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COVID - 19 Status and Forecasting

Dr. Vidya .V. Deshpande

Late. Laxmibai Deshmukh Mahila Mahavidyalay. Parli.v (MH)

Abstract: *The mathematical model plays role in understanding and explaining strategies in controlling infestation. To study the transmission dynamics of corona virus, present study is an effort in developing and testing models on Confirmed cases, Recoveries, deaths. Interventions in modeling will help in describing infestation trade and their effects on human health. The present study is an effort in this direction on testing linear exponential and quadratic responses in studying behavior of number of cases reported, recovery and death. Maharashtra is the highest contributor to the country's Covid-19 tally in terms of both active and recovered cases. Maharashtra reported 14,43,409 Covid-19 cases and 38,084 fatalities till end of October first week. Major activities, including inter-district movement, a rise in office workforce and reopening of commercial activities from the first week of September, have led to a sudden spurt in the number of Covid-19 patients. The common perception is that youngsters can be allowed to step out, while senior citizens must stay at home. The present study is based on the data for the period 9th March, 2020 to 30th Sept, 2020. Weekly data from the published reports has been recorded for analytical purpose. The methods used are Averages, fitting exponential trend and quadratic responses.*

Covid-19 is spreading exponentially and only time is the determinant factor in prediction resulting in increase of confirm cases, recovery and death. Above 95% contribution is explained by time on determining confirm cases, recovery and deaths. Hence appropriate measures need to be chalked out jointly by technicians, bureaucrats, social workers, in the interest of individual's health. COVID -19 disease attack will be continued more than 2 months. i.e. beyond 40th week ending on 7th Jan 2021, and expecting decline thereafter by mid of Jan. These facts are confirmed by the graphs presented.

I. INTRODUCTION

World synchronized by the fear and shock of COVID-19. India experienced 5 lockdowns in facing COVID-19 situation. The pandemic stress by COVID-19 is continuing. The organizing Corona virus situations faced lots of physical, mental, social and economic uncertainties. The outbreak was first announced by World health organization in Wuhan in December 2019. The Indian health organization reported first case of Covid-19 during Jan 2020 in Kerala, a student of Wuhan University China. The major issue and COVID-19 had infection level, resulting in suspending tourist visas and day to day working. COVID-19 being a recently reported infection, even till today, vaccine is awaited on it.

The mathematical model plays role in understanding and explaining strategies in controlling infestation. To study the transmission dynamics of corona virus, present study is an effort in developing and testing models on Confirmed cases, Recoveries, deaths. Interventions in modeling will help in describing infestation trade and their effects on human health. The present study is an effort in this direction on testing linear exponential and quadratic responses in studying behavior of number of cases reported, recovery and death. Mathematical models are powerful tools to study various physical phenomena of real world problems. The respective idea was initiated by Bernoulli in 1776. After that, the first mathematical model of infectious disease was formulated in 1927 by Mckendrick and Karmark. Following that, this area got considerable attention and lots of models, which describe numerous physical or biological processes, were formed. By using mathematical models for the description of infectious diseases, we can get information about the transmission of a disease in a community, its mortality rates, and how

The study of the mathematical models under fractional derivatives instead of usual ordinary derivatives produces more significant results which are more helpful in understanding. In fact, numerous fractional order derivatives have been introduced and used in literature including "Caputo and Riemann-Liouville" derivatives which are the most popular differential operators. to control it. Researchers have been tracking the spread of the virus, have mobilized to speed innovative diagnostics, and are working on a number of vaccines to protect against COVID-19. Cao et al. studied the clinical features of corona virus and discussed the short-term outcomes of 18 patients and 102 patients with COVID-19 in intensive care units. Maharashtra, which is one of the states in India worst hit by the Covid-19 pandemic, has registered nearly 1.4 million cases and 36,662 deaths till now. The active cases in the state are over 260,000 while 1,88,322 people have been recovered.

The corona symptoms dominate respiratory track and leads to respiratory failure. The impact of social isolation in controlling Corona virus was the aim of study. The rate of probability of transforming susceptible from the disease infection that play key role is dynamic of transmission.

