Syllabus
EPP 633: Statistical Genetics and Genomics, Fall 2021
University of Tennessee, Knoxville

Course Section: EPP 633 (CRN 52560)
Course Title: Statistical Genetics and Genomics
Meeting Time and Place: TR (11:20 - 12:40 pm)
Course Credit Hours: 3
Course website: UTK Canvas

Instructor
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Entomology and Plant Pathology

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Office hours: by appointment

Instructor reserves the right to revise this syllabus if necessary. In such a case, students will be notified by email.

Course Description/Information
Statistical concepts for analysis of genetic and genomics data, and fundamental genetic and -omics principles will be taught. Class activities will include a combination of lectures and review of literature. The goal is to understand basic analytical concepts in order to equip students for independent learning.

Value Proposition
Considering the rapid pace of changing technologies, students need to develop critical evaluation skills and the ability to learn independently. The ensuing big data from these technological advances allows for powerful ways to interrogate biological systems. However, this poses new challenges and need for skill set that integrate big data into genetic and genomic studies.

Student learning outcomes/Objectives
i) Ability to effectively communicate genetic/genomic concepts and analytical methods.
ii) Understand limitations of technologies and methods, and ways to leverage their strengths.
iii) Critical thinking and ability to identify strengths and weaknesses in peer-reviewed publications.

Learning Environment
Class environment will be collaborative, and student's preparedness is essential for successful learning experience. Students are required to review relevant literature and course materials prior to each class session. Canvas site will be used to distribute materials. Required and suggested readings will be provided and updated during the semester.

Textbook (Suggested but Optional)
Handbook of Statistical Genomics 4th Edition
by David J. Balding (Editor), Ida Moltke (Editor), John Marioni (Editor)

Course Communications
Besides class sessions and office hours, students are responsible for checking Canvas and their university email accounts for additional information.

How to be successful in this course
Students are expected to be prepared for all classes, respectful of others, actively contribute to the learning activities in class, abide by the UT Honor Code. Instructor(s) are expected to be prepared for all classes, evaluate all fairly and equally, respectful of all students, create and facilitate meaningful learning activities, and behave according to University codes of conduct. Below are some additional information:

1. Regular class attendance**:** if possible, instructor should be informed ahead of time about absence. This is important because participation during class will be graded.
2. Preparation**:** assigned readings prior to class will allow for robust discussions. A flipped Classroom model will be adopted.

Required Equipment

All students are required to have a laptop.

Course Resources

All course materials/resources (including web links to resources) will be available on Canvas.

Course evaluation

Final grades for each student will be graded on the following scale:

90 - 100	A
88 - 89	A-
85 - 87	B+
80 - 84	B
78 - 79	B-
75 – 77	C+
70 - 74	C
68 - 69	C-
65 - 67	D+
60 - 64	D
0 - 59	F

The final grade will be based on

1. Class participation (10%): unweighted average of grades for all classes.
2. Exams (60%): total of best scores from 3 of 4 exams. Each exam accounts for 15%
3. Homework (30%): unweighted average of grades for all assignments.

University Policies:

This required section includes information about discrimination, scholastic dishonesty, cheating, and plagiarism policies (e.g., honor statement, consequences, examples, etc.). The honor statement is included on the Campus Syllabus available on the Provost and TLI websites, and the online UT catalog. These elements are also included below.

Academic Integrity:

"An essential feature of the University of Tennessee, Knoxville is a commitment to maintaining an atmosphere of intellectual integrity and academic honesty. As a student of the university, I pledge that I will neither knowingly give nor receive any inappropriate assistance in academic work, thus affirming my own personal commitment to honor and integrity."

University Civility Statement:

Civility is genuine respect and regard for others: politeness, consideration, tact, good manners, graciousness, cordiality, affability, amiability and courteousness. Civility enhances academic freedom and integrity, and is a prerequisite to the free exchange of ideas and knowledge in the learning community. Our community consists of students, faculty, staff, alumni, and campus visitors. Community members affect each other's well-being and have a shared interest in creating and sustaining an environment where all community members and their points of view are valued and respected. Affirming the value of each member of the university community, the campus asks that all its members adhere to the principles of civility and community adopted by the campus: http://civility.utk.edu/.

Disability Services:

"Any student who feels s/he may need an accommodation based on the impact of a disability should contact Student Disability Services in Dunford Hall, at 865-974-6087, or by video relay at, 865-622-6566, to coordinate reasonable academic accommodations.
Your Role in Improving Teaching and Learning Through Course Assessment:
At UT, it is our collective responsibility to improve the state of teaching and learning. During the semester, you may be requested to assess aspects of this course either during class or at the completion of the class. You are encouraged to respond to these various forms of assessment as a means of continuing to improve the quality of the UT learning experience.

