# Predicting Cases in India using Machine Learning: COVID-19

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***Abstract*—COVID-19, a virus that is said to have originated in Wuhan, China, has a genuine effect on almost the entire world's population. The Health Organization (WHO) has called it a global pandemic due to the complications that this particular healthepidemic has created all over the world. Because of continual alterations in the virus's genetic components, the pandemic has returned in numerous waves. Here, we are detecting the COVID-19 cases, i.e., confirmed, death, and cured cases in India only. We are performing this analysis based on the cases occurring in different states of India in chronological dates. On this dataset, first, we performed data cleansing and feature selection, then performed forecasting of all classes using linear regression model and support vector machine, where support vector machine model outperformed the other, therefore, the linear regression model is used for prediction and analysis of all the results. The predicted value of the model is compared with actual result to find the accuracy.**

***Index Terms*—COVID-19, Masking, Pandemic Waves, SARS-CoV2, Vaccination.**

## I. INTRODUCTION

The Coronavirus pandemic has resulted in a shocking loss of human life around the world, bringing general health, food systems, and the world of work to the ultimate test. According to a study published by the World Health Organization (WHO) on May 11th, 2022, the latest Coronavirus outbreak has infected more than 518,480,076 killed over 6,280,287 people in more than 200 countries worldwide [14].

India remains the world's second-worst-affected region, with 14th-worst-hit countries by current reports [12]. According to the Union Ministry of Health, approximately 1.9billion Covid-19 vaccine doses have been administered.

Everyone is affected by the sickness since it is spreading so quickly and widely. Scientists have warned everyone, including ministers that the third wave of coronavirus may have already emerged and begun in Britain, England, resulting in three weeks of restriction and lockdown.

Noting that the third wave of COVID-19 has ended in India, eminent virologist Dr T Jacob John said he is “fairly confident" that no fourth wave will occur in the country unless an unexpected variant that behaves differently comes up. [1]

The third wave of COVID-19 had plateaued in India and the number of cases started declining after January 21 when 3, 47,254 infections were reported. John, the former director of the Indian Council for Medical Research’s Centre of Advanced Research in Virology, said it can be confidently concluded that the third wave has ended and the country has entered an endemic phase once again.

“I say (entered endemic phase) since my own definition of an endemic state is ‘low and steady daily numbers, with only minor fluctuations, if any, for at least four weeks’. My personal expectation, hence opinion, is that we will be in the endemic phase for more than four weeks. All states in India show the same trend, giving me this confidence," he told PTI. [1]

Not One Death Less or One Death More': Delhi Govt Defends Covid Fatality Figures After WHO Claim. The ‘endemic stage’ is when a population learns to live with a virus. It is different from the ‘epidemic stage’ when the virus overwhelms a population.

Asked about various virologists and others predicting that there would be no third wave, John explained the third wave was driven by Omicron and no one had predicted something like this to emerge, and that assumption that ‘no third wave would come’ was based on the variants present at that time. “Unless an unexpected variant that behavesdifferently from

alpha, beta, gamma or Omicron comes, there would be no fourth wave," he said.

## II. OVERVIEW OF COVID-19

One clear concern is that the international bodies formed in the post - War Period refused to fulfil their prescribed duty to defend humanity. And as late as January 30, 2020, the Director-General of the World Health Organization (WHO) claimed categorically that a clinical emergency occurred. However, he claimed that he was opposed to trade or travel limits on flights from Wuhan and other Chinese cities to the rest of the planet. The best way to avoid a replay is for the world to perform a comprehensive and unbiased international inquiry into the medical causes of COVID-19 and, as a result, the reasons for its rapid spread [9].

Besides the previous two World Wars, this time the fight is with an unknown adversary who can strike at any time and from anywhere. In Walt Kelly's strip commemorating the observance of the primary Earth Day's concept of the environmental situation on April 22, 1970, Pogo the possum opined, "We have encountered the enemy, and he's us."

Half a century later, the idea is much more important in the ongoing conflict, because it is we, the people of the earth, who are to blame for the COVID-19's rise and global spread. As a result, it is up to us to cooperate in order to find a solution, even though we must do so while wearing masks and going about our daily lives for the near future. “The virus, now known as SARS-CoV-2, first emerged in Wuhan, middle China, in December 2019, sparking the worst infectious disease epidemic since the 1918-1919 flu pandemic.

