International Journal of Aquatic Science
ISSN: 2008-8019
Vol 12, Issue 03, 2021

Covid-19 Outbreak Prediction Through Prophet Base Model

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ABSTRACT: The covid-19 pandemic has caused a great health crisis, and which is the main challenge of human beings. The whole world is been fighting this pandemic. The rise of the coronavirus is being from Wuhan where we found the greatest number of patients. This epidemic disease of covid-19 has killed big number of groups around the globe. In this article, we've taken statistics from countries around the world and exposed the number of recovered, treated, and death cases. The fundamental goal of this article is to forecast the healthier, cured, and death cases with the assist of the prophet base model. The information has been gathered from 28 states of India and afterward compare the information with Wuhan and south Korea using machine learning and predicted the number of cases will come for coronavirus using the prophet basemodel.

KEYWORDS: COVID-19, Prophet, Machine Learning, Time Series, virus, India

1. INTRODUCTION

The novel covid-19 is been caused by millions of people. It has started in Wuhan, China in December 2019. It can be spread easily from person to person and this disease caused respiratory or cardiac problems and it mostly attacks a person which has a weak immune system or the person being in old age [1]. On 11 March 2020, the WHO announcedCOVID-19 to be a new pandemic. There are challenges to the disease, as it will demonstrate that after a long time, the infection will spread to the person who has contact with the bug. Vaccination has been reported for coronary artery virus and people are being vaccinated. Until now, no one has shown the side effects of the vaccine[2].

The transmission of coronary artery virus has occurred in three major stages [3]. The first stage is the local split. At this point, the root of the people who transmit the virus will easily be traced since the virus has spread to relatives or friends. The second stage of the disease is Community transmission where we cannot find out the source of spread and the virus spread in communities. The third stage of the virus is Large Scale Transmission where the virus spreadsin

the region or the country and here the source of the virus is difficult.
Due to the mass spread of the coronavirus worldwide, the government imposed a lockdown. On 24 March, Prime Minister Narendra Modi declared that the country will suffer a 21-day failure to fight the increase of the disease. Infections are rapidly rising in Italy, France, Germany, Spain, United Kingdom, and the United States. It has a massive impact on the global economy and stock markets. On 20 May 2020, 4996472 cases were registered, 1897466 cases rescued, 2328115 deaths recorded, and 2770891 active cases worldwide were established. Statistical information has been obtained from the Kaggle and the number of corona cases is from 30 January 2020 to 24 March2020.[4]
The vaccine has been discovered but the vaccine has been on a testing basis. The People of who are on front line workers such as doctor, police, and the minister has taken the coronavirus vaccine but there is no side effect of this vaccine in India till now[5]. In the studies, we have been analyzed that modeling, artificial intelligence plays important role in highlight the spread of the virus [6]. The coronavirus has been spread at a very large scale so predictive analysis has become the help for the fitness services and the administration to plan and control the spread of the virus [7]. Modeling and forecasting help us to detect the daily spread of the virus and we can able to number of patients so for this accurate forecasting is important. There was a diverse method for forecasting and predicting the virus they are ARIMA, SARIMA and Prophet base

The aim of this document we have been analyzed the coronavirus condition of India from 30 January 2020 to 24 March 2020. Then we compare the details with Wuhan and China and see which country has the highest number of incidents. In the beginning when there is a cumulative number of cases where the virus originated from the Wuhan. We also explore the worldwide data and see the conformed, cured, and recovered cases of every country, and with the help of the prophet base model, we have also predicted the forecast of the country and what will be the status of recovered, confirmed and death cases globally. From this article, we are also helping to analyze why PM Narendra Modi was only able to close the lockdown on 24 March 2020. The number of covid-19 cases has been limited from thislockdown

2. LITERATU REREVIEW

There are so many literature studies that focus to predict the coronavirus. The first case study depicts a statistical model base under the chronological Monte Carlo model be used to describe the early propagation rate of the virus by calculating the daily mean replication number Rt with varying parameters, such as the proportion of cases and the reported likelihood of the result. The probability of an epidemic can be improved if the transmission is homogeneous [9]. A mathematical model was derived based on the isolation and contact tracing to control the virus transmission. The interruption since the start of symptoms to isolation was determined which increases the probability of spread. There is uncertainty for knowing the symptom on the premature period and the testing threshold is less which increases the delay and thus, more people are likely to get affected [10]. New technology such as Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL), and Big Data can be used to find different hypotheses on various facets of the war against COVID-19. The main fields in which technology be able to apply include, for example, premature detection of illness, touch tracing, drug production, vaccination, forecasting possible probable events,etc.[11],[12].

