<https://www.maa.org/press/periodicals/loci/joma/the-sir-model-for-spread-of-disease-the-differential-equation-model>

# Modeling the pandemic

N = total population

S = number of susceptible individuals

(currently healthy, not immune)

I = number of infected individuals

R = number of recovered individuals

(immune, not get sick anymore and will not infect other individuals)

S’ = dS/dt = rate of change of S with respect of time (per day)

I’ = dI/dt = rate of change of I per day

R’ = dR/dt = rate of change of R per day

\*\* time t = day

**1. Rate of individuals recover:**

Every day, a fraction “**γ**” of the sick individuals recover.

## R’ = γ\*I

\*\*\*It may take 2 weeks = 14 days for your body to get over the illness. That’s the average recovery time for mild cases, according to the World Health Organization] source: <https://www.webmd.com/lung/covid-recovery-overview#2>

For simplicity, we treat all of the infected individuals the same and use the 14 days as the recovery time, whether they get the disease today or 2 weeks ago.

⇨ **γ (gamma) = 1/14**

**2. Rate of individuals going from susceptible to infected:**

### S’ = – β\*S\*I/N

⇨ S’ proportional to the number of individuals who can get sick (S)

⇨ S’ proportional to the number of infected (I)

**β (unit: 1/day): the transmission coefficient (a constant)**

**Ro: the number of secondary infections generated from one infected individual – is understood to be between 2 and 2.5 (we use 2.25) for COVID-19 virus**

**[source: page 2** <https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200306-sitrep-46-covid-19.pdf?sfvrsn=96b04adf_4>]

**if one infectious person can infect 2.25 persons and the average number of days that this person is infectious (before they are isolated or self-isolate) is 5 days, the transmission rate per day is [source:** <https://staff.math.su.se/hoehle/blog/2020/03/16/flatteningthecurve.html>]

⇨ **β = 2.25 \* 1 / 5**

\*\*\* Negative sign is because the rate of individual infected will decrease the number of susceptible population as time goes on.

**3. Rate of infected changing:**

## I’ = β \*S\*I/N - γ\*I

**β\*S\*I : the rate of infected increases as the number of susceptible transit to infected.**

**γ\*I : the rate of infected decreases as the infected recover**