Prediction and analysis of COVID-19 outbreak in India
State-level forecast

Gaurav

B.Tech. Cluster Innovation Centre
Delhi University

May 24, 2020

DELHI UNIVERSITY

Introduction

- Major states above 3000 infected cases were taken for prediction.
- Data is collected from *covid19india.org* website along with the data of the whole country.
- Susceptible infected recovered (SIR) model is used for the prediction of cases, which gives the final epidemic size of Infected cases in each state.
- MATLAB open source code is used to graphically plot the cases and predictions of India and its states.
- The geographical map shows the distribution of confirmed cases in INDIA among different state with colour as quantitative scale.
- The bar graph show the selected states which are above 2000 of infected cases named as highly infected states.

Total Cases

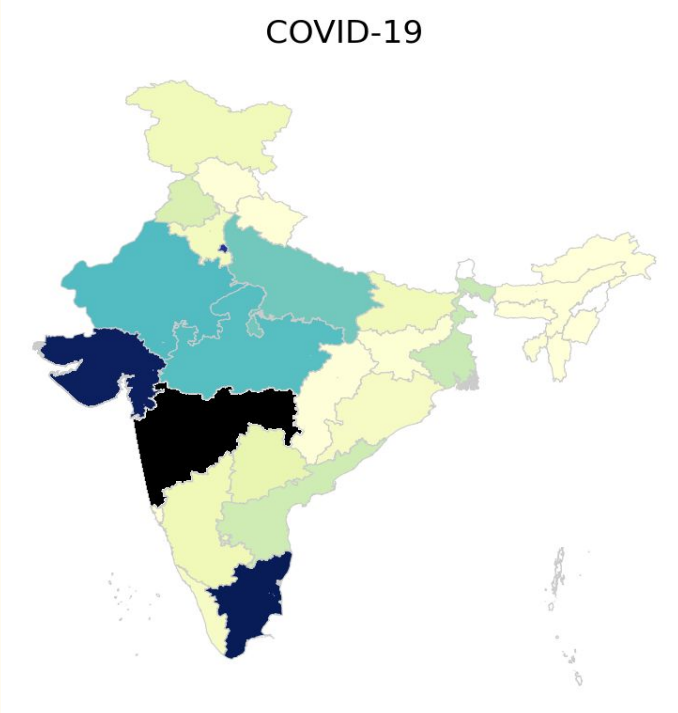

Figure: Distribution of confirmed cases in INDIA

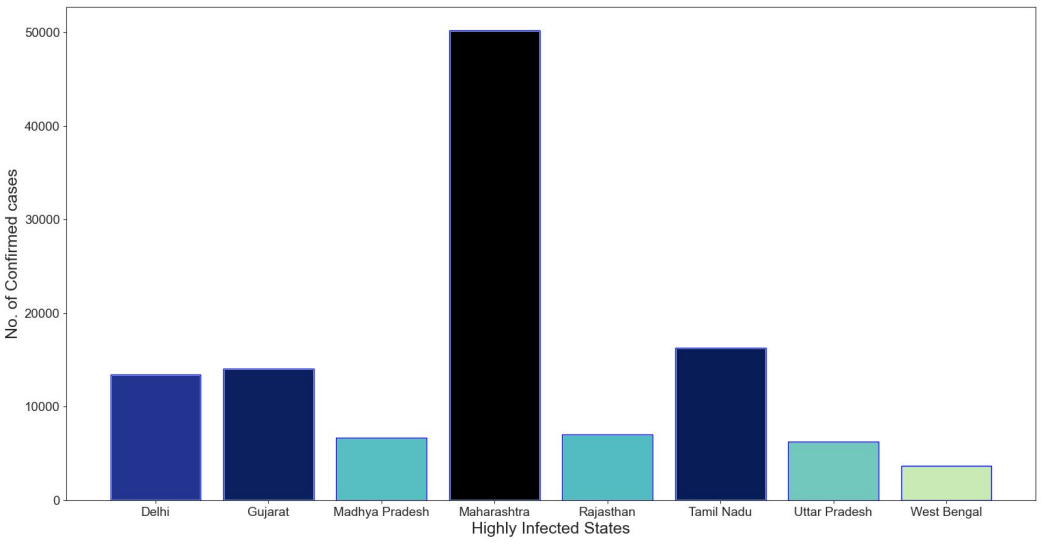

Figure: Infected cases of states above 3000 cases

Predictions

- COVID-19 prediction is shown in form of graphs using MATLAB software of India and its highly infected states (above 3000 cases).
- State included in the prediction are Maharashtra, Gujarat, Delhi, Tamil Nadu, Rajasthan, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, West Bengal.
- First graphs shows the total number of infected cases (here infected cases are shown on scale as multiple of 1000th of y axis on cumulative data) per day.
- Second graph shows the three phases on the plotted no. of infected cases per day.
- Third graphs shows the Growth rate in percentage for upcoming days.

Predictions

- The prediction have 3 bounds, upper bound, lower bound and prediction with red, magenta and black lines, respectively.
- The three phases acceleration phase, steady growth and ending phase are shown with red yellow and green colours respectively.

