

Course Syllabus

PubH 8446-001

Advanced Statistical Genetics and Genomics

Spring 2018

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| Credits: | 3 |
| Meeting Days: | M/W |
| Meeting Time: | 11:15-12:30 |
| Meeting Place: | Moos Health Sci Tower 2-116 |
| Instructor: | Baolin Wu, PhD; Cavan Reilly, PhD |
| Phone: | 612-624-0647 (Wu); 612-624-9644 (Reilly) |
| Fax: | 612-626-0660 |
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| Office Hours: | TBD |

I. Course Description

Statistical methods for low- and high-level analysis of genetic and genomic data including topics on multiple comparison and gene network modeling. Note this course is a continuation of PubH 7445 for PhD students in Biostatistics or Statistics.

II. Course Prerequisites

PubH 7445 Statistics for Human Genetics and Molecular Biology, Statistical theory at the level of Stat 8101-2, a college-level molecular genetics course is recommended, or permission by instructors.

III. Course Goals and Objectives

After taking the course, the students are expected to understand the statistical challenges in genetics and genomics and important statistical methods developed for this field. The students should then be able to conduct independent reading and research in the future.

IV. Methods of Instruction and Work Expectations

The course will focus on four broad research topics over the semester. An introduction covering general research problems and topics in the field will be given in the first week. Each research topic will be presented in 2-4 week period in the rest of the semester (see class schedule). Students are expected to carefully read all the required readings, and are strongly encouraged to also read the optional readings.

V. Course Text and Readings

No required textbooks. Materials will mainly be drawn from the literature. The readings are required (unless identified as optional). The readings have been carefully chosen from the field to represent very good and recent research papers.

The required and optional readings can be retrieved through the University of Minnesota's e-journals. If you have any difficulty accessing any readings, please contact the instructor.

VI. Course Outline/Weekly Schedule

Week 1-2 **Introduction to genome-wide association study (GWAS)**

Week 2-3 **GWAS association test of common variant (discuss the research problem of detecting genetic variants for various type of phenotypes; population stratification)**

Week 4-5 **Introduction to sequencing study: association test of rare variants**

Week 3-4 **Introduction to gene by environment interaction test**

Week 4-5 **Introduction to analysis of GWAS summary data**

Week 6-7 **Introduction to association study of other high-throughput omics data (methylation and microbiome data etc)**

Week 8 **Biological Sequence Analysis: dynamic programming and the extreme value distribution**

Week 9 **Biological Sequence Analysis: hidden Markov models, computational gene recognition**

Week 10 **Biological Sequence Analysis: feature detection, multiple alignment and motif discovery**

Week 11 **Introduction to next generation sequencing-applications, e.g. ChIP-seq, variant calls**

Week 12 **RNA-seq analysis as an alternative to microarrays-low level analysis computational details**

Week 13 **Computational aspects of next generation sequencing**

Week 14 **Quantification of signal in mass spectrometry, tandem mass spectrometry and algorithms for tandem mass spectrometry**

Week 15 **Metabolomics-LC/GC-MS-low level analysis with computational details**

VII. Evaluation and Grading

Course grade is based on homeworks (70%) and final project (30%). A letter grade will be determined from the percentage of points each student receives. The curve for final grades will be: A = 95-100; A- = 90-94; B+ = 85-89; B = 80-84; B- = 75-79; C+ = 70-74; C = 65-69; C- = 60-64; F = below 60. For those registered S/N, S = 60-100.

See the course schedule for homework assignment due date. Unless arrangements have been made with the instructor PRIOR to the due date, homework turned in after it is due will have 50% points deducted and no credit will be given after the next homework is due.

Course Evaluation

Beginning in fall 2008, the SPH will collect student course evaluations electronically using a software system called CoursEval: www.sph.umn.edu/courseval. The system will send email notifications to students when they can access and complete their course evaluations. Students who complete their course evaluations promptly will be able to access their final grades just as soon as the faculty member renders the grade in SPHGrades: www.sph.umn.edu/grades. All students will have access to their final grades through OneStop two weeks after the last day of the semester regardless of whether they completed their course evaluation or not. Student feedback on course content and faculty teaching skills are an important means for improving our work. Please take the time to complete a course evaluation for each of the courses for which you are registered.

