Topics in Modern Ecology – ECOL 8000

Ecological Modeling (Strauss – Fall 2020)

Breakout Room Prompts & Homework Assignments

\*Since you won’t be able to see my slides when we split for breakout rooms, I’ve copied all of the prompts from the slides here. I also copied homework assignments here.

\*\*For most breakout rooms, I suggest that you use the whiteboard function to sketch graphs, etc. I’ll be rotating between rooms to join your space and advise.

**Class 1 (Sep 15)**

Topics: Why Model; Foundations of population models

Prompt 1.1

* Sketch 6 graphs. For both exponential growth and logistic growth, sketch:
	+ Net population growth (dN/dt) over population size (N)
	+ Per capita population growth (1/N dN/dt) over population size (N)
	+ Population size (N) over time (t)

$$\frac{dN}{dt}=rN\left(1-\frac{N}{K}\right)$$

$$\frac{dN}{dt}=rN$$

Prompt 1.2

1. In groups, draw a conceptual model (boxes and arrows) to represent processes by which a population changes over time. Hint: don’t overthink this, and remember that in a model, simplicity is often a virtue)
2. Turn your arrows into hypotheses: how do inputs and outputs into the boxes depend on your state variable(s)?, and how could you plot these graphically and write these mathematically?
3. Put these together into an equation: how do the parameters in your proposed functions relate to *r* and *K*?

Homework

Finish prompt 1.2 on your own (if we didn’t get to it in class).

**Class 2 (Sep 17)**

Topics: Adding complexity; From wooly hypothesis to precise equations

Prompt 2.1

How do I get from this…

 dN/dt = (b0 – b1N) x N – (d0 + d1N) x N

… to this? $\frac{dN}{dt}=rN\left(1-\frac{N}{K}\right)$

In other words, how are r and K related to b0, b1, d0 and d1?

What does this tell us about their meanings?

Prompt 2.2

Our “wooly” question: for a given amount of hunting effort (e.g. boats deployed), what happens to my population size, and my fishing yield?

Solve this model at equilibrium, and sketch population size (N) and yield (qEN) as functions of hunting effort (E)

 $\frac{dN}{dt}=rN\left(1-\frac{N}{K}\right)-qEN$

Homework

* Read two papers; practice ‘chunking’; focusing on how/why model was used.
	+ Courchamp et al. 2006
	+ Strauss et al. 2015
* Jot down four sentences for each paper.
	+ What was the motivating ‘wooly’ hypothesis?
	+ Why did the authors include a model in the paper?
	+ Were parts of the model confusing?
	+ How would conclusions of the paper have been different without the model?

**Class 3 (Sep 22)**

Topics: More complexity; Models in literature

Prompt 3.1

1. Plot the cost per unit catch (CPUC) and the price per unit catch (p) as functions of population size, N.

2. What does this tell you about the equilibrium population size (N\*) under open access exploitation?

3. How does N\*depend on economic parameters (c,p) and hunting technology (q?)

4. Substitute your expression for N\* into the equation for dN/dt to determine the equilibrium value of E (E\*) and interpret this result in relation to model parameters.

 $\frac{dE}{dt}=αE\left(pqN-c\right)$

 $\frac{dN}{dt}=rN\left(1-\frac{N}{K}\right)-qEN$

Prompt 3.2

* Each of you: Brainstorm an ecological question related to your research goals that could be explored with a mathematical model.
* Develop a conceptual model (box and arrows). Identify the state variables your model will track, and what processes cause these to change through time
* Specify your mechanism: what is the driving process your are interested in? How does it affect flow rates that increase or decrease your state variable?

Homework

* Be ready on Thursday to pitch your idea of a model (prompt 3.2) to a different (random) small group.

**Class 4 (Sep 24)**

Topics: Model simplification & thresholds

Prompt 4.1

* Break into 4 groups
* Everyone give a 2 minute ‘pitch’ of their project
* Spend 10 minutes as a group deciding which project you will pursue
* Each group gives their 2 minute pitch to the class

Prompt 4.2

* Suppose the population size of OSE is initially susceptible
* (no-one has had this cold before), so S(0)=N
* Now enter the pesky undergrad, who sneezes, so I(0)=1
* Can you sketch how the number of uninfected and infected individuals changes through time?

$$\frac{dS}{dt}=-pcSI \frac{dI}{dt}=pcSI - γI$$

Prompt 4.3

How does changing *p,c, N* and *g* change R0?

R0 *= pcN*/*g*

For each of *p, c, N* and *g* , describe a disease control intervention that could reduce R0 below 1 (e.g. what kind of control methods could reduce p?)

Homework

Finish prompt 4.3 (if we didn’t get to it in class); you may want to work ahead on group projects.

**Class 5 (Sep 29)**

Group project work

**Class 6 (Oct 1)**

Presentations & wrap-up