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BI 471

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Homework 3

1.

6.1

- One rationale underlying the use of stability is the claim that the systems we see in nature correspond to stable solutions of the models we use to describe these systems (controversial)
- Biologically controversial: how stable are natural systems really? Does variability really represent stability?
- Mathematically controversial: is the mathematical definition of stability the same as the biological? Is there ever a solution for any system? (No)

There seems to be two approaches to the application of stability analysis and equilibrium in nature. One is a what I would call a "perfectionist's approach" and the other a "visual approach." The perfectionist approach is a kind of fact check to the mathematics used to derive these system models, that most systems either don't ever become disturbed within the arbitrary bounds of the model that would allow them to return to equilibrium. Or within the same approach, that most systems operate outside the bounds of "near equilibrium" and so the model isn't as useful as it appears. The visual approach is a more constructive view of the system in that it is useful in beginning to understand the mathematics and how they can fluctuate depending on the system in question. Examples like the ball 'rolls downhill' (Hastings) have helped me understand and visualize the equations we've been working with. The more you begin to understand the visual aspect of stability however, the more you begin to understand the perfectionist approach. There doesn't seem to be any perfect solution for any real system.

6.3

Since in the notation α_{ij} is equal to the partial derivative of the function of species i divided by the partial derivative of the change in density or the disturbance by species j a matrix can be formed known as the species or community matrix. In this matrix there are four values of α_{ij} where the two species are form A and i and j are equivalent to the species 1 and 2 being compared but are meant as place holders where ij = (11, 12, 21, 22). For a two species system this results in an interaction between the two species change in per capita growth (shown as $\frac{\partial f_2}{\partial N_1}$ and $\frac{\partial f_1}{\partial N_2}$). In the case of predator-prey it could be assumed that as the number of predators, let's call them N_1, increase the number of prey (N_2) decreases and so the interaction might look like $\frac{\partial f_2}{\partial N_1} < \frac{\partial f_1}{\partial N_2}$. Competition would be the same but the assigned numbers are less important and so as one population increases the other decreases, and depending on where you start one population might crash. In the case of mutualism I would actually believe the interaction would be the most interesting as the model might look like $\frac{\partial f_2}{\partial N_1} = \frac{\partial f_1}{\partial N_2}$.

2. In Chapter 6 it appears that the α_{ij} is representation of the relationship of the change in per capita growth rate dependent on the species (i) and itself (i) as well as the other species (j). The values derived for α_{ij} are placed in a matrix and used to calculate an eigenvalue. This case gives the α_{ij} an actual intrinsic value that can be calculated from the model and has meaning. In Chapter 7, α_{ij} is derived to be the coefficient representing the effect of one species on another (where α_{ii} is the coefficient of the effect of the species on itself and generally equal to 1). According to Hastings (and Lotka and Volterra) the α_{ij} has no intrinsic meaning or value biologically and is meant to fit the model to data. I think that since the α_i is derived from 1/K that instead of an alpha a lowercase kappa be used instead, representing an arbitrary coefficient $\varkappa_i$. This might remove some of the confusion surrounding the values.

3. Increasing the *p* parameter increases the percent of the population that stays increases. As you increase the *p* the distance between *v0* and *v1* increases indicating a larger initial movement in order to approach steady state. If the *p* value the is more .50 then the steady state will approach the x (California) axis and if it is less than .50 then it will approach the y (New York) axis. This is an interesting interaction because the matrix is dependent on its own values (*p* , *1* - *p*) and so I don't believe that the lambda (eigenvalue) changes as the eigenvectors change. (On second read through I actually read that this is a Markov matrix and the eigenvalue is constant – a "duh" moment but at the same time I'm glad I understand what they mean by lambda always equaling 1).

4. I have studied jellyfish in the past (although not directly). I believe their growth and population blooms are an indicator of global climate change as well as the general health of the ocean. Most cases of large blooms are localized however I believe that this is more cause to study as indicator species might help us dictate which areas are in most need of conservation/intervention. Climate change is a hot topic as of recent and I believe that large amounts of resources should be poured into educating the public on what it means and that jellyfish are a good example of a reason why to contribute to reversing the damage.

Climate-driven population size fluctuations of jellyfish (*Chrysaora plocamia*) off Peru

http://link.springer.com.libproxy.uoregon.edu/article/10.1007/s00227-015-2751-4

- Study of large sums of data as well as experiments done in the southern Pacific Ocean during different weather and climate events

- Extensive research into reproduction and population blooms in sequence with weather events (El Nino, La Viejo/Vieja), fishing (commercial anchovy landings) and temperature

Climate change and dead zones

http://onlinelibrary.wiley.com.libproxy.uoregon.edu/doi/10.1111/gcb.12754/full

- More insight on dead zones and the effect climate change has on estuaries and other at risk areas
- Less about jellyfish but interesting information about opportunistic species