Our investigations concluded that the outbreak was unquestionably caused by an animal. It most definitely came from bats and found its way to people from an unseen go-between creature in an unknown location. Pandemics have historically been sparked by such "zoonotic" infections. However, we are also attempting to validate the precise sequence of events that lead to the latest pandemic. To date, no SARS-CoV-2 has been detected in bats in the Hubei region or in wild life around China,” said a WHO team member.

The beta corona virus, which causes MERS-CoV and SARS, is a bat-borne virus. Civets mediated the virus's spread to cave-dwelling horseshoe bats in Yunnan province, according to Chinese scientists. A virus that induced extreme respiratory distress syndrome caused 8,098 cases in southern China between November 2002 and July 2003, with 774 deaths recorded in 17 countries (9.6% fatality rate), with the majority of cases in mainland China and Hong Kong . Since 2004, there have been no reports of severe acute respiratory syndrome (SARS) recorded worldwide. As a result, respiratory disease and COVID-19 outbreaks were first discovered in China. The corona viruses HCoV-229E, -NL63, -OC43, and -HKU1 occur in the human population on a daily basis, causing respiratory infections in adults and children all over the world.

Coronavirus 2 (SARS-CoV-2) is the third coronavirus to cause a pandemic in humans in the last 20 years. This term is often used in this paper because of its similarities to the SARS-CoV virus, which caused the natural catastrophe in 2003 and is now known as "SARS-CoV-1."

Coronaviruses are a type of single-stranded RNA virus that affects humans. They are one of the most common viruses. SARS-CoV-2 is the seventh coronavirus to infect humans; SARS-CoV-1, MERS-COV, and SARS-CoV-2 are also extremely infectious [8].

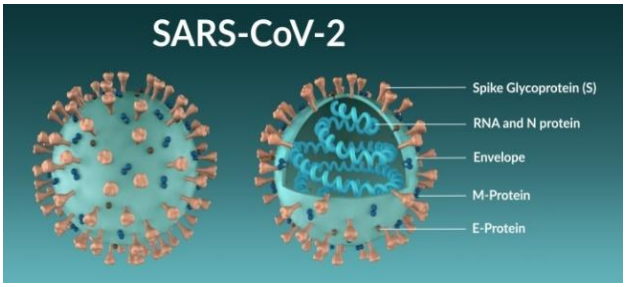



*Fig 1: Structure of SARS-CoV-2* [27]

SARS-CoV-2 is an RNA virus. Its SARS is fibre RNA. The polarity of this virus is positive-sense ((+) ssRNA). RNA viruses have terribly high mutation rates. This can be one reason why it's tough to form effective vaccines to stop diseases caused by RNA viruses [10].

## III. FIRST THREE WAVES EFFECTS

The majority of published data show that children with covid-19 infection are typically asymptomatic or slightly symptomatic, and that mortality from multisystem inflammatory syndrome (MIS-C), which is linked to covid-19 infection, is very rare [13].

On March 25, 2020, the federal government ordered a national lockdown during the first wave. The outcome indicated a well-managed infection rate, and the Indian strategy was praised across the world. Despite the fact that some European nations implemented lockdown in various forms, there appears to be a lack of cooperation between multiple health organizations and the government in India in the second wave [7].

Because of the COVID-19 epidemic, everything came to a halt in 2020. Schools and colleges were closed, isolating children from their teachers and friends; healthcare workers provided services in threatening environments; daily wage workers were thrown into precarious employment situations; an increase in domestic violence and child marriage cases; an economic blow resulting in an incalculable recession and an increased level of mental health crisis [6].

Coronavirus cases in India began to rise again in the first week of March, about six months after the first wave peaked in September 2020, signaling the advent of the second wave of the pandemic in the country [18].

The ICMR DG concluded that there is no significant difference in the way different age groups have been affected by Covid-19 in the first and second waves, which hit India in 2020 and 2021, respectively [16].

According to Dr Balram Bhargava, director-general of the Indian Council of Medical Research (ICMR), the senior population remains more vulnerable in the second wave of Covid-19 this year, while the number of younger people testing positive for coronavirus has only increased somewhat [16].

