MATH5700.001 Statistical Genetics (I)
(BIOL5005-007; BMEN 5800-005; CSCE 5933-009)

All lectures will be held in GAB461, every Monday and Wednesday 9:30 AM - 10:50 AM

Course Title: **Introduction to Statistical Genetics**

Credits: 3 credits

Instructor: Xuexia (Helen) Wang, PhD
Email: Xuexia.wang@unt.edu
Office Hours: Monday and Wednesday 11:00am-12:00pm

Prerequisites: Graduate student.

Course Description:
This is an introductory course for graduate students in Statistics, biology, Bioinformatics and other disciplines which will cover statistical methods for the analysis of family and population based genetic data. Topics covered will include allele frequency estimation, linkage analysis, family-based and population-based association analysis, DNA-seq and RNA-seq analysis. Students will be exposed to the latest statistical methodology and computer tools on gene mapping in complex human disease. They will also read and evaluate current statistical human genetics literature.
Brief Course Description: This course will introduce statistical methods for the analysis of family and population based genetic data, including methods can be used in linkage analysis, family-based and population-based association studies and gene expression analysis.

Course Objectives:
Upon completion of this course, the student will be able to:

1) explain the assumptions of the Hardy-Weinberg equilibrium model
2) understand the theory and applications of both parametric and non-parameter linkage analysis
3) apply family-based and population-based association testing methods
4) describe basic population structure theory
5) understand the admixture mapping approach for identification of genetic variants
6) explain population stratification and correction methods
7) apply statistical genetics software for the analysis of genetic data

Text Book: Nan M. Laird and Christoph Lange (2011) The fundamentals of modern statistical genetics. Springer

Course Requirements:

To meet course objectives, students will:

1. Complete required readings;
2. Constructively participate in class discussions related to required readings and course assignments;
3. Complete the in class midterm exam and the final exam/project;
4. Complete and submit written assignments.

Homework assignments must be turned in on time unless special permission is granted by the Instructor due to extenuating circumstances. Requests for time extension will be considered on a case-by-case basis. No early and make up for all exams.

Attendance Requirements and Policies:

Since considerable learning takes place through sharing of ideas with colleagues, attendance at every class is mandatory. Class participation grades will be based on discussion regarding critical issues and questions raised by required readings and assignments. Any absence or missed daily assignments will lower your final grade. Perfect attendance will help your grade. Habitual tardiness and leaving class early will be counted as class absences. Under special circumstances (hospitalization, death in the family, etc.) an absence may be excused. Leave messages via email to Xuexia.wang@unt.edu.

Format: Lecture**.** This is a more traditional, "chalk-board" style class where considerable material will be communicated via in-class notes.

General Information:

In the event of disruption of normal classroom activities due to an outbreak, or any other public health emergency, the format for this course may be modified to enable completion of the course. In that event, you will be provided an addendum to this syllabus that will supersede this version.

Evaluation: The final grade will be based on the weighted average of scores of participation in class, the homework, the midterm exams (both in-class and take-home), and the final exam (take-home only). Specifically, the following weights will be used: (1) **Participation** in class 10%; (2) **Homework:** 25%. Homework assignments will be assigned on biweekly basis. Students are encouraged to work together on homework assignments to understand the concepts in the problems; however, it is expected that each student will turn in an assignment that reflects their own independent work. (3**) Midterm Exams:** 30% (15% for in-class exam and 15% for take-home exam). (4**) Final Exam** (take-home only): 35%. The total score of the final exam is 100 and accounts 35% of your final score. No early and later exams.

Assignment Deadlines: Each homework or project assignment has a due date announced in the class. On this designated date all homework or projects are due. Five credits will be deducted each day for late homework or project, unless there are extenuating circumstances. There may be rare exceptions made to this policy on an individual basis, provided that this is worked out in advance with the instructor. Daily in class assignments cannot be made up at all.

Grading for this course will be based upon the following scale:

Participation in Class 10%
Homework 25%
Midterm 30%
Final Exam/Project 35%

FINAL GRADING SCALE

%	Grade
90-100	A
80- 89	B
70-79	C
60-69	D
< 60	F

WARNING: If you are on academic probation, in danger of losing your financial aid, or your parent or guardian is expecting a certain grade at the end of the semester, etc., start working today. I will refuse to listen to any pleas at the end of the semester. You will receive precisely the grade that you earn.

Academic Integrity: Students caught cheating or plagiarizing will be subject to any penalty the instructor deems appropriate, ranging from receiving 0 (zero) points on that particular assignment to course failure. Additionally, the incident will be reported to the Dean of Students, who may impose further penalty.

Student Behavior: Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to Dean of Students to consider whether the student's conduct violated the

Code of Student Conduct: The university's expectations for student conduct apply to all instructional forums, including university and electronic classrooms, labs, discussion groups, field trips, etc. The Code of Student Conduct can be found at http://deanofstudents.unt.edu/conduct.

Disability Policy: The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with an accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request accommodations at any time, however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the Office of Disability Accommodation website at http://disability.unt.edu. You may also contact them by phone at (940) 565-4323.

Week	Topics	Reading
Week 1	Basic concepts of human genetics	Chapter 1 and 2 page:1-28
Week 2	Review of statistical methods: counting methods, discrete random variables, probability mass functions, the expectation and variance of a random variable or a function of a random variable.	My hand out
Week3	Introduction to R and high performance clusters	My hand out
Week 4	The analysis of Segregation	Chapter 4 page:45-63
Week 5	Introduction to Linkage Analysis; Parametric and Non-parametric linkage analysis; LOD scores	Chapter 6 page:87-95
Week 6	Allele/genotype/haplotype frequency estimation Family-based association: transmission/disequilibrium test (TDT) and related approaches	Chapter 9 page: 139-158
Week 7	Introduction to association analysis; case-control association: Pearson's classical test, Fisher's exact test, Armitage trend test; odds ratios: estimates, confidence intervals, interpretation	Chapter 7 page:99-122
Week 8	Midterm exam	
Week 9	Rationale for GWAS ;multiple testing in association studies;	Chapter 11.1, Chapter 10.1 page:161-164, 175
Week 10	Population structure: theory, Wright's F statistics ; Admixture Mapping; Population stratification; population stratification correction methods:	Chapter 3 page:33-35 Chapter 8 page:125-136

	Genomic Control, STRUCTURE, EIGENSTRAT	
Week 11	GWAS Design: data collection, multistage & multiethnic designs, power; Meta-analysis	Chapter 11.3, 11.4, 11.5 page:182-186
Week 12	Quality Control for GWAS; Genotype Imputation	Chapter 11.2 page:176 Li Y, Willer CJ, Sanna S, Abecasis GR. (2009) Genotype imputation. *Annual Review Genomics and Human Genetics* 10: 387-406
Week 13	Gene Environment Interaction: one stage and Two stage methods	Chapter 10.3 page:170
Week 14	DNA-seq analysis and RNA-seq analysis	My hand out
Week 15	Final exam	