

STAT 591 B Au 23: Special Topics In Statistics

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Course title: Multiple testing and modern inference

Instructor: Armeen Taeb ataeb@uw.edu

Class Time	T /Th 4:30– 5:50 PM at THO 334
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Office hours:

Tuesdays 3:00 - 4:00PM at Padelford B-310, **If you have time conflicts with this office hour time in general, please let me know!**

Course Description:

STAT 591 is a 10-week lecture-based special topic course that offers a comprehensive study of multiple testing and (some) predictive inference in modern data analysis.

Topics that will be covered include family-wise and false discovery error rates, closed testing, Benjamini-Hochberg procedure, Empirical Bayes perspective and local FDR methods, knockoffs, selective inference, false discovery control in non-standard settings, e-values, and conformal predictions.

Motivation:

In the past decade or so, there have been serious concerns about “reproducibility crisis” in the sciences. Statistical aspects are considered to be a major factor, and as a result, many methods have been developed to ensure statistical replicability. We will begin with some classical solutions that date back to the 1950s, but the majority of methods that we will discuss are modern developments.

Learning Objectives:

Students completing STAT 591 should be able to

1. Understand why methods for multiple testing are needed for replicability
2. Understand various error rates in multiple testing and assess their pros and cons

3. have both theoretical and practical understanding of methods for multiple testing and assumptions under which they work
4. Learn proof techniques, e.g. martingales and the leave one out approach
5. Understand the foundations of distribution-free predictive inference

Required Texts None although we will refer to some books/notes throughout.

Grading policy:

- HW assignments (40%)
- Final project report containing less than 15 pages (50%)
- Class participation and scribe notes (10%)

Final project will ideally be on a research question that you will come up with and (attempt to) answer. You are encouraged to relate your project to your current research.

Link to shared overleaf for scribed notes is available here:

<https://www.overleaf.com/3965762221nkrrqwjsmdp> 

(<https://www.overleaf.com/3965762221nkrrqwjsmdp>). The scribed notes are due one week after the lecture.

Tentative Course Timeline

week	day	lecture topic	assignment	due date
1	Th Sept 28	Introduction to class. Different error metrics and their connections		
2	T Oct 3	Global null tests: Bonferroni, Fisher's combination test, simes test, and comparisons		
	Th Oct 5	Global null test continued, KS test, higher criticism and comparisons		

3	T Oct 10	FWER control: Bonferroni, Sidak, Holmes, and Hochberg	HW 1 assigned	
	Th Oct 12	Closed Testing: step up and step down procedures		
4	T Oct 17	FDR control: Benjamini Hochberg and proof (based on leave one out)	HW 2 assigned	HW 1 due
	Th Oct 19	Finish proof of BH, BH under PRDS, and Benjamini- Yekutieli bound		
5	T Oct 24	Empirical process viewpoint of BH and proof based on Martingales		
	Th Oct 26	Bayesian modeling for testing: local FDR, FDR control with covariates		HW 2 due
6	T Oct 31	Variable selection, challenge with permutation test and conditional randomization tests		
	Th Nov 2	Knockoffs for FDR control and proofs based on Martingales	HW 3 assigned	

7	T Nov 7th	Knockoffs for FDR control and proofs based on Martingales		
	Th Nov 9	Hierarchical + sequential testing		HW 3 due
8	T Nov 14	Conditional inference and post model selection		
	Th Nov 16	Conditional inference and post model selection		
9	T Nov 21	Introduction to e-values; FDR control and coverage using e-values		
	Th Nov 23	Thanksgiving no class		
10	T Nov 28	False discovery control in non-standard settings; model selection over posets		
	Th Nov 30 (possibly another day in the week as I am traveling)	False discovery control in non-standard settings; model selection over posets		

11	T Dec 2	Conformal predictions and predictive inference		
	Th Dec 4th	Conformal predictions and predictive inference		
	T Dec 9th			final report due

Students with disabilities:

If you would like to request academic accommodations due to a disability, please contact Disabled Student Services, 448 Schmitz (206) 543-8924 (V/TTY). If you have a letter from Disabled Student Services indicating you have a disability that requires academic accommodations, please present this letter to me to discuss the accommodations you might need for the class.

Academic Integrity:

Collaboration and discussions are allowed and encouraged in this class, but copying or letting others copy your work amounts to plagiarism. This includes copying model solutions, e.g., from prior years. Although cheating seldom occurs in graduate classes, if it does, I will take the following action: assign a grade of 0.0 for the exam/homework where the cheating occurred, and **report the incident to the Graduate School Committee on Academic Conduct**, which will decide upon an appropriate University course of action.




Religious Accommodations:

Washington state law requires that UW develop a policy for the accommodation of student absences or significant hardship due to reasons of faith or conscience or for organized religious activities. The UW's policy, including more information about requesting accommodation, is available at [Religious Accommodations Policy \(https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/\)](https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the [Religious Accommodations Request form \(https://registrar.washington.edu/students/religious-accommodations-request/\)](https://registrar.washington.edu/students/religious-accommodations-request/).

Student conduct:

Follow the UW Student Conduct Code in your interactions with your colleagues and me in this course by respecting the many social and cultural differences among us, which may include, but are not limited to: age, cultural background, disability, ethnicity, family status, gender identity and presentation, citizenship and immigration status, national origin, race, religious and political beliefs, sex, sexual orientation, socioeconomic status, and veteran status.

Course Summary:

Date	Details	Due
Thu Oct 19, 2023	 Homework 1 (https://canvas.uw.edu/courses/1662623/assignments/8749887)	due by 11:59pm
Sun Nov 5, 2023	 Homework 2 (https://canvas.uw.edu/courses/1662623/assignments/8756347)	due by 11:59pm
Wed Dec 13, 2023	 Homework 3 (https://canvas.uw.edu/courses/1662623/assignments/8811644)	due by 11:59pm