The second case study about the K-Means clustering algorithm, which is an unsupervised machine learning algorithm, was used to cluster COVID-19 data with various variables and prediction principles. The model aims to analyze the countries that are impacted and are expected to be affected in the near upcoming [13]. A clustering technology was used to organize the rate of transmission of the disease in Singapore based on travel history inChina.
In the third case study [14], the authors carried out a forecasting validation analysis of models using COVID-19 day- level cases from the 10 most affected states in Brazil. According to the scientists, the Stacking Ensemble and the SVR have done better than the ARIMA, CUBIST, RIDGE, and RF models for the parameters adopted.
In [15], time-arrangement displaying is utilized to check the division of environment factors on the study of disease transmission of flu transmission in two warm-environment locales, Hong Kong and Maricopa Area (Arizona U.S), while Dominguez et al. [16], utilizing some other time-arrangement approach, intended to inspect the conduct of two pointers of flu movement nearby Barcelona to improve its identification rate. Concerning 19 determining, there has been a flood in logical work distributed through the majority current pair of months. Most of these examinations center around foreseeing Covid related measurements like dynamic cases and passing in China, where the infection initially showedup.
Everyday disease mortality and recuperation rates just as the development of the flare-up in the accompanying three weeks must be additionally anticipated by adjusting the boundaries of the SIRD model. Factual demonstrating was at the core of the methodology followed by IHME Coronavirus wellbeing administration use anticipating group, who expected the pull that would be brought about next to the epidemic in US wellbeing framework by assessing the quantities of medical clinic beds, ICU beds, and ventilators that would be required in the following four months just as the number ofpassing.

3. DESCRIPTION OF PROPHET BASE MODEL

It is a representation for forecasting model-based time series data where non- linear patterns are observed for early, weekly, and daily seasonality effects. It works best with time arrangements that have solid occasional impacts and a few periods of verifiable information. The prophet is open source programming delivered by Facebook's Core Data Science group. It is accessible for download on CRAN and PyPi.It is accurate and fast for giving the output. It is been used by many applications across Facebook for giving the accurate result of the forecast. It is a fit model where we get output in few seconds. Get a sensible estimate on muddled information with no manual exertion. Prophet is strong to anomalies, missing information, and emotional changes in your time arrangement. In this, we have executed the Prophet system in R and Python, yet they share a similar fundamental Stan code for fitting. This representation is used to intended for calculating the recovered and the cured cases of coronavirus. With the help of this model, we can able to predict how many amounts of cases would become in the future or how many amounts of people can be cured or been recovered in the future. This model is useful for the prediction of the coronavirus and people should be aware of it[17].

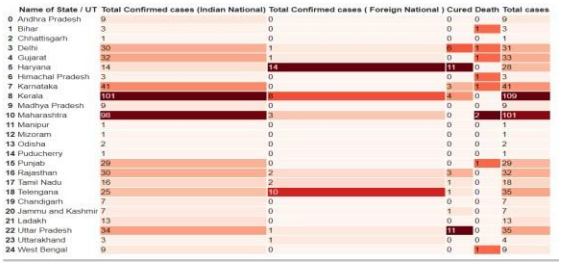
4. COVID-19 Data: Deaths, Confirmed,Recovered

In India, the first case of covid-19 was reported on 30th January 2020 when one student arrived at Kerela from Wuhan, China. After that two more cases have arrived on Kerela. Then after that on 2nd March 2020 five new cases were affecting in covid-19 once that it is affecting in the25 states and Bihar and Manipur have the highest corona patients.

International Journal of Aquatic Science
ISSN: 2008-8019
Vol 12, Issue 03, 2021

Figure1 depicts the coronavirus status in India states and union territory till 22 march.

a. Manipur and Mizoram reports have their firstcase.
b. Kerela has surpassed Maharashtra in terms of the largest number of confirmed cases.
c. Haryana and Telangana have the highest count of confirmed Foreign Nationalcount.
d. Till the 25th of March 9 people have died in India (Kerala, Maharashtra, and Karnataka)are currently top 3 states with the maximum number of confirmed cases.



