

University of Florida
College of Public Health & Health Professions Syllabus
PHC 6937: Statistical Analysis of Genetic Data (3 credit hours)
 Spring: 2019
 Delivery Format: Online & On-Campus
<http://elearning.ufl.edu/>

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 Office Hours: Tuesdays 2pm – 4pm (after class) or by appointment
 Teaching Assistants: Dorothy Ellis (dorothy.ellis@ufl.edu, Office: TBA, Office Hours: Tuesdays 11:40am – 12:40pm)
 Preferred Course Communications: e-mail or Canvas message

Prerequisites

The students should have taken PHC 6092 and PHC6050c, or equivalent. Permission at the discretion of the instructor may be granted if the student is familiar with linear algebra, maximum likelihood, simple hypothesis testing, and linear regression. Students are not required to have any prerequisites in genetics and an overview of relevant genetic concepts will be covered in class.

PURPOSE AND OUTCOME

Course Overview

An introduction to statistical procedures for genetic studies. Topics that will be covered include: basic population/quantitative genetic concepts (Hardy-Weinberg Equilibrium, linkage disequilibrium, additive/dominant genetic models), QTL mapping, linkage analysis for human diseases, genome-wide association studies, and analysis of gene expression data for eQTL analysis. This class will emphasize the statistical theory behind methods for analyzing genetic data and its application in useful software tools. The goal of this course is to prepare students for potential research in statistical genetics but is also open to a wider community.

Relation to Program Outcomes

To introduce a variety of statistical methods commonly used in analyzing genetic data, with a focus on linkage analysis, disease mapping and association studies.

Course Objectives and/or Goals

Upon successfully completing this course, students should be able to:

1. Describe classical genetic concepts such as chromosomal theory of inheritance and meiotic recombination.
2. Discuss basic population and quantitative genetic principles such as Hardy-Weinberg Equilibrium and be able to estimate allele and genotype frequencies.
3. Discuss the difference between linkage and association studies, and family-based versus population-based studies.
4. Describe differences in statistical methods for QTL mapping in experimental crosses (single-marker, EM, regression) and perform an analysis using the R/qtl software.
5. Discuss methods to analyze family-based linkage studies and genome-wide association studies.
6. Interpret results from genome-wide association studies, discuss challenges in analysis such as population stratification, and calculate statistics such as the odds ratio.

7. Perform an eQTL analysis using gene expression (RNA-seq) data.

DESCRIPTION OF COURSE CONTENT

Topical Outline/Course Schedule

Instructor reserves the right to modify the course schedule with advance notice provided to students.

| Week | Date(s) | Topic(s) | Assignments |
|------|------------|--|----------------------|
| 1 | 1/8, 1/10 | Introduction to Genetics | |
| 2 | 1/15, 1/17 | Introduction to R, Genetic Data in R | Genetics Quiz (1/17) |
| 3 | 1/22, 1/24 | Experimental Crosses, Heritability | |
| 4 | 1/29, 1/31 | Linkage, Recombination, EM Algorithm | |
| 5 | 2/5, 2/7 | Genetic Distance, Mapping | HW1 due |
| 6 | 2/12, 2/14 | QTL Mapping, LOD scores | |
| 7 | 2/19, 2/21 | QTL Mapping, Thresholds and Confidence Intervals | Project proposal due |
| 8 | 2/26, 2/28 | Advanced QTL Mapping | HW2 due |
| 9 | 3/5, 3/7 | --Spring Break-- | |
| 10 | 3/12, 3/14 | RNA-seq | |
| 11 | 3/19, 3/21 | eQTL | HW3 due |
| 12 | 3/26, 3/28 | GWAS | |
| 13 | 4/2, 4/4 | GWAS | |
| 14 | 4/9, 4/11 | Multiple Testing, FDR | HW4 due |
| 15 | 4/16, 4/18 | Meta-analysis and integrative analyses | |
| 16 | 4/23 | Student Presentations | |

Course Materials and Technology

There is no required text. Instead, handouts will be given out over the course of the semester.

