

Term Information

Effective Term Summer 2023
Previous Value Summer 2012

Course Change Information

What change is being proposed? (If more than one, what changes are being proposed?)

Reducing the course from 3 to 2 credit hours to match the other advanced electives that we offer our Ph.D. students in Statistics.

What is the rationale for the proposed change(s)?

Reducing the course from 3 to 2 credit hours to match the other advanced electives that we offer our Ph.D. students in Statistics.

The revision is about modernizing the contents as well as cutting down on the materials. Making the topics broad at the moment provides an opportunity for fine tuning when the course is offered to ensure that it is suitable for a 2-hr course.

The topics that were cut entirely from the 2019 offering were linkage analysis and haplotype analysis. We added the topic on race/ethnicity/ancestry specifically (we also discussed this in 2019 although not labeled as a specific topic) as this is increasingly discussed in genetic/genomic research.

The reading assignment has been cut down to about half.

What are the programmatic implications of the proposed change(s)?

(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?

None.

Is approval of the request contingent upon the approval of other course or curricular program request? No

Is this a request to withdraw the course? No

General Information

Course Bulletin Listing/Subject Area Statistics
Fiscal Unit/Academic Org Statistics - D0694
College/Academic Group Arts and Sciences
Level/Career Graduate
Course Number/Catalog 8625
Course Title Statistical Methods for Analyzing Genetic Data
Transcript Abbreviation Stat Meth for Gene
Course Description Basic principles of population genetics; gene frequency estimation; likelihood computation on pedigrees using peeling algorithm, Lander-Green algorithm, Monte Carlo methods; linkage analysis, population and family based association studies.
Semester Credit Hours/Units Fixed: 2
Previous Value Fixed: 3

Offering Information

Length Of Course 14 Week, 12 Week, 8 Week, 7 Week, 6 Week, 4 Week
Previous Value 14 Week, 12 Week, 8 Week, 7 Week, 6 Week
Flexibly Scheduled Course Never

Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites	Prereq: Stat 6802, or permission of instructor.
Previous Value	Prereq: 6802 (622), or permission of instructor.
Exclusions	
Previous Value	Not open to students with credit for 833.
Electronically Enforced	No

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	27.0501
Subsidy Level	Doctoral Course
Intended Rank	Masters, Doctoral

Requirement/Elective Designation

Required for this unit's degrees, majors, and/or minors
The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes	<ul style="list-style-type: none">• Gain a solid understanding of the important role of statistics in genetic and genetic studies• Master key principles underlying statistical methods for analyzing genetic and genomic data• Formulate and sketch a suitable solution for a specific research question concerning genetic/genomic data• Read literature in the field critically and evaluate a paper in its entirety
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[Previous Value](#)

Content Topic List	<ul style="list-style-type: none">• Principles of population genetics• Approaches to account for race/ethnicity/ancestry• Methods for single variant and set-based analysis• Methods for single trait and multi-trait analysis using summary statistics• Survey of methods for multi-omics and integration
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Previous Value

- *Basic principles of population genetics*
- *Gene frequency estimation*
- *Likelihood computation on pedigrees: Peeling algorithm, Lander-Green algorithm, Monte Carlo methods*
- *Parametric and non-parametric linkage analysis*
- *Population and family based association studies*
- *Detection of maternal and imprinting effects*
- *Massively parallel sequencing data*

Sought Concurrence

No

Attachments

- STAT8625_AUTUMN2023.pdf: Syllabus
(Syllabus. Owner: Craigmile, Peter F)
- AU19-STAT-8625-Lin.pdf: Au2019 Syllabus (3 credit course)
(Syllabus. Owner: Craigmile, Peter F)

Comments

- Thank you.

I changed to Su23.

I have attached the syllabus for when the course was last offered in Autumn 2019. *(by Craigmile, Peter F on 11/30/2022 02:28 PM)*

- - Course changes for SP23 should have reached the Registrar's Office by Sept 1. Please select a later effective term.

- Please provide the syllabus for the 3 credit version of the course so that the panel can compare both. *(by Vankeerbergen, Bernadette Chantal on 11/30/2022 02:25 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Craigmile, Peter F	11/28/2022 04:44 PM	Submitted for Approval
Approved	Craigmile, Peter F	11/28/2022 07:20 PM	Unit Approval
Revision Requested	Vankeerbergen, Bernadette Chantal	11/30/2022 02:25 PM	College Approval
Submitted	Craigmile, Peter F	11/30/2022 02:28 PM	Submitted for Approval
Approved	Craigmile, Peter F	11/30/2022 02:28 PM	Unit Approval
Approved	Vankeerbergen, Bernadette Chantal	12/03/2022 09:08 PM	College Approval
Pending Approval	Cody, Emily Kathryn Jenkins, Mary Ellen Bigler Hanlin, Deborah Kay Hilty, Michael Vankeerbergen, Bernadette Chantal Steele, Rachel Lea	12/03/2022 09:08 PM	ASCCAO Approval



