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

Terms offered: Spring.

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 and take-home projects.

Course Learning Outcomes:

A student who has successfully completed MTH 428 will be able to:
• 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.

A student who has successfully completed MTH 528 will be able to:

• Achieve all of the outcomes of students having successfully completed MTH 428 outlined above.

• Learn to read and understand research papers in the area of mathematical biology. This will be tested via additional homework problems based on research publications selected by the instructor.

Students with Disabilities: Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 737-4098.
Course drop/add information is at http://oregonstate.edu/registrar/.

Student Conduct: All students are expected to obey to OSUs Student Conduct Code; see http://oregonstate.edu/studentconduct/ See also http://oregonstate.edu/studentconduct/offenses for information on the consequences of Academic or Scholarly Dishonesty