"More than 70% of patients in both waves are over 40 years old, with a little greater number of younger patients," Dr. Bhargava said, citing a study of 1,885 second-wave patients and 7,600 first-wave patients. While the oxygen requirement in the second wave is larger, the ventilator requirement is not, according to Dr. Bhargava.

VK Paul is a member of the Aayog in charge of health. When comparing the ages of patients in the first and second waves, Paul stated that "basically there is no change." [16] Remdesivir, according to VK Paul, should only be used on hospitalized patients in moderate stages of sickness who are on oxygen, and not at home.

In a June 2021 study, the Lancet covid-19 Commission India Task Force discovered a 2.4% death rate among 2600 children under the age of ten who were hospitalized with covid-19. The majority of the youngsters who died had comorbidities (asthma, gastrointestinal conditions, diabetes, or neuro-disabilities). There is no indication that youngsters are more vulnerable to the delta form, according to studies conducted in India and elsewhere. According to the All India Institute of Medical Sciences (AIIMS), 55.7 percent of children aged 2 to 17 had signs of the virus in their blood samples, compared to 63.5 percent of adults [2].

The pattern of cases and hospitalization in the COVID-19 third wave in India differs from the prior two waves endemic. Why is that? The answer is a combination of factors, including natural infections in the last two years, adult vaccination (nearly 90% of the adult population has received at least one shot and 70% has received both shots, and the country has administered a total of 1.57 billion COVID-19 vaccine doses in one year), and the Omicron variant's high transmissibility but lower virulence. COVID-19 vaccines are quite effective in changing the outcome of infections, according to the statistics, and continue to protect people from severe sickness, hospitalization, and death. The current tidal wave is proof of this [4].

## IV. NEW VARIANT: OMICRON

On the basis of recommendations from WHO's Technical Advisory Group on Virus Evolution, WHO identified the variation B.1.1.529 as a variant of concern (VOC) on November 26, 2021. Omicron is the name given to the variation [23].

The Omicron variation is a highly divergent variety with a large number of mutations, including 26-32 in the spike protein, some of which are alarming and may be linked to immunological escape potential and increased transmissibility. Human infections with this strain have been documented in 63 countries across all six WHO regions as of December 9, 2021. As additional evidence becomes available, our current knowledge of the Omicron variety is likely to alter.

Because cases in South Africa are growing faster than projected and the variation has an unusual number of mutations, the worldwide response to Omicron has been swifter and more severe than for earlier variants. Scientists raced to determine if

Omicron will offer a larger challenge to vaccinations and medicines than its predecessors as soon as its genomic sequence was release. "It's really a new beast," says Richard J. Webby, an influenza expert at St. Jude Graduate School of Biomedical Sciences. "That has set off warning bells." [3].

The novel variant is 10% more toxic than the current Omicron BA2 subtype, according to the World Health Organization. On January 19, the UK saw its first XE case. According to BMC executive health officer Dr. MangalaGomare, Mumbai's XE patient arrived from South Africa on February 10. Prior to that, she had no previous travel experience.

228 of the 376 samples sequenced were from Mumbai, according to the BMC's 11th genome sequencing study. According to BMC additional commissioner Suresh Kakani, Omicron was detected in over 99 percent of these Mumbai patients.

"The Next Generation Genome Sequencing Lab at Kasturba Hospital of BMC and the National Institute of Virology in Pune analysed 376 samples of Covid-infected patients as part of the 11th batch. 230 of the patients are residents of the Mumbai metropolitan. As a result, the results of these 230 samples have been released "The press statement stated.

## V. SYMPTOMS OF OMICRON IN PATIENTS

Most symptoms of the Omicron variant differ from those of COVID-19. Doctors have described the symptoms on several times, and among them are slight fever, weariness, a "scratchy" throat, and "plenty of body aches." [26].

There have been no reports of loss of smell or taste, and some people have reported appetite loss, according to the UK's ZOE Symptoms Study app. The novel coronavirus variant Omicron has been found to be less likely to elicit characteristic COVID-19 symptoms [27].