Incomplete Contracts

A grade of incomplete "I" shall be assigned at the discretion of the instructor when, due to extraordinary circumstances (e.g., documented illness or hospitalization, death in family, etc.), the student was prevented from completing the work of the course on time. The assignment of an "I" requires that a contract be initiated and completed by the student before the last official day of class, and signed by both the student and instructor. If an incomplete is deemed appropriate by the instructor, the student in consultation with the instructor, will specify the time and manner in which the student will complete course requirements. Extension for completion of the work will not exceed one year (or earlier if designated by the student's college). For more information and to initiate an incomplete contract, students should go to SPHGrades at: www.sph.umn.edu/grades.

University of Minnesota Uniform Grading and Transcript Policy

A link to the policy can be found at onestop.umn.edu.

VIII. Other Course Information and Policies

Grade Option Change (if applicable)

For full-semester courses, students may change their grade option, if applicable, through the second week of the semester. Grade option change deadlines for other terms (i.e. summer and half-semester courses) can be found at onestop.umn.edu.

Course Withdrawal

Students should refer to the Refund and Drop/Add Deadlines for the particular term at onestop.umn.edu for information and deadlines for withdrawing from a course. As a courtesy, students should notify their instructor and, if applicable, advisor of their intent to withdraw.

Students wishing to withdraw from a course after the noted final deadline for a particular term must contact the School of Public Health Student Services Center at sph-ssc@umn.edu for further information.

Scholastic Dishonesty

You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code:

http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf) If it is determined that a student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see:

<http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html>.

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: <http://www1.umn.edu/oscai/integrity/student/index.html>. If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

Sexual Harassment

"Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult Board of Regents Policy:

https://regents.umn.edu/sites/regents.umn.edu/files/policies/Sexual_Harassment_Sexual_Assault_Stalking_Relationship_Violence.pdf

Equity, Diversity, Equal Opportunity, and Affirmative Action

The University will provide equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy:

http://regents.umn.edu/sites/default/files/policies/Equity_Diversity_EO_AA.pdf.

Disability Accommodations

The University of Minnesota is committed to providing equitable access to learning opportunities for all students. Disability Services (DS) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.

If you have, or think you may have, a disability (e.g., mental health, attentional, learning, chronic health, sensory, or physical), please contact DS at 612-626-1333 to arrange a confidential discussion regarding equitable access and reasonable accommodations.

If you are registered with DS and have a current letter requesting reasonable accommodations, please contact your instructor as early in the semester as possible to discuss how the accommodations will be applied in the course.

For more information, please see the DS website, <https://diversity.umn.edu/disability/>.

Mental Health and Stress Management

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: <http://www.mentalhealth.umn.edu>.

The Office of Student Affairs at the University of Minnesota

The Office for Student Affairs provides services, programs, and facilities that advance student success, inspire students to make life-long positive contributions to society, promote an inclusive environment, and enrich the University of Minnesota community.

Units within the Office for Student Affairs include, the Aurora Center for Advocacy & Education, Boynton Health Service, Central Career Initiatives (CCE, CDes, CFANS), Leadership Education and Development – Undergraduate Programs (LEAD-UP), the Office for Fraternity and Sorority Life, the Office for Student Conduct and Academic Integrity, the Office for Student Engagement, the Parent Program, Recreational Sports, Student and Community Relations, the Student Conflict Resolution Center, the Student Parent HELP Center, Student Unions & Activities, University Counseling & Consulting Services, and University Student Legal Service.

For more information, please see the Office of Student Affairs at <http://www.osa.umn.edu/index.html>.

Academic Freedom and Responsibility:

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.*

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair, your adviser, the associate dean of the college, or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost.

* Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students".

