BICD 156 – Population Genetics

Fall Quarter 2023
Syllabus

Updates since the previous version are <mark>highlighted</mark>.

Essential course information

Course website: https://canvas.ucsd.edu/courses/48645

Check in several times a week

Instructor: Prof. Sergey Kryazhimskiy

Please ask general questions on the subject matter or course logistics on Piazza. If you have individual matters to discuss, please communicate through Canvas

Office Hours: Monday 2:15 – 3:15 PM, Muir Biology Building, #2205

Instructional Assistant (IA): Alex Bevier <abevier@ucsd.edu>

Office Hours: Wednesday 11:00 AM – 12:00 PM, Art of Espresso (map)

Lectures:

Day	Time	Location
Mon Wed	1:00 PM to 1:50 PM	FAH 1101

<mark>Hands-on sessions:</mark>

<mark>Mode</mark>	<mark>Day</mark>	<mark>Time</mark>	<mark>Location</mark>
<mark>In person</mark>	<mark>Fri</mark>	<mark>1:00 PM to 1:50 PM</mark>	<mark>FAH 1101</mark>
<mark>Virtual</mark>	<mark>Wed</mark>	<mark>3:00 PM to 3:50 PM</mark>	<mark>Zoom</mark>

<mark>There are no discussion sections in the traditional sense. Instead, we will have "Hands-on sessions", one on Friday in-person with the instructor and another one virtually with the IA. These sessions will be devoted to solving problems (including homework), answering your questions, and otherwise discussing the material.</mark>

<mark>Hand-on sessions are an important and required part of the course. These are your main opportunities to earn participation points.</mark>

Key dates:

Midterm 1 is on **27 October 2023** (in class)

Course description

How do natural selection, mutation, migration and genetic drift drive evolution? You will learn how these forces operate and how to describe them quantitatively with simple mathematical models. We will discuss how to apply this knowledge to understand the spread of drug resistance in pathogens, the evolution of beneficial as well as disease traits in our own species, the evolution of engineered organisms and more.

Learning Outcomes

In this course, you will learn how and why genetic composition of populations changes over time, and what practical implications these changes can have. By the end of the course, you will be able to:

- Give examples of currently on-going evolutionary changes in various biological systems.
- Explain what genetic variation is, why it is important, how it can be measured, where it comes from and how it changes over time.
- Explain how models are different from reality and why we need models to understand nature.
- Describe models that we use to understand the evolutionary processes in populations, and explain why certain models are used in certain situations.
- List the forces that determine the dynamics of allele frequencies in a population and explain how these forces affect the dynamics.
- Write down a simple mathematical model of an exponentially growing population and analyze it.
- Write down a simple mathematical model of a competition between two genotypes in a population and analyze it.
- List and explain the sources of randomness in evolution. Write down an expression for the probability of fixation an allele in a population, and analyze it.
- Make basic population genetic calculations and estimates. For example, calculate the expected number of mutations that will arise in a population, or estimate the number of generations to the most recent common ancestor of a group of individuals.
- Give examples of the types of information one can extract from genetic data. Design a simple sampling and analysis procedure to obtain some of this information.
- Make basic inferences about population's evolutionary past from simple genealogical trees.

Course Prerequisites

1. BICD 100 (Genetics)
2. MATH 10A or MATH 20A

Population genetics is a quantitative discipline. To understand the material in this course, you will need to know the basic concepts of genetics and have a working knowledge of calculus. We will review the key topics that will be necessary for this course, but please review this material before the start of the course. You must also be fluent in the following high-school level topics: fractions, operations with exponents and logarithms, solving simple algebraic equations, calculating the slope of a line, basic understanding of functions.

Required Learning Materials

- iClickers will be necessary. Please bring your iClicker to every lecture or use the iClicker app
- Calculators may be helpful sometimes. You can bring a scientific calculator to midterms and the final. No graphical calculators are allowed.
- Short writing activities will be done in class and in discussion sections, so please bring paper, pens and/or pencils.

Optional Learning Materials

Richard Halliburton. "*Introduction to population genetics*", 1st edition. Pearson Education Inc (ISBN 0-13-016380-5).

Daniel L. Hartl and Andrew G. Clark. "Principles of population genetics", Sinauer Associates, Inc (ISBN 0-13: 978-0-87893-308-2).

All the required material will be covered in class. However, reading textbooks will likely be helpful. Halliburton is a basic introductory text, Hartl & Clark is more comprehensive. Textbooks will give you a sometimes different and/or wider perspective on some issues. It also has useful exercises similar to those that will be given on the exams.

Assessment

Mandatory

Item	Percent
Midterm 1	25%
Midterm 2	25%
Homeworks	30%
Group project	10%
Participation	5%
Quizzes in class	5%
TOTAL	**100%**

Optional

[Final exam](#)	25%
[Extra credit (aka Bonus points)](#)	Up to 5%

Midterms

Midterms will be written exams in class, during the regular lecture/in-person discussion section times. If you are not able to make take a midterm due to legitimate unforeseen circumstances, you will be able to take a makeup after presenting evidence to the instructor with a valid excuse (e.g., doctor's notice).

Scope

Midterm 1 will cover Module 1, 2 and 3 (exact scope will be specified in class). Midterm 2 will cover Modules 4 and 5 (exact scope will be specified in class).

Makeups

Midterm 1 makeup: Monday Oct 30 at 11 AM, location TBD (tentative).

Midterm 2 makeup: Monday Nov 20 at 11 AM, location TBD (tentative).

