DSci 521 Applied II, Spring 2026

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Overview

This is a course on large sample causal inference and other forms of missing data analysis using machine learning and AI. It also includes primers/reviews on causal inference without ML or AI and ML and AI approaches to non-causal (i.e., population) inference without missing data.

Learning objectives

1. Learn/review population inference with and without ML/AI.
2. Learn/review causal inference without ML/AI.
3. Learn applied approach to causal inference with ML and AI.

Materials

The class is primarily based off the textbook and notebooks found at https://causalml-book.org/. The instructor will provide supplements as needed. The required reading and the notebooks (in R or Python) **must** be seriously attempted before the class session for which it is assigned. (It is expected that you won't understand everything in the reading, but you need to know what you understand and what you don't understand before you come to lecture.)

- *Applied Causal Inference Powered by ML and AI*, Victor Chernozhukov, Christian Hansen, Nathan Kallus, Martin Spindler, and Vasilis Syrgkanis

Course Schedule (subject to change)

Week	Date	#	Topic	Required Reading
Module 1: Core Material				
Week 1	26-Jan		Predictive Inference with Linear Regression	Chs. 0 and 1
Week 2	2-Feb		Causal Inference	Ch. 2
Week 3	9-Feb		Predictive Inference with High-Dimensional Linear Regression	Ch. 3
Week 4	16-Feb		Statistical Inference on Predictive Effects via High-Dimensional Linear Regression	Ch. 4
Week 5	23-Sep		Causal Inference via Conditional Ignorability	Ch. 5
Week 6	2-Mar		Causal Inference via Linear Structural Equation Models	Ch. 6

Week 7	9-Mar		Spring Break	
Week 8	16-Mar		Causal Inference via Directed Acyclic Graphs and Nonlinear Structural Equation Models	Chs. 7 and 11
Week 9	23-Mar		Predictive Inference via Modern Nonlinear Regression	Ch. 8
Week 10	30-Mar		Statistical Inference on Predictive and Causal Effects via Nonlinear Regression Models	Ch. 9
Week 11	6-Apr		Feature Engineering for Causal and Predictive Inference	Ch. 10
Module 2: Topics				
Week 12	13-Apr		Unobserved Confounders, Instrumental Variables, and Proxy Controls	Chs. 12 and 13
Week 13	20-Apr	18	Heterogeneous Treatment Effects	Chs. 14 and 15
Week 14	27-Apr	20	Difference-in-Differences	Ch. 16

Course Assignments

Your grade comprises homework (40%), a final exam (50%), and class attendance (10%).

The homeworks will be assigned roughly every other week. Working together on the homework assignments is encouraged, but you must write your own solutions. It is highly recommended that you make your solo effort on all the problems before consulting others.

Grading Scale

Your final grade will be assigned based on this grading scale:

A	A-	B+	B	B-	C+	C	C-	D	F
93+	87-92	83-86	80-82	75-79	70-74	65-69	60-64	55-59	0-54

I reserve the right to curve up. That is, you cannot do worse than this scale, but I may assign final grades that are slightly better than this scale.

Policy

General: Students are expected to adhere to the Emory College Honor Code as well as its Conduct Code, see http://college.emory.edu/home/academic/policy/conduct_code.html. Specifically, the honor code is in effect throughout the semester. By taking this course, you affirm that it is a violation of the code to cheat on assignments, end-of-chapter assessments, to plagiarize, to deviate from the teacher's instructions about collaboration on work that is submitted for grades, to give false information to a faculty member, and to undertake any other form of academic misconduct. You also affirm that if you witness others violating the code you have a duty to report them to the honor council.

Special circumstances: Students requiring any type of special classroom/testing accommodation for a disability, religious belief, scheduling conflict, or other impairment that might affect his or her successful completion of this course must personally present the requested remedy or other adjustment in written form (signed and dated) to the instructor, i.e., supporting memorandum of accommodation from the Office of Disabilities Services, http://www.ods.emory.edu/. Requests for accommodations must be received and authorized by the instructor in written form no less than two weeks in advance of need. No accommodation should be assumed unless so authorized. In the event of needs identified later in the course, or for which an adjustment cannot be made on a timely basis, a grade of "I" Incomplete for the course, will be given to accommodate the unanticipated request.

Attendance:

- The OUE student self-service absence form must be submitted if you would like to have your absence excused due to the reasons recognized by the university (See the top of the form). Be sure to complete this form in advance, and you must include all classes you are currently enrolled at the time of completing the form so that all your instructors will be notified all at once. If you wish to explain your situation further, you may also email your instructor in advance, and if necessary, submit official documentations.
- Check our Canvas page regularly! All course materials including lecture materials, assignments, due dates, and important announcements will be posted on Canvas throughout the semester.