

## **Applied Population Genetic Analysis of Microbes**

PLP6621C

3 credit hours

### **Course Description:**

**This course requires no previous experience in population genetics.** Basic population genetics concepts will be introduced, but not derived in this course. Students are expected to have a basic understanding of genetics. The emphasis of this course is on practical aspects of data collection and analysis.

**The course is designed to address specific problems faced when analyzing microbial populations.** Plant pathogens and other microbes often do not conform to the assumptions underlying population genetic analysis, for example sexual populations.

In this course students will learn to use DNA sequence or genetic marker data to describe population genetic variation and infer evolutionary processes in microbes. The emphasis will be on plant pathogens and examples from the plant pathology literature, but will also be applicable to other microbial populations. Topics to be covered include: sampling strategies, marker types and their evolution, genealogical inference, defining population and geographic structure, and coalescent-based methods for inferring demographic processes (e.g. divergence, migration, and recombination/sex). Methods will be applied in weekly computer labs. Students will have the opportunity to analyze their own population genetic data sets.

### **Instructor:**

Erica Goss  
Room 2415 Fifield Hall  
[emgoss@ufl.edu](mailto:emgoss@ufl.edu)  
352-273-4650

### **Office Hours:**

Office hours are Tuesdays 2:00-4:00 pm in 2415 Fifield Hall (also by Skype: ericamgoss), or by appointment.

### **Course Time/ Location:**

Lecture: Tuesday and Thursday, 9:35-10:25 pm.

Computer Lab: Thursday, 1:55-3:50 pm.

Fifield Hall 2564

**Distance:** Course may be taken via polycom, Skype, or Adobe Connect. Students off-site must have a computer with Windows OS on which they will install freely available software for the computer labs. Please discuss logistics with the instructor prior to the first week of class.

### **Course Objectives:**

Sophisticated computational methods are increasingly being coupled with population genetic data to infer the demographic history and evolution of populations. The use of these methods in inferring population processes is particularly critical for pathogens whose ecology or epidemiology may not easily be observed. In this course, you will learn how to use population genetic data to address questions such as: Is a plant pathogen reproducing sexually? Is there migration among habitats or regions? How many times was an invasive pathogen introduced? The course will

specifically address concerns specific to plant pathogens and microbes, which often clonally reproduce or have mixed reproduction systems. This course will provide you with the skills to:

- Understand fundamental concepts in population genetics
- Apply the appropriate analysis to answer your research question
- Interpret the results of analyses
- Evaluate the assumptions, limitations, and appropriate use of analyses

**Required and Recommended Textbooks:**

There is no required textbook for this course, all material will be provided on the Canvas course site at <https://lss.at.ufl.edu>.

An excellent resource for plant pathologists has recently been published, **Population Biology of Plant Pathogens: Genetics, Ecology, and Evolution**, by Michael G. Milgroom. If you are a student member of APS, you can obtain this textbook for \$150.

**Assessment:**

This is an upper level course and you are expected to be taking the course to expand your knowledge and improve your research. The assigned exercises and projects are meant to help you gain experience using these methods and synthesize what you have learned, but they will also be used to evaluate the level of careful thought and effort that you are putting into the course.

**Laboratory Exercises**

55% of the final grade will come from a series of short-answer questions associated with laboratory exercises.

**Exam**

15% of the grade will come from a mid-term take-home exam.

**Final Project**

A final project will count for 30% of the grade. The project will be graded based on a research paper and presentation to the class. Specific guidelines for the paper and presentation will be provided. The project will involve analysis and interpretation of a population genetic data set. These data can come from your own research or the instructor can provide data. Results will be presented in a research style talk during the last three classes of the term. The paper is due by midnight Sunday, April 24.

**Make-up and Attendance Policy:**

Attending course lectures and labs, completing required assignments on time, and making appointments for extra help as needed are expected. In this course lectures and discussions build on each other. Slides for the lectures will be made available and recordings, if possible. Please contact the instructor directly regarding any serious illness or prolonged absence. In exceptional circumstances, labs may be made up on your own time. However, the software used, while all freely available for download, is not necessarily simple to use. If you do not attend lab you may find yourself having trouble completing the exercise. Extensions on assignments will be provided in the case of a valid and documented excuse.

### Course Schedule:

The following is an outline of what we will cover each class. This schedule is subject to change; changes will be posted on the course Canvas site.