Maharashtra is the highest contributor to the country's Covid-19 tally in terms of both active and recovered cases. Maharashtra reported 14,43,409 Covid-19 cases and 38,084 fatalities till end of October first week. Major activities, including inter-district movement, a rise in office workforce and reopening of commercial activities from the first week of September, have led to a sudden spurt in the number of Covid-19 patients. The common perception is that youngsters can be allowed to step out, while senior citizens must stay at home.

The growth in variables understudy and the present status was worked out mainly on the basis of linear and non-linear functions. In view of it, the present study was planned to know about the

- 1) Infestation level in the State till end of November 20
- 2) Increase rate and to forecast the Trend behavior of number of confirm cases, Recovery and Death of COVID-19.

II. METHODOLOGY

Present study is based on secondary data published by government of Maharashtra on confirmed cases, recovery and deaths from time to time, to find-out growth of the parameters under study and also trend behavior observed graphically. The present study is based on the data for the period 9th March, 2020 to 30th Sept, 2020. Weekly data from the published reports has been recorded for analytical purpose. The methods used are:

Averages, fitting exponential trend and quadratic responses.

A. Exponential Trend

$$Y = a \cdot b^t$$

Y is dependent variable

t= time in week

a= constant

b= coefficient

B. Quadratic

$$Y = a + b \cdot t + c \cdot t^2$$

Y= dependent variable

a=constant

b, c= coefficient

t=time in week

The significance of coefficients tested at 5% level of significance assigning * and at 1% level of significance assigning **. The average level of Confirmed, recovery and death cases are presented in table. The forecasting for Confirmed cases, recovery and death on 15th Nov, 20-20 estimated using Fitted Trend Equation.

III. REVIEW OF LITERATURE

A. Sunny Kumar(April, 2020)

Presently, the world is infected by COVID 19 virus which has created an emergency public health. For controlling the spreading of the virus, we have to prepare for precaution and futuristic calculation for infection spreading. The corona virus affects the population of the world including India. Here, we are to study the virus spreading rate on the Maharashtra state which is part of India. We are predicting the infected people by the SIR model. SIR model is one of the most effective models which can predict the spreading rate of the virus. We have validated the model with the current spreading rate with this SIR model. This study will help to stop the epidemic spreading because it is in the early stage in the Maharashtra region.

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This paper aims to study the current scenario of COVID19 cases in Maharashtra state using the geo-visualization techniques. The paper deals with the district wise current situations showing through compiled maps of COVID19 cases and also presents the detailed ward wise map of COVID19 cases of Mumbai city which has the highest number of cases in Maharashtra state.

B. Kamal Shah Etal(27 may 2020)

In this article, a qualitative analysis of the mathematical model of novel corona virus named COVID-19 under nonsingular derivative of fractional order is considered. The concerned model is composed of two compartments, namely, healthy and infected. Under the new nonsingular derivative, we, first of all, establish some sufficient conditions for existence and uniqueness of solution to the model under consideration. Because of the dynamics of the phenomenon when described by a mathematical model, its existence must be guaranteed.

Therefore, via using the classical fixed point theory, we establish the required results. Also, we present the results of stability of Ulam's type by using the tools of nonlinear analysis. For the semi analytical results, we extend the usual Laplace transform coupled with Adomian decomposition method to obtain the approximate solutions for the corresponding compartments of the considered model. Finally, in order to support our study, graphical interpretations are provided to illustrate the results by using some numerical values for the corresponding parameters of the model.

C. Gitanjali R. Etal (11 June, 2020)

COVID-19 is a pandemic that has affected over 170 countries around the world. The number of infected and deceased patients has been increasing at an alarming rate in almost all the affected nations. Forecasting techniques can be inculcated thereby assisting in designing better strategies and in taking productive decisions. These techniques assess the situations of the past thereby enabling better predictions about the situation to occur in the future. These predictions might help to prepare against possible threats and consequences.

This study categorizes forecasting techniques into two types, namely, stochastic theory mathematical models and data science/machine learning techniques. Forecasting of a pandemic can be done based on various parameters such as the impact of environmental factors, incubation period, the impact of quarantine, age, gender and many more. This study discusses these challenges and also provides a set of recommendations for the people who are currently fighting the global COVID-19 pandemic.

