A computational analysis of the Susceptible-Infected-Recovered (SIR) Model

Ella Xu

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Background

- Kermack & McKendrick 1927
- Assumptions
  - Simple closed population & simple disease
- 3 population categories
  - **Susceptible** (S) - people who have not yet been infected
  - **Infected** (I) - currently sick and can transmit the disease to **Susceptibles**
  - **Recovered** (R) - individuals who have stopped being **Infected**

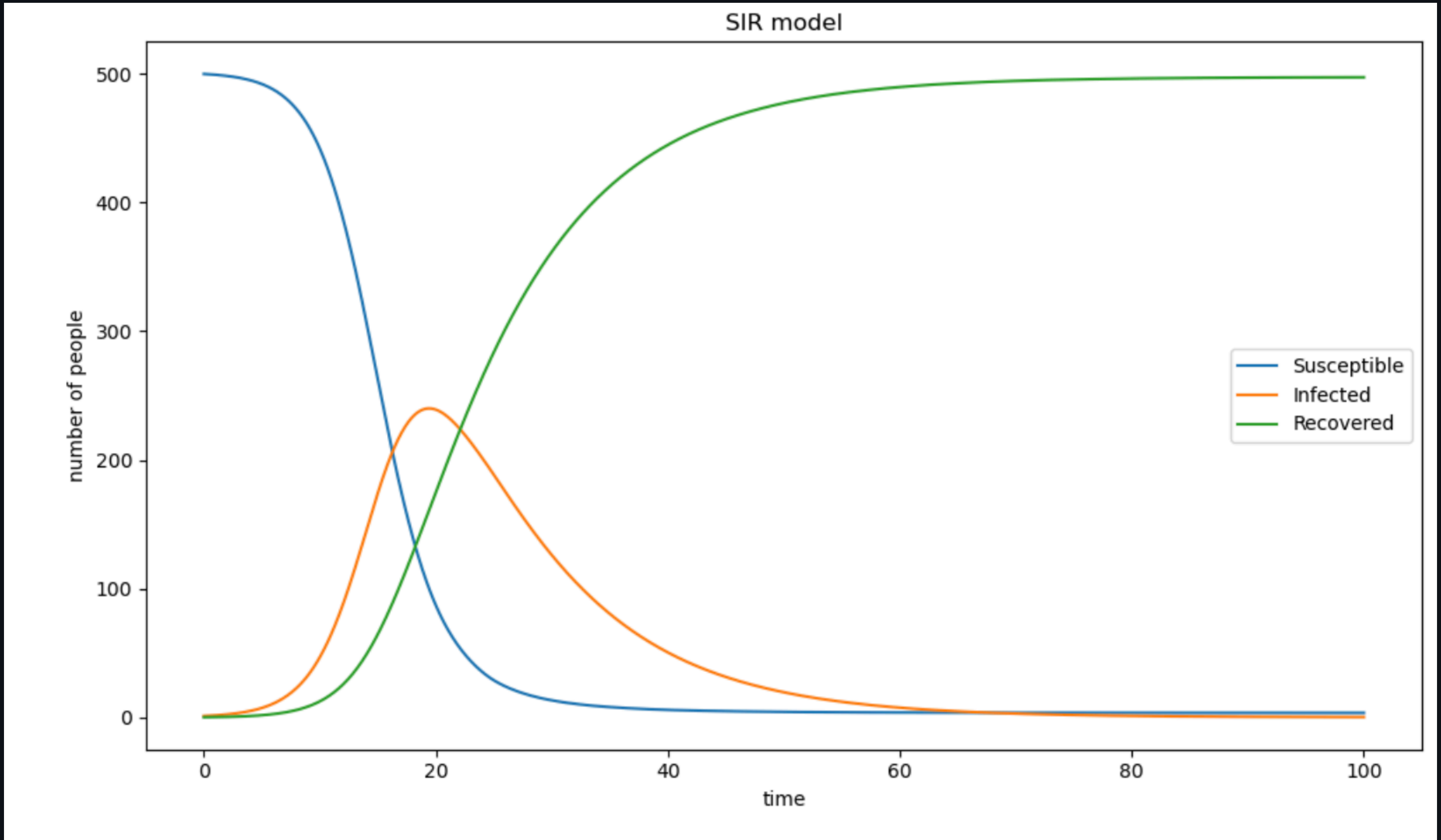