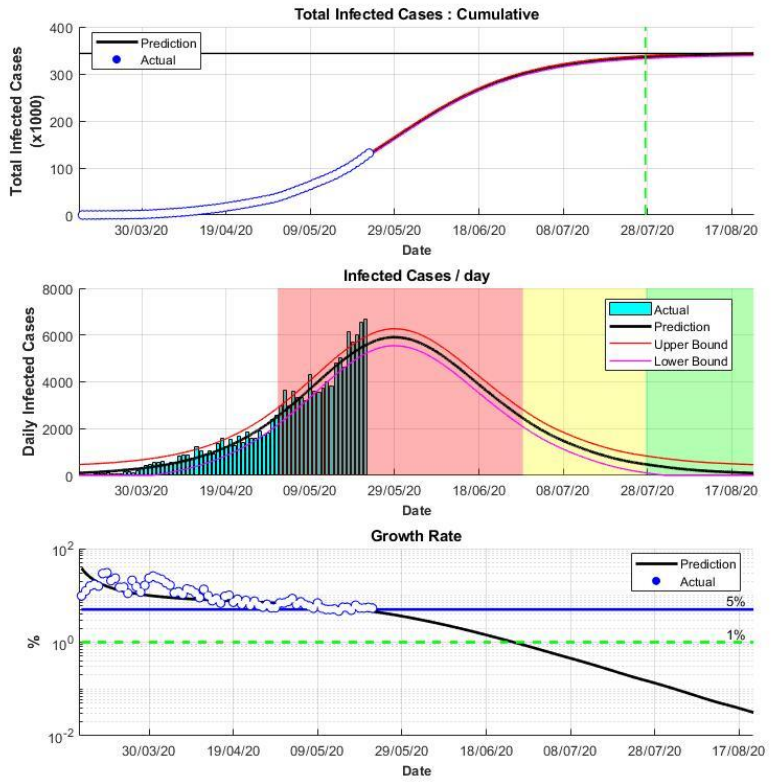

Figure: Prediction of COVID-19 India

Statewise Predictions

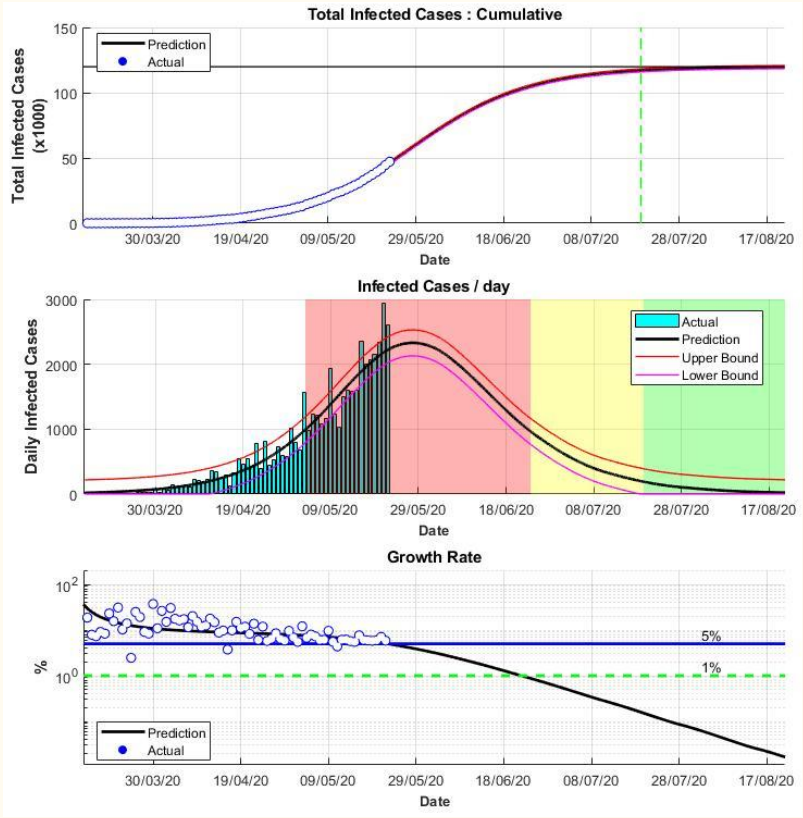

