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**STAT 992: Selective Inference in Computational Genomics**

**1 Credit**

**Course Designations and Attributes**

Natural Science

LAS Credit

Intermediate

**Course Description**

Computational genomics operates in an inferential regime far beyond classical statistics. Researchers routinely evaluate hundreds of thousands — even millions — of hypothesis, and new statistical technology is needed to discover relevant signals and ensure that findings replicate. In this spirit, the field of selective inference has emerged and contributed theoretical and algorithmic advances that make it possible to draw inferences even after first narrowing down on (“selecting”) patterns of interest. Prominent concepts in this space include false discovery rate control, data splitting, post-selection inference, knockoffs, and conformal inference. This course will examine these algorithms and their role in computational genomics. Further, the course aims to facilitate the transition from coursework to research and creates opportunities for students to experiment with different ways of reading, critiquing, and presenting research at the intersection of statistics and biology.

**Requisites**

Graduate/professional standing, member of Statistics Visiting International Scholars program

**Meeting Time and Location**

Thursdays 11 – 11:50am, 2425 Sterling Hall.

**Instructional Modality**

In-person

**How Credit Hours are Met by the Course**

The credit standard for this course is met by an expectation of a total of 135 hours of student engagement

with the courses learning activities (45 hours per credit), which include regularly scheduled: readings,

recorded lectures, in-class exercises, one midterm exam, problem sets, and a group project, as described in this syllabus.

**Regular and Substantive Student-Instructor Interaction**

Participation in regularly scheduled lectures each week will include the opportunity for direct interaction between students and the instructor. The instructor will also frequently interact and post announcements in Canvas and email students about academic aspects of the class.

Instructors & Teaching Assistants

**Instructor**

Kris Sankaran ([ksankaran@wisc.edu](mailto:ksankaran@wisc.edu)). Office hours can be arranged by appointment and can be held either at Medical Sciences Center 7225C or at this [zoom link](https://uwmadison.zoom.us/j/8622164885). You do not have to prepare a specific agenda to attend office hours. You are welcome to just visit.

Course Learning Outcomes

By the end of this course, you will be able to:

1. Describe algorithms in selective inference, including those based on classical multiple hypothesis testing, covariate reweighting, post-selection inference, knockoffs, and data splitting, and evaluate their value in specific scientific contexts.
2. Explain the biological interpretation of data from modern sequencing technologies and the role of statistical inference in analyzing these data.
3. Apply selective inference algorithms on real datasets and explore their properties through designed simulation studies.
4. Present modern research in selective inference and computational genomics and guide critical, productive discussion about papers with one’s peers.

**Grading**

Assignments: 40%

Presentation: 40%

Participation: 20%

Grades will be assigned according to the percentage scale, A = 92-100, AB = 88-91.9, B = 82-87.9, BC = 78-81.9, C = 70-77.9, D = 60-69.9, F = 0-59.9 (92% of points => A); and according to the percentile scale, A = 75, AB = 65, B = 45, BC = 30, C = 10, D = 5, F = 0 (performing better than 75% of the class => A). Your grade will be the higher of these two grades.

Course Website, Learning Management System & Digital Instructional Tools

Canvas:

Required Textbook, Software & Other Course Materials

* There are no required textbooks. All readings are provided in the table below.

Campus provides students with [technology guidelines and recommendations](https://it.wisc.edu/learn/guides/learning-online-technology-tips-tools/) for instruction. Students should consult these resources prior to the start of the semester.

Homework & Other Assignments

* Readings and Presentations
  + We will review the papers listed on [this schedule](https://docs.google.com/spreadsheets/d/18grMYMWR7Y3mMVAiY1evxY9X3v55mAtMnbF-non50iw/edit#gid=0), which will be drawn from the [reading list](https://docs.google.com/document/d/1VoTfdo1cQeCqdlkuqPfEhhokaCXTwuDHe6tOarYaNRQ/edit). You are expected to have completed the readings before each presentation/discussion.
  + You will lead two 35-minute discussions (including a 20-minute introductory presentation) over the course of the semester. See the presentation assignment description for details.
* Assignments
  + You will prepare peer reviews for one of the course sessions. See the peer review assignment description for details.
  + There will be one computational exercise, due **May 2**, that asks you to either prepare a real-data case study or a benchmarking experiment using methods from selective inference.
* All assignments must be submitted on Canvas.
  + For every 24 hours late that a submission is made, it will be penalized 5%, for up to 4 days, after which no submissions will be accepted. The only exception for late acceptance will be in documented medical or family emergencies.

Exams, Quizzes, Papers & Other Major Graded Work

* There are no exams.

Teaching & Learning Data Transparency Statement

*The privacy and security of faculty, staff and students’ personal information is a top priority for UW-Madison. The university carefully evaluates and vets all campus-supported digital tools used to support teaching and learning, to help support success through*[learning analytics](https://teachlearn.provost.wisc.edu/learning-analytics/)*, and to enable proctoring capabilities. View the university’s full*[teaching and learning data transparency statement](https://teachlearn.provost.wisc.edu/teaching-and-learning-data-transparency-statement/)*.*

Privacy of Student Records & the Use of Audio Recorded Lectures Statement

*View* [more information about *FERPA*](https://registrar.wisc.edu/ferpa-facstaff/)*.*

Lecture materials and recordings for this course are protected intellectual property at UW-Madison. Students in this course may use the materials and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record my lectures without my permission unless you are considered by the university to be a qualified student with a disability requiring accommodation. [Regent Policy Document 4-1] Students may not copy or have lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the instructor’s express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the university’s policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct.

Course Evaluations

Students will be provided with an opportunity to evaluate this course and your learning experience. Student participation is an integral component of this course, and your confidential feedback is important to me. I strongly encourage you to participate in the course evaluation.

UW-Madison uses a digital course evaluation survey tool called [AEFIS](https://kb.wisc.edu/luwmad/page.php?id=81069). For this course, you will receive an official email two weeks prior to the end of the semester, notifying you that your course evaluation is available. In the email you will receive a link to log into the course evaluation with your NetID. Evaluations are anonymous. Your participation is an integral component of this course, and your feedback is important to me. I strongly encourage you to participate in the course evaluation.

Students Rules, [Rights & Responsibilities](https://guide.wisc.edu/undergraduate/#rulesrightsandresponsibilitiestext)

Diversity & Inclusion Statement

[Diversity](https://diversity.wisc.edu/) is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.

Academic Integrity Statement

By virtue of enrollment, each student agrees to uphold the high academic standards of the University of Wisconsin-Madison; academic misconduct is behavior that negatively impacts the integrity of the institution. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these previously listed acts are examples of misconduct which may result in disciplinary action. Examples of disciplinary action include, but is not limited to, failure on the assignment/course, written reprimand, disciplinary probation, suspension, or expulsion.

Accommodations for Students with Disabilities Statement

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA. (See: [McBurney Disability Resource Center](https://mcburney.wisc.edu/))

[Academic Calendar & Religious Observances](https://secfac.wisc.edu/academic-calendar/)

*You can use the link above to provide your students with information about the current and future academic calendars, along with the university’s religious observance policy.*