Coding Assignment 3

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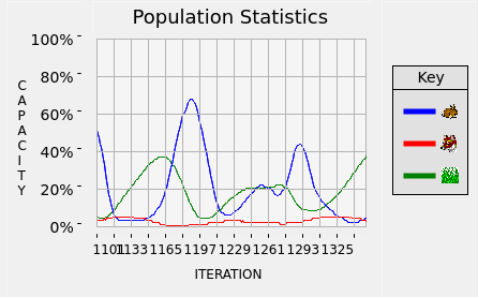
Problem 1 — Lotka-Volterra Model

Part 1: Questions from Biology Corner

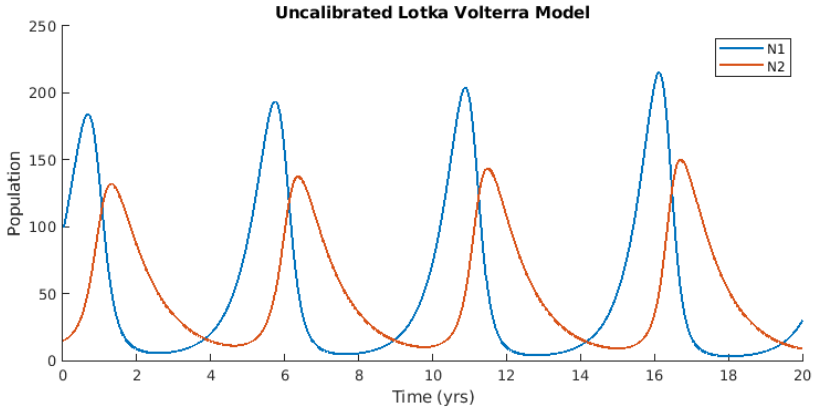
1. Over time, the grass becomes healthier/greener as rabbit population declines, since less rabbits are there to eat it. Rabbits get more populous with more abundant green grass. Wolves don't survive because the wolf population is so highly dependent on the rabbit population density that when the rabbit population decreases, the large number of wolves cannot survive/mate.
2. In order to get a stable run for 1000+ iterations, the parameters need to be modified s.t. the wolves clear out just the right amount of rabbits as the grass gets eaten up. I did this by setting Rabbit repo age to **5**, the wolf repo age to **15** and wolf repo food level to **140**.
3. For the above to work, forest size needed to be set at **huge**.



Problem 1 — Lotka-Volterra Model

Part 2: Simulate LV Model

The initial, uncalibrated simulation of my model is shown below:



Problem 1 — Lotka-Volterra Model

Part 2: Cost Function Used

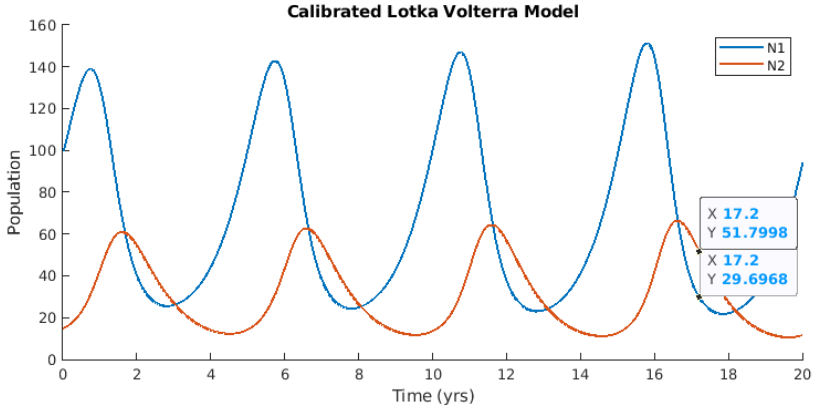
I decided to use the sum of the sum of square errors:

$$Error = \sum_{j=1}^{k=2} \sum_{i=1}^{length(N_j)} (N_j - Obs_j)^2$$

Problem 1 — Lotka-Volterra Model

Part 2: Calibrate LV Model

The calibrated simulation of my model is shown below:



Note: the datatips match the observed data.

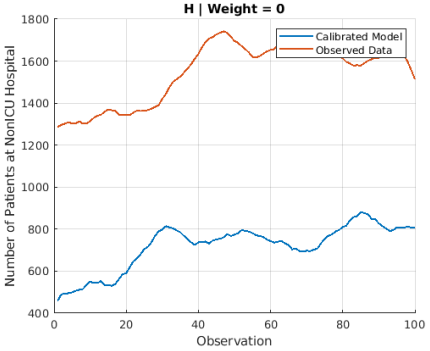
Problem 2 — Task 1 Model Calibration

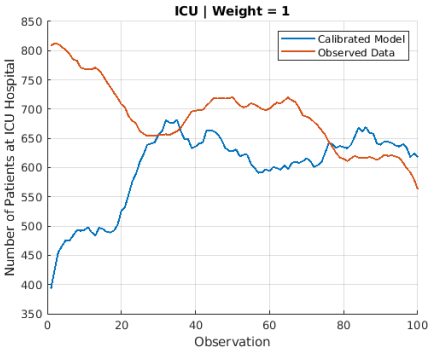
I used MSE this time as my cost function, trying to minimize error using `fmincon`:

$$Error = \alpha MSE_H + (1 - \alpha) MSE_{ICU}$$

Problem 2 — Task 1 Model Calibration

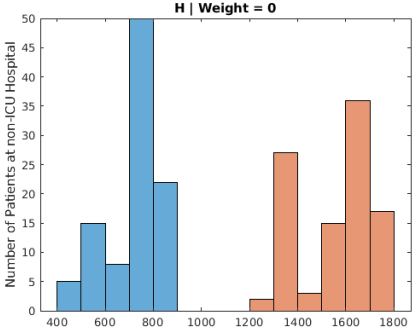
My calibration accuracy depends on the alpha value, as this weights the cost function either towards a better calibration for H or ICU. Here alpha = 0, so the calibration is weighted entirely towards ICU:

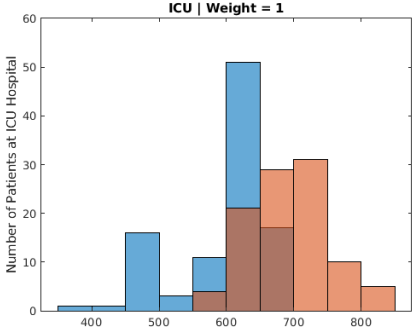




Problem 2 — Task 1 Model Calibration

This data can also be visualized using histograms.





Problem 2 — Task 1 Model Calibration

Additionally, alpha can be varied to adjust our callibration. Note how ICU calibration is worse than two slides prior...