D. Subhas Khajanchi Etal (28 June, 2020).

In India, 100,340 confirmed cases and 3155 confirmed deaths due to COVID-19 were reported as of May 18, 2020. Due to absence of specific vaccine or therapy, non-pharmacological interventions including social distancing, contact tracing are essential to end the worldwide COVID-19.

We propose a mathematical model that predicts the dynamics of COVID-19 in 17 provinces of India and the overall India. A complete scenario is given to demonstrate the estimated pandemic life cycle along with the real data or history to date, which in turn divulges the predicted inflection point and ending phase of SARS-CoV-2.

The proposed model monitors the dynamics of six compartments, namely susceptible (S), asymptomatic (A), recovered (R), infected (I), isolated infected (I_q) and quarantined susceptible (S_q), collectively expressed $SARII_qS_q$. A sensitivity analysis results reveal that achieving a reduction in the contact rate between uninfected and infected individuals by quarantined the susceptible individuals, can effectively reduce the basic reproduction number.

Elimination of ongoing SARS-CoV-2 pandemic is possible by combining the restrictive social distancing and contact tracing on how and when quarantine, isolation and precautionary measures are enforced.

E. B. G. Kodge (27 july 2020)

The coronavirus is showing its strength and spreading exponentially in all the corners of India. Due to this, India is moving under a pandemic situation and most of the states are badly suffering from it. The Maharashtra state in India is a highly infected state and has maximum number of COVID19 (Corona Virus Disease 2019) cases.

Therefore, this paper aims to study the current scenario of COVID19 cases in Maharashtra state using the geo-visualization techniques.

The paper deals with the district wise current situations showing through compiled maps of COVID19 cases and also presents the detailed ward wise map of COVID19 cases of Mumbai city which has the highest number of cases in Maharashtra state. This review briefly covers the introduction, current cases, recovered cases, deceased cases, predictions, supports and preventive measures taken by authorities, and some basic advices and suggestions; however these are subjected to change in due course of time as is the number of cases and mortality.

IV. RESULTS AND DISCUSSION

The study is based on secondary data published by Maharashtra Government from time to time. Weekly data on number of confirmed cases, recovery and Death occurred during a particular week were regressed on time. Exponential growth worked out fitting exponential trend. The following table presents the forecast based on quadratic response curve.

Table No.-1. Regression Analysis Regression Equation $Y=a.b^t$

Sr. No	Particulars	Intercept (a)	Coefficient Log(b)	R ²	Mean	CGR
1	Confirmed Cases	2.1502	0.1815	0.7873**	64230	51.85**
2	Recovery	1.1572	0.2369	0.8215**	51460	72.55**
3	Death	0.9822	0.1567	0.7479**	1732	14.33**

The results of the analysis confirms that the exponential trend fitted was sufficient to predict, the forecast on number of confirm cases during a week, patients recover and death as the coefficient of determination R² was significant at 1% level of significance as described by F value in ANOVA.

The compound growth rate on the weekly data were 51.85% for confirm cases, 72.55% for recovery, 14.33% for death as the coefficient of t is significant , growth rate also significant. The average number of confirm cases per week, were 64730, recovery 51460 and death 1732 , concluding severity in the state.

Subhas Khajanchi etal (28 June, 2020) in their study concluded that, due to non availability of specific vaccine or therapy, non pharmacological interventions are essentials.

Geethanjali. R etal 2020, the number of infected and diseased patients is increasing at an alarming rate.

Kodge 2020: Corona virus is spreading exponentially in all the corners of india.

Sunny kumar 2020: world is infected by COVID-19 virus which has created an emergency public health issue.

Above discussions conclude that, covid-19 is spreading exponentially and only time is the determinant factor in prediction, resulting in increase of confirm cases, recovery and death.

The table below presents the results of quadratic response curve fitted to the data. The quadratic response curve is especially used in optimizing the independent variable in prediction of Y. in view of it the time response was regressed on number of confirm cases, recover cases and death.

