MTH 428/528 Stochastic Elements in Mathematical Biology

Course description: This course is an introduction to stochastic modeling of biological processes. Stochastic models covered may include Markov processes in both continuous and discrete time, urn models, branching processes, and coalescent processes. Biological applications modeled may include genetic drift, population dynamics, genealogy, demography, and epidemiology. Mathematical results will be qualitatively interpreted and applied to the biological process under investigation.

Credits: 3

Meets: Three weekly lectures.

Prerequisites: MTH 341 and (MTH 361 or MTH 463/563), or permission of the instructor. All courses used to satisfy prerequisites must be completed with a C or better.

Course Content: The goal of this course is to familiarize students with the stochastic modeling of various biological processes. Different models are often appropriate to understand distinct features, and choosing an appropriate model is an integral part in the modeling procedure. The models to be introduced in this course may include

- Discrete time and continuous time Markov chains.
- Mathematical models of genetic drift. Wright-Fisher model and binomial distribution.
- Application: Wright-Fisher model as a Markov chain.
- Moran process (aka ‘Moran model’) as a model of finite populations.
- Branching processes and their applications in genealogy.
- Coalescent processes and their applications in population genetics.

A variety of mathematical techniques will be covered when analyzing these models.

Learning Resources: Lecture notes, handouts, web materials, and copies of papers will be provided.

Grading: the grade will be entirely determined by the outcomes of homework assignments/projects.
Course Learning Outcomes:

- Convert verbal descriptions of biological systems into appropriate mathematical models amenable to quantitative and qualitative analysis. This will be tested via homework problems in which students will be provided with a verbal description of a biological system, and asked to write down a stochastic model (for example, a Markov chain).

- Obtain mathematical results from stochastic models, then provide biological interpretations of the results. This will be tested via homework problems and final exam.

- Communicate biological models to life scientists. This will be tested by students’ class participation. Since the background of the students of this interdisciplinary class is expected to be quite diverse, exposure to other areas, and interdisciplinary training will be tangible outcomes of this course.

- Learn to read and understand research papers in the area of mathematical biology (MTH 528 only).

Students with Disabilities: Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

Course drop/add information can be found at http://oregonstate.edu/registrar/

Academic Honesty and Student Conduct: Students are expected to be familiar with Oregon State University’s Code of Student Conduct. Please review this statement at https://beav.es/codeofconduct

Reach out for Success: University students encounter setbacks from time to time. If you encounter difficulties and need assistance, it’s important to reach out. Consider discussing the situation with an instructor or academic advisor. Learn about resources that assist with wellness and academic success at http://oregonstate.edu/ReachOut. If you are in immediate crisis, please contact the Crisis Text Line by texting OREGON to 741-741 or call the National Suicide Prevention Lifeline at 1-800-273-TALK (8255)