Regrading

We will do our best to ensure that no grading mistakes are made. However, mistakes happen. If you think that there was a grading mistake on you midterm grade, bring this up to the IA.

The deadline for regrading requests for Midterm 1 is Monday November 6.

The deadline for regrading requests for Midterm 2 is Monday June 12.

Hopefully, either you agree with the IA that the grade was correct or the IA agrees with your argument, in which case they will change your grade. If you cannot resolve the disagreement between yourself and your IA, you have the option of escalating your concern to the instructor. In this case, send a Canvas message to the instructor (CC your IA) with the scan/photo of the entire exam and an explanation of what you think the problem is. All requests will be addressed, but, due to severe time constraints on the instructor's time, these requests will not be high priority.

Final

The final exam will be optional. You will need to decide by the end of Week 9 whether you want to take it or not. If you do not take the final exam, your final grade will be calculated based on all the other assessments. If you do take the final, it will constitute 25% of your grade, and your midterms will contribute 12.5% each. The final will be a written exam. No makeups will be available.

Scope

The final will be cumulative. Problems will similar to those midterms, quizzes and homeworks.

Regrading

The final exam will not be returned to you and no regrading will be possible.

Homeworks

Homeworks are an essential element of the course. Homeworks will primarily consist of problem sets, but there may also be other assignments. Problems in the exams will be similar to those in the homeworks, but usually easier. So, if you do well on your homeworks, you will do well on the exams. You will do well on the homeworks if you attend discussion sections and ask questions. If you have difficulties with homework problems, please talk to the instructor or IA.

Submit your homeworks electronically via GradeScope by the date/time specified on the homework itself. There will be a grace period until 6 PM of the due date. Turn-ins after the grace period will not be accepted. The lecture plan gives an approximate timeline for all homeworks.

Team Project

Two of the most valuable soft skills that you need to master to succeed in any future career are (i) working effectively in a team and (ii) presenting your work in a clear compelling way.

To sharpen these skills, everyone will participate in a team project. The goal of the project is to read and understand a primary research paper about evolution and present it to the class in one of several formats. Each team will consist of 3-4 people. The total score for the presentation for each person will consist of two parts, the Quality Score (QS) and the Contribution Score (CS). The total score is calculated as $0.8 \times QS + 0.2 \times CS$. All team members will receive the same QS based on the assessment of the quality of the presentation by the instructor. CS will be determined by each individual's contribution to the team. You can present the work in one of several formats. The most common ones are a 1-page report, a 2-minute video, a 5-minute presentation in class. More detailed instructions on this assignment will be given during class.

Participation

During lectures and hands-on sessions, there will be many opportunities to interact with the instructor and IA, including individual and group exercises, problem solving on the board and answering questions. The purpose of these activities is not to test your knowledge, but to help you learn. Every time you participate in one of those activities, you get a full or fractional participation point, depending on the difficulty of the activity. One-one interactions with the instructor or IA do not earn you participation point. You

Quizzes

We will have a 5-minute iClicker quiz in class on every Monday. Quizzes are designed primarily for the instructor to gauge how you absorb the material, they constitute only 5% of the grade. Quizzes should be easy. If you feel that you do not know how to solve the problem on the quiz, talk to your IA or the instructor. Midterms and the final will most certainly have problems that are analogous to those in quizzes but harder. No makeups are available for missed quizzes, even if you have a valid excuse.

Extra credit

A number of extra credit (bonus) assignments may be given throughout the course. Bonus problems/assignments may be more difficult than usual. Bonus points are meant as rewards for individuals who are willing to put extra effort into mastering the material. Extra credit points are added on top of your regular grad and each bonus point (BP) is worth 1% point of the final grade. For example, if your final grade on all the mandatory assessments is 95% and you got 4 BPs, your final grade will be 99%. You can earn at most 5 BPs.

Conversion from percentages to letter grades

Your percentage, x	Your letter grade
$x \geq 97$	A+
$93 \leq x < 97$	A
$90 \leq x < 93$	A−
$87 \leq x < 90$	B+
$83 \leq x < 87$	B
$80 \leq x < 83$	B−
$77 \leq x < 80$	C+
$73 \leq x < 77$	C
$70 \leq x < 73$	C−
$67 \leq x < 70$	D+
$60 \leq x < 67$	D
$x < 60$	F

Other Course Policies

- <u>Late turn-ins</u> will generally not be accepted.

- Teamwork Policy. You are encouraged to work together with other students on homeworks and take-home exams, or you can consult with the IAs or the instructor, if you have questions. However, you must write the final answers by yourself based on your own understanding, without consulting with other students. Thus, no two handed-in homeworks/exams should ever be exactly identical.
- Academic Conduct Policy. Compliance with the general academic conduct policy is expected at all times. Visit the [Office of Academic Integrity](#) (OAI) for more information.

Lecture plan

Check Canvas for the current lecture plan.

Instructor Goals

At a minimum, I hope to pursue the following goals and solicit your open and timely feedback on how well we are meeting these goals:
- Communicate effectively and frequently;
- Be an enthusiastic, active and involved;
- Demonstrate a mastery of the discipline;
- Relate material to current practices;
- Clearly explain complex concepts and ideas;
- Provide a framework for lifelong learning;
- Strive to involve participant in class activities;
- Be available to assist participants in or out of class; and
- Have respect and concern for all participants.

To provide your feedback, you can either talk to the instructor in person during office hours, or relay your feedback through your IA (anonymously, if you wish).