The SEIR Model: Adding an "Exposed" Compartment

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Below is the SEIR model with demographics. As with the SIR-with-demographics model, we assume that the birth rate μ equals the death rate.

$$\frac{dS}{dt} = \mu - \beta SI - \mu S \,, \tag{1}$$

$$\frac{dE}{dt} = \beta SI - \sigma E - \mu E \,, \tag{2}$$

$$\frac{dI}{dt} = +\sigma E - \gamma I - \mu I \,, \tag{3}$$

$$\frac{dR}{dt} = +\gamma I - \mu R \,. \tag{4}$$

1. Modify the basic SIR code so that it applies to the above equations. Note that you are adding a new compartment, E. This may take a little bit of work. In the R project I shared with you last week there is a file called `SIR_without_demographics`. I would suggest making a copy of this file and calling it `SEIR_with_demographics`.

2. Try out your code! Does it make sense? Let's use the following assumptions:

   - $\beta = 2$.
   - People are exposed for an average of 5 days.
   - People are infectious for an average of 7 days.
   - People live an average of 70 years.

   Note the different time units.

3. Now try a very large σ. Very large. Like 200 or 1000. What happens? How can you explain what is going on, mathematically and epidemiologically?