	Name of State / UT	Total Confirmed cases (Indian National)	Total Confirmed cases (Foreign National)	Cured	Death	Total cases
0	Andhra Pradesh	9	0	0	0	9
1	Bihar	3	0	0	1	3
2	Chhattisgarh	1	0	0	0	1
3	Delhi	30	1	6	1	31
4	Gujarat	32	1	0	1	33
5	Haryana	14	14	11	0	28
6	Himachal Pradesh	3	0	0	1	3
7	Karnataka	41	0	3	1	41
8	Kerala	101	8	4	0	109
9	Madhya Pradesh	9	0	0	0	9
10	Maharashtra	98	3	0	2	101
11	Manipur	1	0	0	0	1
12	Mizoram	1	0	0	0	1
13	Odisha	2	0	0	0	2
14	Puducherry	1	0	0	0	1
15	Punjab	29	0	0	1	29
16	Rajasthan	30	2	3	0	32
17	Tamil Nadu	16	2	1	0	18
18	Telengana	25	10	1	0	35
19	Chandigarh	7	0	0	0	7
20	Jammu and Kashmir	7	0	1	0	7
21	Ladakh	13	0	0	0	13
22	Uttar Pradesh	34	1	11	0	35
23	Uttarakhand	3	1	0	0	4
24	West Bengal	9	0	0	1	9

FIGURE 1: CORONA VIRUS STATUS IN INDIA AND UNION TERRITORY

Infigure2the‘pink’linedepictsthetotal number of cases till 22 march and green line depicts the recovered cases till now. Uttar Pradesh and Haryana have a greater number of recovered cases and Kerala and Maharashtra have more number of confirmedcases.

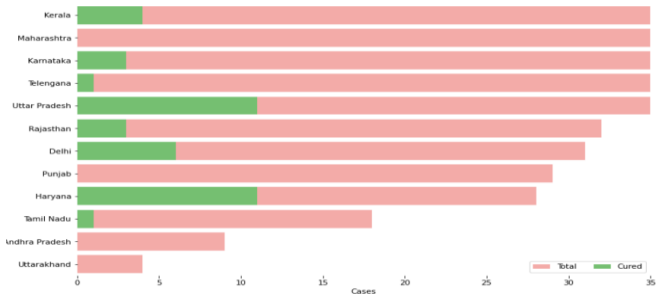
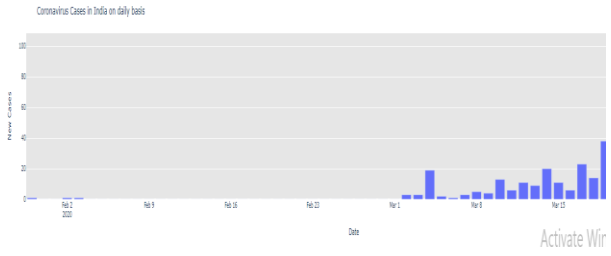


FIGURE 2: CONFIRMED VD CURED CASES IN INDIA

The figure 3 depicts the per day cases of India till 22 march where in the February we have two cases of corona virus and in the march, we have maximum number of cases where we have 103 cases in India.

5. COVID-19DATASET



International Journal of Aquatic Science
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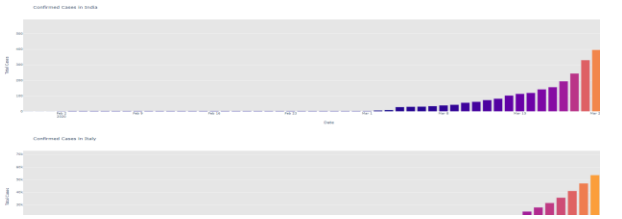
FIGURE 3 : PER DAY CASES IN INDIA

The figure 4 we have compared we have compare the corona virus cases in India and Italy. Till 25 March 2020 the Italy have more number of cases then India.



