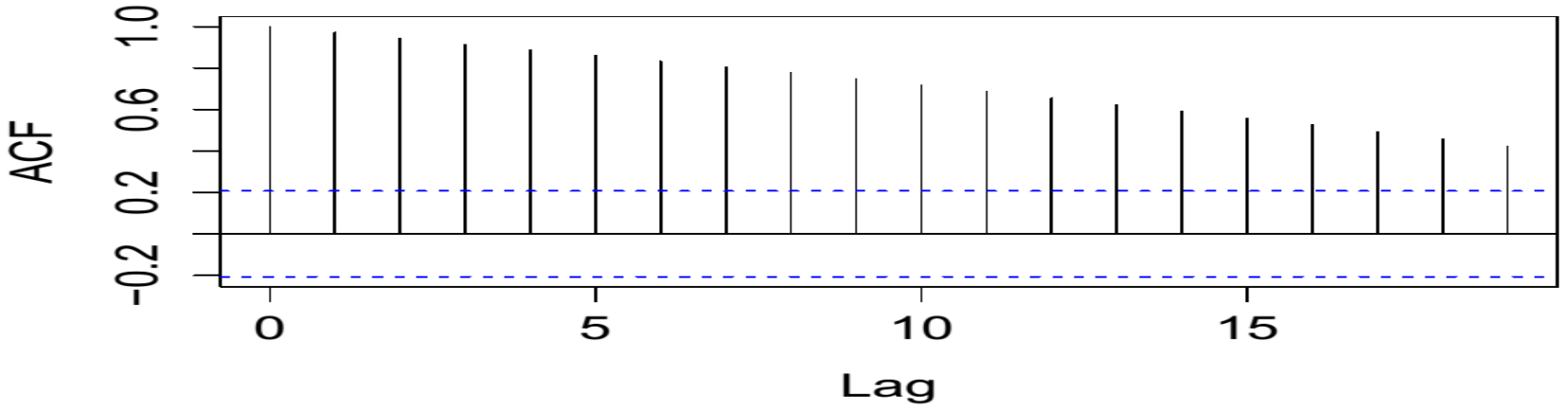


Figure 2 : ACF of Log Transformed Series

It is clear that that from the above figure the 95% of the sticks are not within the blue confidence lines. Hence the given model is non stationary. This gives rise to two ideas: to try to directly adjust the quadratic model to this series, or to find the first difference in the series and adjust a linear model to said difference. In principle, a linear model would allow us to describe more simply the internal mechanism of the phenomenon's evolution. On the other hand, the quadratic adjustment shows considerably self-correlated residues that suggest that the series may not be adequately predictable through a simple model. Thus, we consider that the first analysis to attempt is the linear model on the first difference in the series. The graph shows series dlC (=d(ln(C))) with a superimposed linear adjustment. In principle, it appears to be an adequate description of said difference. However, it is necessary to carry out some statistical verifications in order to validate the visual representation. We did two types of verifications:

• Verification of the linear adjustment: Analysis of the self-correlations of the residues and crossed validation of the degree of the adjustment polynomial.

• In the predictions provided by the model: Stability in the predictions as days of observation increase and stability in the solutions as less importance is assigned to older data potentially less relevant to the future .

