

## Population Genetics, BIOL 4315 (or 5301)

Fall Semester, 2021

Lecture: Tues & Thurs from 9:00am – 10:20am, Education Building 313

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### Recommended textbooks for the course:

Halliburton, Richard. 2004. Introduction to Population Genetics. Pearson Prentice Hall.

Gillespie, John H. Population Genetics: A Concise Guide. Johns Hopkins University Press.

Falconer, Douglas S. & Mackay, Trudy F.C. Introduction to Quantitative Genetics. Pearson Education Limited.

\*\* A computer and calculator will also be needed.

### Course Description:

Broadly defined as the study of the genetic composition of populations, population genetics attempts to quantify the distribution of genetic variation and changes in the frequencies of alleles. Specifically, we will examine how the four evolutionary processes (mutation, genetic drift, natural selection, and gene flow) affect the genetic composition of natural populations. Population genetics has a large theoretical component and is rich in empirical data that we will be exploring through lectures and labs, respectively. Students will get hands-on experience analyzing Sanger and Next-Generation Sequencing data that will include humans, model organisms (e.g., *Drosophila*), and non-model organisms; although, students are encouraged to bring their own data as well.

The lab component will focus on methods of analyzing genetic data. We will analyze real data sets using a variety of computer programs. Each lab is designed to correspond with the lecture topic for that week, which will reinforce those concepts.

### Grading (undergraduate / graduate % of grades are provided):

Quizzes (Thursdays; 5 total)	50 pts (10% / 8%)
Midterm	100 pts (20% / 17%)
Paper Evaluation	50 pts (10% / 8%)
Final	100 pts (20% / 17%)
<b>*Lead Module &amp; Presentation</b>	<b>100 pts (- / 17%)</b>
Labs (8 total)	160 pts (32% / 27%)
<u>In-class Participation</u>	<u>40 pts (8% / 7%)</u>
<b>Total for students:</b>	<b>500 pts / 600 pts</b>

### \*Only Graduate Students do

Grades will be assigned as: 90+% = A, 80-89% = B, 70-79% = C, 60-69% = D, <60% = F.

### Quizzes (10%/8.3%):

There will be 5 10-pt quizzes. Each quiz will be based on 2-3 weeks of material. *Although each quiz will*

*largely focus on material from those 2-3 weeks of material, questions will incorporate information across weeks, and thus students will need to maintain a building foundation.* Quizzes will each consist of approximately 5-10 questions evenly divided into conceptual & computational components. The conceptual component will focus on the concepts covered in lecture, whereas the computational components will focus on applying concepts to solve mathematical problems in population genetics. You are permitted to use a calculator and a list of relevant formulae will be provided. **Quizzes can consist of multiple choice, problem solving, and short & long-answer questions. You need to know the lecture material to complete this exam in the allotted time.**

Paper Evaluation (10% / 8%):

All students will complete an evaluation of a peer reviewed article with topics broadly focusing on population genetics. The papers must include original empirical data collected from at least two different populations.

Lead Module & Presentation (Graduate Students only = 17%):

Each Graduate student will be required to develop and teach a module on at least 1 program that is used to analyze DNA data. The student will then present the program and teach the rest of the class how to actually run the program, what kind of analyses are done, etc. **I need to approve the module before proceeding.**

Lecture Exam & Final (40% / 33%):

There will be a 100-pt midterm exam and 100-pt Final. **Exams will each consist of true/false, multiple choice, and short answer. You need to know the lecture material to complete this exam in the allotted time.**

Labs (32% / 27%)

You will have a total of 8 labs worth 20 points each (total = 160 pts). Students are expected to follow and complete computational lab protocols. All Labs are due by the following Thursday meeting. **5 points will be deducted for each day late.**

Participation (8% / 7%):

You are expected to participate, especially during group discussions following student presentations. You will have role taken randomly as part of your participation grade.

Missed Due Date(s) Policy:

If you miss quizzes or assignments due to illness or death of a family member or close friend, you must (1) notify me prior to the exam (in exceptional cases, I will wave this requirement) and (2) provide an official record of a visit to the doctor or an obituary. Otherwise, you will earn zero points for the missed quizzes/assignments.

Academic Integrity:

Cheating or plagiarism will not be tolerated. The university gives students and faculty guidelines on how to deal with violations of academic integrity, which we expect you to follow and I will follow myself (you can read them at <http://sa.utep.edu/osccr/academic-integrity/>). This policy exists to level the playing field for all students and not give the few cheaters an unfair advantage over the vast majority of students, who are hard-working and honest. Copying from a peer is easy to detect and will be considered as plagiarism.

Special needs and circumstances:

If you need any special accommodations please let me know at the beginning of the class and/or register with the [Center for Accommodations and Support Services](#). Also, if you run into personal problems beyond your control, please let me know before missing a deadline etc. I will try to be accommodating and understanding. Letting me know about problems after you missed a deadline or failed an assignment usually suggests that you are making an excuse. For the official policies on academic integrity and scholastic dishonesty, please refer to [Handbook of Operating Procedures](#).

**Campus Carry:** Persons holding a Concealed Handgun License can lawfully carry their handgun into a UTEP classroom as long as the gun remains concealed. Open carry remains prohibited on campus. In other words, none of us should see (or be able to tell that there is) a gun at UTEP. Call the University Police at 747-5611 or dial 911 if you see any individual on campus with a handgun or other type of weapon. For more information on campus carry, see [<http://sa.utep.edu/campuscarry/>]; for more information on overall campus safety, see [<http://admin.utep.edu/emergency>].

