Welcome to Ecological Modeling (BI382)

Among professionals, “modeling” is ambiguous

- Dear Dr. Moore, … I was very excited to learn about your work and its alignment with our goals for this position.

  - **Position description**: The successful candidate will teach a 200-level ecology course with a field-based laboratory, *a 300-level course in ecological modeling*, …

- Dear Search Committee Chair, … I have one question about the position that will help me better understand one of the teaching requirements. Specifically, courses on ecological modeling can be rather disparate, and I've seen them as strictly mathematical, simulation-based (e.g., agent-based modeling, GUI-based laboratories), or statistical, as examples. My question is: does the department or committee a specific aspect of ecological modeling in mind?

- Hello Chris, … We have been intentionally vague on the modeling course . . . We would prefer a broad course that introduces students to the concept of ecological modeling and includes both mathematical and computational approaches. *Our students are just figuring out the role that modeling can play in scientific inquiry.*

Professional discussion on mathematics in ecology

- url: https://dynamicecology.wordpress.com/2014/10/20/what-math-should-ecologists-teach/

- “Here’s my list of topics that a very well-trained mathematical ecologist would need (beyond a 1st year calculus sequence):

1. Multivariate calculus simplified (partial derivatives, volume integrals)
2. Matrix algebra and eigenvectors
3. Dynamical systems (equilibrium analysis, cycling and chaos)
4. Basic probability theory and stochastic processes (especially Markov chains with brief coverage of branching processes and master equations)
5. Optimization theory focusing on simple calculus based optimization and Lagrange multipliers (and numerical optimization) with brief coverage of dynamic programming and game theory”

How computers help us

An equation published by me

$$\frac{1}{N_1}\frac{dN_1}{dt} = r_1 - \alpha_1 N_1^{\theta_1} + \beta_1 N_2$$

$$\frac{1}{N_2}\frac{dN_2}{dt} = r_2 - \alpha_2 N_2^{\theta_2} + \beta_2 N_1 .$$

An equation published by Denise Bruesewitz in ES

$$\frac{dP}{dt} = G \times P - Zgp - Pm \times P - Pl \times G \times P$$

$$\frac{dZ}{dt} = Zgp \times Zep + Zgb \times Zeb + Zgd \times Zed - Ze \times Z - Zm \times Z$$

$$\frac{dBA}{dt} = Bdone + Bnhe - Zgb - BAm \times BA$$

$$\frac{dNN}{dt} = DNN - G \times Fnn \times P$$

$$\frac{dNH}{dt} = DNH - G \times Fnh \times P - Bnhe + BAm \times + \left(\frac{3}{4} \times Ze \times Z\right) + \left(\frac{2}{3} \times Zm \times Z\right)$$

$$\frac{dDON}{dt} = DDON + Pl \times G \times P + c \times D + \left(1 - \frac{3}{4}\right) \times Ze \times Z - Bdone - s \times DON$$

$$\frac{dD}{dt} = (1 - Zep) \times Zgp + (1 - Zeb) \times Zgb - Zgd \times Zed - c \times D + Pm \times P + \frac{1}{3} \times Z$$

$$Ae = e^{-a \times NH}$$

$$Fnn = \left(\frac{NN \times Ae}{NN + Knn}\right)$$

$$Fnh = \left(\frac{NH}{NH + Knh}\right)$$

$$e = Zgpp \times P + Zgpb \times BA + Zgpd \times D$$

$$Zgp = Zg \times Z \times (Zgpp \times P)/(h + e)$$

$$Zgb = Zg \times Z \times (Zgpb \times B)/(h + e)$$

$$Zgd = Zg \times Z \times (Zgpd \times D)/(h + e)$$

$$G = Pg \times (Fnn + Fnh)$$

$$Bdone = \frac{BAe \times BA \times DON}{Kba + DON + NH}$$

$$Bnhe = \frac{BAe \times BA \times NH}{Kba + DON + NH}$$