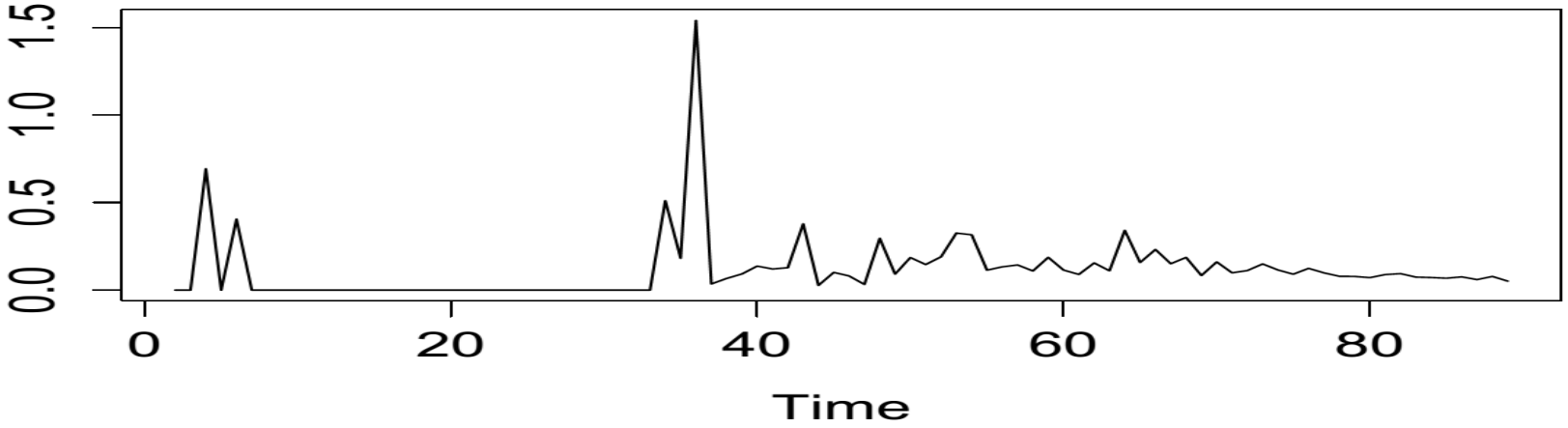
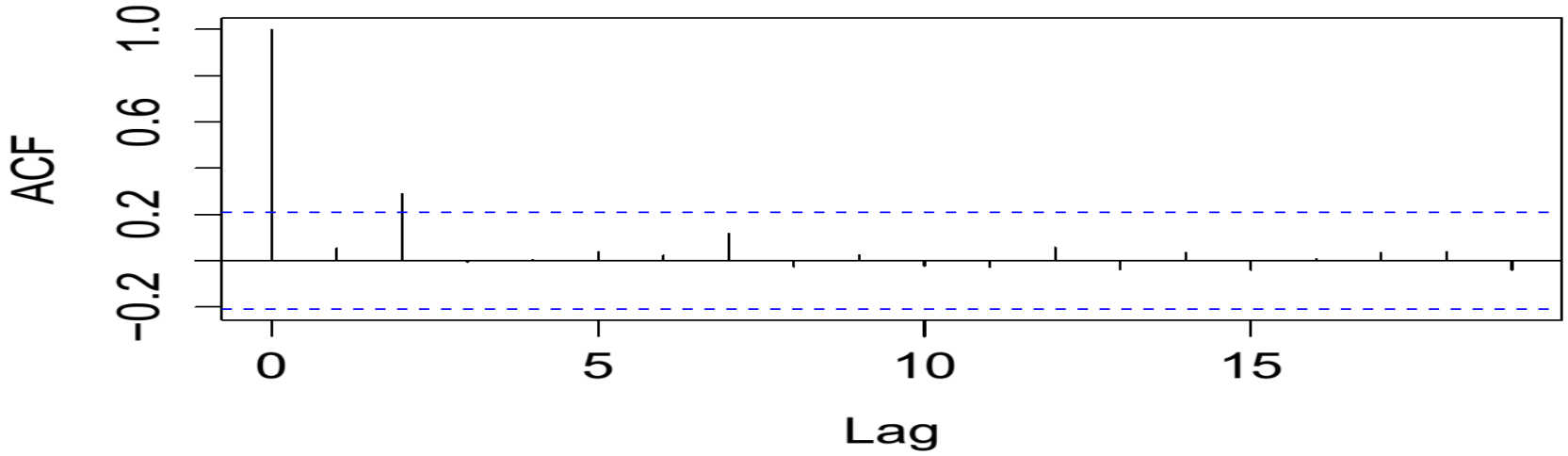


Figure 3: Difference in logarithm series.

Now we plot auto correlation function (ACF) and partial auto correlation function (PACF) to check is the series is stationary after taken the first order differentiate .



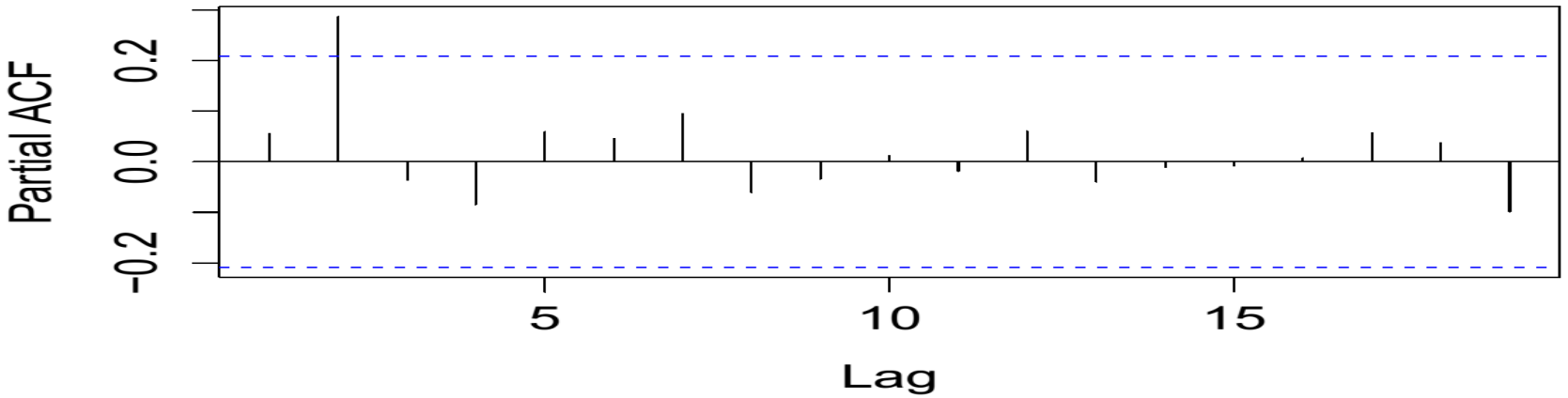


Figure 4: ACF of Differenced Log Transformed Series & PACF of Differenced Log Transformed Series

From the above ACF plot, we observe that the 95% of the sticks are within the blue confidence lines. Hence the given model is non stationary.

