Course Number and Title: PCB4553/6685 Population Genetics

Catalog Description: This course provides a comprehensive introduction to the mathematical theory of allele and genotype frequency dynamics within and between populations and will serve as a springboard to more advanced topics in evolutionary biology. Topics covered include deterministic and stochastic processes in evolution and an introduction to classical quantitative genetics theory.

Credit Hours

4 credit hours

Pre-requisites and Co-requisites

Consent of instructor; there are no formal prerequisites. The course assumes familiarity with basic transmission genetics ("Mendelian genetics") and mastery of basic algebra. Some knowledge of calculus and elementary probability theory is useful but not assumed.

Course Objectives

By the end of the course the student will have a basic working knowledge of the fundamental mechanisms of evolution, including:

- Mutation
- Recombination
- Random genetic drift
- Natural selection
- Components of phenotypic variance

Instructor Information

Name: Charles F. Baer
Office location: 621 Bartram Hall
Telephone: 352-392-3550 (office); 352-327-1138 (cell)
E-mail address: cbaer@ufl.edu
Web site: http://people.clas.ufl.edu/cbaer/about/
Office hours: Wednesday period 6-7 (~1:00 – 2:30 pm) or by appointment

Teaching Assistant Information (if applicable):

N/A

Course Meeting Time(s) T/Th P2-3 (8:30-10:25)

Course Meeting Location(s) ROG (Frazier-Rogers) 0110

Course Website

PCB6685/4553 on Canvas. You are responsible for all announcements made in class and/or posted on the course website for this course.

Fees: NONE

Required Materials

Textbook or Other Readings

Option 1. Gillespie, J. H. Population Genetics: A Concise Guide, 2nd Ed. 2004, Johns Hopkins Press. Note: this is the book from which my lectures are drawn. It costs about $30 new.

Option 2. MiniCoop3. This is a FREE population genetics text authored by Graham Coop. A pdf is in the Readings folder in the Files directory on the Canvas site. It contains (almost) all of the material covered in class, and is an excellent presentation. I will attempt to approximately map my lectures onto this book, but they won't be a perfect 1:1 correspondence.

Software

NA

Other Materials (e.g., clickers, instruments, etc.)

NA

Recommended Materials

NA

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For online course with recorded materials:

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

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Course Outline (topics covered by week or by class period)

Week	Day	Lecture	Topic	Reading	Homework
1	T 1/9	1	Introduction, Intro to probability theory	Preface, JHG Appendix A, B, 1.1,1.2	
	H 1/11	2	One-locus dynamics; Genetic Drift I: the Wright-Fisher Model; Moran model	JHG 1.3-1.4; 2.1-2.2; Moran 1958	
2	T 1/16	3	Drift and Mutation II: Effective population size and the Neutral Theory	JHG 2.3-2.5, 2.7; Hartl and Clark, 2nd ed., pp. 66-70; Charlesworth 2009	1
	H 1/18	4	Drift and Mutation III: The neutral coalescent	JHG 2.6; Hudson 1990	
3	T 1/23	5	Natural Selection I: General viability selection in an infinite population	JHG 3.1-3.2	2
	H 1/25	6	Nat Sel II: Maintenance of genetic variation; Intro to Diffusion Theory: Equilibrium Distribution of *p*	JHG 3.3-3.4, 3.7; Rice Ch. 5; Roughgarden, Ch.5	
4	T 1/30	7	NS3: Diffusion theory, con't: Fixation probability	JHG Appendix B, p.200-206; JHG 3.8-3.10;	3
	H 2/1	8	Two-locus (dis)equilibrium	JHG 4.1-4.2	
5	T 2/6	9	Non-random mating: Inbreeding, population subdivision	JHG 5.1-5.3, 5.5	4
	H 2/8	10	Molecular population genetics: Estimators of Theta; Tajima's D	JHG 2.6;	
6	T 2/13	11	Quantitative Genetics I: Correlation between relatives	JHG 6.1	5
	H 2/15	12	QG II: Response to selection	JHG 6.2, 6.5	
7	T 2/20	13	QG III: Dominance and epistasis	JHG 6.4	
	H 2/22	14	QGIV: Evolution of correlated traits	TBA	
8	T 2/27	15	Genetic Load	JHG Ch. JHG 3.5, Charlesworth 2013	6
	H 2/29	16	Evolution of Genetic Systems (e.g., Sex)	JHG Ch. 7; Sharp & Otto 2016	
9	T 3/4	17	Crow 1958 (Opportunity for selection)		
	H 3/6	18	Lewontin and Kojima 1960 (Evolutionary dynamics of complex polymorphisms)		
10	T 3/19	19	Hill and Robertson 1966 (Effect of selection at linked loci)		
	H 3/21	20	Kimura and Maruyama 1966 (Genetic load with epistasis)		

