

University of Florida
College of Public Health & Health Professions Syllabus
PHC 6937: Causal Inference (3 credit hours)

Fall: 2024

E-Learning: lss.at.ufl.edu

Instructor: Feifei Xiao, Ph.D.

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Course Hours: Tuesday 9:35am-10:25am and Thursdays 9:35am-11:30am

Course Location: HPBP G105

Office Hours: Thursday 3:00pm-4:00pm and by appointment

Prerequisites: Courses in introductory statistics, regression, and computer programming. Some knowledge of R. Students must own a computer that can run the statistical package R, which is freely available at <http://cran.r-project.org/>.

PURPOSE AND OUTCOME

Course Overview

Concepts and methods for causal inference from randomized trials and observational studies.

Relation to Program Outcomes

This course serves the knowledge and skills student learning objectives by preparing students to communicate the underpinning of biostatistics concepts and methods and to apply biostatistical concepts and methods on one's own, including interpretation and communication of results.

Course Objectives and/or Goals

Upon successful completion of the course, students should be able to:

- Formulate and explain assumptions required for causal inference from randomized trials or observational studies.
- Target appropriate causal effect measures, understanding the implications for effect-measure modification.
- Adjust for confounding using statistical methods such as standardization with an exposure or outcome model, difference-in-differences estimation, instrumental variables estimation, front-door adjustment, and propensity-score adjustment.
- Use causal directed acyclic graphs to formulate and assess statistical methods for causal inference.
- Conduct mediation analyses and instrumental variable analyses such as mendelian randomization.
- Adjust for time-dependent confounding.

Instructional Methods

Lectures with slides, data analysis demonstrations in R, and discussions. Homework assignments for each chapter and two take-home exams.

DESCRIPTION OF COURSE CONTENT

Topical Outline/Course Schedule

1. Introduction: A Brief History, Data Examples (Aug 22, 27)
2. Conditional Probability and Expectation (Aug 29, Sep 3)
3. Potential Outcomes and the Fundamental Problem of Causal Inference (Sep 5, Sep 10)
4. Effect-measure Modification and Causal Interaction (Sep 12, Sep 17)
5. Causal Directed Acyclic Graphs (Sep 19, 24)
6. Adjusting for Confounding: Backdoor Method via Standardization (Sep 26, Oct 1, Oct 3, Oct 8)
7. TAKEHOME EXAM 1: Handed out Oct 8, Return Oct 15
8. Adjusting for Confounding: Difference-in-Differences Estimators (Oct 10, Oct 15)
9. Adjusting for Confounding: Propensity-Score Methods (Oct 17, Oct 22)
10. Adjusting for Confounding: Instrumental Variables (Oct 24, 29)
11. Mendelian Randomization (Oct 31, Nov 5)
12. Mediation (Nov 7, Nov 12)
13. TAKEHOME EXAM 2: Handed out Nov 12, Return Nov 19
14. Adjusting for Time-Dependent Confounding (Nov 14, Nov 19)
15. Guest Lecture: Dr. Muxuan Liang (Nov 21)
16. Review of Course, Discussion and Farewell (Dec 3)

Course Materials and Technology

Required text:

- *Fundamentals of Causal Inference* (2021), by Babette A. Brumback, Boca Raton: Chapman & Hall, forthcoming. A pdf is posted on e-Learning for your use, provided you do not share with anyone outside of the class.
- *Causal Inference: What If* (2020), by Miguel A. Hernan and James M. Robins, Boca Raton: Chapman & Hall/CRC, forthcoming. Available for free download at <https://www.hsph.harvard.edu/miguel-hernan/causal-inference-book>, but please use the version posted on e-Learning so that everyone has the same one.

Recommended texts:

- *The Book of Why: The New Science of Cause and Effect* (2018), by Judea Pearl and Dana Mackenzie, Basic Books, New York, NY.
- Additional Course Materials Available via E-Learning at lss.at.ufl.edu

For technical support for this class, please contact the UF Help Desk at:

- Learning-support@ufl.edu
- (352) 392-HELP - select option 2
- <https://lss.at.ufl.edu/help.shtml>

ACADEMIC REQUIREMENTS AND GRADING

Assignments

Students are expected to be actively involved in each class, including sharing comments of required reading, discussing answers and questions to homework assignments, and participating in class discussion.

The overall grade will include quizzes, class participation and two take home exams. Class participation will include weekly attendance, sharing reading comments, and leading and participating in discussion. Students are encouraged to discuss either in groups or with the instructor on homework assignments.