SYLLABUS: STAT 8625

STATISTICAL METHODS FOR ANALYZING GENETIC DATA

Autumn 2023 (full semester)
2 credit hours

COURSE OVERVIEW

Instructor

<NAME TO BE ANNOUNCED>

Email address: <TO BE ANNOUNCED>

Lectures: **This class will meet 2 days a week for 55 minutes in a** <LOCATION TO BE ANNOUNCED>

Office hours: <TO BE ANNOUNCED>

Graduate teaching assistant

<NAME>

Email address: <TO BE ANNOUNCED>

Office hours: <TO BE ANNOUNCED>

Prerequisites

STAT 6802, or permission of instructor

Course description

This course discusses statistical methods for analyzing genetic and genomic data. Topics include:

- Principles of population genetics and methods to account for ancestry
- Methods for single variant and set-based analysis
- Methods for single trait and multi-trait analysis using summary statistics
- Survey of methods for multi-omics and integration

Course learning outcomes

By the end of this course, students should successfully be able to:

- Gain a solid understanding of the important role of statistics in genetic and genetic studies
- Master key principles underlying statistical methods for analyzing genetic and genomic data
- Formulate and sketch a suitable solution for a specific research question concerning genetic/genomic data.
- Read literature in the field critically and evaluate a paper in its entirety

COURSE MATERIALS AND TECHNOLOGIES

Textbooks

Required

Lange K (2003) Mathematical and statistical methods for genetic analysis, 2nd Ed, Springer

Research Papers

Price, A. *et al.* Principal components analysis corrects for stratification in genome-wide association studies. *Nat Genet* **38**, 904–909 (2006). doi: 10.1038/ng1847

Manolio, T.A. *et al.* Finding the missing heritability of complex diseases. *Nature* **461**, 747-53 (2009). doi: 10.1038/nature08494.

Wu, M.C. *et al.* Rare-variant association testing for sequencing data with the sequence kernel association test. *Am J Hum Genet.* 89, 82-93 (2011). doi: 10.1016/j.ajhg.2011.05.029.

Turley, P. *et al.* Multi-trait analysis of genome-wide association summary statistics using MTAG. *Nat Genet* **50**, 229–237 (2018). doi: 10.1038/s41588-017-0009-4

Bersanelli, M. *et al.* Methods for the integration of multi-omics data: mathematical aspects. *BMC Bioinformatics* **17** (Suppl 2), S15 (2016). doi: 10.1186/s12859-015-0857-9

Necessary Software

- This class requires you to use the statistical software packages called R (The R Project for Statistical Computing; <http://www.r-project.org/>) and RStudio (<https://posit.co>). These software packages are available as Free Software. More details will be given in lectures.

GRADING AND FACULTY RESPONSE

ASSIGNMENT CATEGORY	PERCENTAGE
Homework	20%
Midterm	30%
Reading and participation in class discussion	10%
Project presentation	20%
Final report	20%
Total	100%

Homework: There will be regular homework assignments. Homework must be uploaded to Carmen by the posted deadline on the day it is due. Homework is not accepted by email. You are encouraged to work together on the homework, but do not copy any part of others' work. Each student must produce his/her own homework to be handed in.

Reading and participation in class discussion: Students will be assigned regular reading material (journal articles) on a bi-weekly basis. Although this is not part of the formal homework assignments, students are expected to read the papers and contribute to class discussions on these papers in class.

Exams: There will be one midterm. The midterm will be administered in the classroom and is closed book/closed notes. There are no make-up exams. A basic calculator is allowed – tablets, laptops, and cellphones are not allowed. Statistical tables will be provided as needed.

Project: The project is to read, summarize, and present a journal article. Novel ideas on extending statistical methodologies or improving computational algorithms will be viewed as superior. A more research-oriented project is also possible. Further details will be given in class.

Late assignments

<Policy will be added when the course is offered>

Instructor feedback and response time

<Policy will be added when the course is offered>

COURSE SCHEDULE

Refer to the Carmen course for up-to-date assignment due dates.

Week	Dates	Topics	Reading	Homework
1	Aug 22 Aug 24	Overview; population genetic principles	Lange: Chapters 1, 2	
2	Aug 29 Aug 31	Data types; HWE and LD; statistical tests	Lange: Chapters 2, 4	
3	Sep 5 Sep 7	Genetic relatedness and IBD	Lange: Chapters 5, 6	HW1 due
4	Sep 12 Sep 14	GWAS single variants	Price, A. <i>et al.</i>	
5	Sep 19 Sep 21	Population stratification		HW2 due
6	Sep 26 Sep 28	Set-based methods	Manolio, T.A. <i>et al.</i>	
7	Oct 3 Oct 5	Kernel-based methods		HW3 due
8	Oct 10 Oct 12	Single and multi-trait methods	Wu, M.C. <i>et al.</i>	
9	Oct 17 Oct 19	Methods based on summary statistics		HW4 due
10	Oct 24 Oct 26	Midterm	Turley, P. <i>et al.</i>	
11	Oct 31 Nov 2	Meta analysis		HW5 due
12	Nov 7 Nov 9	Multi-omics	Bersanelli, M. <i>et al.</i>	
13	Nov 14 Nov 16	Multi-omics		Presentation slides due
14	Nov 21	Presentations		