Table No.-2. Quadratic Response COVID-19 $Y=a+bt+ct^2$

Sr. No	Particulars	Intercept (a)	b	c	R ²	t opt
1	Confirmed Cases	6093.686	-4227.4*	666.84**	0.9643**	3.169
2	Recovery	17036.55**	-8223.95**	792.0976**	0.979087**	5.192
3	Death	-433.15	124.45*	5.054*	0.949	12.32

*→Significant at 5% level of significance.

**→ Significant at 1% level of significance.

The values presented are described below. The intercept was positive in no. of confirmed cases and recovery while it was negative for number of deaths occurred. The coefficient b was negative for confirm cases and recovery, while it was positive for deaths. The significance concludes the best fit of quadratic response. The coefficient of determination for all the 3 variable ranges between 0.9490 to 0.9790. the optimum values in number of days were 3,5, and 12. Concluding the response curve decline in the beginning while exhibited consistent increase after the optimum number of days.

Subhas Khajanchi Etal (28 June, 2020) reported interventions like social distancing, minimum exposure to the outside environment, diet regularization should be followed till vaccine is available in market.

Geethanjali R Etal 2020 reported the spread of COVID-19 needs to be viewed seriously to control the spread.

Kodge 2020 opined exponential raise of COVID19 needs to be checked by pharmacological and non pharmacological means.

Sunny Kumar 2020 infection by COVID -19 is alarming for the world in the interest of public health.

Above discussions conclude that, above 95% contribution is explained by time on determining confirm cases, recovery and deaths. Hence appropriate measures need to be chalked out jointly by technicians, bureaucrats, social workers, in the interest of individual's health.

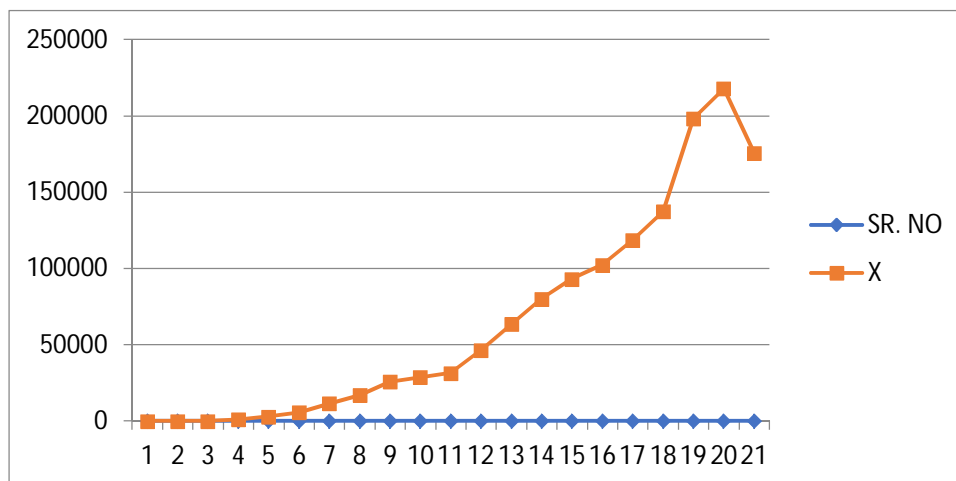
The following table presents the forecast based on quadratic response fitted to the data with time as individual variable. The responses were worked out for 25th week (15-9-2020) 30th week (20-10-20) 35th week (30 Nov, 2020) 40th week (7th Jan, 2021).

