

Modeling Project #3

Your main goal in this project is to model a system of interacting species. Start by describing a real-world scenario in which two species interact. Develop a mathematical model for your scenario that uses nonlinear differential equations. Analyze your mathematical model to reach conclusions or get insight on the real-world scenario. Finally, write a report describing your scenario, model, results, and conclusions.

Your report is due Wednesday, December 6.

1. Here are some factors that you might want to consider in setting up your scenario:
 - (a) Does the interaction involve competition, predation/parasitism, or mutualism?
 - (b) Is either species limited by environmental resources?
 - (c) Is the ecosystem being managed (for example, by harvesting)?
 - (d) Is the ecosystem closed or is migration occurring?
 - (e) How do parameters such as net growth rate compare? For example, does one species reproduce rapidly in comparison with the other species?
 - (f) How do the initial values compare? For example, you might have a scenario with two competing species. If one species has invaded the ecosystem, it would have a small initial size in comparison with the established species.
2. You can think of specific species (e.g. liger and zeldebeest) or work with generic species (e.g. predator and prey). The scenario you describe will be artificial to some degree.
3. You should avoid a scenario or model for which you've seen analysis in our text or other source. If you have seen analysis in our text or another source, your own analysis should extend or complement that analysis.
4. You can work with parameters as symbols or specific values. One question you can ask is how behavior of the model system changes as one or more parameters change. Are there values of a parameter at which the behavior of the system changes significantly? For example, if there is an equilibrium point of interest, how does stability of that equilibrium point depend on the values of parameters? Does the equilibrium point go from stable to unstable as the values of some parameter go through a specific value?
5. You can also look at how the behavior of solutions depends on initial conditions. Are there initial conditions leading to a certain behavior (for example, extinction of one species) and other initial conditions leading to a different behavior?
6. Feel free to discuss your scenario and model with me before starting detailed analysis.