Assignment -4: Covid-19 Modelling

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Oct 21, 2022

Problem Statement: Predict Covid Cases:

Here, we have used the SEIRV model in which, which is as follows:

$$\Delta S(t) = -\beta(t)S(t)I(t)/N - \varepsilon\Delta V(t) + \Delta W(t)$$

$$\Delta E(t) = \beta(t)S(t)I(t)/N - \alpha E(t)$$

$$\Delta I(t) = \alpha E(t) - \gamma I(t)$$

$$\Delta R(t) = \gamma I(t) + \varepsilon\Delta V(t) - \Delta W(t).$$

Input:

- N = 70000000
- eff = 0.66
- alpha = 1/5.8
- gamma = 1/5
- S0,E0,I0,R0,beta,CIR0 = 49000000.0, 700000.0, 700000.0, 9600000, 0.8, 20

Functions:

There are mainly three functions to be performed, which are as follows:

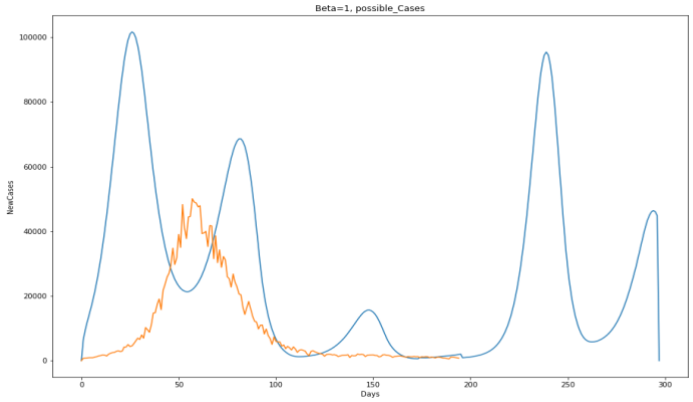
- ***COVID19Cases***:
  - This function returns gradient and loss for a single iteration for gradient Descent.
  - As it is said to take a running average of 7 days, we have defined S, E, I, R, dS, dE, dI, dR array of days between 8 March and 26 April 2021. For this reason, I have chosen seven days prior data to make it easier to get the 7-day running average.
  - Gradient takes all possible combinations of values and gives results accordingly.
  - The time to train a model is very high due to little change in gradient, so no of iterations taken is around 1.5 lakhs, but it still doesn't converge to the minimum.

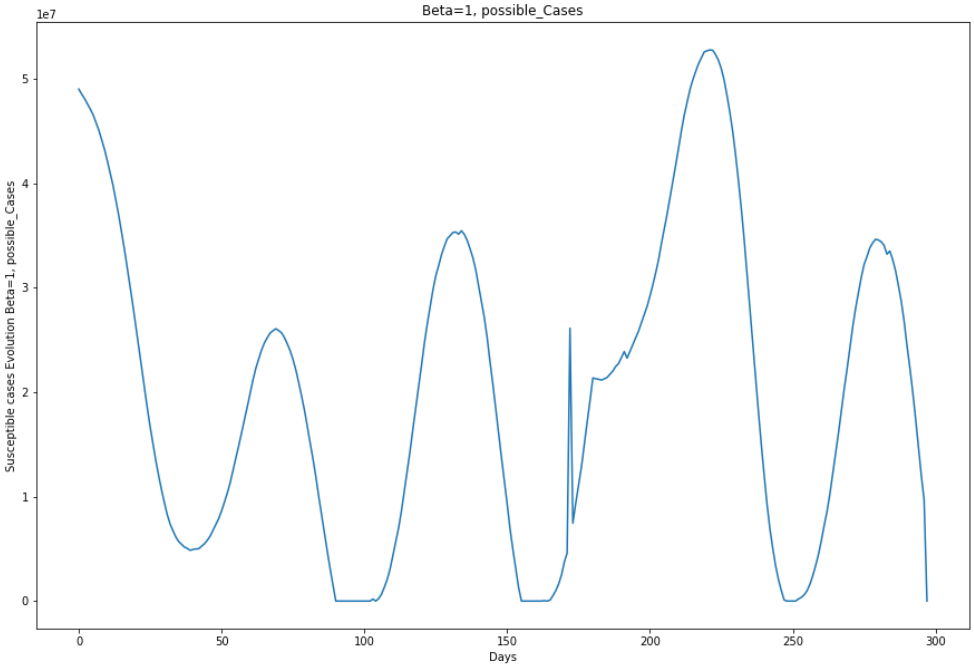
- ***GradientDescent:***
  a) This function trains the model by optimising the initial random values for parameters so that prediction can be made. Be done properly.
  b) In this function, we are doing the value conservation check at every 10,000 iterations.