Table No. 3 Weekly forecast

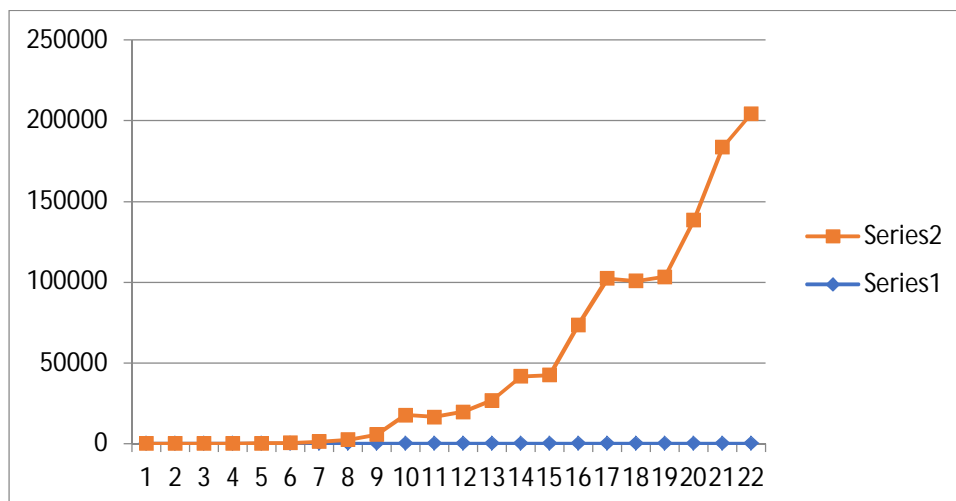
Sr. No	Week	Confirm	Recovery	Death
1	25 th	13171809	1306498	5836
2	30 th	1479423	1432059	7836
3	35 th	1675082	1651780	10113
4	40 th	1903934	1855434	12630

On going through the table, it is confirmed that COVID spread will not be under control during 2020. The expected number of confirm cases by end of Nov 2020 will be 16,75,082. However, recovery rate will be substantially higher. Concluding that the COVID -19 disease attack will be continued more than 2 months. i.e. beyond 40th week ending on 7th January 2021, and expecting decline thereafter by mid of January 2021 . These facts are about confirm by the graphs presented.

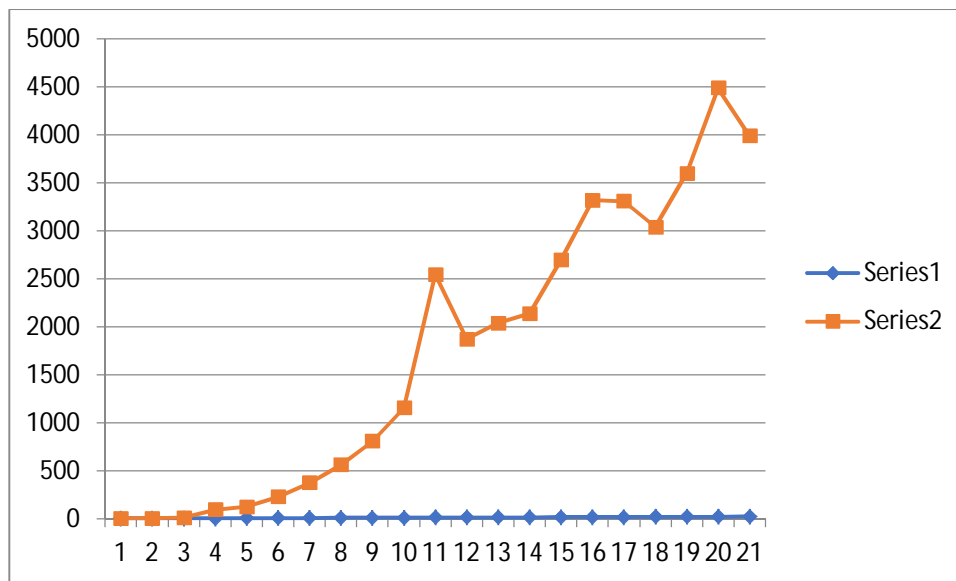
A. Confirmed Cases



B. Recovered Cases



C. Death



V. CONCLUSION

- A. Covid-19 is spreading exponentially and only time is the determinant factor in prediction resulting in increase of confirm cases, recovery and death.
- B. Above 95% contribution is explained by time on determining confirm cases, recovery and deaths. Hence appropriate measures need to be chalked out jointly by technicians, bureaucrats, social workers, in the interest of individual's health.
- C. COVID -19 disease attack will be continued more than 2 months. i.e. beyond 40th week ending on 7th Jan 2021, and expecting decline thereafter by mid of Jan. These facts are confirm by the graphs presented.

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