The course materials will be available through the Canvas course website at <https://ufl.instructure.com>. It is imperative that students familiarize themselves with Canvas, check Canvas frequently for possible announcements, and make sure that their e-mail account in Canvas is correct and active.

Students will be required to use their own computers in order to complete the assignments, and homework problems will require R programming. R is freely available to download on all operating systems at <https://cran.cnr.berkeley.edu>. Help can be found at <https://www.r-project.org/help.html>.

For technical support for this class, please contact the UF Help Desk at:

- Learning-support@ufl.edu
- (352) 392-HELP - select option 2
- <https://lss.at.ufl.edu/help.shtml>

ACADMIC REQUIREMENTS AND GRADING

Assignments

All assignments must be typed (unless otherwise noted in class) and submitted electronically on Canvas. Your responses must be supported by both written explanations and the code you generate to produce your result.

Final Project: The goal of the final project is complete a genetic data analysis from start to finish. Students should download publicly available genetic data and re-analyze the data differently than the original authors (or subsequent publications) using methods described in class or newly published statistical methods. Students can either form groups of 2 themselves or work individually. A final report is required and should

contain an introduction and description of the data, the biological question of interest, detailed descriptions of the analysis and statistics performed, and a discussion of the results. The final report should also include the R code used in the analysis. Detailed instructions about the final project and paper will be described in class on Thursday Jan. 17. A brief project proposal will be due on Thursday Feb. 21 and is part of the final project grade. In addition to the report, an in-class presentation (10-15 min) is scheduled for Tues April 23, although this may change depending on the size of the class. The final report is due on the day of the presentation.

Homework: There will be four homework assignments throughout the course. Two weeks will be given to complete homework assignments and more specific information is given in class. A typical assignment will include a variety of problems. Students may be asked to: calculate or estimate various statistics, simulate data from a particular statistical model and vary initial parameter settings or compare models, derive new estimates of statistics used in genetic studies and compare to ones derived in class, and critically examine relevant literature. For problems involving calculations, all work (or code) must be shown to receive full credit. For problems involving comparisons of models or examinations of the literature, homework questions are written to elicit thoughtful responses (e.g. questions starting with Why?). Discussion of homework is allowable, but plagiarism is prohibited. A key will be posted shortly after the homework is due.

Quiz: A quiz will be given in the second week of class to ensure students understand the basics of genetics based on material directly in the lecture slides given in the first week.

Grading

| Requirement | Due date | Points or % of final grade (% must sum to 100%) |
|-----------------------|-------------|---|
| Quiz (Genetics) | January 18 | 10% |
| Homework 1 | February 8 | 10% |
| Project Proposal | February 22 | 10% |
| Homework 2 | March 1 | 10% |
| Homework 3 | March 22 | 10% |
| Homework 4 | April 12 | 10% |
| Project Presentations | April 24 | 20% |
| Project Paper | April 24 | 20% |

Point system used:

| Points Earned | 93-100 | 90-92 | 87-89 | 83-86 | 80-82 | 77-79 | 73-76 | 70-72 | 67-69 | 63-66 | 60-62 | Below 60 |
|---------------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----------|
| Letter Grade | A | A- | B+ | B | B- | C+ | C | C- | D+ | D | D- | E |

Letter grade to grade point conversions are fixed by UF and cannot be changed.

| Letter Grade | A | A- | B+ | B | B- | C+ | C | C- | D+ | D | D- | E | WF | I | NG | S-U |
|--------------|-----|------|------|-----|------|------|-----|------|------|-----|------|-----|-----|-----|-----|-----|
| Grade Points | 4.0 | 3.67 | 3.33 | 3.0 | 2.67 | 2.33 | 2.0 | 1.67 | 1.33 | 1.0 | 0.67 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

For greater detail on the meaning of letter grades and university policies related to them, see the Registrar's Grade Policy regulations at: <http://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Policy Related to Make Up Exams or Other Work

Full credit will be given for assignments turned in on the due date (by 11:59pm). 80% credit for one day late. Assignments turned in the next school day after the due date will have a maximum possible credit of 80%. 50% credit for two days late. Assignment turned in two school days after the due date will have a maximum credit of 50%. NO credit given after two days late. If you are out sick, no deduction will be taken if you inform me before the homework is due that you are ill. Please stay home and do not get other people sick. Just turn in your homework as soon as you can. If you are going to miss school on the day the homework is due (going out of town, religious holiday, etc.) please turn your homework in early.