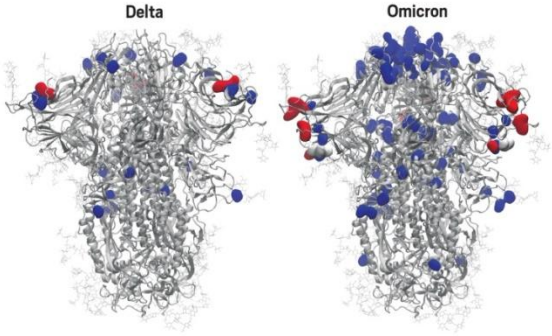



*Fig 2: Delta and omicron comparison* [10]

Dr Angelique Coetzee, Chairperson of the South African Medical Association, previously stated that the individuals identified with the Omicron had showed no evidence of loss of smell or taste. Furthermore, no incidences of a stuffy, blocked nose or a very high temperature have been reported among Omicron-infected individuals [27]. Professor Tim Spector, the director of the UK's ZOE Covid study app, also stated that symptoms such as fever, cough, and loss of smell are now considered "minorities." "The majority of folks don't have traditional symptoms," he says [27].

An RT-PCR test is the most accurate approach to establish whether you have the common cold, flu, or COVID-19 [27].

Professor Spector advises everyone experiencing cold symptoms to get tested for COVID-19 in order to prevent the virus from spreading further. It's also a good idea to stay at home until you figure out what's wrong. Self-quarantine is the next step in ensuring the safety of others around you [27].

The harsh winters have also increased the number of common cold cases in India. However, the concurrent surge in COVID-19 cases in the country might indicate that your cold symptoms are more serious than they appear [27].

## VI. VACCINATION FOR OMICRON

An early efficacy trial in Britain demonstrated that the Oxford-AstraZeneca vaccine exhibited no capacity to stop omicron infection six months after immunization [15]. This injection, known as Covishield, was given to 90% of India's vaccinated people; it was also widely used across much of Sub-Saharan Africa, where COVAX, the global COVID immunization programme, provided 67 million doses to 44 countries.

The Russian Sputnik vaccine, which is widely used in Africa and Latin America, will give equally low protection against omicron, according to researchers [15].

Unvaccinated patients are more likely to develop 'severe' symptoms than those who have been vaccinated, according to South African doctor Angelique Coetzee [27].

COVID-19 vaccinations, as far as we know, do not protect you against catching the virus, but doctors believe they can help you avoid serious infections [27]. Despite the fact that the extensively altered

Omicron version is thought to elude vaccination protection, it is the only option to avoid COVID-related problems.

"Booster, in my opinion, is a necessity. Your degree of protection declines after two doses of any immunization, especially after 3 to 6 months [24]. If you get a third dosage or a booster, your chances of getting a serious illness and being hospitalized decrease." said Director of ILBS Delhi, Dr. SK Sarin.

Dr Rajendra Rao, India's chief public health officer (CPCI), has stated that the number of illnesses associated to the Omicron version of Covid-19 in the country may be under control. If it exceeds the critical limit, there will be broad community transmission and a full-fledged third wave. The other hypothesis is a large number of spontaneous illnesses caused by the Delta variant during the second wave and a jump in vaccination coverage in the second half of the year [17].

Dr. Rao believes that, in addition to hybrid immunity, India may have an edge over South Africa, which has seen a significant increase in the number of Covid-19 cases due to the Omicron form. South Africa has a completely vaccinated population of 26% (32 % have had at least one shot), whereas India has a fully vaccinated population of 39.7% (60% with at least one dose). The combination of hybrid protection from the Delta variant with a whole-virion vaccination like Covaxin may result in a milder third wave in India.

According to early studies, COVID-19 vaccinations used in most countries provide minimal or no protection against the highly pathogenic Omicron form [25]. However, it was discovered that current vaccinations appeared to offer protection against severe Omicron disease [25].

While the Pfizer and Moderna vaccinations demonstrated some efficacy in preventing Omicron infections when supplemented with a third booster dose, these two mRNA vaccines are not widely accessible in most countries [25].

According to Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases and the US President's Chief Medical Advisor, new data show that COVID-19 booster shots offer protection against the Omicron variant and that there is no need to reformulate shots for variant-specific boosters at this time [25]. In terms of India, the nation has yet to contemplate legalizing booster vaccines. However, conversations over it are still going on [25].

