BCB 722: Topics in Population Genetics

8/11/2020 – 9/10/2020
Tuesdays and Thursdays, 11:30 – 12:45
Location: Zoom (https://software.sites.unc.edu/zoom/);

Instructor:

Dr. Daniel Schrider
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5111 Genetic Medicine Building
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Office hours: Wednesdays at 3:00 – 4:00, and by appointment, via zoom

Teaching Assistant:

Logan Whitehouse
Bioinformatics & Computational Biology Curriculum
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Office hours: Monday at 11:00 AM, and by appointment, via zoom

Sakai site URL:

https://sakai.unc.edu/portal/site/bcb722_fall2020_popgen

Course description:

What are the evolutionary forces the genetic and phenotypic diversity within species? In what manner does natural selection play a role? What about non-selective demographic forces such as population size changes and migration events? The best way to answer these questions is to study the dynamics of mutations as they spread across populations. This is the study of population genetics. This course will cover the essentials of population genetic data and theory, and equip students with the methodological tools required to combine the two in order to make evolutionary inferences from modern population genomic data sets.

Course requirements:

To obtain full credit, students must attend 80% of the lectures, complete all reading/homework assignments, and achieve a passing grade overall. If any students believe they may have to miss more that 20% of the lectures, they must discuss this with the lead instructor in advance.

Grading rubric:
- In-class participation: 30%
- Final writing assignment: 15%
- Homework assignments: 50%
- End-of-module survey completion: 5%

Syllabus:

All homework assignments will be uploaded onto Sakai immediately following the lecture (if not sooner). These assignments will typically be short answer questions about the concepts/results from the required reading. There will also be two computer programming assignments due on 8/25 and 9/3, respectively. These assignments will be a mix of coding up methods discussed in class (in the R programming language), applying these methods, and answering and few questions about the results. These assignments are to be completed individually—no working in groups (but do take advantage of office hours if you need help!).

Each time materials are deposited onto the course site you should receive an e-mail notification. All assignments are due at the time of lecture (i.e. 11:30 am) on the specified due date. Reading assignments are to be submitted by emailing the document to me (drs@unc.edu), and the programming assignments will be submitted through Sakai.

Please also note I may modify the course syllabus at any time, but will inform the students both in lecture and through Sakai if/when this happens.

Every lecture will start with brief discussion of ~1-2 concepts in population genomics, largely based on questions that students submitted on the first day of class. (Questions will be selected for discussion on the basis of their relevance to the lecture topic and the overall course material.)

Optional textbooks:

Because this is a 5-week course there will not be any books that you are required to purchase. However, I want to recommend a couple of introductory population genetics textbooks that those interested in delving a little bit deeper into this area of study or just supplementing the material in the lectures/readings or might consider. The first is an accessible introduction to the theoretical foundations of population genetics, while the second is more focused on the practice of population genetic analysis (while covering relevant theory where required).

1. Population Genetics: A Concise Guide (2nd edition). John H. Gillespie. The Johns Hopkins University Press (Baltimore & London).
   https://jhupbooks.press.jhu.edu/content/population-genetics

2. Molecular Population Genetics (1st edition). Matthew W. Hahn. Sinauer Associates (New York & Oxford).
   https://global.oup.com/academic/product/molecular-population-genetics-9780878939657?cc=us&lang=en&

Schedule of lectures and readings/assignments:

Date	Topic(s)	Required readings for next class	Assignments and due dates
8/11	What is population genetics?	Crow_mutation.pdf	Three questions about Pop Gen (due 8/13).
8/13	Genetic Drift, the neutral theory, and the coalescent	Gould_spandrels.pdf Hudson_coalescent.pdf*	Coalescent reading/questions (due 8/18).
8/18	Population structure and migration: models and inference	Rosenberg_structure.pdf Novembre_PCA.pdf	Pop. structure reading/questions (due 8/20).
8/20	Natural selection I: Types of selection and their impact on variation; direct selection and linked selection.	Nielsen_selection.pdf Fay_WuH.pdf*	Selection I reading/questions (due 8/5)
8/25	Recombination	Reich_LD.pdf	Recombination reading/questions (due 8/27); Programming assignment 1 due.
8/27	Natural selection II: Recurrent hitchhiking, local adaptation, and selective sweeps	Barreiro_Fst.pdf McDonald_Kreitman.pdf Reinhardt_clines.pdf*	Selection II reading/questions (due 9/1)
9/1	Polygenic selection and quantitative traits	Turchin_GIANT.pdf Sohail_uncorrectedStruct.pdf Berg_polygenic.pdf*	Polygenic selection and adaptation reading/questions (due 9/3)
9/3	Guest lecture: Dr. Anton Suvorov, topic: Phylogenetics, and its intersection with population genetics	Hahn_chapter10.pdf	Population genomics reading/questions (due 9/18); Programming assignment 2 due.
9/8	Demography: inference, and confounding relationship with selection (and vice-versa).	Li_PSMC.pdf Fagundes_ABC.pdf*	Demographic inference reading/questions, and Exit Survey (both due 9/10)
9/10	Population genomics and the future: genome-wide data, time series data, ancient DNA, joint inference of selection and		Writing assignment due

	demography		

*Optional reading assignment. Completing the "optional reading assignment" form and submitting prior to lecture on the due date will result in bonus points (equal to one-third of a required reading assignment).