Epidemiology Report on SARS-COV-2 West Bengal, India

-By Ashutosh Saxena

SIR Model: -

The **SIR Model** is one of the simplest compartmental models, and many models are derivatives of this basic form. The model consists of three compartments: **S** for the number of Susceptible, **I** for the number of Infectious, and **R** for the number of Recovered or deceased (or immune) individuals.

Variables Used: -

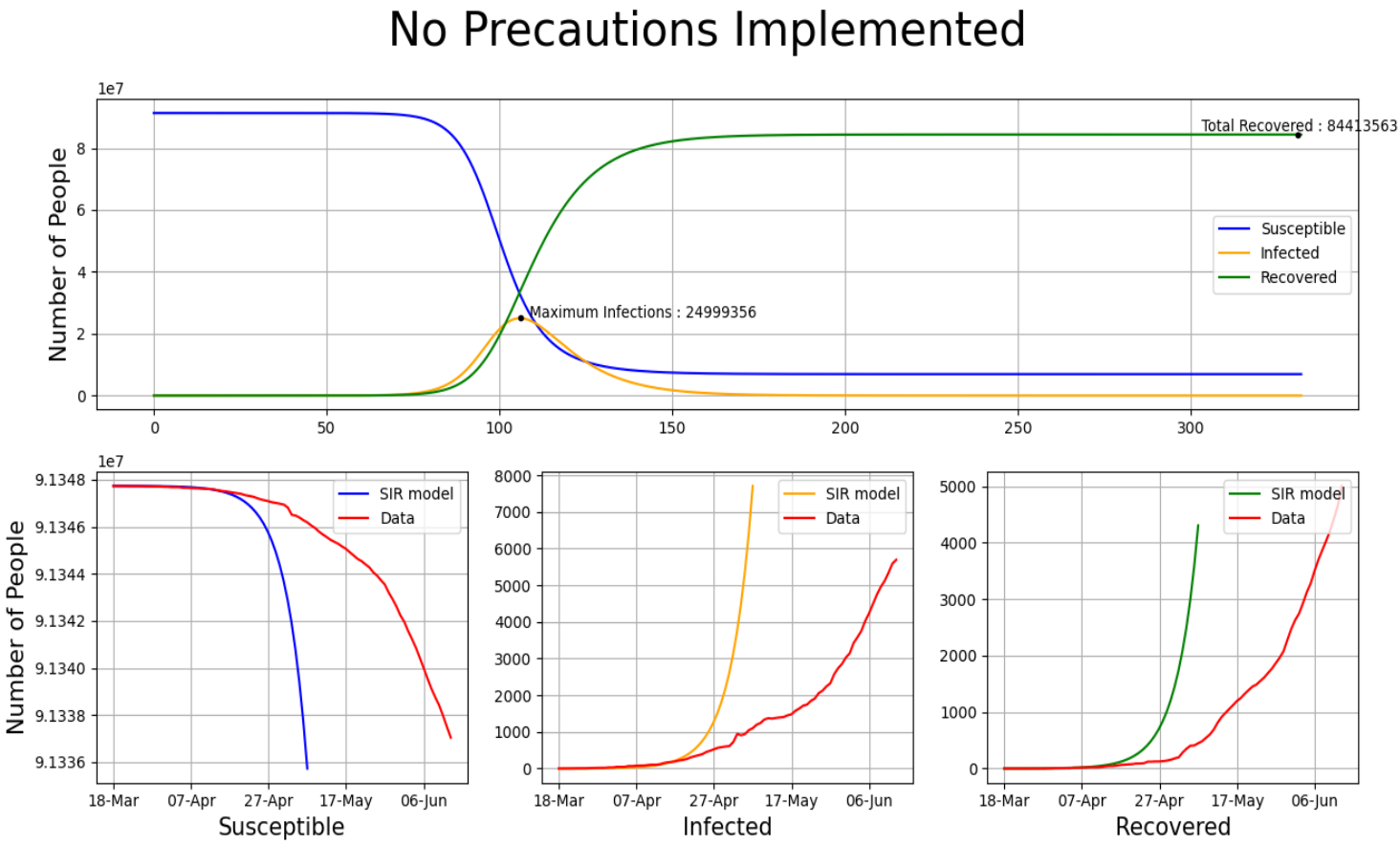
N: - Total population
S(t): - Number of people susceptible on day t
I(t): - Number of people infected on day t
R(t): - Number of people recovered on day t
β: - Expected amount of people an infected person infects per day
D: - Number of days an infected person has and can spread the disease
γ: - The proportion of infected recovering per day (γ = 1/D)
R_0: - The total number of people an infected person infects (R_0 = β / γ)
L: - Days after the start of outbreak, lockdown was imposed

Equations & Initial Variables Used:

- $Ro = \frac{N * \ln\left(\frac{S2}{S1}\right)}{(\Delta I + \Delta S)}$
- $\frac{dS}{dt} = -\beta * I * \frac{S}{N}$
- $\frac{dI}{dt} = \beta * I * \frac{S}{N} - \gamma * I$
- $\frac{dR}{dt} = \gamma * I$

