BIOSTATS 690MS: Stochastic Models in Population Genomics
Fall 2015, MoWe 2:30PM-3:45PM, Arnold House, Room 103

INSTRUCTOR:
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Office Hours: Tu 10:00AM-12:00PM

REQUIREMENTS:
- STAT 515 & 516
- Programming experience (R, C++, Java, Python, ...)
  [level: completion of http://www.codecademy.com/en/tracks/python or equivalent for other languages]
- Working knowledge of LaTeX (or willingness to aquire)

COURSE DESCRIPTION: This lecture will introduce stochastic models used in Population Genomics to study the evolutionary forces that shape genetic variation. We will introduce these models in the neutral setting, and extend them to incorporate biological phenomena like natural selection, recombination, and changes in population size and structure. We will learn how to use these models for simulation, as well as applying them to modern genomic datasets to infer biological relevant parameters.

COURSE OBJECTIVES:
- Learn theoretical foundations of stochastic models used in population genomics.
- Implement these models for simulation and analysis of genetic data.

RECOMMENDED SUPPLEMENTAL MATERIAL:
- Probability Models for DNA Sequence Evolution by R. Durrett; Springer (2007). http://www.math.duke.edu/~rtd/Gbook/PM4DNA_0317.pdf
- Gene Genealogies, Variation and Evolution by J. Hein, M. Schierup, and Carsten Wiuf; Oxford University Press (2002).
- Mathematical Population Genetics (2nd Edition) by W. Ewens; Springer (2004).
- Coalescent Theory by J. Wakeley; Roberts & Co. (2008).

MOODLE:
A moodle course is associated with this lecture. Please log into moddle at https://moodle.umass.edu/ and confirm that the course **BIOSTATS690MS** is listed under your courses for this semester. The lecture notes and supplemental material for the class will be posted here. The homework sets will be posted on moodle and have to be submitted through moodle.

GRADING:
4 Homework assignments: 60%
Final exam: 40%

HOMEWORK:
The homework sets will consist of problem-set-style assignments and implementation exercises. Four homework sets will be posted on moodle at the indicated dates. The solutions have to be submitted through moodle in electronic form (pdf, word, ...) one week after the day they are posted by 1:30 PM. Homework solutions turned in up to 48 hours after the time they are due will be scored with a multiplier of 0.5. Homeworks handed in later than 48 hours after the due date will not be graded. Submit a textual answer to each problem. Additionally, for problems that require implementation, a working implementation of the

solution has to be submitted (in R,C++, Java, or Python; different language by request). Collaboration on homework is encouraged, although every student must write up and submit their own assignment (no copy and paste). The level of expected programming proficiency is that after completion of the online tutorial at http://www.codecademy.com/en/tracks/python or equivalent for other languages.

FINAL EXAM:

The final exam will be a written in-class exam on the given date. The exam will be 90 minutes long. It will cover all topics addressed throughout the lecture. There will be no implementation part. Student's are allowed to take a one-page (back and front) self-written cheat sheet into the exam with them.

LECTURE NOTES:

Lecture notes will be scribed by the students. For each lecture, one student will be assigned as scribe, who should take notes during the lecture, compile the lecture notes, and submit them to the instructor a week after the respective class (later if homework is due). After editing, they will be posted on moodle. Each student has to scribe 3 lectures throughout the semester. Provided the assigned notes are completed in a timely and orderly manner, they will not affect the grade. A LaTeX template for the lecture notes will be provided.

Course Outline (27 Lectures)

Date	Day	Note	Content
9/7	M	NO CLASS	Labor Day
9/9	W		Review Syllabus, Course overview
9/14	M		1. Background & Wright-Fisher Model
9/16	W		2. Ancestral Process
9/21	M		
9/23	W	Homework 1 posted	3. The Coalescent Process
9/28	M		
9/30	W	Homework 1 due	
10/5	M		
10/7	W		
10/12	M	NO CLASS	Columbus Day
10/13	Tu	Monday class	3. The Coalescent Process (cont'd)
10/14	W	Homework 2 posted	4. Site-Frequency Spectrum & Variable Population Size
10/19	M		
10/21	W	Homework 2 due	
10/26	M		
10/28	W		5. Coalescent with Recombination
11/2	M		
11/4	W	Homework 3 posted	6. Sequentially Markov Coalescent
11/9	M		
11/11	W	NO CLASS	Veteran's Day
11/12	Th	Homework 3 due	6. Sequentially Markov Coalescent (cont'd)

Date	Day	Note	Content
11/16	M		7. Structured Coalescent
11/18	W		
11/23	M		8. Wright-Fisher Diffusion
11/25	W	Homework 4 posted	
11/30	M		
12/2	W	Homework 4 due	9. Spectral Representation of WF Diffusion
12/7	M		
12/9	W		
12/14	M		Final Exam
12/16	W	No Class	Final Week

Academic Honesty Policy Statement:

Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst.

Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. The procedures outlined below are intended to provide an efficient and orderly process by which action may be taken if it appears that academic dishonesty has occurred and by which students may appeal such actions.

Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent. For more information about what constitutes academic dishonesty, please see the Dean of Students' website: http://umass.edu/dean_students/codeofconduct/acadhonesty/

Disability Statement

The University of Massachusetts Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological, or learning disability on file with Disability Services (DS), Learning Disabilities Support Services (LDSS), or Psychological Disabilities Services (PDS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements.