Principles of Population Genetics 1
ECEV 35600/EVOL 35600

Winter 2020, TuTh 2:00 PM - 3:20 PM, Zoology Building, Room 212 (Lillie Room)

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).

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 2020. The homework sets will be posted on Canvas and solutions to the implementation exercises 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: 100%

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 2:00 PM (beginning of class). 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 as a hard-copy (printed) at the beginning of class. Additionally, for problems that require implementation, a working implementation of the solution in R has to be submitted on Canvas by the same deadline. Collaboration on homework is encouraged, although every student must write up and submit their own assignment (no copy and paste).

Discussion section:

The course will be accompanied by a weekly hour-long discussion section 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.

Course Outline:

Date	Day	Note	Content
1/7	Tu		Historical overview
1/9	Th		Gentic drift & Mutation
1/14	Tu	HW 1 posted	Linkage disequilibrium
1/16	Th		Selection
1/21	Tu	HW 1 due / HW 2 posted	
1/23	Th		Quantitative traits
1/28	Tu	HW 2 due / HW 3 posted	The Coalescent process
1/30	Th		
2/4	Tu	HW 3 due / HW 4 posted	Ewens Sampling Formula, D-tests for neutrality
2/6	Th		Site-Frequency spectrum (SFS)
2/11	Tu	HW 4 due / HW 5 posted	Variable population size
2/13	Th		Coalescent with recombination
2/18	Tu	HW 5 due / HW 6 posted	Sequentially Markovian Coalescent
2/20	Th		Structured Coalescent
2/25	Tu	HW 6 due / HW 7 posted	Wright-Fisher diffusion
2/27	Th		Wright-Fisher diffusion with Selection
3/3	Tu	HW 7 due	Time series genetic data
3/5	Th		Poisson Random Field, SFS
3/10	Tu		
3/12	Th	No Class	Reading Period
3/16	Tu	No Class	Reading Period