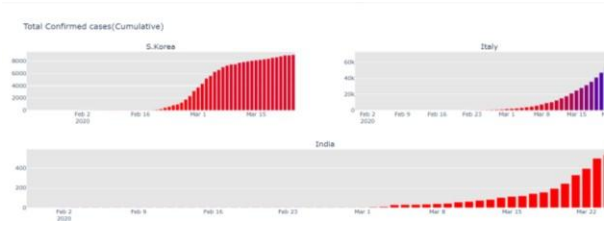


FIGURE 5 : COMPARISON BETWEEN THE RISE OF CASES IN INDIA, ITALY AND SOUTHKOREA METHODOLOGY

The projected method has six steps which is been mentioned below:

i. Collection
ii. Cleaning
iii. Visualization
iv. Build Model
v. Train Model
vi. Forecasting

The dataset that has been used for learning that has an Indian total no of cured , confirmed and improved cases and it also have achina dataset and South Korea and has been compare to the dataset of India .It also have the world wide datasets of globe which is also affected during the virus. The time of data is from January 30, 2020 to March 25, 2020. This time series data is collected fromKaggle.

A . DATA PROCESSING

This gathered data was subject to different pre-processing steps, making it more practical.

Data is pre unrelated value that are analyzed by deleting missing values.

B. ALGORITHM ESTIMATION

Machine Learning predictive analysis algorithms are works that train historical data and are examples of deep learning, linear regression etc. [17]. According to dataset features, these algorithms pick the most fitting model and predict future performance. For global epidemic results, the research related similar activities to the COVID-19forecast.
There are versions with different time series forecasting such as ARIMA, SARIMA, GARCH, Dynamic linear model, TBATS, Prophet, LSTM. We have tested a famous known FB-Prophet Open-Source framework which was introduced in 2017 prediction through an additive Model in which we use the time series.
Nonlinear trends of the Fb-Prophet are identified with regular, weekly and annual seasonality, effect [16]. This matches well with historical data from information from numerous seasons and strong seasonal effects, and with minimal manual participation, it is entirely automated. In addition to future forecasts, a well- derived Prophet model helps to spot anomalies and fill holes in missing values.

For saturating predictions, Prophet utilizes two approaches.

1. Forecasting Growth 2.SaturatingMinimum

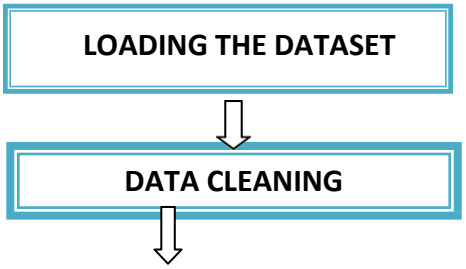
Most researchers prefer either time series models (i.e. ARIMA) or SEIR models to perform epidemic forecasting. A nonlinear time series model of three components such as seasonality, pattern and holidays is included in thispaper.

$y(t) = g(t) + s(t) + h(t) + e_t$; where

$g(t)$: stepwise linear or logistic growth curve for modeling of nonperiodic changes in timeseries.
$s(t)$: seasonal changes, $h(t)$: effects of holidays with irregular schedules
et: error term

C.ANALYSIS AND OUTBREAK PREDICTION

The method shown in Figure6 is used to research and estimate the number of COVID-19 patients in India and to equate this information with data from around the world. The data will be obtained from Kaggle for the period from 30 January 2020 until 24 March 2020. This dataset contains statistics on the number of infected cases, recovery, and periodic deaths. It has 38,107 row and a total of 10 column. These are the columns in the dataset.



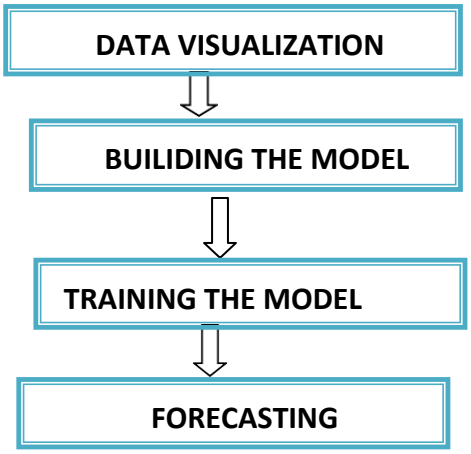


FIGURE 6 - WORK OF ANALYSIS AND FORECASTING

We have analyzed in the paper that how that coronavirus has been spread in the India and how India got the first case in Kerala and then compared the information with Italy, Wuhan and south Korea. With the help of the prophet base model has also analyze why the PM Narendra Das Modi has put the lockdown on 24 march 2020.We have predicted the forecast early of the confirmed and the recovered cases we will got after next 7 days with the help of the prophet base model.

