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
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: https://ufl.zoom.us/j/442616674

Teaching Assistant:
Fernanda Iruegas Bocardo
Room 2437 Fifield Hall
firuegas@ufl.edu
Office hour: Friday 10:00-11:00 am or 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

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 27.

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, 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.

Date		Topic
Jan.	7	Introduction and evolutionary framework
	9	Population genetic theory - drift and new mutations
	14	Lab: Genetic drift simulations
	16	Sequence evolution
	21	Discussion: Using genetic markers to study genetic diversity and evolution
	23	Lab: Sequence polymorphism
	28	More of population genetic dversity
	30	Lab: Diversity statistics - R
Feb.	4	Inferring trees & networks, methods & assumptions
	6	Lab: Tree-building – MEGA
	11	Sex and recombination
	13	Lab: index of association
	18	Population structure
	20	Lab: Structure
	25	Population structure
	27	Lab: adegenet/DAPC – R
March	Spring Break	
	10	Best practices/common mistakes
	12	Lab: Population genomics quality control
	17	Selection and molecular evolution
	19	Lab: Datamonkey or PAML
	24	Coalescent theory and methods
	26	Lab: Migrate
	31	Phylodynamics/phylogeography
April	2	Lab: BEAST

7	Recombination
9	Selection and population genomics
14	Ploidy and parasexuality
16	Big picture
21	Presentations

Grade Points

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

Letter Grade	Percentage
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**

Online Course Evaluation Process

Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. These evaluations are conducted online at https://evaluations.ufl.edu/. Evaluations are typically open for students to complete during the last two or three weeks of the semester; students will be notified of the specific times when they are open. Depending on the end of course presentation schedule, the instructor may provide students class time to complete the course evaluation on a laptop or mobile device. Summary results of these assessments are available to students at https://evaluations.ufl.edu/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
- 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*."

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should

report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code.

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.

Services for 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. 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/

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/**
  - Counseling Services
  - Groups and Workshops
  - Outreach and Consultation
  - Self-Help Library
  - Wellness Coaching
- U Matter We Care, **www.umatter.ufl.edu/**
- *Career Resource Center,* First Floor JWRU, 392-1601, **www.crc.ufl.edu/**

- 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*.