Here the ACF cuts off after lag 1 and the PACF tails off. So the value of p is 0 q is 1 and since we have taken first order difference, hence the model is ARIMA (0, 1, 1).

Method of Mathematical Curves:-

This is perhaps the best and most objective method of determining trend. In this case, an appropriate type of trend equation is at first selected, and then the constants involved in the equation are estimated on the basis of the data in hand. Usually, a polynomial of a suitable degree is chosen either for the original variable or for a transformed variable and its constants determined by the method of least squares. The choice of the appropriate polynomial is facilitated by a graphical representation of the data, for which, apart from the usual arithmetic scales, semi-logarithmic or doubly-logarithmic scales may be used.

Supposing a polynomial of degree K in t is chosen to represent the trend T, viz.

$$T_t = a_0 + a_1 t + a_2 t^2 + \cdots \ldots \ldots + a_k t^k \qquad \ldots\ldots\ldots\ldots\ldots(1)$$

The normal equations for determining the unknown constants $a_0, a_1, a_2, \ldots \ldots \ldots, a_k$ will be

$$\sum y = n a_0 + a_1 \sum t + a_2 \sum t^2 + \cdots \ldots + a_k \sum t^k$$

$$\sum t\, y = a_0 \sum t + a_1 \sum t^2 + a_2 \sum t^3 + \cdots \ldots + a_k \sum t^{k+1}$$

$$\sum t^2 y = a_0 \sum t^2 + a_1 \sum t^3 + a_2 \sum t^4 + \cdots \ldots \ldots + a_k \sum t^{k+2}$$

$$\sum t^k y = a_0 \sum t^k + a_1 \sum t^{k+1} + a_2 \sum t^{k+2} + \cdots \ldots \ldots + a_k \sum t^{2k}$$

Using the estimates obtained from equations (2), we get the trend value for any given time t by substituting that values of t in (1).Obviously, for linear trend,

$$T_t = a_0 + a_1 t$$

and there will be two normal equations, viz.

$$\sum y = n a_0 + a_1 \sum t$$

and,

$$\sum t\, y = a_0 \sum t + a_1 \sum t^2$$

For quadratic trend,

$$T_t = a_0 + a_1 t + a_2 t^2$$

and the normal equations are

$$\sum y = n a_0 + a_1 \sum t + a_2 \sum t^2$$

$$\sum t\, y = a_0 \sum t + a_1 \sum t^2 + a_2 \sum t^3$$

and,

$$\sum t^2 y = a_0 \sum t^2 + a_1 \sum t^3 + a_2 \sum t^4$$

Usually, the successive points of time will be equidistant, the common difference being h, say. By taking as origin the mid- point of the period covered by the data, one can then make each sum of odd powers of t equal to zero. Further simplification can be made if one takes h or h/2 as the new unit for t, according as the number of points is odd or even.

In this paper we present a mathematical model of the spread of the novel corona virus in India. We use it to study the impact of the most common social distancing measures that have been initiated to contain the epidemic in India: workplace non-attendance, school closure, **"Janata Curfew"** (22nd March, 2020) and lockdown started from 25th March, 2020 and going on still the paper work is doing , the latter two of which attempt, respectively, complete cessation of public contact for brief and extended periods. We now investigate the impact of social distancing measures on the unmitigated epidemic. We assume that social distancing in any public sphere, which in our model is partitioned into workplace, school and all others, removes all social contacts from that sphere. This, of course, transfers the weight of these removed contacts to the household, where people must now be confined. We interpret the lockdown imposed from 25 March 2020 to remove all social contacts other than the household ones. We emphasise that models that do not resolve social contact structure cannot provide information on the differential impact of each of these measures. This information is vital since each of the specific social distancing measures have widely varying economic costs. Our model allows for the assessment the rate of spread of infected of the COVID-19 infection in India for last week of the lock down(19th April to 26th April, 2020).

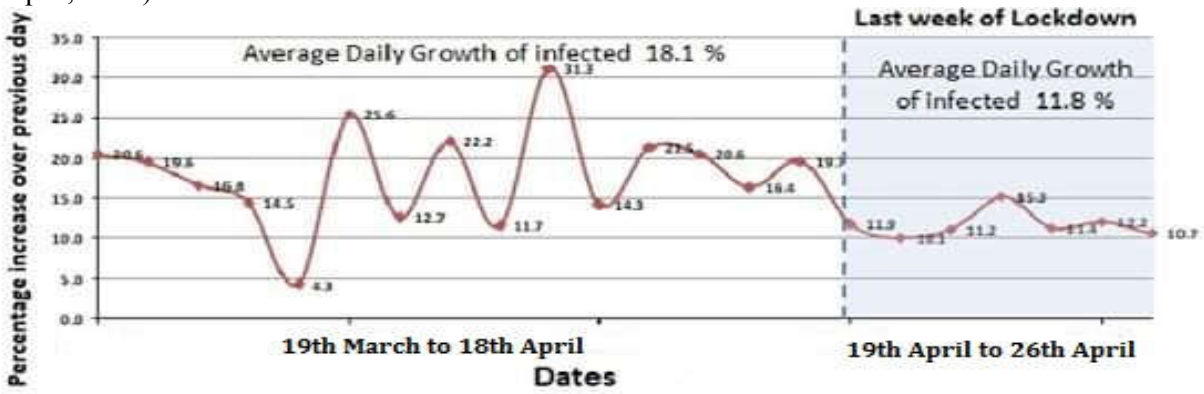


Figure 5: Daily Growth of COVID19

Here plotting the data set from 30th January, 2020 to 26th April, 2020 to seen in this graph the daily growth rate of decrease the positive cases of COVID 19 in India.

