SIS Model

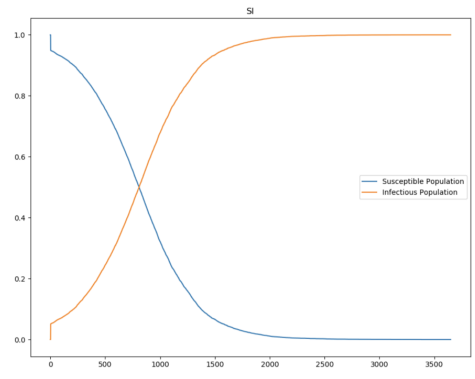

Figure 1: Example SIS model

The SIS model assumes that the disease confers no long term / long lasting immunity for infected patients, which allows the disease to obtain a steady state. Infected patients, once recovered, return immediately to the susceptible population.

Variables: S (susceptible patients), I (infected patients)
$S \rightarrow I \rightarrow S$

The model is given by:

- $\frac{dS}{dt} = -\beta SI + \alpha I$
- $\frac{dI}{dt} = \beta SI - \alpha I$

Where, α gives the fraction of individuals who recover and re-enter the susceptible group, per unit time.

The βSI represents average infected individual who makes contact sufficient enough to infect βN others per unit time. The probability that a given individual that each infected individual comes in contact with is susceptible is S/N.

Each infected individual causes $(\beta N)(S/N) = \beta S$ infections per unit time. Therefore, I infected individuals cause a total number of infections per unit time of βSI.

Once solved, this yields a R_0 equation of:
$R_0 = \frac{\beta N}{\alpha}$
$R_0 > 1$, where I=0 is stable
$R_0 < 1$, with I= N - α/β as stable.

Vital Dynamics
To add vital dynamics to a population, let μ and ν represent the birth and death rates, respectively, for the model. To maintain a constant population, assume that $\mu = \nu$. Therefore, the ODE becomes:

$\frac{dS}{dt} = \mu N - \frac{\beta SI}{N} + \gamma I - \nu S$

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