Problem Set 1
MA104, Spring 2006
DUE: January 19, 2006
Value: 40 points

Instructor: Dr. Leigh Noble

Assigned: January 11, 2006

Recall that this graded assignment must be accompanied by appropriate documentation as per the USMA *Documentation of Written Work.* The assignment is considered late if not turned in by the beginning of class on the due date. You may neatly and carefully sketch graphs by hand, remembering to label all axes and important features. If you use Mathematica to produce graphs, please include the actual Mathematica commands you used to produce each graph.

Sociologists recognize a phenomenon called *social diffusion*, which is the spreading of a piece of information, technological innovation, or cultural fad among a population. The members of a population can be divided into two classes: those who have the information and those who do not. In a fixed population whose size is known, the rate of diffusion is assumed to be proportional to the number of people who have the information times the number yet to receive it.

Use the idea of social diffusion to analyze the spread of a rumor at a small college setting by answering the problems below.

1. Write the spread of a rumor as a differential equation. Be sure to identify all the quantities in your equation.

2. Discuss the reasonableness of the social diffusion model for the spread of a rumor. (A few paragraphs showcasing your primary thoughts about this model are sufficient. You may want to revise your thoughts after you complete parts 3 and 4.)

3. Sketch a slope field (direction field) for the case where there are 4000 students at the college and the proportionality constant is $\frac{1}{1000}$. From this graph, what happens to the rate at which the rumor spreads after a long time? Mark any equilibrium solutions on your graph. Draw a curve representing the case when 20 people initially know a rumor.

4. Sketch the graph of the rate at which the rumor spreads versus the number of people who know the rumor. From this graph, what can you conclude about the number of people who eventually know the rumor?