EEMB 247/BMSE 247: Quantitative Methods in Biology, Winter 2018

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This course will explore the quantitative methods required to develop models of biological and ecological systems.

Topics to be covered:

Constructing models of biological systems, using:

- Differential equations
- Difference equations
- Various stochastic formulations

Solving models that can be solved analytically:

- Linear differential equations
- Linear difference equations and matrix models

Non-linear models:

- Various mathematical functions
- Numerical solutions of differential and difference equations
- Graphical analysis
- Equilibria, linearization, and local stability analysis
- Non-dimensional form

Various approaches to stochastic simulation

Techniques for fitting models to data:

- Likelihood
- Optimization
- Observation and process error
- Trajectory matching
- State-space models

Format of class, and grading:

Each week the first half of the class with consist of lectures, and the second half will be computer exercises, using R. Bring your laptop every week.

Homework: There will be homework assignments as part of every computer exercise. These will be due the following Friday.

Final Project: The final project will involve taking any model that interests you and trying out 2 or more of the techniques that we learn in class on it. During the final class session, each student will give a short presentation on his/her model, analysis efforts, and results.

Tentative Schedule:

Date	Topics
Jan. 19	Introduction, how to construct a model, introduction to ODEs, introduction to R
Jan. 26	Linear models in continuous and discrete time (e.g. matrix models) Numerical solutions to difference equations and differential equations.
Feb. 2	Linearization and Local Stability Analysis
Feb. 9	Separation of timescales
Feb. 16	Putting equations into dimensionless form
Feb. 23	Stochastic models, Gillespie method
Mar. 2	Fitting models to data
Mar. 9	Spatial models of various types, patch models, lattice models, partial differential equations
Mar. 16	Student presentations of projects