## VII. PRECAUTIONS

Corona infection can take anywhere from 2 to 14 days to manifest third wave symptoms. Various advices are presented in this document to safeguard you from the third wave of Corona [1].

a. Put on a mask that covers your mouth and nose. When putting on and taking off your mask, make sure your hands are clean [19].
b. Maintain a physical gap of at least 1 meter between yourself and others.
c. Avoid crowded or poorly ventilated areas.
d. Increase interior ventilation by opening windows.
e. Hands should be washed often.
f. Cover your mouth with a cloth when coughing.
g. If your health is already compromised, you should stay at home.
h. Avoid lungs-weakening activities such as smoking.
i. Do not leave the house unless absolutely essential work.
j. Get immunized when it's your turn. COVID-19 vaccinations that have been authorized by the World Health Organization are both safe and effective [21].

The second wave of COVID-19 witnessed an increase within the variety of youngsters infected by the virus. Kids who were till then being thought of as silent carriers were equally at risk of the virus now and showed varied symptoms. Youngsters are infected the most throughout the third Covid-19 wave, but it is merely a claim with none solid piece of proof. The Indian Academy of medical specialty (IAP) has same that it is true that youngster's square measure extremely vulnerable to infection, but the third wave of COVID-19 is unlikely to predominantly have an effect on youngsters.

## VIII. EXPERIMENTAL DATA AND VISUALIZATION

The Johns Hopkins University Center for Systems Science and Engineering (JHU-CSSE) contributed the data, which includes three time series with the number of daily confirmed cases, recovered cases,

and deaths per country. This database is automatically updated every day.

We used data from 1 January 2022 to 31March2022 for this study. Initially, data pre-processing was almost challenging and much time was required because the dataset was not standard and many data cleaning processes were required. This part was done carefully and some appropriate data frames were prepared.

Following our exploration of the data, we used visualizations to gain a deeper understanding of the data and how the epidemic is affecting us all.

For example, in Figure 3, we can see the status of Active cases in the India.

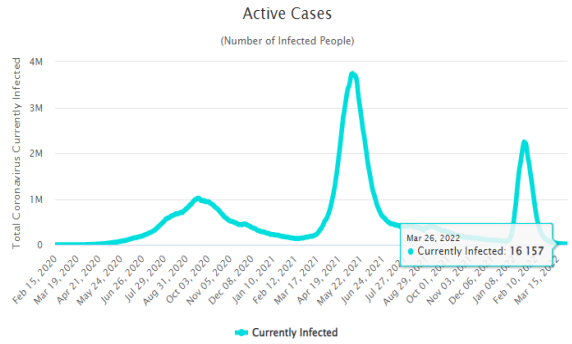
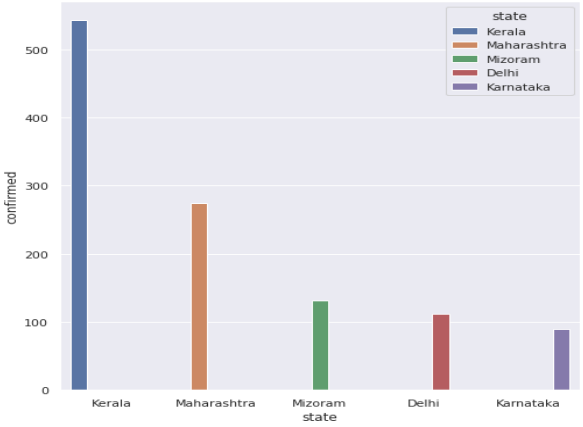



*Fig 3: Total Active COVID cases of India*

Also as an example, Figure 4 shows comparisons between the latest COVID-19 cases status of 5 most affected sates i.e., Kerala, Maharashtra, Mizoram, Delhi and Karnataka.

If we look more closely for individual state such as Maharashtra which has more number of death cases.



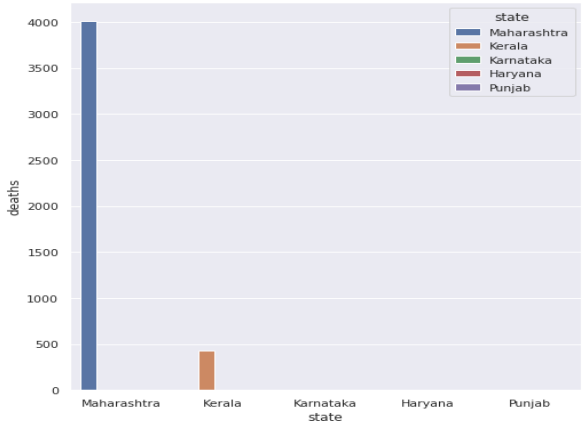




*Fig 4: Comparison between COVID cases: Confirmed cases and Deaths*

1. Even though the total number of confirmed cases and deaths in India are monotonically (almost exponentially) increasing, the recovery rate shows some increase whereas the mortality rate shows some decrease.