- ***OpenLoopControl***

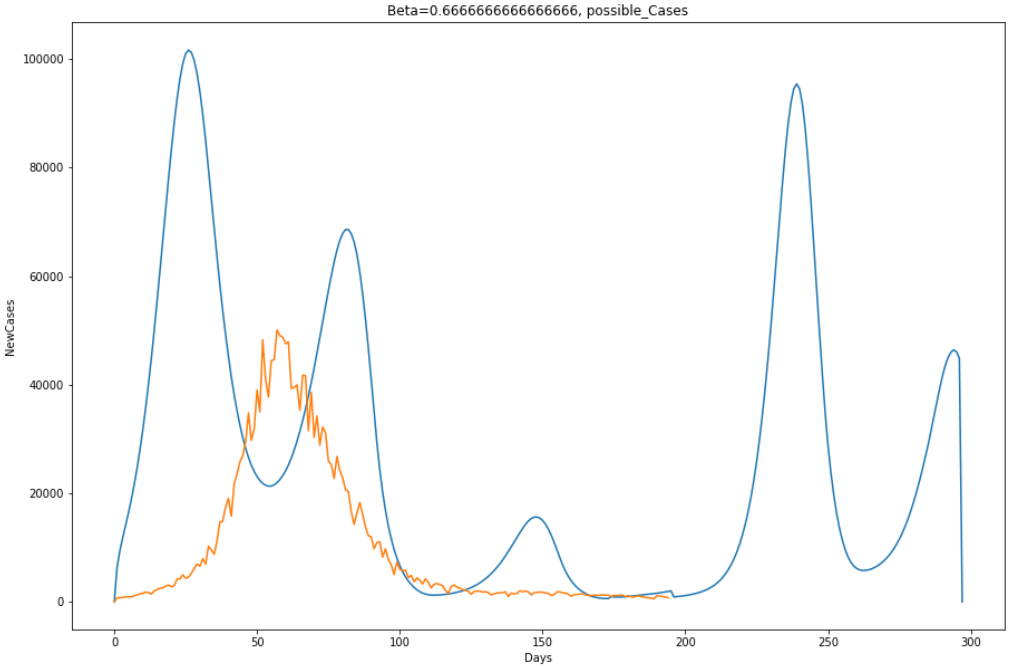
  This function predicts the data accordingly to the beta value, which is identical for every data in this function.
  The plot generated for different values of Beta for this function is as follows:

