Math 110 | **BASIC CALCULUS I** | Fall 1998

Class 6

A model for the spread of disease

Suppose we want to model the spread of an infectious disease.

Simplifying assumptions:
– Nobody dies from it!
– Recovery always takes 14 days.
– You're contagious during those 14 days.
– You cannot get it twice.

Notation:
I = # of infected people.
R = # of recovered people (i.e., already had it).
S = # of susceptible people (i.e., haven't had it yet).

Rates of change: I', R', S'.
Units: ________________ per day.

Q: If I people are currently infected, how many of them do you expect will recover today? ______.

So,

$$R' =$$

True of false?
I' = # of people who get infected per day.
S' = -(# of people who get infected per day).

To write an equation for S', first note that on any given day, the number of people who get infected depends on the number of susceptible people who come into contact with infected people:
–If everything else was the same except there were twice as many *susceptible people, how would this affect the number of people who* become infected?

So,

$$S' \propto$$

–If everything else was the same except there were twice as many *infected people, how would this affect the number of people who* become infected?

So,

$$S' \propto$$

These combine to give

$$S' =$$

What about I' ? It should equal
(# of people who get infected per day) – (# of people who ______________________).

So,

$$I' =$$

Using Euler's Method on the SIR model

Suppose we're given:
$S' = -.00001SI$
$I' = .00001SI - I/14$
$R' = I/14$

with initial values at time $t = 0$ (in units of days):
$S(0) = 45400,\ I(0) = 2100,\ R(0) = 2500.$

(a) Find $S'(0)$, $I'(0)$, and $R'(0)$.

(b) Estimate $S(1)$, $I(1)$, $R(1)$.

(c) Using Euler's Method with $\Delta t = 1$, repeat parts (a) and (b) above to find the number of infected people on the fourth day ($t = 4$).

ANNOUNCEMENTS

Homework, due Wednesday, 9/16/98:
CiC (Calculus in Context), section 1.1 : 8, 9, 10, 15, 16, 17.