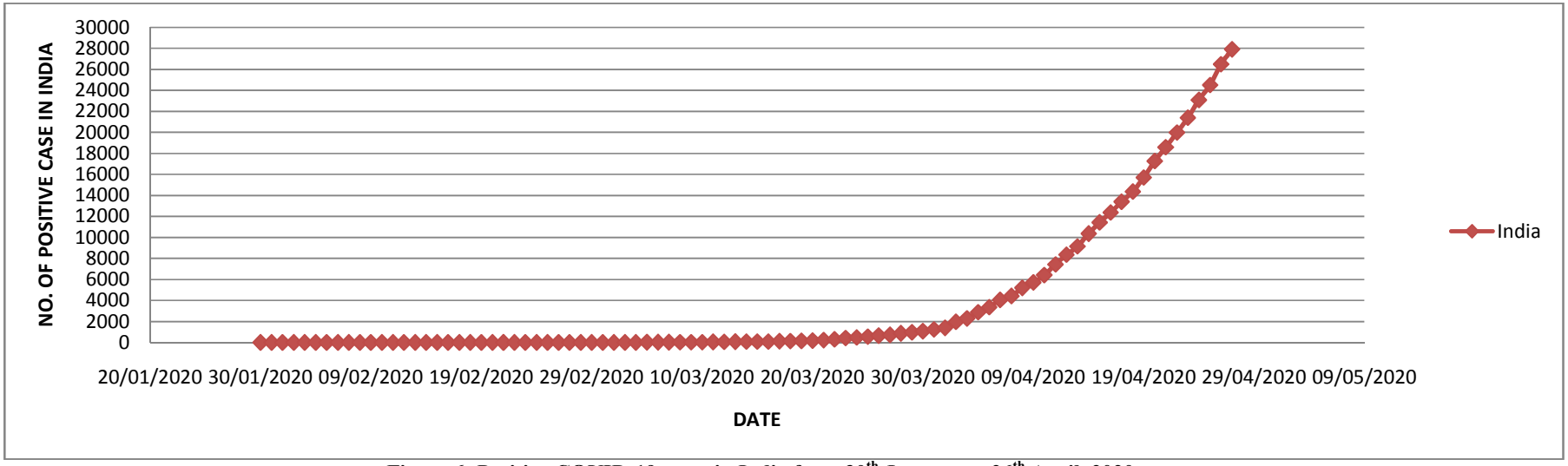


Figure 6: Positive COVID-19 cases in India from 30th January to 26th April, 2020

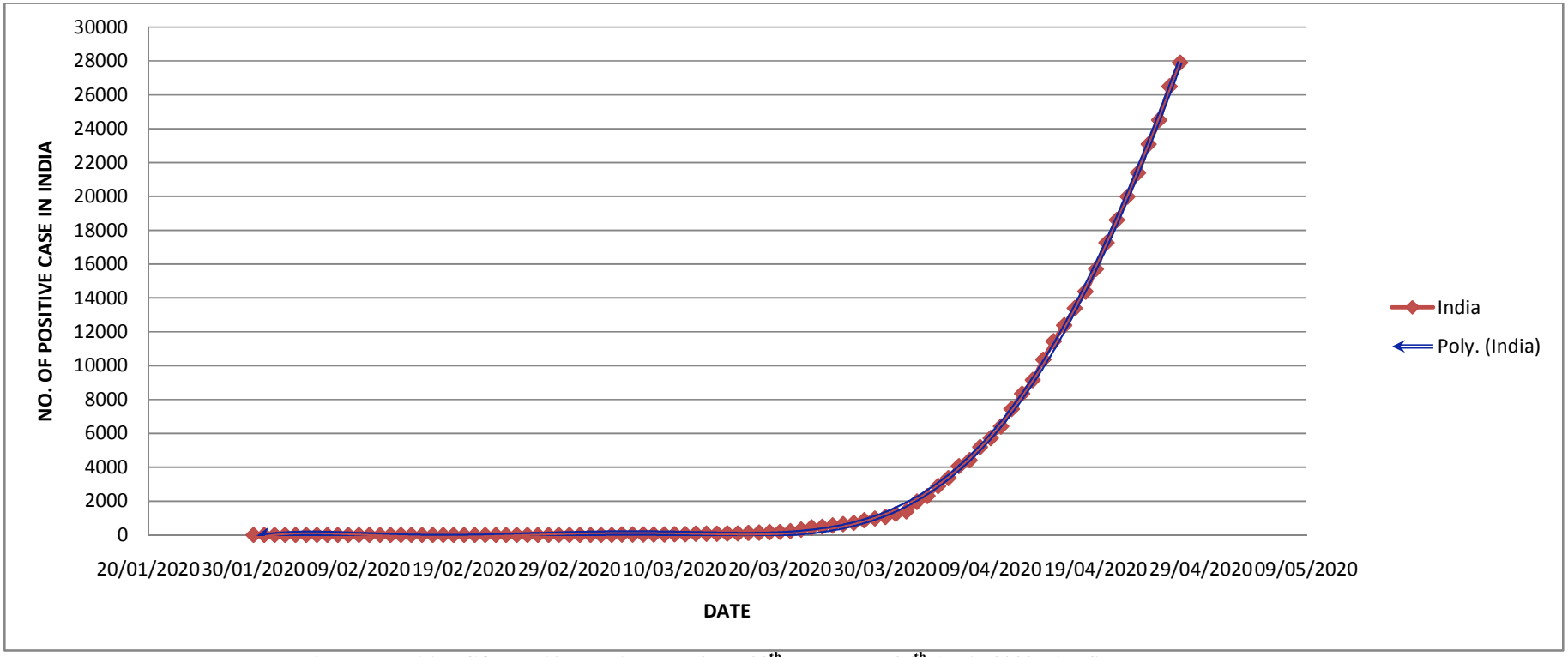


Figure7: Positive COVID-19 cases in India from 