Class participation: 10%; Homework: 30%

Exam 1: 30%; Exam 2: 30%

The grading scale for this course consists of the standard scale, including minus grades, below. Percentages will be rounded to the nearest grade.

93% - 100% = A

90% - 92% = A-

87% - 89% = B+

83% - 86% = B

80% - 82% = B-

77% - 79% = C+

73% - 76% = C

70% - 72% = C-

67% - 69% = D+

63% - 66% = D

60% - 62% = D-

Below 60% = E

Please be aware that a C- is not an acceptable grade for graduate students. A grade of C counts toward a graduate degree only if an equal number of credits in courses numbered 5000 or higher have been earned with an A.

Letter grade to grade point conversions fixed by UF:

Letter Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E	WF	I	NG	S- U
Grade Points	4.0	3.67	3.33	3.0	2.67	2.33	2.0	1.67	1.33	1.0	0.67	0.0	0.0	0.0	0.0	0.0

For greater detail on the meaning of letter grades and university policies related to them, see the Registrar's Grade Policy regulations at:

<http://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Exam Policy

The exam and the homework assignments are take-home. Students are bound by the UF honor code (see below) and may neither give nor receive aid on the exams. Students may not share exams or homeworks or solutions with anyone outside the course at any time, even after the

course is finished.

Policy Related to Make up Exams or Other Work

In the event of unusual circumstances, a student could receive an extension of the due-date to a take-home exam or an incomplete grade in the course.

Policy Related to Required Class Attendance

Attendance of all online sessions is expected. Exceptions will be granted with the expectation of watching the video recordings of the online classes missed. We will follow the UF Attendance Policy. For information regarding the UF Attendance Policy see the Registrar website for additional details: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.asp>

STUDENT EXPECTATIONS, ROLES, AND OPPORTUNITIES FOR INPUT

Expectations Regarding Course Behavior

Students are expected to show up for each online class prepared and on time. Students should mute their microphones in the event of external noise.

Communication Guidelines

Students are expected to participate in class discussions. Assignments must be clearly written in reasonably good English.

Academic Integrity

Students are expected to act in accordance with the University of Florida policy on academic integrity. As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge:

“We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.”

You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied:

“On my honor, I have neither given nor received unauthorized aid in doing this assignment.”

It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For additional information regarding Academic Integrity, please see Student Conduct and Honor Code or the Graduate Student Website for additional details:

<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>

<http://gradschool.ufl.edu/students/introduction.html>

Please remember cheating, lying, misrepresentation, or plagiarism in any form is unacceptable and inexcusable behavior.

Online Faculty Course Evaluation Process

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results>

SUPPORT SERVICES

Accommodations for Students with Disabilities

If you require classroom accommodation because of a disability, you must register with the Dean of Students Office <http://www.dso.ufl.edu> within the first week of class. The Dean of Students Office will provide documentation of accommodations to you, which you then give to me as the instructor of the course to receive accommodations. Please make sure you provide this letter to me by the end of the second week of the course. The College is committed to providing reasonable accommodations to assist students in their coursework.

Counseling and Student Health

Students sometimes experience stress from academic expectations and/or personal and interpersonal issues that may interfere with their academic performance. If you find yourself facing issues that have the potential to or are already negatively affecting your coursework, you are encouraged to talk with an instructor and/or seek help through University resources available to you.

- The Counseling and Wellness Center 352-392-1575 offers a variety of support services such as psychological assessment and intervention and assistance for math and test anxiety. Visit their web site for more information: <http://www.counseling.ufl.edu>. On line and in person assistance is available.
- You Matter We Care website: <http://www.umatter.ufl.edu/>. If you are feeling overwhelmed or stressed, you can reach out for help through the You Matter We Care website, which is staffed by Dean of Students and Counseling Center personnel.
- The Student Health Care Center at Shands is a satellite clinic of the main Student Health Care Center located on Fletcher Drive on campus. Student Health at Shands offers a variety of clinical services. The clinic is located on the second floor of the Dental Tower in the Health Science Center. For more information, contact the clinic at 392-0627 or check out the web site at: <https://shcc.ufl.edu/>
- Crisis intervention is always available 24/7 from:
Alachua County Crisis Center
(352) 264-6789
<http://www.alachuacounty.us/DEPTS/CSS/CRISISCENTER/Pages/CrisisCenter.aspx>

Do not wait until you reach a crisis to come in and talk with us. We have helped many students through stressful situations impacting their academic performance. You are not alone so do not be afraid to ask for assistance.