11	T 3/26	21	Price 1970, Price 1972 (Generalized selection theory / Fisher's fundamental theorem)
	H 3/28	22	Felsenstein 1974 (Evolutionary advantage of recombination)
12	T 4/2	23	Maynard Smith and Haigh 1974 (Genetic hitchhiking); Charlesworth, Morgan and Charlesworth 1993 (Background selection)
	H 4/4	24	Hudson, Kreitman and Aguade 1986; McDonald and Kreitman 1991 (Tests of non-neutral evolution of DNA sequences)
13	T 4/9	25	Birky and Walsh 1989 (Effects of linkage on molecular evolution); Kondrashov and Crow 1993 (Tests of non-neutral evolution, part II)
	H 4/11	26	Houle 1992 (Heritability and evolvability)
14	T 4/16	27	Gillespie 2000 (Genetic Draft)
	H 4/18	28	**Project Presentations (? TBA)**
15	T 4/23	29	**Project Presentations (? TBA)**

Attendance Policy

Attendance and promptness are optional but strongly recommended.

Conduct in Class

- Please be courteous and do not talk during lecture. This can be distracting to other students and the instructor.
- Only approved electronic devices may be used in class. Approved electronic devices are laptop computers (when used to take notes or otherwise participate in classroom activities) and voice recording devices. Unapproved electronic devices include cell phones, video recorders, digital cameras and MP3 players.

Grading

Midterm Exam (100 points, 50% of final grade): The midterm is a weekend-long take-home exam. I will post it on the afternoon of Friday, 10/19; it will be due at the beginning of class on Tuesday, 10/23. Open book/notes/Internet. **You may NOT discuss any aspect of the midterm exam with any other individual human, or any Natural Language AI software (e.g., ChatGPT)**.

Class Participation (20 points, 10% of final grade): Each student will be responsible for leading an in-class discussion on one or more of the assigned readings.

Homework will not be graded; it is for your edification. However, I strongly recommend you do the homework!

Final Project (80 points, 40% of final grade). NEW FOR 2024! The final project is a group project in which you design and execute a forward-in-time population genetic simulation, using a programming language of your choosing (e.g., Python, R, Matlab, C, etc.). Group size will be determined by the number of students in the class and the relevant programming expertise, but will be between 3 and 5 people.

Grading Scale

>90%, A; >80-90, B; >65-80, C; <65, E.

Grade Curve Policy

The grades shown in the table are guarantees, e.g., if you make AT LEAST a 65 you are GUARANTEED a C. I reserve the right to curve downward, i.e., to be more generous.

Make-up Exam Policy

Make-up exams will be administered on a case-by-case basis. Valid excuses include (but are not necessarily limited to) personal illness or injury or the illness, injury, or death of a family member. If you know you will need to miss class (e.g., for a job interview), please notify me in advance.

UF Counseling Services

- Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
  - UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
  - Career Resource Center, Reitz Union, 392-1601, career and job search services.
- Many students experience test anxiety and other stress related problems. "A Self Help Guide for Students" is available through the Counseling Center (301 Peabody Hall, 392-1575) and at their web site: http://www.counsel.ufl.edu/.

Honesty Policy

- All students registered at the University of Florida have agreed to comply with the following statement: "I understand that the University of Florida expects its students to be honest in all their academic work. I agree to adhere to this commitment to academic honesty and understand that my failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University."
- In addition, on all work submitted for credit the following pledge is either required or implied: "*On my honor I have neither given nor received unauthorized aid in doing this assignment*."
- If you witness any instances of academic dishonesty in this class, please notify the instructor or contact the Student Honor Court (392-1631) or Cheating Hotline (392-6999). For additional information on Academic Honesty, please refer to the University of Florida Academic Honesty Guidelines at: http://www.dso.ufl.edu/judicial/procedures/academicguide.html.

Accommodation for Students with Disabilities

- Students who will require a classroom accommodation for a disability must contact the Dean of Students Office of Disability Resources, in Peabody 202 (phone: 352-392-1261). Please see the University of Florida Disability Resources website for more information at: http://www.dso.ufl.edu/drp/services/.
- It is the policy of the University of Florida that the student, not the instructor, is responsible for arranging accommodations when needed. Once notification is complete, the Dean of Students Office of Disability Resources will work with the instructor to accommodate the student.

Software Use

All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.