2. Although Maharashtra has shown the greatest rise in the number of confirmed cases and deaths, its death curve is flattening.

3. Between 5 most affected states, Active the greatest rise in the number of recovered cases, whereas Maharashtra shows very few recoveries.

After visualization, we investigated data modelling and prediction based on Univariate time series, using linear regression, Support vector machine

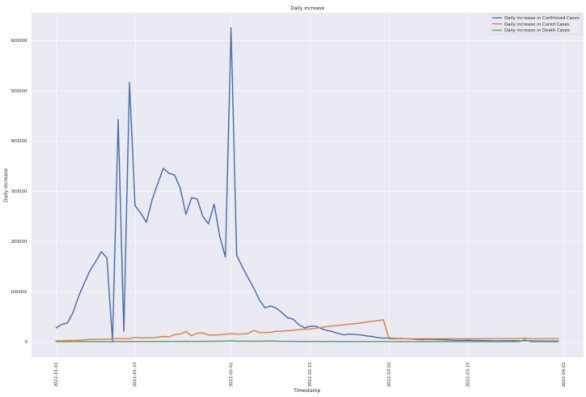


*Fig 5: Comparison of confirmed, death, active and cured cases of India*

### *A Prophet*

Prophet is a procedure for forecasting time series data based on an additive model where non-linear trends

are fit with yearly, weekly, and daily seasonality, plus holiday effects. It works best with time series that have strong seasonal effects and several seasons of historical data. Prophet is robust to missing data and shifts in the trend, and typically handles outliers well.

Prophet is open source software released by Facebook's Core Data Science team. It is available for download on CRAN and PyPI.

***Why Prophet?***

- ***Accurate and fast.***

Prophet is used in many applications across Facebook for producing reliable forecasts for planning and goal setting. It is found it to perform better than any other approach in the majority of cases. You should fit models in Stan so that you get forecasts in just a few seconds.

- ***Fully automatic.***

Get a reasonable forecast on messy data with no manual effort. Prophet is robust to outliers, missing data, and dramatic changes in your time series.

- ***Tuneable forecasts.***

The Prophet procedure includes many possibilities for users to tweak and adjust forecasts. You can use human-interpretable parameters to improve your forecast by adding your domain knowledge.

- ***Available in R or Python.***

Implemented the Prophet procedure in R and Python, but they share the same underlying Stan code for fitting. Use whatever language you're comfortable with to get forecasts

The input to prophet is always a data frame with two columns: **ds** and **y**. The **ds (date stamp )** column would be of a format expected by Pandas, ideally YYYY-MM-DD for a date or YYYY-DD-MM HH:MM:SS for a timestamp. The y column must be numeric and represents the measurement we wish to forecast.

### *B Forecasting in India*

The prophet uses an additive regression model. It uses a piecewise linear/logistic growth curve. It detects trends in the data points. Since the COVID data is of a few months, the package was only able to detect weekly trends. Yearly and monthly trends require data spanning over many months/years.

The weekly plot shows the number of cases to be quite high on Fridays. This is more likely to occur due to delay in reporting or data updating. The weekly fluctuation can indicate the process used for testing or reporting the cases. It does not show the likelihood of people becoming infected on a certain day. The predict method will assign each row in future a predicted value which it means **yhat**. Of you pass in historical dates. It will provide an in-sample fit.

- Confirmed cases

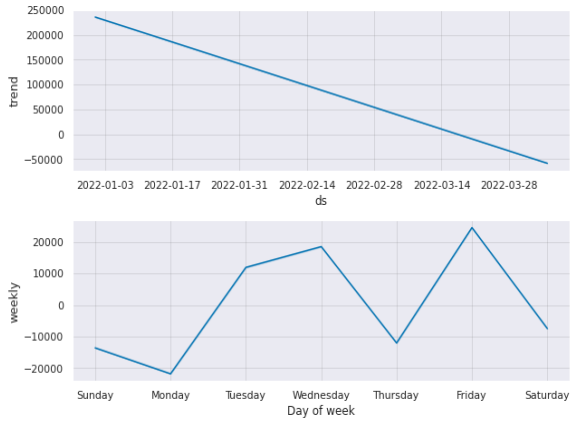



*Fig 6: The prediction as well as the weekly trend of confirmed cases*

In graph there is a hug dip in Monday which means there was a huge dip in number of cases in India that particular day.