**COVID-19 PRECAUTION:** Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to covidaction@utep.edu, so that the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID-19 testing.

The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area, and will be available at no charge on campus during the first week of classes. For more information about the current rates, testing, and vaccinations, please visit epstrong.org.

### **Important School Dates:**

Aug 23<sup>rd</sup> = Fall classes begin

Aug 23-27<sup>th</sup> = Late registration

Sept 7<sup>th</sup> = Labor Day (**University Closed**)

Sept 8<sup>th</sup> = Fall Census Day

Oct 29<sup>th</sup> = Fall Drop/Withdrawal Deadline

Nov 25-26<sup>th</sup> = Thanksgiving Holiday (**University Closed**)

Dec 2<sup>nd</sup> = Last Class Day

	Date		Lecture Topic	Lecture Topic/LAB
WEEK 1	24-Aug	Tues	Lecture 1: Introduction; What is Population Genetics?	No Lab
	26-Aug	Thurs	Lecture 2: Genetic Variation, Hardy-Weinberg Principle & Linkage Disequilibrium	Lab 1 (Take Home): GenBank Lab (Due 9/2)
WEEK 2	31-Aug	Tues	Lecture 3: Pop structure & sig differentiation (F stats, Phist), etc.	No Lab
	2-Sep	Thurs	LAB 2	Quantifying genetic variation (Due 9/9)
WEEK 3	7-Sep	Tues	Lecture 4: Mutation & Genetic Drift	No Lab
	9-Sep	Thurs (Quiz 1)	LAB 3	Types of Mutations (Due 9/16)
WEEK 4	14-Sep	Tues	Lecture 5: Migration & Gene Flow	No Lab
	16-Sep	Thurs	LAB 4	Recombination (Due 9/28)
WEEK 5	21-Sep	Tues	<b>Class Cancelled</b>	<b>Class Cancelled</b>
	23-Sep	Thurs	<b>Class Cancelled</b>	<b>Class Cancelled</b>
WEEK 6	28-Sep	Tues	Lecture 6: Effective Population Size, Tajima's D, & SFS	No Lab
	30-Sep	Thurs (Quiz 2)	Lecture 7: Linkage DisEq	No Lab
WEEK 7	5-Oct	Tues	Lecture 8: Coalescent Theory	No Lab
	7-Oct	Thurs (Quiz 3)	Lecture 9: Neutral Theory	No Lab
WEEK 8	12-Oct	Tues	<b>MIDTERM</b>	No Lab
	14-Oct	Thurs	LAB 5	Constructing genealogies (Due 10/21)
WEEK 9	19-Oct	Tues	Lecture 10: Selection I	No Lab
	21-Oct	Thurs	LAB 6	Population subdivision (Due 10/28)
WEEK 10	26-Oct	Tues	Lecture 10: Selection II	No Lab
	28-Oct	Thurs (Quiz 4)	LAB 7	Natural selection (Due 11/4)
WEEK 11	2-Nov	Tues	Lecture 11: Forensic Science	No Lab
	4-Nov	Thurs	LAB 8	Forensics Lab (Due 11/11)
WEEK 12	9-Nov	Tues	Lecture 12: Quantitative Genetics	No Lab
	11-Nov	Thurs	Lecture 13: Phylogenetics	No Lab
WEEK 13	16-Nov	Tues (Quiz 5)	Lecture 14: Population Genomics	<b>Scientific Paper Evaluation DUE</b>
	18-Nov	Thurs	LAB : Graduate Student Module	**Graduate Student Module
WEEK 14	23-Nov	Tues	LAB : Graduate Student Module	**Graduate Student Module
	25-Nov	Thurs	<i>Thanksgiving Holiday – University closed</i>	<b>UNIVERSITY CLOSED</b>
WEEK 15	30-Nov	Tues	LAB : Graduate Student Module	**Graduate Student Module
	2-Dec	Thurs:	<b>FINAL TEST</b>	No Lab

Software may/will be used during labs

1. Arlequin 3.5 (<http://cmpg.unibe.ch/software/arlequin35/Arl35Downloads.html>)
2. DNAsp v5 (<http://www.ub.edu/dnasp/>)
3. MEGA5 (<http://www.megasoftware.net/>)
4. Network 4.610 (<http://www.fluxus-engineering.com/sharenet.htm>)
5. PHASE (<http://stephenslab.uchicago.edu/phase/download.html>)
6. MrBayes (<http://mrbayes.sourceforge.net/>)
7. testing for recombination program ....there are many (TBA)
8. MS (<http://home.uchicago.edu/~rhudson1/source/mksamples.html>)
9. IM & IMA2 (<https://bio.cst.temple.edu/~hey/software/software.htm>)
10. STRUCTURE 2.3.3 ([http://pritch.bsd.uchicago.edu/structure\\_software/release\\_versions/v2.3.3/html/structure.html](http://pritch.bsd.uchicago.edu/structure_software/release_versions/v2.3.3/html/structure.html))
11. R programs – e.g., PopGenome, PCA, adagenet
12. BayeScan (<http://cmpg.unibe.ch/software/BayeScan/>)
13. *dadi* (<https://bitbucket.org/gutenkunstlab/dadi>)
14. Stacks (<http://catchenlab.life.illinois.edu/stacks/>)
15. .... Other types of programs