

The Ohio State University College of Public Health
PUBHBIO 7255 – Introduction to Causal Inference in Health Science Research
3 credit hours – Autumn, 2025

Class Meetings:	Mondays/Wednesdays, 2:20 to 3:40 pm Cunz Hall 230 (in-person section) and Zoom (online section)
Course Instructor:	Eben Kenah (kenah.1@osu.edu) Office: Cunz Hall 380F <i>Please use Carmen messages for communication about class.</i> You can generally expect responses to Carmen messages or discussion posts within one working day and grades within one week. If there will be a significant delay for any reason, this will be announced to the class. If you have not gotten a response within these time frames, please do not hesitate to follow up.
Office Hours:	Thursdays 11 am to 1 pm (in person or on Zoom) or by appointment
Teaching Assistant:	Jeongjin Lee (lee.10449@buckeyemail.osu.edu) Office hours Tuesday 11 am to 12 pm on Zoom or by appointment The TA will hold regular office hours, may assist during class sessions, and may help respond to Discussion posts. The TA may assist with scoring assignments, but final grades will be assigned by the instructor. <i>Questions about grading should be directed to the instructor, not the TA.</i>
Course Description:	This course is an introduction to statistical methods for causal inference. The topics covered include potential outcomes, identification assumptions, causal graphs (DAGs and SWIGs), confounding and selection bias, propensity scores, sensitivity analysis, time-dependent confounding, marginal structural models, causal mediation analysis.
Prerequisites:	B- or higher in PUBHBIO 6211 or permission of instructor
Text/Readings:	M. A. Hernán and J. M. Robins (2025). <i>Causal Inference: What If</i> . This is freely available online: https://miguelhernan.org/whatifbook . Slides and any other readings will be available on Carmen.
Required Software:	Statistical programming with R is required, and RStudio is the recommended IDE. Prior experience with statistical software, but not with R/RStudio specifically, is assumed. Instructions for installing both are at https://posit.co/download/rstudio-desktop/ . Resources for installing this software are available on the course website, and the instructor will provide assistance with installation or alternative methods for running remote versions of the software if necessary.

Class Format:

- **Mode of delivery:** Asynchronous video lectures and in-class activities or labs. Asynchronous lecture videos will be posted on Carmen, and note taking is strongly encouraged. R labs are meant to build skills introduced during lectures. It is recommended that students bring a device capable of running R/RStudio to class sessions or plan to use the lab computers.
- **Work expectations:** This is 3-credit-hour course. According to Ohio State policy (go.osu.edu/credithours), students should expect around 3 hours per week of time spent on direct instruction in addition to 9 hours of indirect instructions (e.g., homework or active learning activities outside of class).
- **Participation requirements:** It is expected that all students will regularly attend class and participate fully. Students anticipating more than sporadic absence (> 2 class days) should discuss their situation with the instructor as soon as possible.

Carmen:

All course materials will be available on the Carmen site for this course: <http://carmen.osu.edu>.

You will need to use BuckeyePass (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions (<https://admin.resources.osu.edu/buckeyepass/adding-a-device>).
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile app (<https://admin.resources.osu.edu/buckeyepass/installing-the-duo-mobile-application>) to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

Technology Support:

For help with your password, university email, Carmen, or any other technology issues, questions, or requests, contact the Ohio State IT Service Desk. Standard support hours are available at and support for urgent issues is available 24/7.

- Self-service and chat support: <http://it.osu.edu/help>
- Phone: 614-688-4357 (614-688-HELP)
- Email: servicedesk@osu.edu

Note that questions related to statistical programming should be directed to the Instructor or the TA.

Assignments:

- **R labs (40%)** are meant to build skills introduced during lectures. Thus they will be started in-class with aid from any materials or people (including classmates), but each student must complete and submit their own code and worksheets. The lowest R lab score will be dropped.
- **Data analysis projects (60%)** are meant to assess practical skills. Thus they will be done primarily outside of class with aid from materials (book, notes, pre-existing internet resources), but not other people (students or otherwise). Students may revise data analyses one time before the next section's checkpoint or the scheduled final exam time (there will be no final exam for this class).

Students are required to turn in all written assignments electronically via Carmen by the dates/times listed on the course website for each assignment. In order to facilitate grading, both a source Quarto document and compiled HTML document must be submitted. Questions about grading should be brought to the instructor within one week of the return of the assignment. Regrading will apply to the entire assignment, not just the part where the student suspects a mistake.

