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DS 3500: Advanced to Programming with Data
Filename: pred.py
Description: animation of fox and rabbit prey and predator model

a. Which species is better able to survive?

Based on the manipulation of the fox k value, rabbits are better able to survive as the k value is manipulated. The fox k value represents the number of cycles or generations that the foxes can go without food. When the fox k value was 10 or 20 the fox population eventually went extinct, but the rabbit population stabilized along with the grass coverage. As the fox k value increased to 30, meaning they could last 30 cycles without food, their population also stabilized and harmony was found in the ecosystem. Because the rabbits do not rely on another animal to survive, their survival is impacted by the grass growth rate. This contrasts the survival of foxes because foxes depend on rabbits for food, so in order for a fox population to be stable, the rabbit population needs to be stable, which is dependent upon a reliable supply of grass. Because of this food chain relationship, rabbits are better able to survive as long as there is a sufficient amount of grass.

b. Does your outcome depend on the size of the field or the rate at which grass grow or the fox k value? If so, how?

The outcome depends on a variety of factors including size of the field and more importantly the grass growth rate and the fox k value. Based on the graphs that visualize populations over time, the fox population stabilizes when they can last 30 cycles without food, in other words when k is equal to 30. When k was 10 or 20, the foxes could not survive long enough without food to reproduce and maintain a stable population. Having adequate grass is another crucial factor to see if the foxes and rabbits will find harmony. For the purposes of our simulation, the default grass growth rate is 0.05, which is enough to support the tested rabbit populations. If there is not enough grass, the rabbits will die, and consequently the foxes will die too. This is evident in the graph with 50 foxes, a fox k value of 30, 100 rabbits, size 200, and a grass growth rate of 0.025. In this graph, once the rabbit population spikes from eating all the grass, it quickly falls and the rabbits all die because the grass does not grow fast enough to sustain the rabbits. To contrast that is a graph with a grass growth rate of 0.075 and the same other parameters as the previous graph, which allowed life to flourish more as the rabbits had more food to eat and were able to reproduce more, and in turn the foxes also had more food to eat. Based upon manipulation of the size of the field, a size of about 200 seems to be optimal, but overall size of the field is not the greatest contributor to outcome. As long as the field is not too small or unreasonably large, for example, 1000, with a starting population of foxes and rabbits being small, for example under 10 each, the population should be able to sustain itself as they reproduce. A population so small in such a large environment would make it difficult for the foxes to find the few rabbits that are there. Likewise, large populations crowded in a small field size would not allow the animals to flourish.

To conclude, size of the field, grass growth rate, and fox k value, are all factors that influence the outcome of the fox and rabbit populations. Based on our simulations, we have found that an optimal k value is above 30, a grass growth rate of 0.05 is okay if the fox k value is closer to 50 otherwise a rate of 0.075 is necessary to sustain an initial fox:rabbit ratio of 1:2, and a field size of 200 is sufficient but can fluctuate without a great impact on the populations.