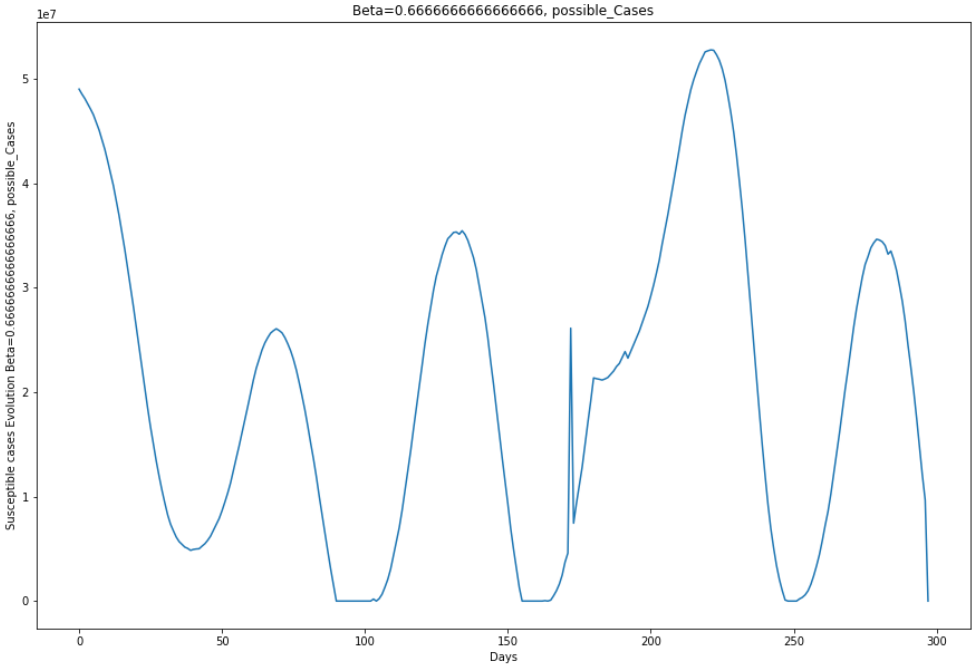
  A) B = beta



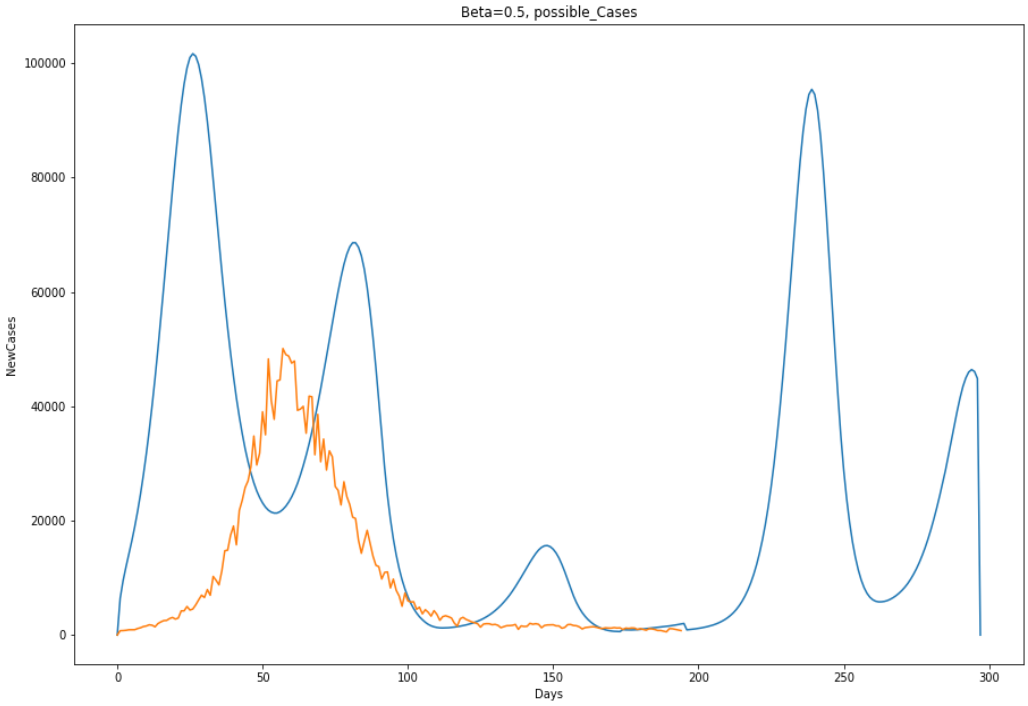


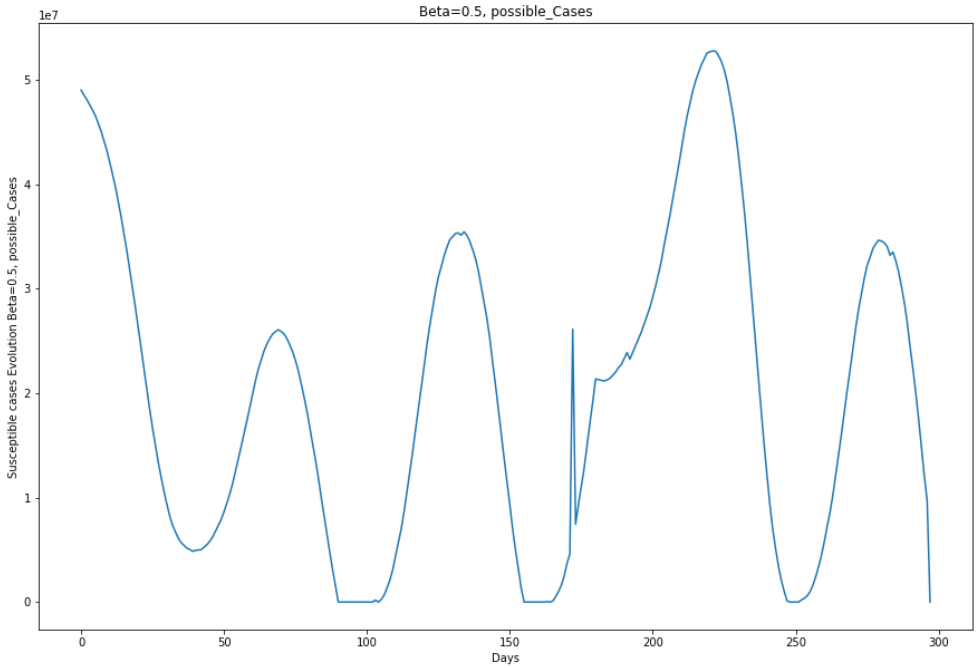
B) B= 2*beta/3


Beta=0.6666666666666666, possible_Cases
NewCases
Days
0
20000
40000
60000
80000
100000
0
50
100
150
200
250
300