Figure: Prediction of COVID-19 (State: Maharashtra)

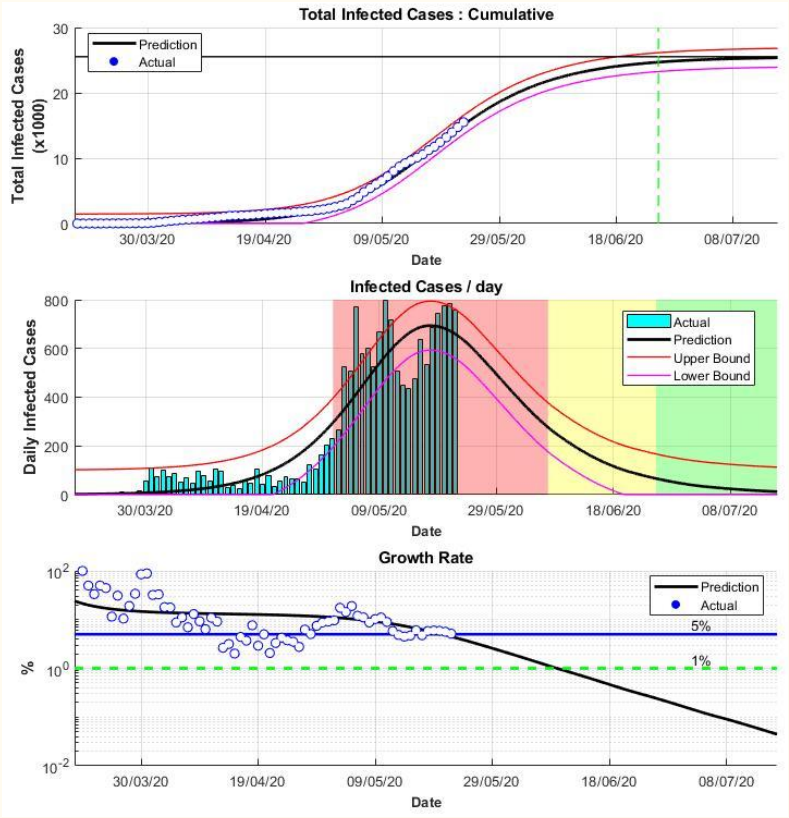

Figure: Prediction of COVID-19 (State: Tamil Nadu)

