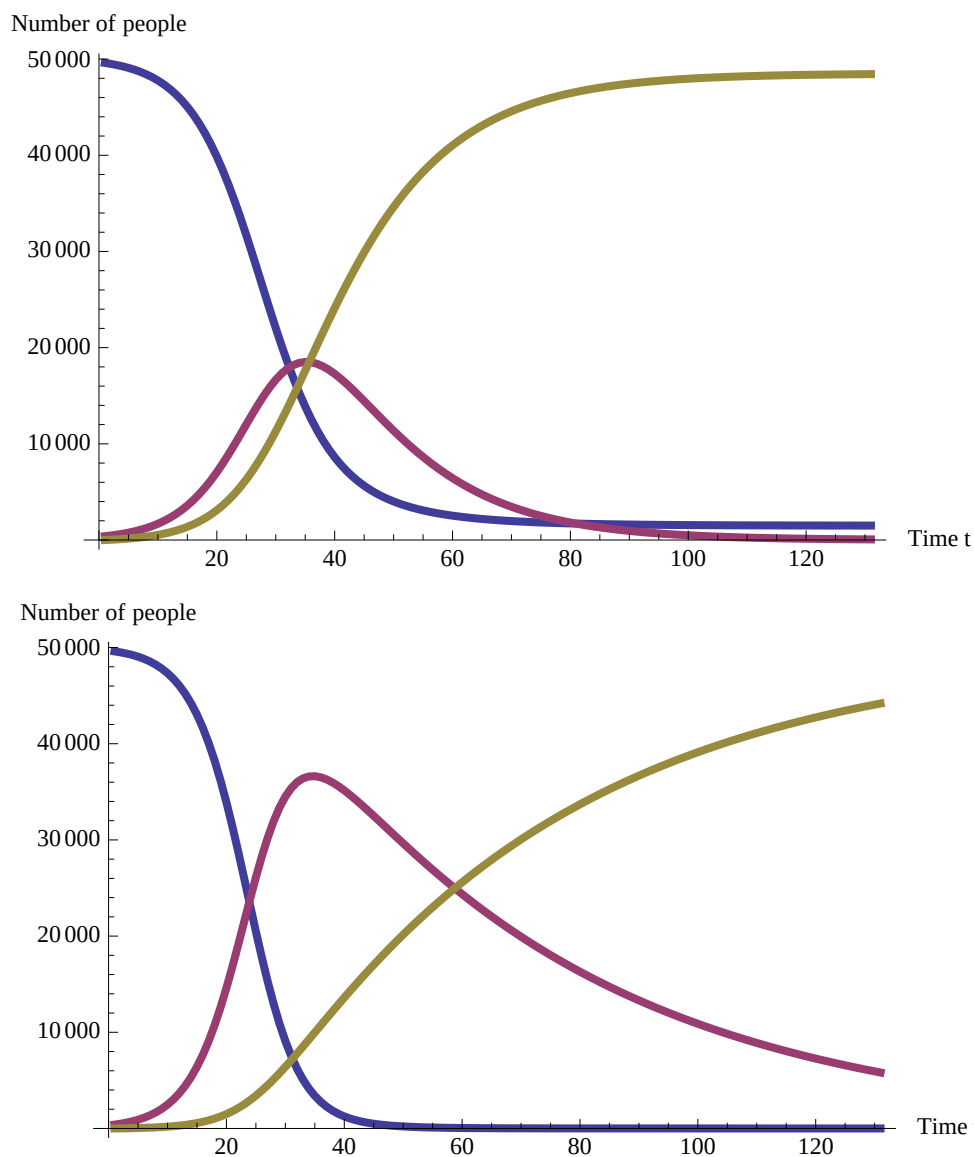


Goal: To explore some more ideas about modeling with rate equations and SIR .

1. Pictured below are two graphs depicting evolution of diseases that progress according to the usual SIR model. For both graphs, the initial values $S(0)$, $I(0)$ and $R(0)$, and the transmission coefficient a , are the same. But the two graphs correspond to different recovery coefficients b .



(a) On each of the graphs, label which curve is S , which is I , and which is R .

(b) Which of the above two graphs corresponds to the *larger* value of b ? Please explain.

(c) Which of the above two epidemics has the larger basic reproduction number r_0 ? Please explain.

2. Consider an epidemic that progresses according to the usual *SIR* model, *except* that, now, recovered people become susceptible again (and can infect again) after m days.

- (a) *Modify* the usual *SIR* equations to reflect this new feature (wherein recovered can become susceptible again). HINTS: (a) Your new equations will look a *lot* like the old ones, but with some *new terms* added on. These terms should account for the facts that, now, on average, $1/m$ of the recovered population gets *added to* susceptible population, and *subtracted from* the recovered population, on any given day. (b) Your new equations should involve unspecified parameters a , b , and c , where a and b are as above, and $c = 1/m$.

- (b) In the two graphs on the next page, the transmission and recovery coefficients a and b are the same, but the number of days m that it takes to become susceptible again differs from one graph to the next. For which of the two graphs – the one on the top or the one on the bottom — does it take *longer* to become susceptible again? Please explain.

