

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

PLP6621C Spring 2022

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 by appointment.

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

Lecture and computer lab: Tuesday and Thursday, 9:35-11:30 am.

Fifield Hall 2564

**Distance:** Course may be taken via Zoom. Students off-site must have a computer 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.

Zoom link for REC students will be available on the Canvas course front page

### **Technical Assistance:**

Dr. Anuj Sharma

[anujsharma@ufl.edu](mailto:anujsharma@ufl.edu)

Meetings by appointment

**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. The course will specifically address concerns specific to plant pathogens and microbes, which often clonally reproduce or have mixed reproduction systems.

This course covers challenging material that one cannot master in a single semester and different students will have different reasons for taking this course. You may want to specialize in population genetic analysis in your career, or you may have one chapter of your thesis that requires some population analysis. I will aim to provide two sets of learning objectives for the materials in the course, one for those who are looking for basic familiarity with presented topics and another for those looking to understand the material more deeply.

**Objectives for everyone:**

- Learn that population genetic data can be applied address questions such as: Is a pathogen reproducing sexually? Is there migration among habitats or regions? How many times was an invasive pathogen introduced?
- Describe key concepts in population genetics
- Explain how population genetics analysis can be used to learn about microbial populations
- Recognize the assumptions, limitations, and appropriate use of population genetic analysis in the published literature
- Implement analyses using pre-prepared data sets and interpret major results

**Objectives for deeper understanding:**

- Explain key concepts in population genetics
- Apply the appropriate analysis to answer your research questions
- Interpret results of analyses and explain their limitations
- Compare and contrast the assumptions, limitations, and appropriate use of different analyses in your work and the published literature

**E-learning with Canvas:** All students must use Canvas for this course. Syllabus, assignments, resources, grades, and other materials will be posted on the course Canvas page throughout the semester.

**Required and Recommended Textbooks:**

There is no required textbook for this course, all material will be provided on the Canvas course site at <https://elearning.ufl.edu>. For labs, students may use their own laptop or a department laptop.

An excellent resource for plant pathologists is **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 class of the term. The paper is due Monday April 25.

**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 and class sessions will be audio visually recorded for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image on these days are agreeing to have their video or image recorded. 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 nor shared.

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, 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.

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.

**Course Schedule:**

The schedule is subject to change; changes will be posted on the course Canvas site.

Date	Topic
Jan. 6	Introduction and evolutionary framework
11	Population genetic theory - drift and new mutations
13	Coalescent theory, simulation lab
18	Sequence evolution
20	Sex and recombination
25	Sequence polymorphism lab
27	No class – catch up on reading
1	Population genetic diversity
Feb. 3	Calculating diversity statistics
8	Inferring trees & networks, methods & assumptions

	10	Tree-building
	15	Population structure – Fst and AMOVA
	17	Investigating population structure
	22	Baysian clustering
	24	Structure
	1	Discriminant analysis of principal components
	3	Midterm exam
March	Spring Break	
	15	Best practices in population genomics
	17	SNP calling
	22	Detection of sex and recombination
	24	Coalescent methods and MCMC
	29	Estimating migration rates
	31	Dating phylogenies
April	5	Molecular evolution
	7	Detecting selection
	12	Advances in population genomics
	14	Student choice
	19	Presentations

### 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

For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### Online Course Evaluation Process

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

Should you have any complaints with your live or distance experience in this course that cannot be resolved by the instructor, please visit:

- Residential Course: [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf)
- Online Course: <http://www.distance.ufl.edu/student-complaint-process>

### **Academic Honesty**

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following 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."* You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."* The Conduct Code specifies a number of behaviors that are in violation of this code and the possible sanctions. [Click here to read the Conduct Code](#). If you have any questions or concerns, please consult with the instructor.

Many of the assignments in this course are collaborative. Except for the final paper, which may be submitted as a group, all work should be written up in your words even if you discussed it with fellow students.

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. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

0001 Reid Hall, 352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)

### **Accommodations for Students with Disabilities**

If you require classroom accommodation because of a disability, you must first register with the Dean of Students Office (<http://www.dso.ufl.edu/>). The Dean of Students Office will provide documentation to you, which you then give to the instructor when requesting accommodation. The College is committed to providing reasonable accommodations to assist students in their coursework.

### **Campus 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.

- *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
  - Wellness Coaching

- Crisis intervention is available 24/7 from Alachua County Crisis Center: (352) 264-6789.

**\*\*\*\*\* Do not wait** until you reach a crisis to come in and talk. We have helped many students through stressful situations impacting their academic performance. You are not alone so do not be afraid to ask for assistance.

*U Matter, We Care:* If you or someone you know is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu), 352-392-1575, or visit [U Matter, We Care website](#) to refer or report a concern and a team member will reach out to the student in distress.

*Counseling and Wellness Center:* [Visit the Counseling and Wellness Center website](#) or call 352-392-1575 for information on crisis services as well as non-crisis services.

*Student Health Care Center:* Call 352-392-1161 for 24/7 information to help you find the care you need, or [visit the Student Health Care Center website](#).

*University Police Department:* [Visit UF Police Department website](#) or call 352-392-1111 (or 9-1-1 for emergencies).

*UF Health Shands Emergency Room / Trauma Center:* For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; [Visit the UF Health Emergency Room and Trauma Center website](#).

*GatorWell Health Promotion Services:* For prevention services focused on optimal wellbeing, including Wellness Coaching for Academic Success, visit the [GatorWell website](#) or call 352-273-4450.

## **Academic Resources**

*E-learning technical support:* Contact the [UF Computing Help Desk](#) at 352-392-4357 or via e-mail at [helpdesk@ufl.edu](mailto:helpdesk@ufl.edu).

*Career Connections Center:* Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services.

*Library Support:* Various ways to receive assistance with respect to using the libraries or finding resources.

*Teaching Center:* Broward Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring.

*Writing Studio:* 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers.

*Student Complaints On-Campus:* [Visit the Student Honor Code and Student Conduct Code webpage for more information](#).

*On-Line Students Complaints:* [View the Distance Learning Student Complaint Process](#).

## **In-Class Recording**

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.