Statewise Predictions

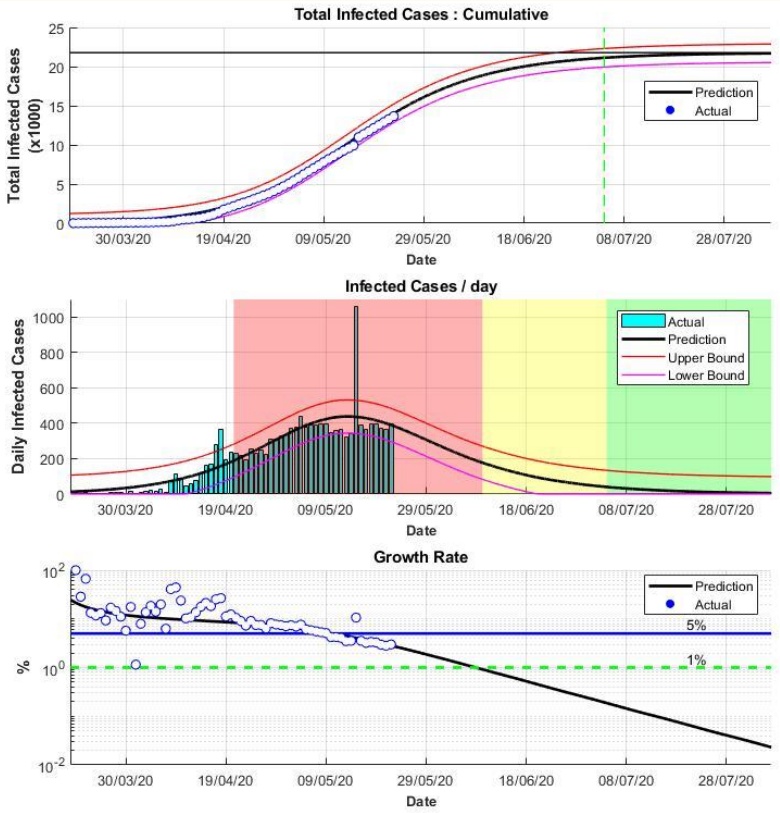

Figure: Prediction of COVID-19 (State: Gujarat)

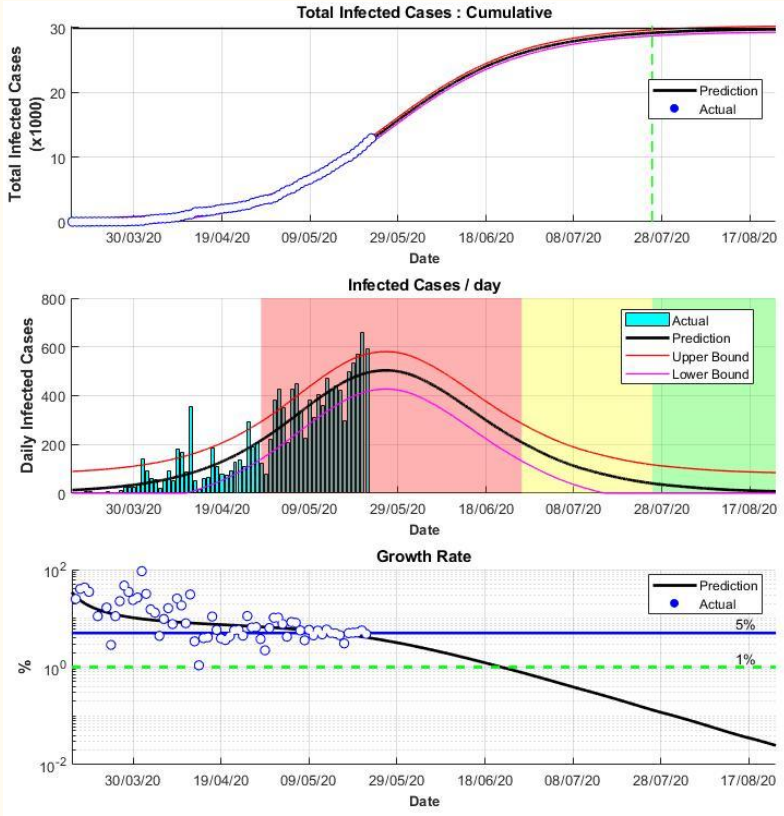

Figure: Prediction of COVID-19 (State: Delhi)