30th January to 26th April, 2020 with fitted model.

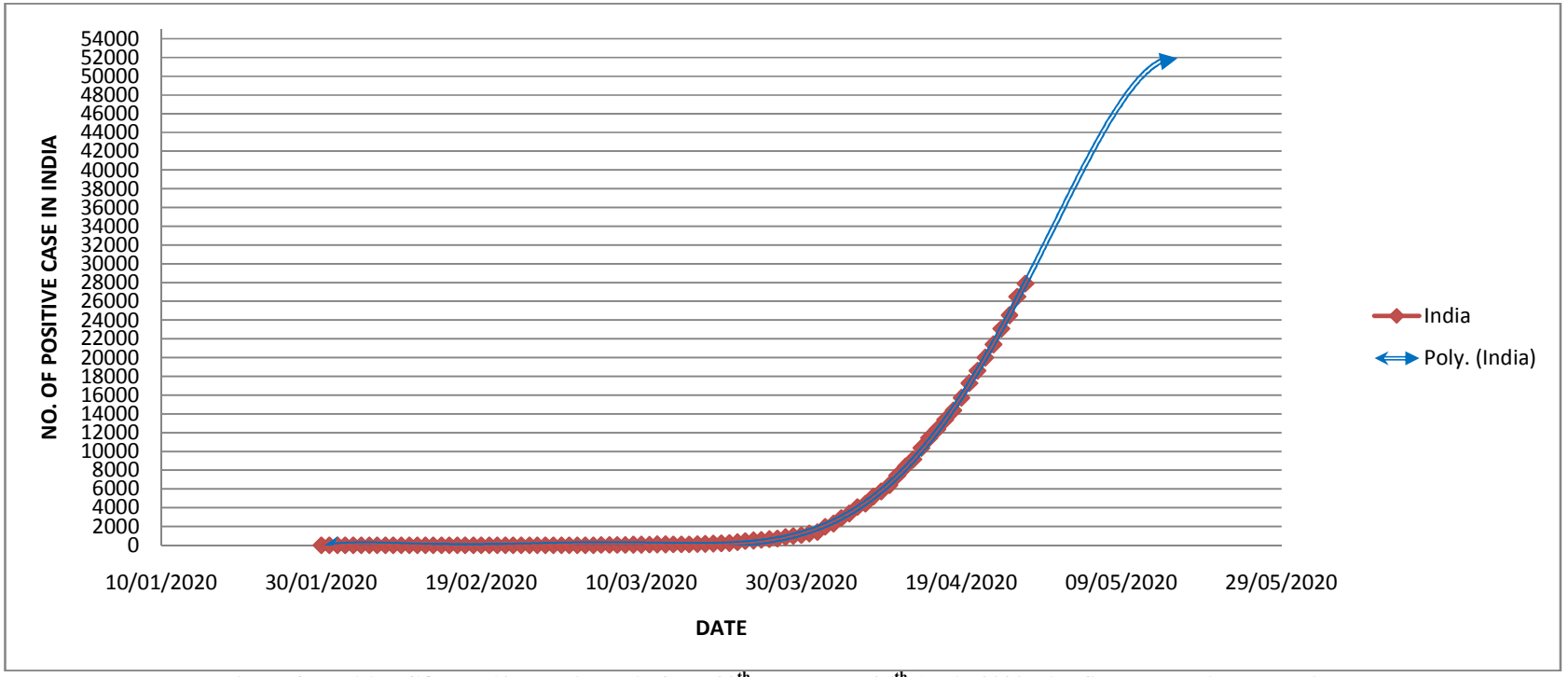


Figure 8: Positive COVID-19 cases in India from 30th January to 26th April, 2020 with fitted model in peak point.

