Exercise 10 - Dynamic Modeling

Complete the tasks below and submit your results via a pull request on GitHub by 8 pm next Thursday.

To begin this week, fork the TA's Exercise 10 Github repo. Clone the forked repo so that you have the required files. Be sure to commit regularly to show how you arrived at your solutions.

1. Models not very different from the population growth model we worked on this week can be used to explore cancer biology. In this exercise, you will use a population model to investigate evolution of drug resistance in tumors.

Imagine a cancer cell in a tumor that spontaneously exhibited a mutation that confers drug resistance. The mutation does not have any positive or negative effects on growth rate of that sub-population when the cancer drug is absent. However, when the cancer drug is present the mutant sub-population grows at 50% of its growth rate in the absence of the drug and the non-mutant sub-population declines rapidly. The model we will use to represent the growth of the two sub-populations is this:

$N_t = N_t + r_N N_t(1 - \frac{(N_t+M_t)}{K})$

$M_t = M_t + r_M M_t(1 - \frac{(N_t+M_t)}{K})$

Assume in the absence of the cancer drug that the cells grow at a rate of 0.1 per day ($r_N = r_M = 0.1$) and the carrying capapcity (K) of the tumor is one million cells. The mutation of a single cell occurred early in the tumor growth and when it occurred there were 100 total cells in the tumor. Drug treatment of non-mutant cells results in a negative growth rate of -0.1.

Generate a script that simulates growth of the two sub-populations in the tumor to equilibrium followed by drug treatment. Plot your results using a line graph.

Turning in your assignment via GitHub

Once you have committed all changes to your local Git repo and pushed all of those commits to the forked repo on GitHub, you can "turn in" your assignment using a `pull request`. This can be done from the GitHub repo website. When viewing the forked repo, select "Pull requests" in the upper middle of the screen, then click the green "New pull request" button in the upper right. You'll then see a screen with a history of commits for you and your collaborator, select the green "Create pull request button". In the text box next to your user icon near the top of the page, remove whatever text is there and add "last name submission", but obviously substitute your last names. Then click the green "Create pull request" button.