Statewise Predictions

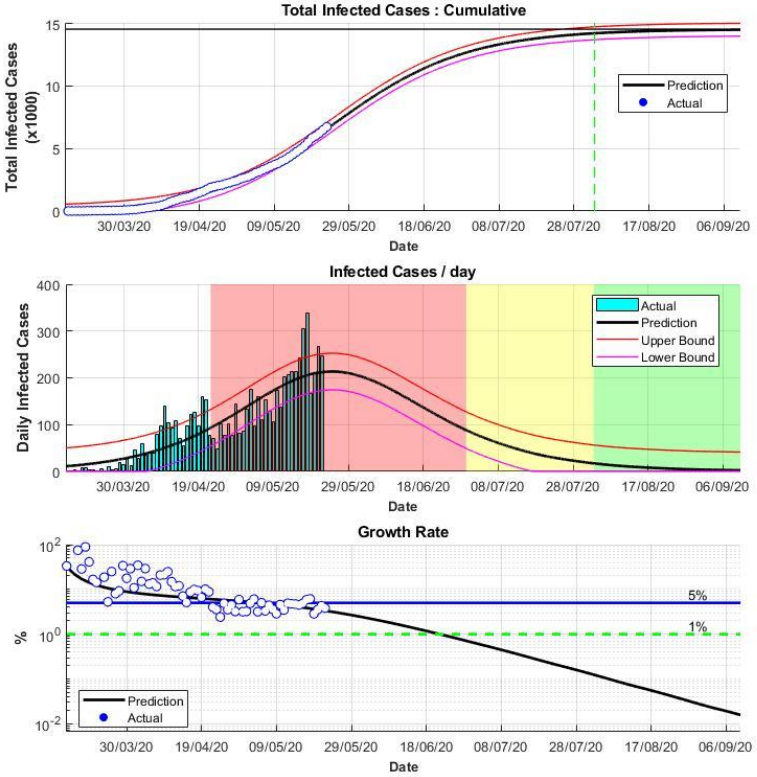

Figure: Prediction of COVID-19 (State: Rajasthan)

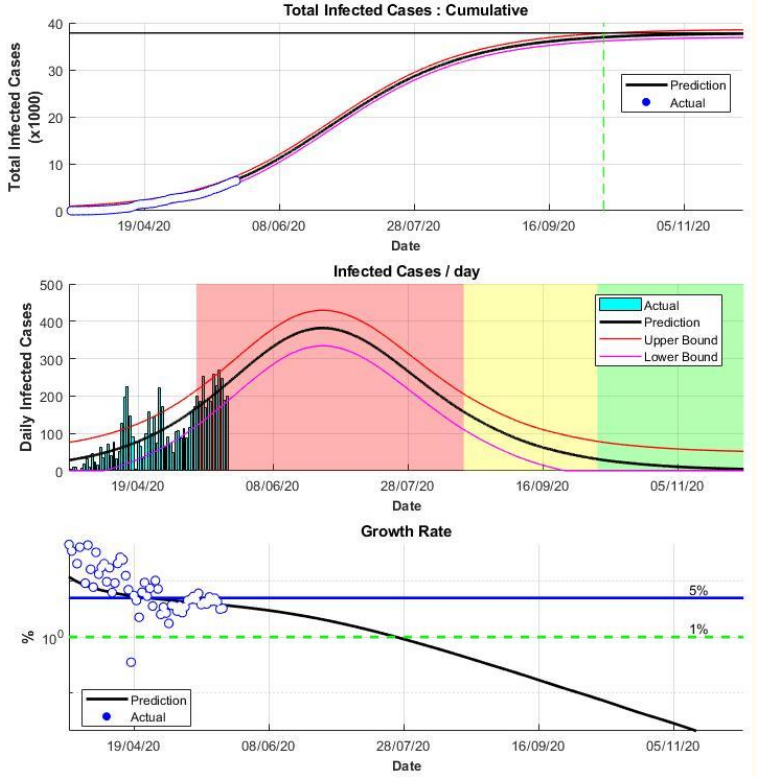

Figure: Prediction of COVID-19 (State: Madhya Pradesh)

