Exercise 10 - Statistical and Dynamic Modeling

Complete the tasks below and submit your results via a pull request on GitHub by the beginning of tutorial next Friday.

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. In lecture, we used maximum likelihood and a likelihood ratio test to complete a t-test. We can actually use a likelihood ratio test to compare two models as long as one model is a subset of the other model. For example, we can ask whether `y` is a hump-shaped vs. linear function of `x` by comparing a quadratic $(a + bx + cx^2)$ vs. linear $(a + bx)$ model. Generate a script that evaluates which model is more appropriate for the data in `data.txt`.

2. A classic model of competition between two species was developed by Lotka & Volterra. This model has two state variables described by two differential equations:

$\frac{dN_1}{dt} = R_1(1 - N_1\alpha_{11} - N_2\alpha_{12})N_1$

$\frac{dN_2}{dt} = R_2(1 - N_2\alpha_{22} - N_1\alpha_{21})N_2$

The criteria for coexistence of two species in the Lotka-Volterra competition model is

$\alpha_{12} < \alpha_{11}$ and $\alpha_{21} < \alpha_{22}$

Generate a script that uses three or more model simulations to demonstratethe validity of these criteria for coexistence.

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.