Jan.	5	Introduction and evolutionary framework
	7	Population genetic theory, part I
	7	<u>Lab</u> : Population simulations
	12	Genetic markers – DNA sequences and SNPs
	14	Genetic markers – Microsatellites
	14	<u>Lab</u> : Sequence polymorphism - DnaSP
	19	Measures of population genetic variation
	21	Measures of population genetic variation, cont.
	21	<u>Lab</u> : Diversity statistics - Poppr
	26	Recombination
	28	Sampling
	28	<u>Lab</u> : Recombination and LD – Poppr
Feb.	2	Inferring trees, methods & assumptions
	4	Inferring trees & networks
	4	<u>Lab</u> : Tree-building – MEGA & Poppr
	9	Population structure
	11	Population structure cont.
	11	<u>Lab</u> : Analysis of molecular variance, F-stats - Arlequin
	16	Population structure – Bayesian inference
	18	Population structure – model-free inference
	18	<u>Lab</u> : Structure
	23	Case studies
	25	Exam
March		<b>Spring Break</b>
	8	Population genetic theory, part II
	10	Coalescent theory
	10	<u>Lab</u> : Coalescent simulations
	15	Coalescent methods
	17	Migration (Migrate)
	17	<u>Lab</u> : Migrate
	22	Recombination (ClonalFrame)
	24	Approximate Bayesian Computation (DIYABC)
	24	<u>Lab</u> : TBD
	29	Time-calibrated genealogies (BEAST)
	31	Site frequency spectrum methods (dadi)
	31	<u>Lab</u> : BEAST
April	5	Molecular evolution
	7	Open
	7	<u>Lab</u> : Selection
	12	Open
	14	Open
	14	<u>Lab</u> : Student Presentations
	19	Student Presentations

## **Academic Honesty, Software Use, UF Counseling Services, Services for Students with Disabilities**

In 1995 the UF student body enacted a new honor code and voluntarily committed itself to the highest standards of honesty and integrity. When students enroll at the university, they commit themselves to the standard drafted and enacted by students.

In adopting this honor code, the students of the University of Florida recognize that academic honesty and integrity are fundamental values of the university community. Students who enroll at the university commit to holding themselves and their peers to the high standard of honor required by the honor code. Any individual who becomes aware of a violation of the honor code is bound by honor to take corrective action. The quality of a University of Florida education is dependent upon community acceptance and enforcement of the honor code.

**The Honor Pledge: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.**

On all work submitted for credit by students at the university, the following pledge is either required or implied: **“On my honor, I have neither given nor received unauthorized aid in doing this assignment.”**

The university requires all members of its community to be honest in all endeavors. A fundamental principle is that the whole process of learning and pursuit of knowledge is diminished by cheating, plagiarism and other acts of academic dishonesty. In addition, every dishonest act in the academic environment affects other students adversely, from the skewing of the grading curve to giving unfair advantage for honors or for professional or graduate school admission. Therefore, the university will take severe action against dishonest students. Similarly, measures will be taken against faculty, staff and administrators who practice dishonest or demeaning behavior.

Students should report any condition that facilitates dishonesty to the instructor, department chair, college dean, Student Honor Council, or Student Conduct and Conflict Resolution in the Dean of Students Office.

*(Source: 2011-2012 Undergraduate Catalog)*

### **If you are taking this course distance:**

Should you have any complaints with your experience in this course please contact the instructor. If not resolved, visit <http://www.distance.ufl.edu/student-complaints> to submit a complaint.

### **Software Use:**

All faculty, staff and students 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.

## Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, [www.counseling.ufl.edu/cwc/](http://www.counseling.ufl.edu/cwc/)
  - Counseling Services
  - Groups and Workshops
  - Outreach and Consultation
  - Self-Help Library
  - Training Programs
  - Community Provider Database
- Career Resource Center, First Floor JWRU, 352-392-1601, [www.crc.ufl.edu/](http://www.crc.ufl.edu/)

## Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. 0001 Reid Hall, 352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)

## Grade Points

In accordance with current University of Florida policy, grade points will be assigned as follows.

<u>Letter Grade</u>	<u>Percentage</u>
A	90 or above
B+	87-89
B	80-86
C+	77-79
C	70-76
D+	67-69
D	60-66
E	59 or below

Detailed and up-to-date information on grades and grading policies can be found at the UF registrar web site, [www.registrar.ufl.edu/catalog/policies/regulationgrades.html](http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html)

## Related Courses:

University of Florida offers a number of courses that cover various aspects of population genetics. See the following website for selected offerings:

<http://evolution.group.ufl.edu/course-offerings/>