15	Nov 28 Nov 30	Presentations		
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OTHER COURSE POLICIES

Academic integrity policy

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university’s *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- Committee on Academic Misconduct web page (go.osu.edu/coam)
- Ten Suggestions for Preserving Academic Integrity (go.osu.edu/ten-suggestions)

Copyright for instructional materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on Title IX

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at <http://titleix.osu.edu> or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu

Commitment to a diverse and inclusive learning environment

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

Land Acknowledgement

We would like to acknowledge the land that The Ohio State University occupies is the ancestral and contemporary territory of the Shawnee, Potawatomi, Delaware, Miami, Peoria, Seneca, Wyandotte, Ojibwe and Cherokee peoples. Specifically, the university resides on land ceded in the 1795 Treaty of Greeneville and the forced removal of tribes through the Indian Removal Act of 1830. I/We want to honor the resiliency of these tribal nations and recognize the historical contexts that has and continues to affect the Indigenous peoples of this land.

More information on OSU's land acknowledgement can be found at <https://mcc.osu.edu/about-us/land-acknowledgement>

Your mental health

As a student you may experience a range of issues that can cause barriers to learn, 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 or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling [614-292-5766](tel:614-292-5766). CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at [614-292-5766](tel:614-292-5766) and 24 hour emergency help is also available 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

ACCESSIBILITY ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Requesting accommodations

The university strives to make all learning experiences as accessible as possible. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process, managed by Student Life Disability Services. If you anticipate or experience academic barriers based on your disability including mental health, chronic or temporary medical conditions, please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. **SLDS contact information:** slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of course technology

This course requires use of CarmenCanvas (Ohio State's learning management system) and other communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- Canvas accessibility (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- CarmenZoom accessibility (go.osu.edu/zoom-accessibility)
- Collaborative course tools

Statistics 8625 (Autumn 2019)
Statistical Methods for Analyzing Genetic Data

Instructor	Prof. Shili Lin, 440K Cockins Hall, 2-7404, shili@stat.osu.edu										
Lectures	TR 9:35 AM - 10:55 AM; McPherson Lab 1008. No classes on October 10, November 28										
Office Hours	TR 11:00 AM - 12:00 PM										
Grader	Mr. Chenggong Han; han.1071@osu.edu										
Website	http://carmen.osu.edu										
Prerequisite	Stat 6802 or equivalent, or permission of instructor										
Course Requirements	You are responsible for: material covered in class, assigned readings, homework assignments, and project. Class attendance is required.										
Topics	<i>Subject areas:</i> Population genetics Linkage analysis (sib-pairs and extended families) (Genome-wide) Association studies (GWAS; population and family; SNP and haplotype) Differential analysis (gene expression, DNA methylation, Epigenome-wide AS - EWAS) Chromatin 3D structure and spatial gene regulation (long-range interaction) Quantitative Trait Loci (QTL), mediation analysis, data integration, and genetic network Microbiome <i>Statistical methods:</i> Exact and Monte Carlo methods Likelihood-ratio test, score test, and non-parametric test Kernel-based methods Lasso, Bayesian Lasso, graphical Lasso, and other methods for sparse features Stochastic and hierarchical modeling										
Homework	There are several homework assignments. They are based on the materials covered in lectures. No late homework will be accepted.										
Assessments	There is one midterm exam; date TBA.										
Project	The project is to read, summarize, and present a journal article. Novel ideas on extending statistical methodologies or improving computational algorithms will be awarded extra points. A more research oriented project is also possible.										
Grades	The final numerical grade will be determined as follows: <table><tr><td>Homework assignments</td><td>15%</td></tr><tr><td>Midterm exam</td><td>25%</td></tr><tr><td>Reading and participation in class discussion</td><td>10%</td></tr><tr><td>Project presentation</td><td>30%</td></tr><tr><td>Final report</td><td>20%</td></tr></table>	Homework assignments	15%	Midterm exam	25%	Reading and participation in class discussion	10%	Project presentation	30%	Final report	20%
Homework assignments	15%										
Midterm exam	25%										
Reading and participation in class discussion	10%										
Project presentation	30%										
Final report	20%										
References	Research Papers (More classical topics) Lange K (2003) <i>Mathematical and statistical methods for genetic analysis</i> , 2 nd Ed										

Academic Misconduct It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

Disability Services Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue telephone 614- 292-3307, slds@osu.edu; slds.osu.edu.