γ: 0.1 (Gamma)
N: 91,347,735 (Total Population)
β: R_0 γ
I (0): 1
R (0): 0

Figure-1



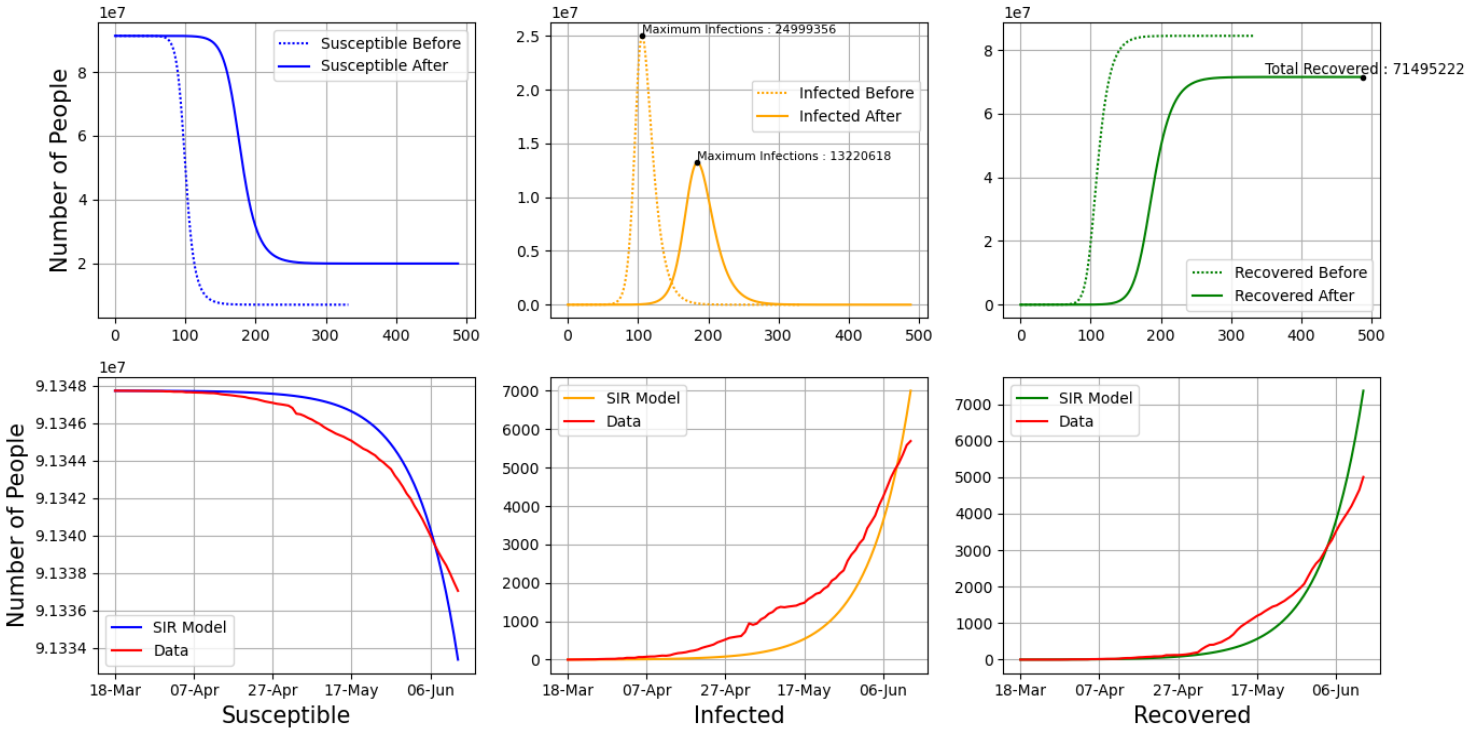
The High Inaccuracy observed here in the model is due to the fact that the model here uses **R_0 = 2.79** which we have taken as basic reproductive number for SARS-COV-2 (source = https://academic.oup.com/jtm/article/27/2/taaa021/5735319) i.e. if **NO** precautions were implemented by government and any preventive measures such as social distancing were not adhered to ,similar situation may have been observed.

Predictions in accordance with SIR Model (Actual observed values may be in vicinity**): -

- Highest Number of Infected that may be Observed = **24,999,356** on 106th day from the start of Epidemic.
- Total Number of Recovered that may be Observed = **84,413,563** at the end of the Epidemic
- Duration of Epidemic = **331 days**

Figure-2

Lockdown Implemented (from 25 March 2020)



Implementation of lockdown has **significantly** brought down the numbers of max infected, but a downside being the predicted duration of epidemic has **increased considerably** from **331 to 488 days**.

The R_0 **= 1.950171884** for fitting the data is calculated using the following equation

$$Ro = \frac{N * \ln\left(\frac{S2}{S1}\right)}{(\Delta I + \Delta S)}$$ at each day and averaging over the time period.

Predictions in accordance with SIR Model (Actual observed values may be in vicinity**): -

- Highest Number of Infected to be Observed = **13,220,168** on 184th day of the Epidemic
- Total Number of Recovered to be Observed = **71,495,222** at the end of the Epidemic
- Duration of Epidemic = **488 days**

Limitations of the model: -

- Over-Simplified
- Assumes that individual characteristics of immunity, susceptibility, and ability to recover, are essentially the **same** for all members of the population.
- It is assumed that the transmission rate remains **constant** throughout the period of pandemic.
- Assumes recovered individual has become **immune** to epidemic.
- A sudden change in the graph of actual data can't be taken into account due very high numbers of variables involved.