Any requests for make-ups due to technical issues MUST be accompanied by the ticket number received from LSS when the problem was reported to them. The ticket number will document the time and date of the problem. You MUST e-mail me within 24 hours of the technical difficulty if you wish to request a make-up.

Policy Related to Required Class Attendance

Attendance is not taken for a grade, but students are expected to be at all class sessions and are responsible for any missed materials. If you know you will be absent, please notify me in advance.

Please note all faculty are bound by the UF policy for excused absences. For information regarding the UF Attendance Policy see the Registrar website for additional details:
<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

STUDENT EXPECTATIONS, ROLES, AND OPPORTUNITIES FOR INPUT

Expectations Regarding Course Behavior

Students are expected to spend an average of at least 2-1/2 hours per week per credit hour on the course exclusive of class time. This time includes but is not limited to reading, research, preparation for class, and course work.

Communications Guidelines

The preferred methods of communication for the course are messages in Canvas or e-mail. Please adhere to Netiquette Guidelines: <http://teach.ufl.edu/wp-content/uploads/2012/08/NetiquetteGuideforOnlineCourses.pdf>

Academic Integrity

Students are expected to act in accordance with the University of Florida policy on academic integrity. 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 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 additional information regarding Academic Integrity, please see Student Conduct and Honor Code or the Graduate Student Website for additional details:

<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>

<http://gradschool.ufl.edu/students/introduction.html>

Please remember cheating, lying, misrepresentation, or plagiarism in any form is unacceptable and inexcusable behavior.

Online Faculty Course Evaluation Process

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

SUPPORT SERVICES

Accommodations for Students with Disabilities

If you require classroom accommodation because of a disability, you must register with the Dean of Students Office <http://www.dso.ufl.edu> within the first week of class. The Dean of Students Office will provide documentation of accommodations to you, which you must then give to me as the instructor of the course to receive accommodations. Please make sure you provide this letter to me by the end of the second week of the course. The College is committed to providing reasonable accommodations to assist students in their coursework.

Counseling and Student Health

Students sometimes experience stress from academic expectations and/or personal and interpersonal issues that may interfere with their academic performance. If you find yourself facing issues that have the potential to or are already negatively affecting your coursework, you are encouraged to talk with an instructor and/or seek help through University resources available to you.

- The Counseling and Wellness Center 352-392-1575 offers a variety of support services such as psychological assessment and intervention and assistance for math and test anxiety. Visit their web site for more information: <http://www.counseling.ufl.edu>. On line and in person assistance is available.
- You Matter We Care website: <http://www.umatter.ufl.edu/>. If you are feeling overwhelmed or stressed, you can reach out for help through the You Matter We Care website, which is staffed by Dean of Students and Counseling Center personnel.
- The Student Health Care Center at Shands is a satellite clinic of the main Student Health Care Center located on Fletcher Drive on campus. Student Health at Shands offers a variety of clinical services. The clinic is located on the second floor of the Dental Tower in the Health Science Center. For more information, contact the clinic at 392-0627 or check out the web site at: <https://shcc.ufl.edu/>
- Crisis intervention is always available 24/7 from:
 - Alachua County Crisis Center: (352) 264-6789
 - <http://www.alachuacounty.us/DEPTS/CSS/CRISISCENTER/Pages/CrisisCenter.aspx>

Do not wait until you reach a crisis to come in and talk with us. 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.

Student Safety

UF Public Safety YouTube Channel: <https://www.youtube.com/watch?v=0hOWQu1r49s>

More resources on student support and safety are available at: <http://www.ufl.edu/student-life/health-safety/>