ODEs

$$\frac{dS}{dt} = -\frac{\beta}{N} S I$$

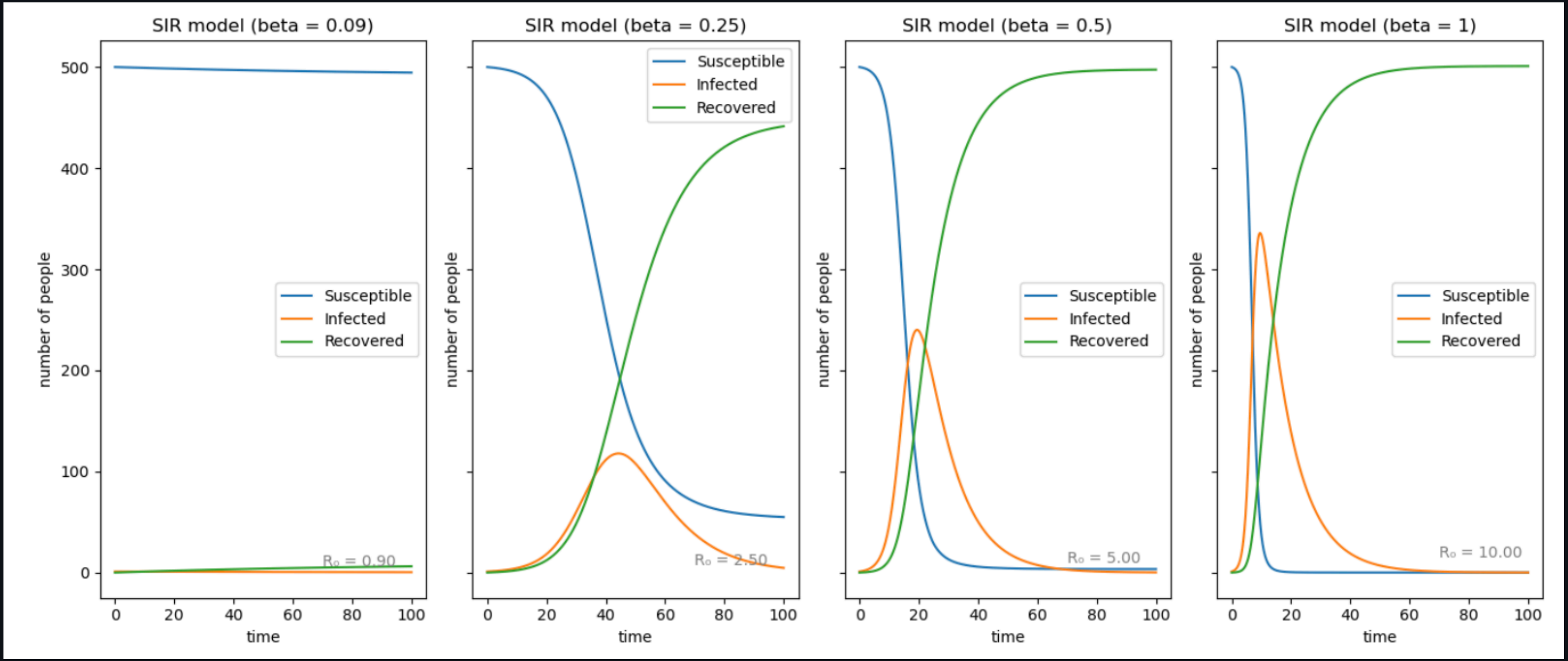
$$\frac{dI}{dt} = \frac{\beta}{N} S I - \gamma I$$

$$\frac{dR}{dt} = \gamma I$$

SIR Dynamics



What happens if we change β?



R_0 (not to be confused with $R(0)$)

$$R_0 = \frac{\beta}{\gamma}$$

$R_0 > 1$ describes an outbreak/epidemic.

Limitations and extensions of the classical SIR model

- SEIR model (latency and temporary immunity)
- localized networks
- stochastic effects

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