25 Jan p. 1

SIR model

$$S \to I \to R$$

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

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

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

$S + I + R = N = 1$

DFE = $I = 0$, $S + R = 1$

(usually take $S = 1$, $R = 0$) ??

seasonal INFLUENZA : cross-immunity

pandemic INFLUENZA: ?biology?

$\boxed{\text{SIRS}}$

H1N1

H3N2

haemagglutinin

neuraminidase

$I(0) = 0$

$S(0) + R(0) = N \; (\neq 1)$

$R(0) > 0$

without loss of generality ✱

$N' = N - R(0)$

model $\{S, I\}$ system without the already-recovered people

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

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

$S(0), \quad I(0) = R(0) = 0$

DFE : $S^* = 1 \; ; \; I^* = 0$

$S^* = 0$

$I^* = 0$

ENDEMIC equilibrium $(I^* > 0 \; ?)$:

$$\frac{dS}{dt} = -\beta S I \quad (\leq 0)$$

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

$I \ll 1$:

$I(\beta S - \gamma)$

$= I(\beta - \gamma)$

AS LONG AS $I \ll 1$

\ll $\ll$ $\left(\begin{matrix} I \approx 0, \\ I > 0 \end{matrix} \right)$

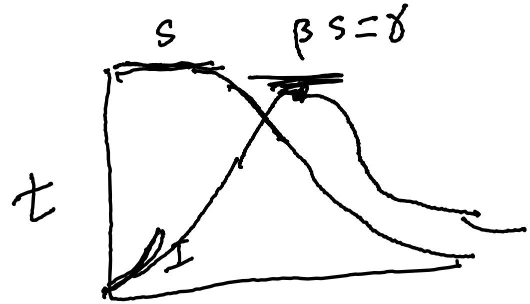
\gg $\gg$

JACOBIAN : stability of DFE

$$\begin{pmatrix} \frac{\partial g_s}{\partial S} & \\ & \end{pmatrix} = \begin{pmatrix} -\beta I & -\beta S \\ \beta I & \beta S - \gamma \end{pmatrix}$$

$$\rightarrow \begin{pmatrix} 0 & -\beta \\ 0 & \beta - \gamma \end{pmatrix} \rightarrow \{\beta - \gamma, 0\}$$

$\beta > \gamma$



$\beta S I - \gamma I = 0$

$\beta S < \gamma$