USC School of Medicine   **PM599 Population Genetics**
Units: 3
Summer Semester, Tuesdays: noon-2.55pm

Location: Soto Building Room 303, HSC
Instructor: Paul Marjoram
Office: Room 202V Soto Building, 2001 N. Soto St., HSC.
Office Hours: Thursdays 1-2pm
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Teaching Assistant: TBD.
Office Hours: TBD.
Contact info: TBD.

IT Help: Not applicable.

Course Description:
"Nothing in biology makes sense except in the light of evolution." - Theodosius Dobzhansky, noted Russian geneticist.

We live in an era in which massive population-level genome-wide data are being collected. Often the goal is to uncover connections between genetic and phenotypic variation. A fully-informed interpretation of such data depends upon an understanding of the effects of a variety of natural phenomena on the evolution of patterns of variation we might expect to see. For example, if a population experiences a bottleneck, such as the Out of Africa event for humans, levels of variation are drastically reduced.

In this course we introduce students to population genetics, the study of the processes that influence the genetic make up of populations. We will study processes such as mutation, recombination, selection and genetic drift. We will then examine the impacts of features such as population stratification, or changes in population sizes, upon the properties of that data.

We will attack these problems using many tools, but our principle approach will depend upon a mathematical model called the *coalescent*, Introduced by Kingman in 1982.

Learning Objectives
Students should finish the course with a good grounding in the importance of population genetics process and the influence they have on the properties of genetic variation data. This will allow for more accurate and informed analysis of such variation data. We will make extensive use of 'off the shelf' software that will allow various population genetic scenarios to be easily simulated. In this way we will observe and/or predict the effects of population genetics scenarios and theory.

Prerequisite(s): No formal prerequisites, but students will need to have a background in elementary probability skills and use of a programming language.
Co-Requisite (s): None.
Concurrent Enrollment: None.

Recommended Preparation: It wouldn't hurt to brush up on your understanding of basic probability and genetics.

Course Notes
Projects and exercises will be assigned throughout the course. Final grades will be determined by performance on these projects. There will be no final exam.
Copies of lecture slides and other class information will be posted on Blackboard.

Technological Proficiency and Hardware/Software Required
Not applicable.

Required Readings and Supplementary Materials
Coalescent Theory: An Introduction - John Wakeley (the course will be self-contained, but this is the recommended text for the mathematical material).
An Introduction to Population Genetics: Theory and Applications – Rasmus Nielsen and Monty Slatkin (this book is a slightly lower-level introduction to the math. material).
Principles of Populations Genetics – Daniel Hartl and Andrew Clark. One of the 'bibles' of the field. It covers more of the biological background.
All are readily available via Amazon.com.

Description and Assessment of Assignments
I propose to use written assignments as well as software-based analysis assignments. This is the first time this course has been taught, so: a) those aren't written yet, b) this means that you can help influence exactly what those assignments are, and how they should be conducted, as we move through the course.

Grading breakdown:
Final grades will be assessed based on grading of examinable assignments and projects during the course.

Assignment Submission Policy
Each assignment will have a stated due date. Submission will be electronic, using pdfs or Word documents, as you please.

Additional Policies
None.

Course Schedule: A Weekly Breakdown
See next page.

	Topics/Daily Activities	Readings and Homework	Deliverable/ Due Dates
Week 1 Dates	Introduction – course overview	To be determined	
Week 2 Dates	Neutral evolution – historical perspectives and Mendel's peas.	TBD	Assignment possible. If so, it will be due two weeks later
Week 3 Dates	Randomly-mating populations, Wright-Fisher models and Hardy-Weinberg equilibrium.	TBD	Assignment possible. If so, it will be due two weeks later
Week 4 Dates	Modern methods for randomly-mating populations – the coalescent.	TBD	Assignment possible. If so, it will be due two weeks later
Week 5 Dates	More on the coalescent - we dig deeper into the theory	TBD	Assignment possible. If so, it will be due two weeks later
Week 6 Dates	But populations don't mate at random - adding realism to the idealized models. I: Population structure and changes to population size.	TBD	Assignment possible. If so, it will be due two weeks later
Week 7 Dates	Adding realism to the idealized models II: Recombination and Linkage Disequilibrium. Part 1	TBD	Assignment possible. If so, it will be due two weeks later
Week 8 Dates	Adding realism to the idealized models II: Recombination and Linkage Disequilibrium. Part 2	TBD	Assignment possible. If so, it will be due two weeks later
Week 9 Dates	Adding realism to the idealized models III: Selection. Part 1	TBD	Assignment possible. If so, it will be due two weeks later
Week 10 Dates	Adding realism to the idealized models III: Selection. Part 2	TBD	Assignment possible. If so, it will be due two weeks later
Week 11 Dates	Quantitative traits.	TBD	Assignment possible. If so, it will be due two weeks later
Week 12 Dates	So what can we use all this for? Imputation and Association.	TBD	Assignment possible. If so, it will be due two weeks later
Week 13	Implications for Human evolution.	TBD	Assignment possible. If so, it will be due two weeks later

Week 13 Dates	Implications for Human evolution.	TBD	Assignment possible. If so, it will be due two weeks later
Week 14 Dates	How do we analyze the data? Approximate Bayesian computation. Part 1	TBD	Assignment possible. If so, it will be due two weeks later
Week 15 Dates	How do we analyze the data? Approximate Bayesian computation. Part 2		No assignment

IMPORTANT:
In addition to in-class contact hours, all courses must also meet a minimum standard for out-of-class time, which accounts for time students spend on homework, readings, writing, and other academic activities. **For each unit of in-class contact time, the university expects two hours of out of class student work per week over a semester.**

(Please refer to the *Contact Hours Reference,* located at usc.edu/curriculum/resources.)

Statement on Academic Conduct and Support Systems

Academic Conduct
Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards*https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct/.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu/ or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems
A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.htmlprovides certification for students with disabilities and helps arrange the relevant accommodations. If an

officially declared emergency makes travel to campus infeasible, *USC Emergency Information* *http://emergency.usc.edu/*will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.