

## Does Everyone Die?

The answer is of course yes. But it is of intense interest to us when we die. To this end there are several models to estimate the number of diseased and of removed (dead or immune). The first one is as follows.

$$\frac{dI}{dt} = -\beta IS$$

$$\frac{dS}{dt} = \beta IS - \gamma I = I(\beta S - \gamma)$$

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

First notice that

$$\frac{d(S + I + R)}{dt} = \frac{dS}{dt} + \frac{dI}{dt} + \frac{dR}{dt} = 0$$

so  $S + I + R$  is a constant. This reduces the set of equations to.

$$\frac{dI}{dt} = -\beta IS$$

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

Examining the equations they both have a factor of  $I$  so they are both zero on the  $S$  axis. The equilibrium line is attractive  $S < \frac{\gamma}{\beta}$  and repulsive with  $S > \frac{\gamma}{\beta}$ . The vector field.