Statewise Predictions

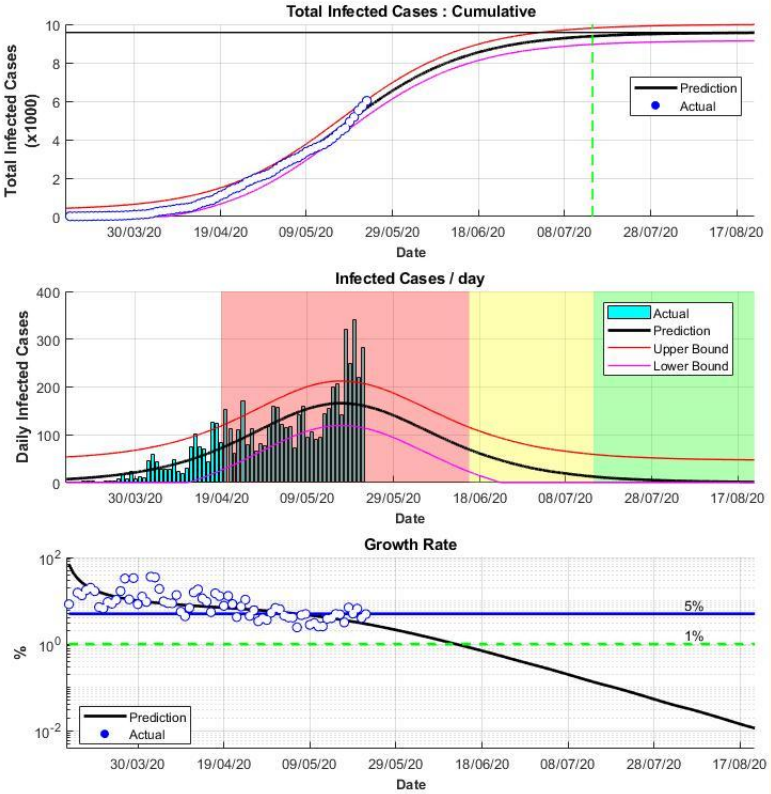

Figure: Prediction of COVID-19 (State: Uttar Pradesh)

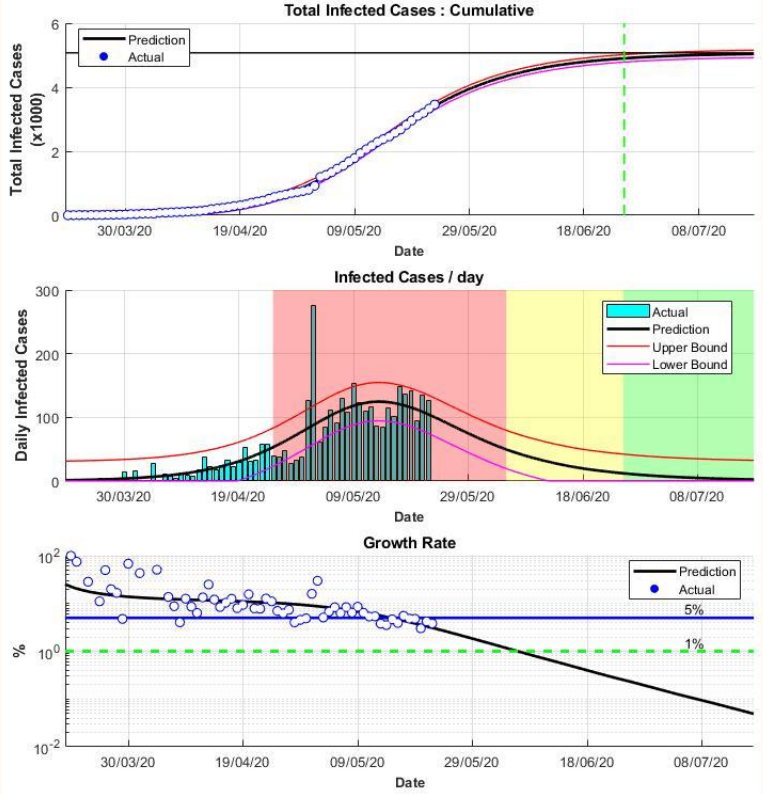

Figure: Prediction of COVID-19 (State: West Bengal)