6. RESULTS AND DISCUSSION

The plan of the representation is to predict the corona virus in the up coming years by the help of fast and accurate model that is prophet base model. It has predicted the confirmed case as well as the recovered case of corona virus and depict which day or the date have maximum number of cases or which day most number of cases have been recovered.
For predicting the recovered, death and cured cases we will import prophet in the ROM.. In the prophet model we have two columns that is ds and y where ds is the date stamp column [YYY-MM-DD] and y is the numeric measurement which we need to forecast.

```
from fbprophet import Prophet

confirmed = df.groupby('Date').sum()['Confirmed'].reset_index()
deaths = df.groupby('Date').sum()['Deaths'].reset_index()
recovered = df.groupby('Date').sum()['Recovered'].reset_index()
```

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FORECASTING CONFIRMED CASES WORLDWIDE WITH THE HELP OF PROPHET BASEMODEL

```
confirmed.columns = ['ds','y']
#confirmed['ds'] = confirmed['ds'].dt.date
confirmed['ds'] = pd.to_datetime(confirmed['ds'])
```

```
confirmed.tail()
```

	ds	y
57	2020-03-19	242708.0
58	2020-03-20	272166.0
59	2020-03-21	304524.0
60	2020-03-22	335955.0
61	2020-03-23	336004.0

In the prophet we have taken the two values that are ds and y which we have taken for the confirmed datasets. We have chosen to show the tail where we are getting bottom five values of March 19 to 23 March 2020 and y shows the values. We will now generate the forecast for the week with the help of prophet base model and now predict the forecast of confirmed cases after 23 March2020.

```
m = Prophet(interval_width=0.95)
m.fit(confirmed)
future = m.make_future_dataframe(periods=7)
future.tail()
```

OUTPUT

	ds
64	2020-03-26
65	2020-03-27
66	2020-03-28
67	2020-03-29
68	2020-03-30

We will now generate the forecast for the week with the help of prophet base model and now predict the forecast of confirmed cases after 23 March 2020.It will predict the forecast of the upcoming week. The interval width can be in decimal or in percentage and it shows 0.95 that means the forecast of the confirmed cases will be 95 per cent accurate and 0.05 per cent inaccurate. So the output we have obtained is the bottom values of the dataset because we want the latest value should be forecasted.The timestamp is from 26 March 2020 to 30 March 2020.

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PREDICTING THE RANGE OF FORECAST

```
#predicting the future with date, and upper and lower limit of y value
forecast = m.predict(future)
forecast[['ds', 'yhat', 'yhat_lower', 'yhat_upper']].tail()
```

	ds	yhat	yhat_lower	yhat_upper
64	2020-03-26	355136.872975	334528.065132	375783.318057
65	2020-03-27	372235.326938	352255.379470	393445.643369
66	2020-03-28	388674.964143	365576.776644	409082.412328
67	2020-03-29	405307.954675	383048.982510	427881.817197
68	2020-03-30	418529.648466	395248.266367	439566.860005

In this forecast we have predicted the range with the help of y_hat from 26 March 2020 to 30 March 2020. y_hat is the predicted values and yhat_lower depicts low the predicted number can go and yhat_upper depicts high the predicted number can go. The tolerance lies between yhat_lower toyhat_upper.

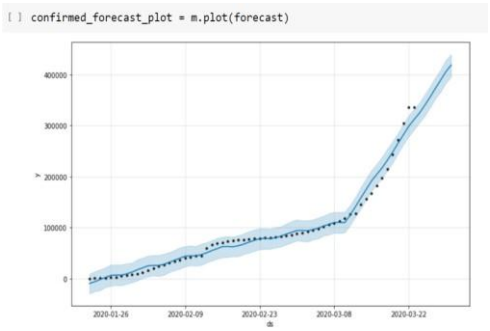

FIGURE-8 : PLOT THE FORECAST OF CONFIRMED CASES

In figure 8 we have forecst the graph of confirmed cases and the graph goes beyond 24 March 2020. We have forecast the graph with the hep of forecast_plot method.