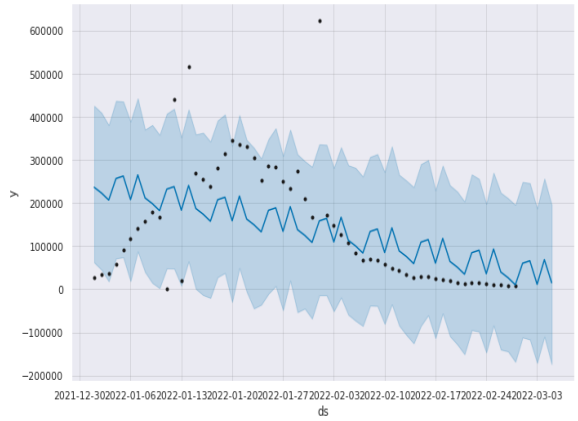



*Fig 7: Predicting the future with date and upper and lower lists of y values*

- Cured cases

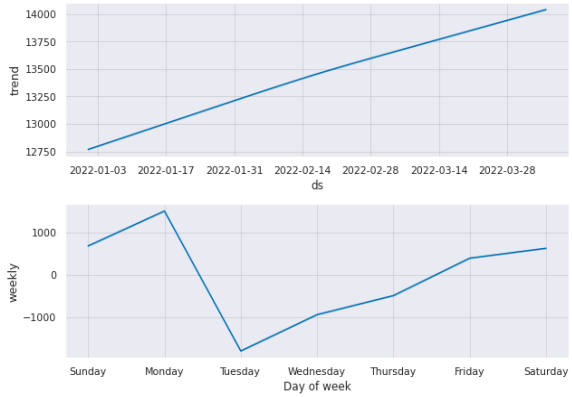



*Fig 8: The prediction as well as the weekly trend of cured cases*

In graph there is a hug dip in Tuesday which means there was a huge dip in number of cases in India that particular day.

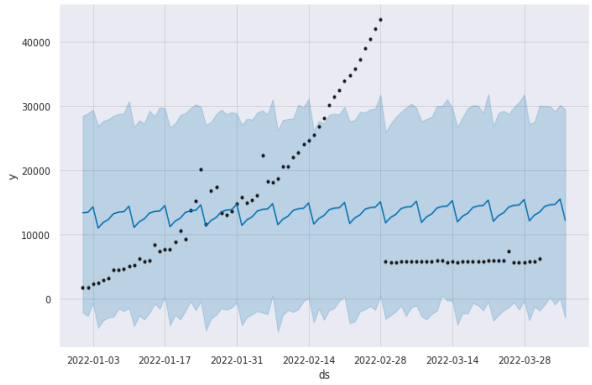



*Fig 9: Predicting the future with date and upper and lower lists of y values*

- Death cases

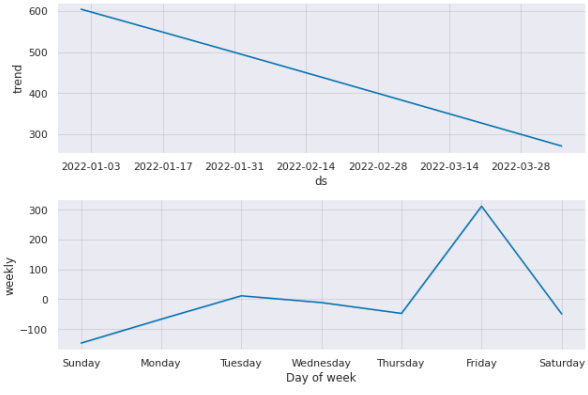



*Fig10: The prediction as well as the weekly trend of cured cases*

In graph there is a hug dip in Tuesday which means there was a huge dip in number of cases in India that particular day.

