SFU

Stochastic Processes In Biology

MATH 468/768

Instructor Info

Ailene MacPherson

Office Hrs: Tu&Fr 12:30-1:30

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Course Info

https://amacp.github.io/PopGen/

Math 360 or equiv

MWF

12:30-1:20

Overview*

The natural world is inherently random. Describing, understanding, and predicting phenomena in Ecology, Evolution, and Epidemiology therefore requires the use of mathematical models that explicitly include this randomness. In this course we will cover methods and applications of probability, stochastic processes, and computer simulation to these three fields.

*This is for the Spring 2024 offering. Content may vary.

Course Objectives

- Mastery of the principals of probability and stochastic processes.
- Learn to develop and analyze probabilistic and stochastic models for applications in Ecology, Evolution, and Epidemiology.
- Use computational methods to simulate and analyze random events and processes in biology.
- Develop and sharpen your ability to formulate scientific questions and address those questions with mathematics.
- Gain skills in scientific writing, this involves the formulation and communication of perspectives and the expression scientific findings in a clear and concise manner.

Selected Texts

The following texts will be used in this course but are not required.

- Otto, Sarah P. & Day, Troy. *A Biologists Guide to Mathematical Modelling in Ecology and Evolution.* 2007.
- Durrett, Rick. *Essentials of Stochastic Processes.* 1999. ISBN: 0-387-98836-X
- Karlin, Samuel & Taylor, Howard. *A Second Course in Stochastic Processes.* 1981. ISBN 0-12-398650-8.

Grading Scheme

Component	Weight
Bi-Weekly Homework[1] x 6	30% (5% each)
Midterm[2]	20%
Presentation	10%
Final Project	40%

[1] 768 will include an additional challenge question
[2] 768 will include an additional take-home portion

Final Project

Length Requirement: 10pg max, $\geq$1 figure

Section	Description	Grade
Proposal[1]	A 1pg summary outlining proposed project.	15%
Title & Abstract	A short summary (200 word max) of the project that clearly states aims and focal conclusions.	5%
Intro.	Provides background, context, and motivation. Must include a thesis statement (e.g., "This works evaluates...").	20%
Methods[2] & Results	Summarize what methods you used. Why are these methods were appropriate. Explain what you found.	30%
Discussion	What are the implications of what you found? What are the limitations of your work?	15%
Figure	Figure(s)/tables(s) that support(s) the content of the methods or results	10%
References[3]	Reference list of additional literature	5%

[1] 768 proposal must include 3 references
[2] 768 required to have an appendix with a key derivation
[3] 468(768) required to have at least 1(5) references.

Diversity and Inclusivity Statement

In this course you will treat others and be treated with respect. We welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, orientations, national origins, abilities, and other visible and non-visible differences. All members of this course are expected to contribute respectfully and in return each contribution will be appreciated and treated with respect.

Academic Integrity

“All members of the university are expected to uphold the values of academic integrity: honesty, trust, fairness, respect, responsibility, and courage. SFU considers any act of falsification, misrepresentation or deception to be destructive because it is unfair to students who pursue their studies honestly, it compromises the worth of other’s work, and ultimately prevents students from meaningfully reaching their own scholarly potential.

Being an SFU student means you belong to a scholarly community where you will develop the critical thinking and research skills to not only be job ready but life ready. The satisfaction of a degree earned through hard work and persistence is a prize that is profoundly meaningful and universally respected.” `https://www.sfu.ca/students/academicintegrity.html`

Class Schedule

Week	Topic	Assignments etc.
Week 1-2	Probability	HW 1
Week 3-4	Discrete-time Discrete-space Markov Chains	HW 2
Week 5	Poisson Processes	HW3 & Midterm
Week 6-7	Continuous-time Discrete-space Markov Chains	HW 4
Week 8	Auto-regressive Processes	Proposal[1]
Week 9	Stochastic Differential Equs.	HW 5
Week 10	Individual (Agent)-Based Simulations	
Week 11	Model Fitting	HW 6
Week 12-13	Presentation & Writing Workshop	

[1] Project proposal due (1pg)