Key Campus Resources for Students:

- Center for Career Development (Career counseling and resources; HIRE-A-VOL job search system)
- Course Catalogs (Listing of academic programs, courses, and policies)
- Hilltopics (Campus and academic policies, procedures and standards of conduct)
- OIT HelpDesk (865) 974-9900
- Schedule of Classes/Timetable
- Student Health Center (visit the site for a list of services)
- Student Success Center (Academic support resources)
- Undergraduate Academic Advising (Advising resources, course requirements, and major guides)
- University Libraries (Access to library resources, databases, course reserves, and services)

Course Outline/Assignments/Units of Instruction/Clinic Schedule:
[This section typically includes a table or list with the tentative calendar, topics, and assignments, dates for exams and due dates, special events, etc.] This is highly recommended, but this section may also refer students to a dynamic document, a calendar or other page on a Canvas course site, or be posted as a graphic. Major dates for assignments should not be changed or students should be given reasonable advanced notice.

Course Outline and Dates

Date	Topics
TR Aug. 24/26	*Basic concepts in genetics and genomics*
TR Aug. 31/ Sept. 2	*Theory and principles: statistical genetics and genomics*
TR Sept. 7/9	*Theory and principles: quantitative genetics*
T Sept. 14	*Theory and principles: population genetics*
R Sept. 16	*Exam-1*
TR Sept. 21/23	*Genome mapping- part 1 (mitosis, meiosis, and linkage mapping)*
T Sept. 28	*Genome mapping- part 1 (comparative genomics)*
R Oct. 1	*Fall Break*
TR Oct. 5/7	*Genome mapping- part 2 (QTL analysis, and fine mapping)*
TR Oct. 12/14	*Genome mapping- part 2 (genome-wide association analysis)*
TR Oct. 19/21	*Genome mapping- part 2 (joint linkage and association analysis)*
T Oct. 26	*Genetics of polyploid and complex genomes*
R Oct. 28	*Exam-2*
TR Nov. 2/4	*Concepts in marker/genomic-assisted crop improvement*
TR Nov. 9/11	*Statistical methods in genomic prediction*
TR Nov. 16/18	*Exam-3*
TR Nov. 23	*Analysis of metagenomic data*
TR Nov. 25	*Thanksgiving Holiday*
T Nov. 30	*Analytical methods that Integrate various-omic data set*
T Dec. 7	*Exam-4*

Course Outline

1. Basic Concepts in Genetics and Genomics
    a. Genome, chromosome, and genes
    b. Gene in molecular terms and mendelian terms
    c. Genic and allelic interactions, and gene-by-environment interactions
    d. Genetic/molecular markers
    e. Forward and reverse genetic approaches
    f. History of genetics and genomics
2. Theory and Principles of Population and Quantitative Genetics
    a. Gametic and genotypic linkage disequilibrium *(LD)*
    b. Population structure
    c. Hardy-Weinberg Equilibrium (HWE) and Departures from HWE.
    d. Identity by Descent, Inbreeding and relatedness
    e. Individual identification and parentage inference
3. Theory and Principles of Statistical Genetics and Genomics
    a. Probability models and distributions
    b. Joint and Conditional probability
    c. Maximum likelihood and Bayesian estimation
    d. Statistical sampling, Re-sampling (e.g. Jackknife, bootstrap), and simulations.
    e. Permutations and cross-validation
    f. Multiple testing and tests for homogeneity
    g. Logistic models, linear models, and model selection
    h. Correlation, clustering, and multivariate analysis
4. Genome Mapping- part I
    a. Mitosis and Meiosis
    b. Genetic linkage Mapping
    c. Genetic maps vs. Physical Maps
    d. Polyploid genetics
    e. Comparative genomics
5. Genome Mapping- part II
    a. Controlled-cross populations (single-marker analysis, interval mapping)
    b. Additive, Dominance, epistatic effects
    c. Natural/General populations (Genome-wide Association Analysis)
    d. Haplotype-based analyses, joint linkage analysis, and Nested association mapping populations
    e. QTL to causal gene: fine mapping and map-based cloning
6. Marker/Genomic-assisted Crop Improvement
    a. Heritability, breeding values and selection index
    b. Best Linear unbiased Prediction
    c. Marker-assisted selection
    d. Methods in Genomic prediction/selection
7. Analysis of metagenomic data