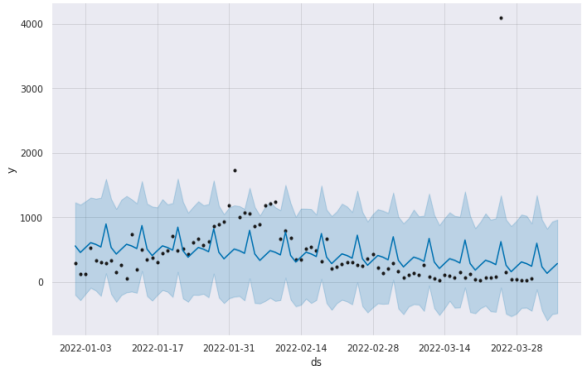



*Fig 11: Predicting the future with date and upper and lower lists of y values*

Looking at the graphs we can see that the confirmed, cured and death cases are decreasing and making the equilibrium graph.

## IX. RESULT

After using support vector machine and linear regression, we got negative answers for support vector model. But from linear regression we got accuracy above 98.0% which means that the predicted value is accurate from the actual value.

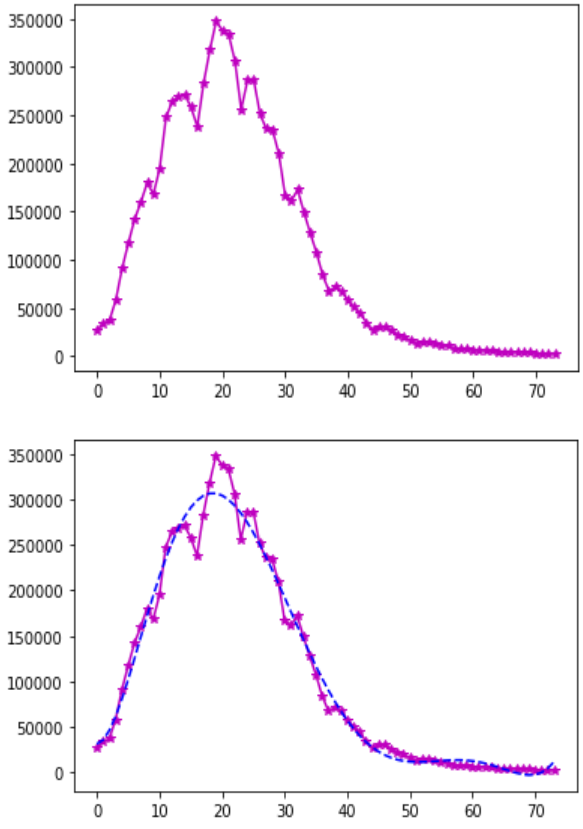


*Fig 12: Plotting the graph of confirmed cases for Covid cases forecasting*

| SN | Date | Prediction Confirmed Cases | Actual Confirmed Cases |
|---|---|---|---|
| 1 | 2022-04-01 | 1320 | 1260 |
| 2 | 2022-04-02 | 1034 | 1096 |
| 3 | 2022-04-03 | 846 | 913 |
| 4 | 2022-04-04 | 910 | 795 |
| 5 | 2022-04-04 | 1185 | 1086 |

*Table 1: Difference between the actual and predicted cases*

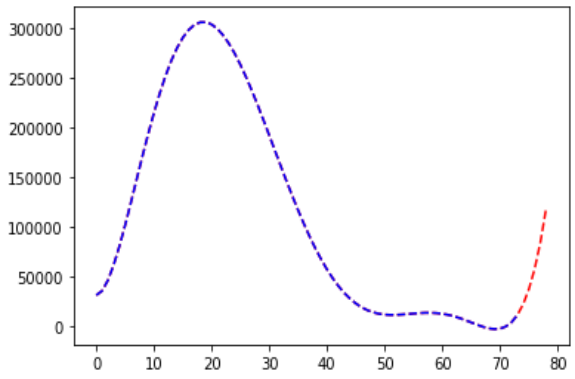



*Fig 13: Prediction of Covid cases for next 5 days*

## X. CONCLUSION

In this research, the JHU CSSE data is used to predict the Covid cases. By comparing the linear regression and SVM on the dataset different values were found one negative and positive. Therefore linear regression was considered for prediction.

Linear Regression's accuracy of 98.02% comparing both actual and predicted confirmed cases of India.

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