Statewise Predictions

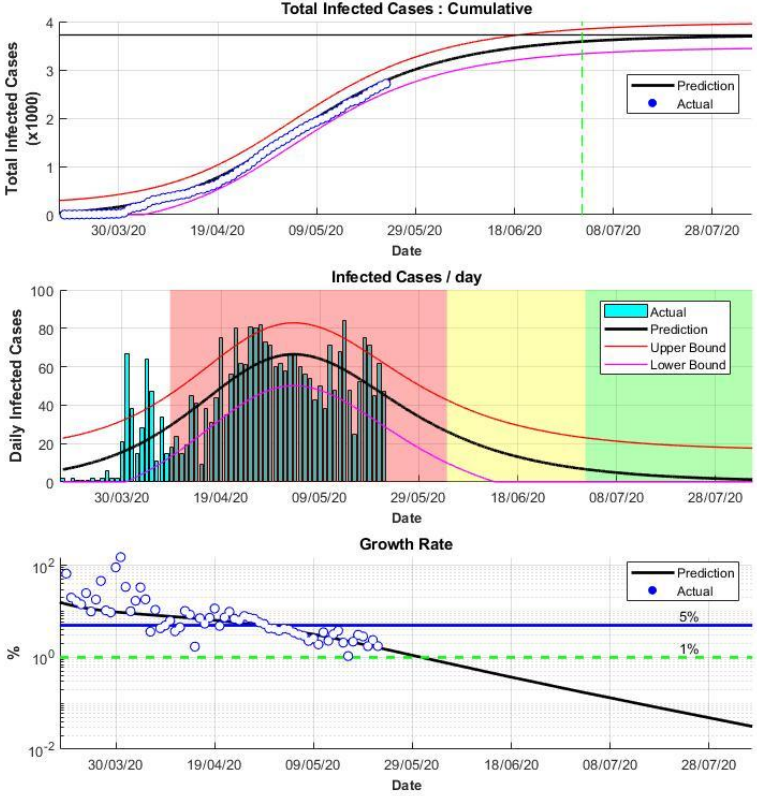

Figure: Prediction of COVID-19 (State: Andhra Pradesh)

