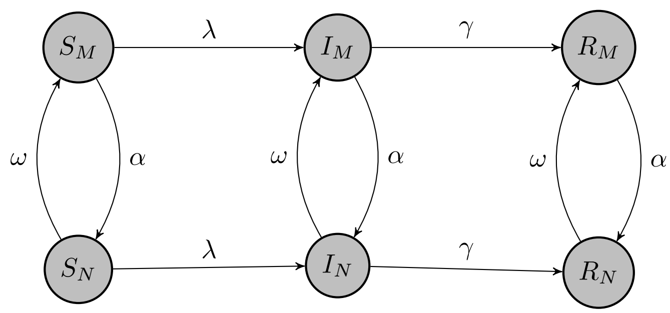
SIR and mask

Basic idea

- Simple SIR model with extra compartments for S-masked, S-no mask, I-masked, I-no mask.
- Supposing wearing a mask reduces both susceptibility and infectiousness (depending on who is wearing it)
- Assume transitions between masked-not masked based on social influence and fear of disease
- Assume all recovered do not wear mask
- Work in proportions such that S + I + R = 1
- no demography

State diagram



Parameter description

- λ is the transmission rate, assuming a form of FD
- $\frac{1}{\gamma}$ is average rate of recovery
- α is transition rate from wearing a mask to not wearing a mask
- ω is transition rate from not wearing a mask to wearing a mask

Further parameters that will pop up

- β is the infectiousness
- c is the reduction in chance of catching disease if S is wearing a mask
- p is the reduction in chance of spreading disease if I is wearing a mask
- α_1 is the rate of transition to no mask based on social influence of no mask
- α_2 is the rate of transition to no mask based on fear of disease
- ω_1 is the rate of transition to mask based on social influence of mask
- ω_2 is the rate of transition to no mask based on fear of disease

Basic system of ODEs

$$
\begin{aligned}
\dot{S}_N &= -\lambda S_N + \alpha S_M - \omega S_N \\
\dot{S}_M &= -\lambda(1-c)S_M - \alpha S_M + \omega S_N \\
\dot{I}_N &= \lambda S_N + \alpha I_M - \omega I_N - \gamma I_N \\
\dot{I}_M &= \lambda(1-c)S_M - \alpha I_M + \omega I_N - \gamma I_M \\
\dot{R}_N &= \gamma I_N + \alpha R_M - \omega R_N \\
\dot{R}_M &= \gamma I_M - \alpha R_M + \omega R_N \,,
\end{aligned}
$$

where

$$
\begin{aligned}
\lambda &= \beta \left(I_N + (1-p)I_M\right) \\
\omega &= \omega_1(S_M + I_M + R_M) + \omega_2(I_M + I_N) \\
\alpha &= \alpha_1(S_N + I_N + R_N) + \alpha_2(1 - (I_M + I_N)) \,.
\end{aligned}
$$