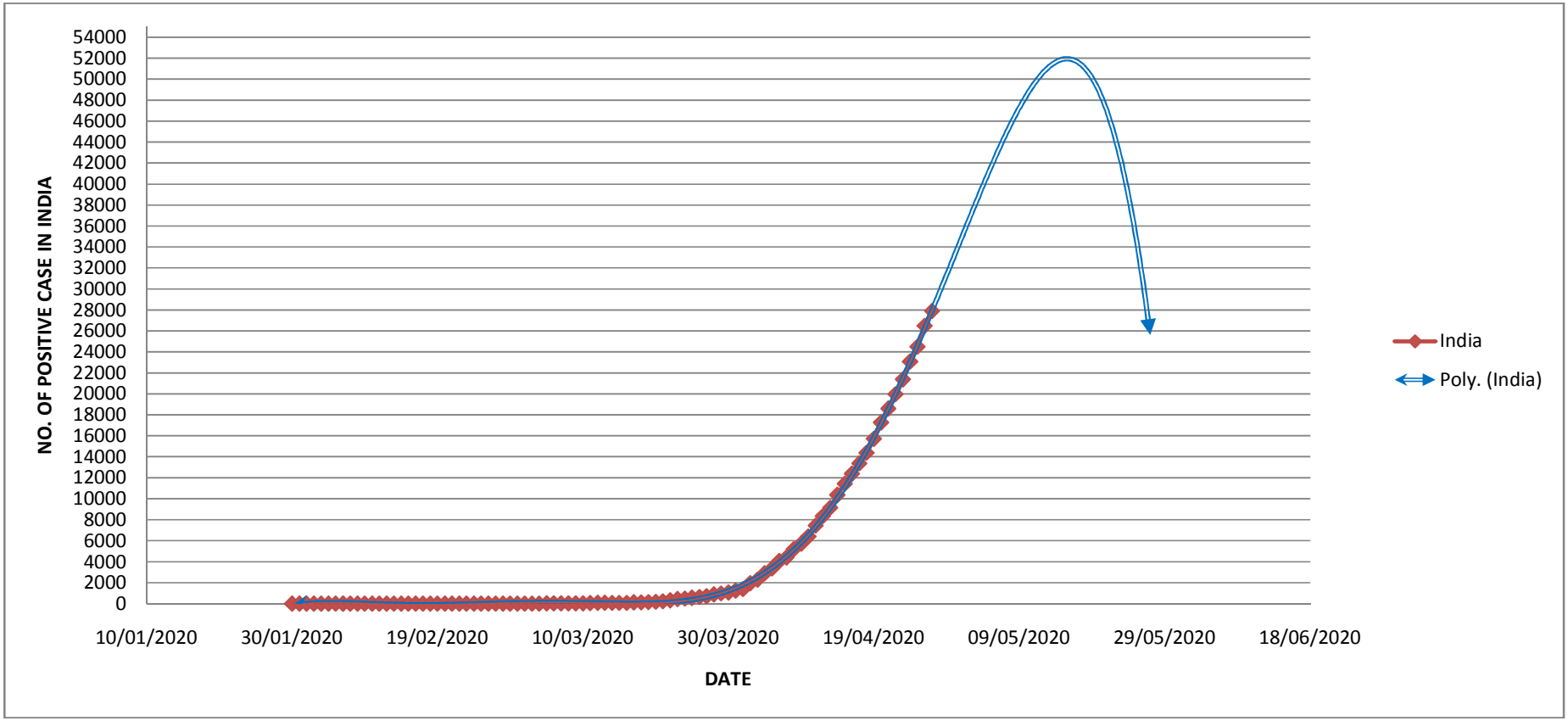


Figure 9: Downwards COVID 19 in Fitted Model

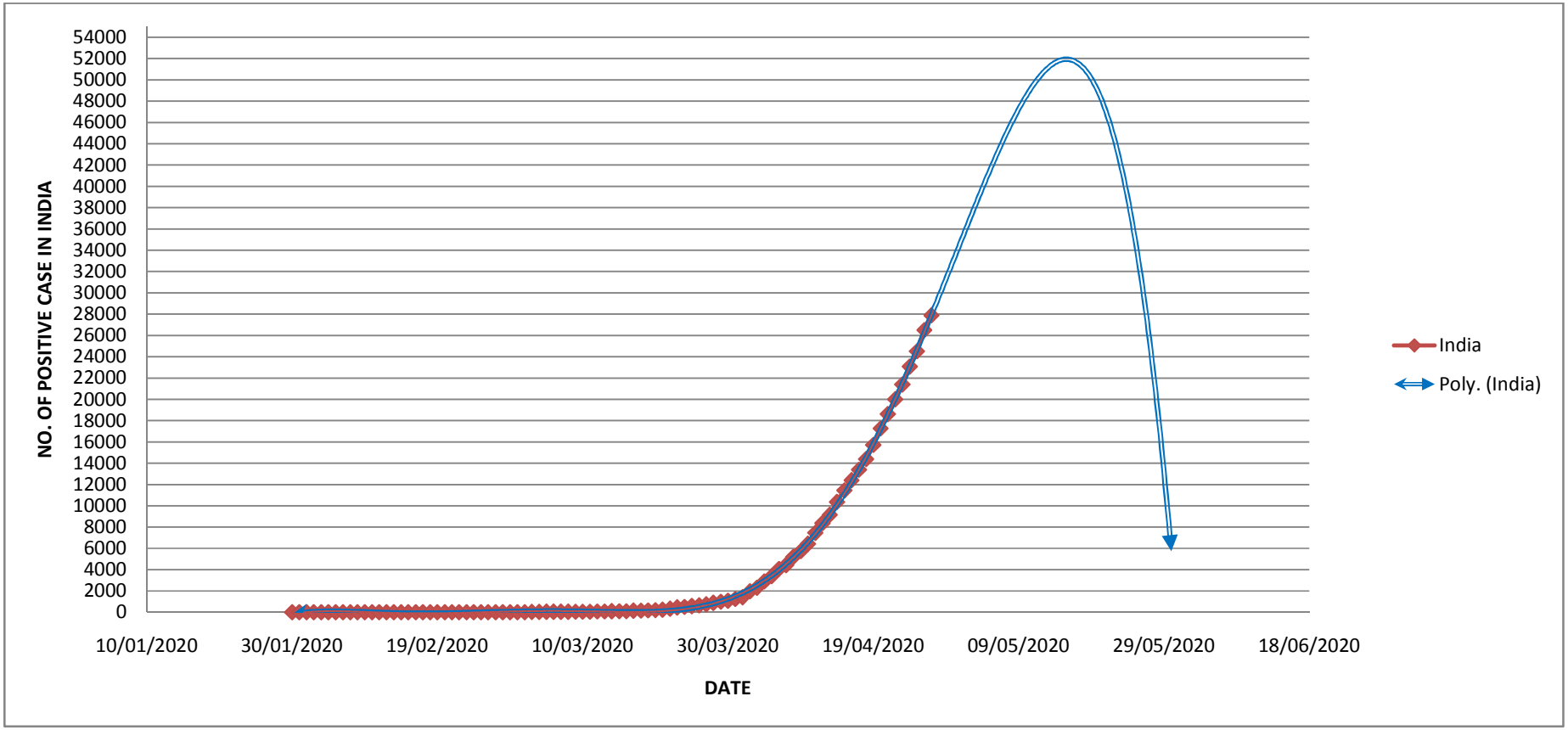


Figure 10: Downwards COVID 19 in Fitted Model

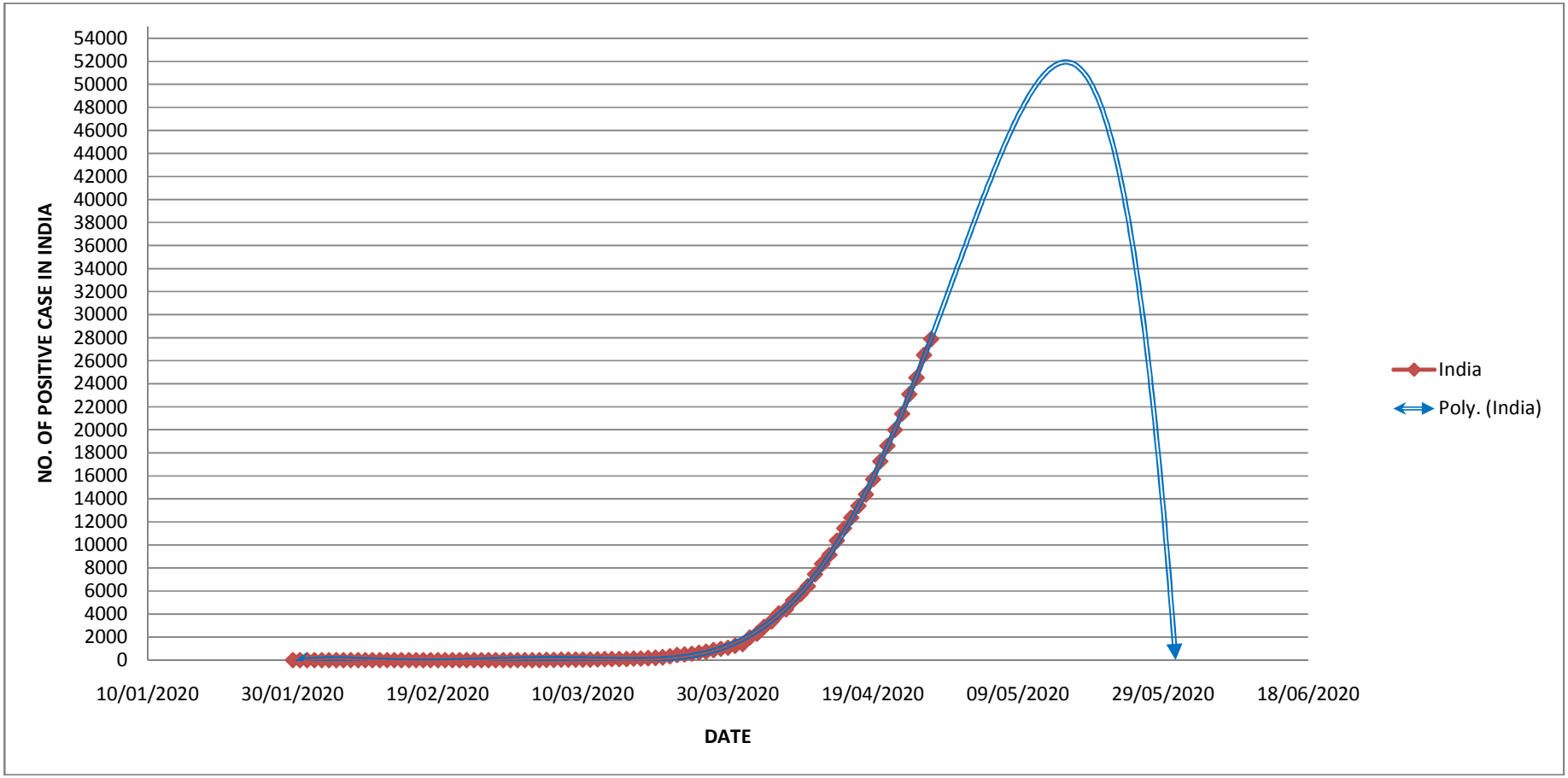


Figure 11: Under control situation of COVID 19 in Fitted Model

Result and discussion:

In **figure 1**: Use the Logarithm scale of accumulated confirmed cases from 30th January to 26th April, 2020, in **figure 2** auto correlation function of Log Transformed Series and finds that the 95% of the sticks are not within the blue confidence lines. Hence the given model is non stationary, in **figure 3:** Difference in logarithm series, in **figure 4**: Auto correlation function (ACF) of Differenced Log Transformed Series & Partial auto correlation (PACF) of Differenced Log Transformed Series, and finds from the auto correlation function (ACF) plot, we observe that the 95% of the sticks are within the blue confidence lines. Hence the given model is non stationary. Here the auto correlation function (ACF) cuts off after lag 1 and the PACF tails off. So the value of p is 0 q is 1 and since we have taken first order difference, hence the model is ARIMA (0, 1, 1). In **figure 5**, Daily Growth of COVID19 in lock down periods, mainly focused on 19th April to 26th April, 2020 (last week of study) ,finds the daily growth rate of decrease the positive cases in India, We use it to study the impact of the most common social distancing measures that have been initiated to contain the epidemic in India: workplace non-attendance, school closure, **"Janata Curfew" (22nd March, 2020)** and lockdown started from 25th March , 2020 and going on still the paper work is doing , complete cessation of public contact for brief and extended periods. Now investigate the impact of social distancing measures on the unmitigated epidemic. Assume that social