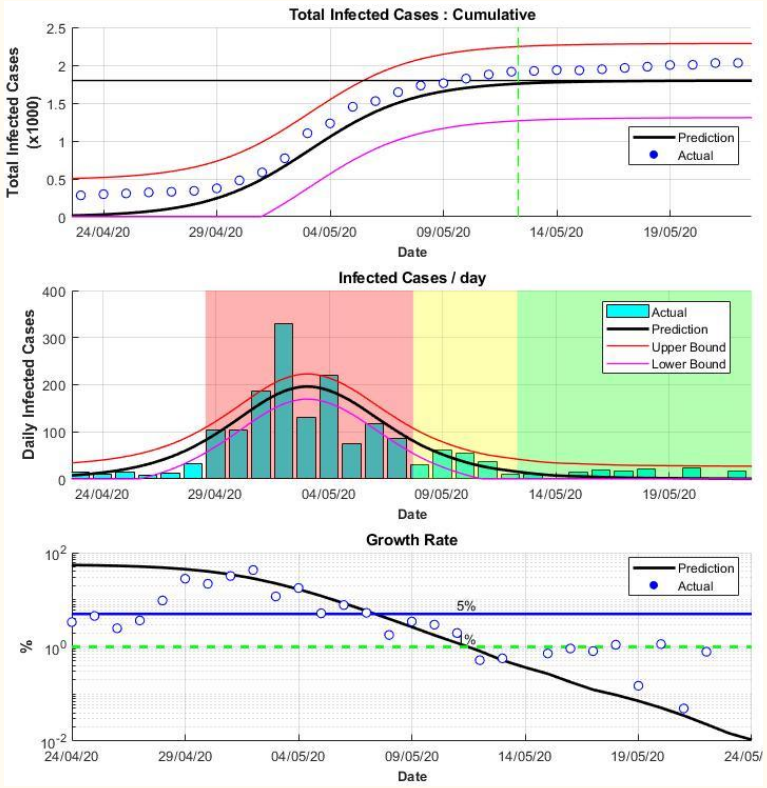

*Figure: Prediction of COVID-19 (State: Punjab)

Statistical parameters for the model

State	Data	Confirmed Infected Cases	Predicted Infected Cases	Relative Error (%)	Predicted Infected Cases on 30/5/2020	R_0 (Basic Reproduction No.)
Maharashtra	21st May 22nd May 23rd May	41642 44582 47190	41450 43905 46950	0.46 1.52 0.51	63100	1.3020
Gujrat	21st May 22nd May 23rd May	12910 13273 13669	13020 13130 13360	0.84 1.08 2.26	17600	1.6156
Delhi	21st May 22nd May 23rd May	11659 12319 12910	12530 12600 12800	6.95 2.23 0.85	16600	1.2664
Tamil Nadu	21st May 22nd May 23rd May	13967 14753 15512	13560 14500 15700	2.91 1.71 1.20	19800	1.7801
Rajasthan	21st May 22nd May 23rd May	6223 6490 6738	6190 6500 6950	0.53 0.15 3.05	9200	1.2320
India	21st May 22nd May 23rd May	118223 124759 131422	119530 125990 130420	1.09 0.98 0.76	172000	1.2471

Statistical parameters for the model

State	Data	Confirmed Infected Cases	Predicted Infected Cases	Relative Error (%)	Predicted Infected Cases on 30/5/2020	R_0 (Basic Reproduction No.)
Madhya Pradesh	21st May 22nd May 23rd May	5981 6170 6371	5900 6050 6200	1.35 1.94 2.68	8200	1.2616
Uttar Pradesh	21st May 22nd May 23rd May	5515 5735 6017	5420 5650 5890	1.72 1.48 2.11	7400	1.1166
Andhra Pradesh	21st May 22nd May 23rd May	2605 2667 2714	2540 2670 2760	2.50 0.11 1.67	3500	1.9408
Punjab	21st May 22nd May 23rd May	2028 2029 2045	2015 2035 2040	0.64 0.29 0.24	2060	18.9254
West Bengal	21st May 22nd May 23rd May	3197 3332 3459	3050 3390 3610	4.60 1.71 4.18	4690	1.8628

Discussion & Conclusion

- After lockdown COVID-19 curves for different states are very dissimilar. India and its state maharashtra prediction graph curve is have a slow exponential growth leading to higher uncertainty in long-term predictions due to lockdown 4.0
- The spread of COVID-19 will continue for at least the next three to four weeks as shown in the prediction
- Most state lies in acceleration phase, thus still showing the growth in cases, Growth rate tends to decrease as the cases enters the steady phase.
- Most of the states will tend to to show high growth in infected cases as lockdown 4.0 is implemented with removal of some restriction.
- States which had reached their ending phase, might show the growth in cases again.

Discussion & Conclusion

- Major states with high population like Maharashtra will show high growth rate during lockdown 4.0.
- In (*Figure) Punjab the cases have reached its ending phase but due to lockdown 4.0 the cases will grow in number.
- Cases must be updated regularly with right numbers for forecast/prediction to be more accurate and precise.
- Necessary action should be taken according to the forecast provided for different states infected with COVID-19.
- India will reach its inflection point on 29th May.
- Table shows the Relative error between the Confirmed and the predicted infected cases.
- R_0 here above represents the basic reproduction number of infected cases