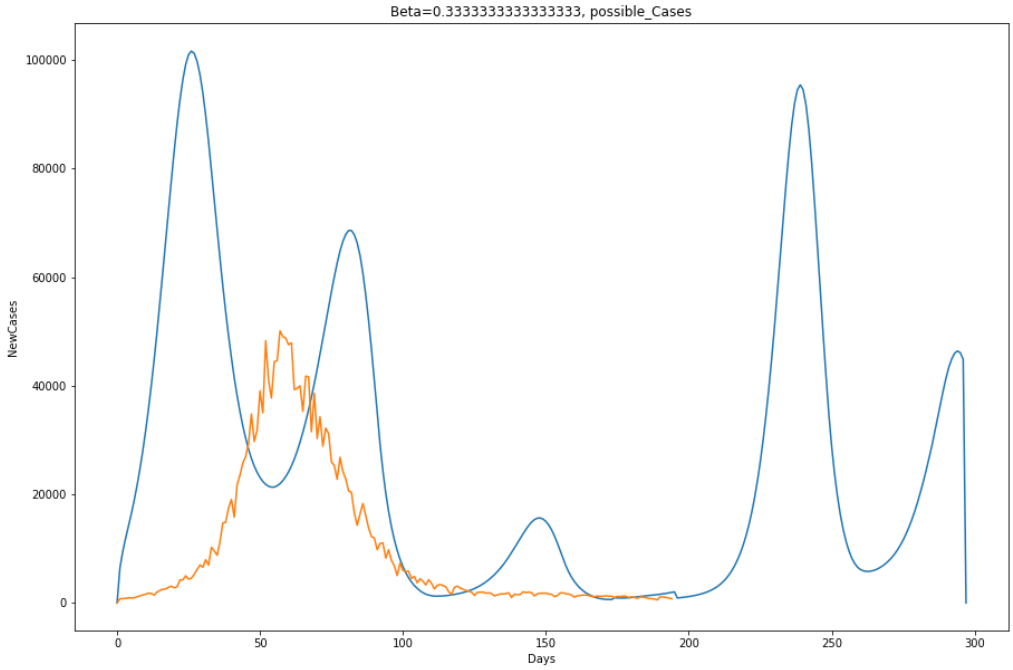

Beta=0.6666666666666666, possible_Cases
1e7
Susceptible cases Evolution Beta=0.6666666666666666, possible_Cases
Days
0
1
2
3
4
5
0
50
100
150
200
250
300

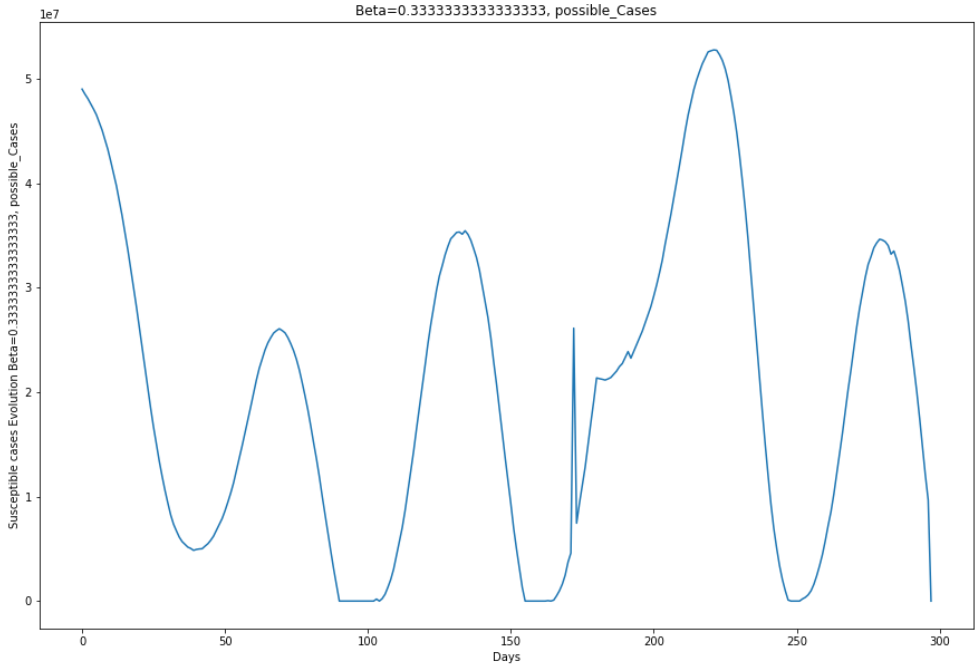
C) B = beta/2


Beta=0.5, possible_Cases
NewCases
Days
0
20000
40000
60000
80000
100000
0
50
100
150
200
250
300


Beta=0.5, possible_Cases
1e7
Susceptible cases Evolution Beta=0.5, possible_Cases
Days
0
1
2
3
4
5
0
50
100
150
200
250
300

