Term Project Part B
Due Tuesday, April 30

For this assignment, you need to complete the project you proposed in Term Project Part A.

Specifically, for Part B you need to complete and turn in a report that includes all of the following.

1. A description, in words, of your **original** "real-world" situation to be modeled by a system of differential equations and a set of initial conditions – that is, by an initial value problem;
2. A statement of the differential equations and initial conditions that model this situation;
3. A Sage program that solves your initial value problem numerically, using Euler's method;
4. The graphical output from your Sage program;
5. A brief analysis (just a few sentences) of your results.

Some hints and notes:

(a) Again, you may want to look at the **sample Term Projects** that were attached to Part A of this assignment (on our course page). These are actual Term Projects handed in by groups from previous semesters.

DISCLAIMER: these samples are excellent, but not perfect. (Some axes labels are missing, etc.) Think carefully about your own work, to make sure you don't replicate any imperfections.

(b) To write your Sage program, *do not* start from scratch. Instead, **start from the Sage worksheet SIR.sws,** available on our course page, under the link for "The Sage Page." (Or you can start from the SIR code **you** handed in for Mini Project 1.) Modify this code as necessary: replace all occurrences of S, I, and R with the appropriate variable names/letters; replace parameter values and initial values with new ones; replace the SIR differential equations with the ones from your proposal, modify all comment lines appropriately, etc.

You might have to experiment quite a bit with parameter and initial values to come up with ones that give you nice output. (In "real life," you'd need to think carefully about the values of your parameters, and they'd need to be chosen realistically; you can't just plug in any numbers you want. For *this project*, the primary question you should be asking yourself about the parameters is: what values yield a nice graph at the end?)

If you still can't get things to work, try modifying your differential equations a bit. (Maybe you can remove one or two terms, or replace a complicated term with a simpler one, etc.) But remember: these differential equations should match the assumptions you made initially. So if you tweak the differential equations, you may need to modify the assumptions as well.

You can tell things are working if your graph looks good, meaning you can see how each of your variables evolves with time. If one or more or your variables *doesn't evolve* – it doesn't show up on the graph at all, or it stays flat, or it immediately drops down to zero, or blows up to infinity, and stays there, etc. – then you'll probably need to tweak something.

(c) Use a small enough stepsize. Here's a good two-part test to check that you've found a suitable stepsize: (i) your graph is smooth, rather than jagged, AND (ii) if you divide that stepsize by two, it doesn't produce a noticeable change in your graph.

(d) Make sure you label your axes, mark which curve corresponds to which of your dependent variables, and specify *units* for all of your variables.

(e) To get full credit, your Sage code should be **neat** and **commented** nicely. See the solutions to Mini Projects #'s 2 and 3.

(f) Get started *early.* Give your group's brains time to play around with this. And allow time for things to not work on the first go, because they probably won't.

(g) Your project will be checked against the **checklist** that appears at the end of this assignment. Study this checklist, and make sure you've addressed all of the items there.

(h) Have fun with it!!!

(i) Don't forget the checklist on the next page.

Checklist for Term Project Part B

Please check your project against this checklist. You will lose points for any item that you fail to address.

1. Make sure your term project has a cover page, as described in our homework assignment guidelines.
2. Make sure everything is presented in an organized fashion.
3. Make sure your real life scenario is explicitly stated and described.
4. Make sure your differential equations are explicitly written out **in the write-up** (that is, NOT just in the Sage code).
5. Make sure you initial conditions are specified **in the write-up** (that is, NOT just in the Sage code).
6. Make sure your parameters are specified **in the write-up** (that is, NOT just in the Sage code).
7. Make sure your stepsize is small enough. See the assignment sheet for what "small enough" means.
8. Make sure all dependent variables are graphed, and each individual curve is labeled. (You can label the curves by hand – there are ways to make Sage do this if you want, but you don't have to.)
9. Make sure appropriate comment lines are supplied.
10. Make sure your axes have labels and tick marks.
11. Make sure you conclude with a brief analysis/description of your results.