Heroin Model Summary

$$
\begin{aligned}
S_{n+1} &= S_n + \beta E - \alpha S - \underbrace{S(\sigma + \xi(I+H))}_{\text{to resistant}} - \underbrace{S(\delta_1 E + \delta_2 I)}_{\text{to opioid addiction}} - \underbrace{S(\mu_1 + \mu_2 H)}_{\text{to heroin addiction}} \\
&\quad + d_I I + d_H H + d_r R + d_e E \\
E_{n+1} &= E_n - \beta E + \alpha S - \underbrace{E(\sigma + \xi(I+H))}_{\text{to resistant}} - \underbrace{E(\mu_1 + \mu_2 H)}_{\text{to heroin addiction}} - \underbrace{\epsilon E}_{\text{to I}} - d_e E \\
I_{n+1} &= I_n + \underbrace{\epsilon E}_{\text{from E}} + \underbrace{S(\delta_1 E + \delta_2 I)}_{\text{from S}} - \underbrace{\gamma(H) I}_{\text{to H}} - \underbrace{iI}_{\text{to R}} - d_I I \\
H_{n+1} &= H_n + \underbrace{\gamma(H) I}_{\text{from I}} + \underbrace{(S+E)(\mu_1 + \mu_2 H)}_{\text{from S and E}} - \underbrace{hH}_{\text{to R}} - d_H H \\
R_{n+1} &= R_n + \underbrace{(S+E)(\sigma + \xi(I+H))}_{\text{from S and E}} + \underbrace{iI}_{\text{from I}} + \underbrace{hH}_{\text{from H}} - d_r R \\
\gamma(H) &= \gamma_0(\mu_1 + \mu_2 H)
\end{aligned}
$$

We assume that $0 \leq \delta_1 \leq \delta_2 \leq 1$, $\mu_1 < \mu_2$, and d_r includes both natural death and backsliding from drug resistant to susceptible.