Principles of Population Genetics 1
ECEV 35600/EVOL 35600

Winter 2020, Tu 1:00 PM - 2:20 PM, Zoom (Link will be provided on Canvas)

Instructors:

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Requirements:
- Calculus
- Introduction to Probability and Statistics (Stat 24400 or equivalent)
- Programming experience in R

Course Description:
This graduate level course introduces foundational theoretical concepts in population genetics underlying the study of evolutionary forces that shape genetic variation. The course introduces these concepts in the neutral setting, and extends them to incorporate biological phenomena like inbreeding, different modes of selection, recombination, and changes in population size and population subdivision. During the course, students will learn how to use coalescent and diffusion models for simulation, as well as applying them to modern genomic datasets to test hypothesis and learn about the underlying evolutionary processes.

Recommended supplemental reading:
- Population Genetics – A Concise Guide (2nd Edition) by J. Gillespie (2004).
- Notes on Population Genetics by G. Coop (2017). https://github.com/cooplab/popgen-notes/blob/master/popgen_notes.pdf
- Probability Models for DNA Sequence Evolution by R. Durrett (2007). http://www.math.duke.edu/~rtd/Gbook/PM4DNA_0317.pdf
- Gene Genealogies, Variation and Evolution by J. Hein, M. Schierup, and C. Wiuf (2002).
- Coalescent Theory by J. Wakeley (2008).

Remote teaching:
The course will be taught entirely remotely. Once a week, on Tuesdays from 1:00 pm to 2:20 pm, the class will meet on Zoom (Link will be provided on Canvas) to discuss the indicated content for that week. Students will be expected to prepare for these meetings by watching two pre-recorded lectures on the respective content, each approximately 1 hour in length. The pre-recorded lectures will be made available one week in advance on Canvas. During the discussion, students will have the opportunity to ask clarifying questions and key concepts can be discussed in more detail. To better prepare for the discussion, each student should submit two questions pertaining the content of the lectures on the day before the meeting (email to Marty and Matthias). In this unusual situation, things might have to be adjusted as the Quarter proceeds, and we might have to deviate from this setup.

ZOOM:

The weekly class meeting will be held on Zoom (Link will be provided on Canvas). If you use your UChicago Zoom-account, you should be able to access the meeting. If you have trouble joining, feel to reach out to us. Ideally, we should be able to solve all technical problems at the beginning of the first session in the Quarter.

CANVAS:

A Canvas course is associated with this lecture. Please log into Canvas at https://canvas.uchicago.edu/ and confirm that the course **ECEV 35600** or **EVOL 35600** is listed under your courses for Winter 2021. The pre-recorded lectures, the link to the weekly discussion, and homework sets will be posted on Canvas and solutions to the homework have to be submitted through Canvas. Slides from the lectures, additional reading, supplemental material, and announcements for the class will be posted on Canvas as well.

GRADING:

7 Homework assignments:	85%
Participation in discussion on Zoom and discussion section:	15%

HOMEWORK:

The homework sets will consist of problem-set-style assignments and implementation exercises. Seven homework sets will be posted on Canvas at the indicated dates. The solutions have to be submitted one week after the day they are posted by 1:00 PM (beginning of class) on Canvas. 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 in R has to be submitted on Canvas by the same deadline. We strongly encourage using RMarkdown for the homework submissions. Collaboration on homework is encouraged, although every student must write up and submit their own assignment (no copy and paste). We will deduct points for copied assignments.

DISCUSSION SECTION:

The course will be accompanied by a weekly hour-long discussion section on Zoom lead by the Teaching Assistant. The purpose of this section is to introduce some mathematical background, clarify questions about the lecture or the homework sets, and discuss reading material related to the lectures. A suitable time for this section will be determined via a doodle poll. Students are expected to prepare for this discussion section and answer prompts or send two questions about the respective material to the TA beforehand.

Course Outline:

Date	Day	Note	Content
1/12	Tu		Historical overview
1/19	Tu	HW 1 posted	Gentic drift & Mutation Linkage disequilibrium
1/26	Tu	HW 1 due / HW 2 posted	Selection Quantitative traits
2/2	Tu	HW 2 due / HW 3 posted	The Coalescent process
2/9	Tu	HW 3 due / HW 4 posted	Ewens Sampling Formula, D-tests for neutrality Site-Frequency spectrum (SFS)
2/16	Tu	HW 4 due / HW 5 posted	Variable population size Coalescent with recombination (SFS)
2/23	Tu	HW 5 due / HW 6 posted	Sequentially Markovian Coalescent Structured Coalescent
3/2	Tu	HW 6 due / HW 7 posted	Wright-Fisher diffusion Wright-Fisher diffusion with Selection
3/9	Tu	HW 7 due	Time series genetic data Poisson Random Field, SFS
3/16	Tu	No Class	

Disability Statement

University of Chicago is committed to ensuring equitable access to our academic programs and services. Students with disabilities who have been approved for the use of academic accommodations by Student Disability Services (SDS) and need a reasonable accommodation(s) to participate fully in this course should follow the procedures established by SDS for using accommodations. Timely notifications are required in order to ensure that your accommodations can be implemented. Please meet with me to discuss your access needs in this course after you have completed the SDS procedures for requesting accommodations.