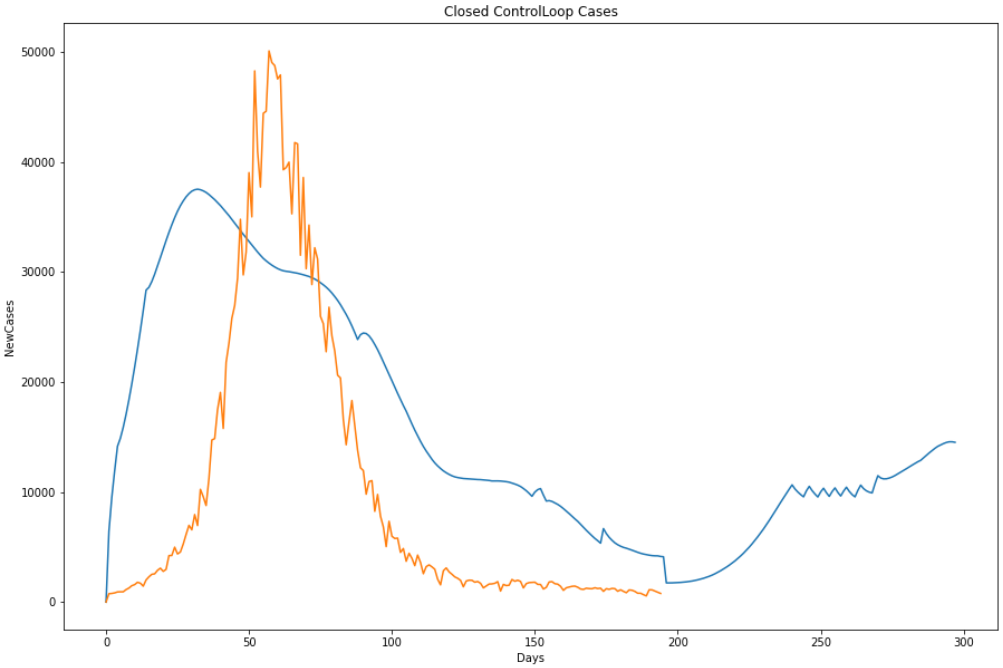
D) B = beta/3

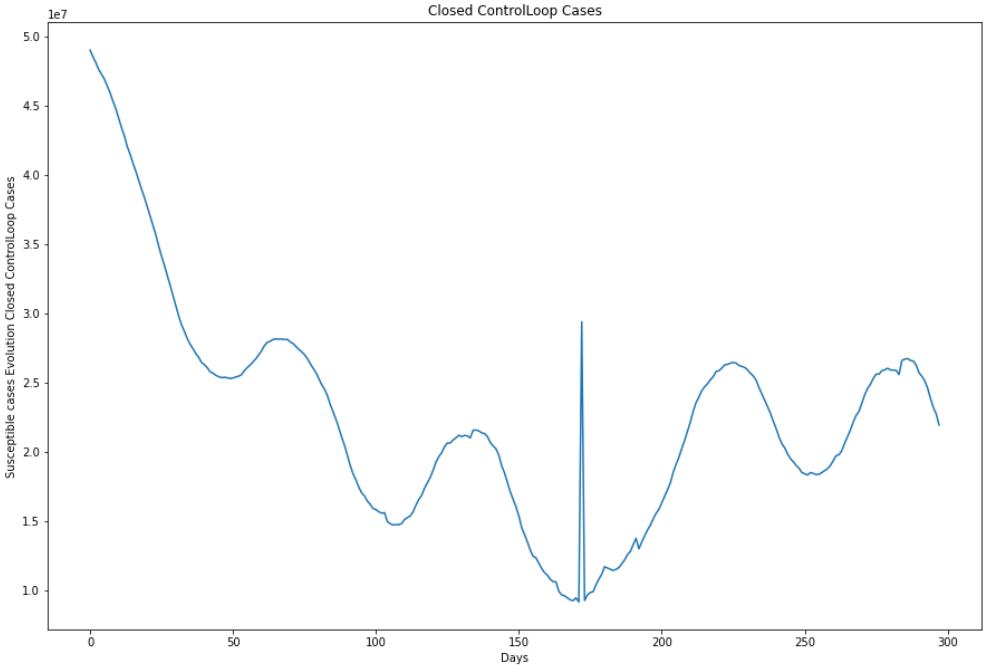




- ***OpenLoopControl***

  This function predicts the data accordingly to the range of I [t] values and applies beta accordingly, The graph for that is shown below:


Closed ControlLoop Cases
NewCases
Days
0
10000
20000
30000
40000
50000
0
50
100
150
200
250
300


Closed ControlLoop Cases
1e7
Susceptible cases Evolution Closed ControlLoop Cases
Days
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
0
50
100
150
200
250
300