AMSC/MATH 420, Spring 2013
Modeling Epidemics: Team Homework 2

due Monday February 25

Our next goals are to see how the modified SIR model discussed in class compares to our previous SI model in two ways:

1. What are the possible outcomes as $t \to \infty$?
2. How much better can it fit your data set?

To simplify matters, for the second question you can concentrate separately on the case $q = \mu = 0$ (standard SIR model) and the case $r = \nu = 0$ (SI model with growth/renewal). In each case you can use a solution formula (if you can find one), or find an approximate solution numerically. For a numerical solution, you'll need to choose numerical values for the parameters and initial conditions, then use a differential equation solver like MATLAB's `ode45`, or approximate the model in discrete time (replacing dS/dt with $S(t+1) - S(t)$, etc.)

For question 1 (outcomes), particular items to consider are what happens to each of the four quantities S, $\mathcal{I}$, R, and the rate of new infections $pS\mathcal{I} = \lambda S\mathcal{I}/N$ as $t \to \infty$; does it always go to 0, does it approach a nonzero constant, does it grow toward ∞, does it do something more complicated, and does the outcome depend on the parameters? For this purpose you only need to try different values of μ and ν, since as we discussed in class these determine the overall "shape" of the solutions – in other words, what happens qualitatively.

For question 2 (fit), focus on the rate of new infections (in your data, new diagnoses per month). For each of the cities you were initially assigned and each of the two new parameters, minimize the sum of the squares of the residuals (E_y) as best you can, and report how much smaller you can make E_y compared to the best fit you found for the SI model.