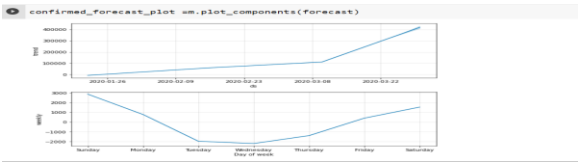

FIGURE-9 : WEEKLY FORECAST OF CONFIRMED CASES

It predicted the weekly forecast .In the figure9 it is been seen there is huge dig in Wednesday of the China in thenumber of cases.On Tuesday in India there was junta curfew on 22 march 2020 and then from 24 March there was complete lockdown in the entire country.The method helped to normalize thecrowd.

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FORECASTING DEATHS CASES USING PROPHET BASE MODEL

```
[ ] deaths.columns = ['ds','y']
    deaths['ds'] = pd.to_datetime(deaths['ds'])
```

```
[ ] m = Prophet(interval_width=0.95)
    m.fit(deaths)
    future = m.make_future_dataframe(periods=7)
    future.tail()
```

```
m = Prophet(interval_width=0.95)
m.fit(deaths)
future = m.make_future_dataframe(periods=7)
future.tail()
```

```
INFO:fbprophet:Disabling yearly seasonality. Run prophet with yearly_seasonality=True to override this.
INFO:fbprophet:Disabling daily seasonality. Run prophet with daily_seasonality=True to override this.
```

	ds
64	2020-03-26
65	2020-03-27
66	2020-03-28
67	2020-03-29
68	2020-03-30

This is tail of bottom five death values and the time stamp is from 26 March to 30 March 2020.

```
[ ] forecast = m.predict(future)
    forecast[['ds', 'yhat', 'yhat_lower', 'yhat_
```

	ds	yhat	yhat_lower	yhat_upper
64	2020-03-26	15411.877522	14506.669158	16322.757255
65	2020-03-27	16199.617603	15187.307521	17260.231237
66	2020-03-28	17006.904589	16003.567990	17949.461483
67	2020-03-29	17831.505383	16830.760736	18853.197424
68	2020-03-30	18490.986176	17395.392854	19622.449331

```
deaths_forecast_plot = m.plot(forecast)
```

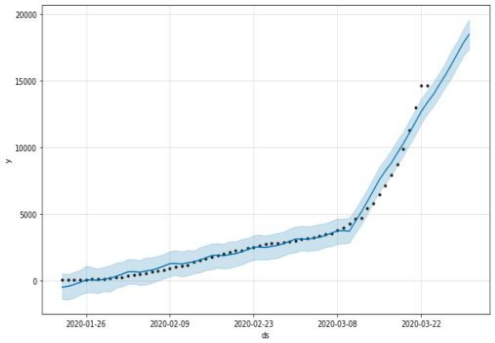

FIGURE-10 : ACTUAL AND PREDICTED VALUE OF DEATH CASE

In figure 10 the back dot represent the original values and the blue line also represent the

forecast values.In the beginning these two lines are coinciding with each other.

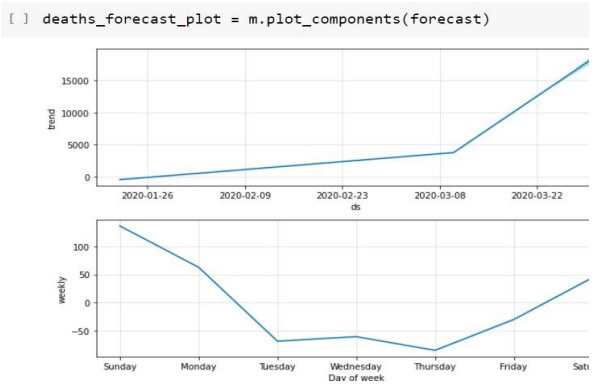

FIGURE-11 : WEEKLY PREDICTED DEATH CASES

From the figure11 , the number of death is been decreased in Tuesday because the number of confirmed cases is predicted to come down in between those three days.These graph are consistent with each other.Tuesday , Wednesday and Thursday it is predicted there is no cases and in the Saturday the graph isrising.