distancing in any public sphere, which in our model is partitioned into workplace, school and all others, removes all social contacts from that sphere. This, of course, transfers the weight of these removed contacts to the household, where people must now be confined. Interpret the lockdown imposed from 25 March 2020 to remove all social contacts other than the household ones. In **Figure 6**, Here seen the increase of positive case of COVID 19 in India from 30th January to 26th April, 2020, in **figure 7** Fit a polynomial on the existing data (30th January 2020 to 26th April 2020) and the fitted polynomial equation like as: $\mathbf{y = -1E\text{-}06x^6 + 0.318x^5 - 34942x^4 + 2E+09x^3 - 7E+13x^2 + 1E+18x - 9E+21}$ and the value of $\mathbf{R^2}$ is **0.999**. In **figure 8**, forecasting the above model on the basic of data and find the peak of the disease COVID 19 will take place in near about **19th May,2020** ,In **figure 9** finds the point of downwards of the disease COVID 19 will take place in near about **31th May,2020**, in **figure 10** find the point of downwards of the disease COVID 19 will take place in near about **6th June, 2020**,in **figure 11** finds the point of the disease COVID 19 will be control under situation in near about **12th June, 2020**.

Conclusion:

The simple mathematical model was used to predict the characteristics of the epidemic caused by corona virus in India. The numbers of infected, the peak time periods, downwards situations and under control situation were predicted and compared with the new data obtained after 26th April, 2020, when the calculations were completed. Unfortunately, many cases have not been included in the official counts and have appeared on 26th April, 2020 only. It makes the predictions reported on 30th January, 2020 to 26th April, 2020, no longer relevant. The rate of infected will be downwards if the social distancing, lock down are obey properly. One thing is clear that after the last week (19th April, 2020 to 26th April, 2020) of lock down the rate of spread of infection is decline and one another thing from the mid of May, 2020 to mid of

June,2020 is very crucial and important for COVID 19 in India. The model shows that the growth in confirmed cases will conclude in a matter of days or weeks, with a limited number of periods affected. The alarming predictions made at the outset of this epidemic are fortunately not materializing. Thus, it appears that this is a major epidemic in number of persons affected or extension in time, but rather an epidemic with a moderate impact. It is important to continue monitoring the evolution in number of persons affected in order to re-evaluate the model and perceive over time the real scope of any deviation or change in the tendency of this epidemic. Further research should focus on updating the predictions with the use of corrected data and more complicated mathematical models. In addition, another concerned question is: When wills the epidemic of the new corona virus COVID-19 end? Judging from the SARS situation in 2003, the date corresponding to the maximum number of cumulative diagnoses was basically the date when the epidemic ended. According to the results and data of this article, it is estimated that the epidemic of COVID-19 in novel corona virus will end at the end of July 2020 in India. It is worth noting that the above results and conclusions are under the precondition that the prevention and control measures for the epidemic situation of COVID-19 are stable and reliable, foreign cases are not imported into India on a large scale, and the virus of COVID-19 does not produce new and serious acute variations.

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