FORECASTING RECOVERED CASES USING PROPHET BASE MODEL

```
recovered.columns = ['ds','y']
recovered['ds'] = pd.to_datetime(recovered['ds'])
```

```
m = Prophet(interval_width=0.95)
m.fit(recovered)
future = m.make_future_dataframe(periods=7)
future.tail()
```

```
INFO:fbprophet:Disabling yearly seasonality. Run prophet with yearly_seasonality=True to override this.
INFO:fbprophet:Disabling daily seasonality. Run prophet with daily_seasonality=True to override this.
```

	ds
64	2020-03-26
65	2020-03-27
66	2020-03-28
67	2020-03-29
68	2020-03-30

This is tail of bottom five recovered values and the timestamp is from 26 March to 30 March2020.

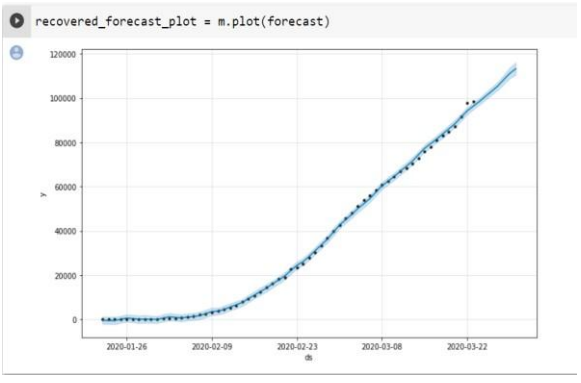

FIGURE-12 : GRAPH OF ACTUAL AND PREDICTED CASES

In figure 12 the back dot represents the original values and the blue line also represent the forecast values.In the beginning these two lines are coinciding with each other.The predicted and the actual cases have been coinciding with each other.The actual increase of the predicted and the actual cases is having amazing cohesiveness.

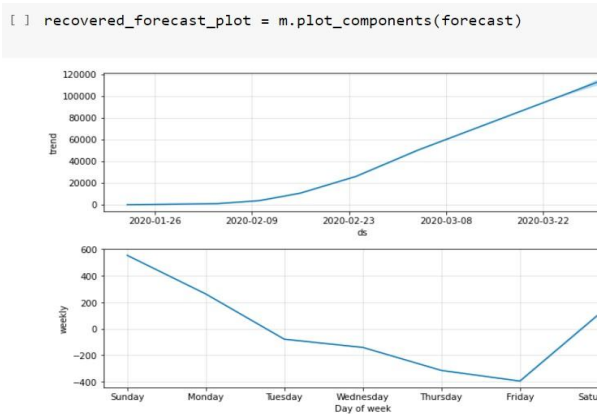

FIGURE13 : WEEKLY RECOVOVERED CASES FROM 26 MARCH 2020 TO 30 MARCH 2020

From the figure 13 we can see Sunday and Monday have the most number of recovered cases and Tuesday, Wednesday and Thursday and Friday it has a hit rock bottom as predicted by the model we have no case in the three days and the recovered cases rises in theSaturday.

7. FUTURE WORK

The World Health Organisation has been stated a pandemic by COVID-19 and has affected many countries and poses a significant threat to human's race. In this article, we outlined the forecast of the Covid-19 epidemic with the help of the Prophet Base Model. We also gathered data from the states of India and compared the data with the countries of the world. As we note, Wuhan has the highest number of beginning events. So, we've also compared India's Covid-19 cases with Wuhan, Italy, and South Korea. There are different time series models, but we have selected them. Prophet's simple model, which is precise and fast and provides the most reliable prediction of death, recovered and healed cases ofcovid-19.

The pattern research indicates dramatic increases in contaminated patients, and the forecast report shows a large increase in predicted active, recovered, and fatal cases worldwide. Lockdowns and containment policies, however, can affect the outcomes of forecasts. The adopted models have worked well, but our research limits the usefulness of the models, which can be further increased by using a set of several prediction models. The findings obtained can be further enhanced by considering different factors such as population density, temperature, health environment, medical background, etc. using deep learning techniques and artificialintelligence.

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