Grading scale:

The final class grade will be determined as follows:

Grade	Range
A	94% to 100%
A-	90% to < 94%
B+	87% to < 90%
B	83% to < 87%
B-	80% to < 83%
C+	77% to < 80%
C	73% to < 77%
C-	70% to < 73%
D+	67% to < 70%
D	60% to < 67%
E	< 60%

The instructor may adjust the grading scale if it appears necessary due to overall class performance. These adjustments will only raise a student's grade, not lower it.

Generative AI policy:

The use of generative artificial intelligence (GenAI) tools is permitted for all assignments in this course. These are considered an internet resource, not help from other people. There are three conditions:

- Include a permanent copy of any relevant chat log as a separate document when submitting your work (copy/paste is fine but sharing a link is not).
- Cite the GenAI tool if you use any verbatim or near-verbatim text it generates.
- You are responsible for any errors.

Any use of GenAI tools that violates these conditions may be considered a violation of Ohio State's [Academic Integrity Policy](#) and [Code of Student Conduct](#), and it may result in referral to the Committee on Academic Misconduct.

Copyright:

This syllabus and all course materials (e.g., homework assignments, solution keys, course materials) are under copyright by the instructor and cannot be posted elsewhere without written permission.

Course Objectives

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

1. Distinguish causation versus association
2. Evaluate assumptions related to making causal inference
3. Critically assess the appropriateness of the methods adopted in public health literature
4. Apply commonly used statistical methods for analyzing observational datasets encountered in health science research, including propensity score adjustment, sensitivity analysis, instrumental variables, marginal structural models, and mediation analysis.
5. Use R to implement the statistical methods taught in the course.

Interdisciplinary PhD Program in Biostatistics Learning Goals

- Understands the theoretical foundations of statistical methods (1)
- Critique general scientific research articles and assess the appropriateness of the statistical applications and methodology involved (2)

MS-BIO Specialization Competencies:

- Address problems arising in public health and medicine through appropriate statements of hypotheses, study design, data collection, data management, statistical analysis, and interpretation of results (7)
- Recognize strengths and weaknesses of study designs, data sources, and analytic methods (8)
- Use computational methods to effectively analyze complex public health and medical data (10)

MPH-BIO Specialization Competencies:

- Address problems arising in public health and medicine through appropriate statements of hypotheses, study design, data collection, data management, statistical analysis, and interpretation of results (1)
- Recognize strengths and weaknesses of study designs and data sources commonly encountered in public health (2)
- Identify strengths and weaknesses of standard analytic methods (3)

Course Outline

This syllabus and outline should be taken as a fairly reliable guide for the course content. However, the instructor reserves the right to change schedules, due dates, or the methods of assessment. Any changes will be announced on Carmen.

Day	Topic	Suggested reading
W 8/27	0. Logistics & Introduction	Examples
M 9/1	<i>Labor Day (no class)</i>	
Module 1: Fundamentals		
W 9/3	1. Standardization	Kenah (2024)
M 9/8	2. Potential outcomes & causal effects	HR 1.1-1.4
W 9/10	3. Treatment assignment & observation	HR 1.5, 2.1-2.3, and 3
M 9/15	4. Modeling & inference	HR 11
W 9/17	Review 1	
M 9/22	Checkpoint 1: Fundamentals	
Module 2: Control of confounding		
W 9/24	5. Causal diagrams	HR 6-7
M 9/29	6. Propensity score matching	HR 15
W 10/1	7. More PS matching	Stuart (2010)
M 10/6	8. PS stratification	
W 10/8	9. IPT weighting	HR 2.4
M 10/13	Review 2	
W 10/15	Checkpoint 2: Propensity scores	
Module 3: Unobserved confounding		
M 10/20	10. Sensitivity analysis	D'Agostino & McGowan (2022)
W 10/22	11. Instrumental variables	HR 16
M 10/27	12. Nonadherence to randomization	
W 10/29	13. Principal stratification	
M 11/3	14. Difference-in-differences	
W 11/5	15. Unobserved spatial confounders	
M 11/10	Checkpoint 3: Unobserved confounding	
Module 4: Complex exposures		
W 11/12	16. Marginal structural models	HR 12
M 11/17	17. Time-dependent confounding	HR 19-21
W 11/19	18. Causal mediation	
M 11/24	19. Separable effects	HR 23
W 11/26	<i>Pre-Thanksgiving (no class)</i>	
M 12/1	20. Causal mediation with MSMs	
W 12/3	Checkpoint 4: Complex exposures	
W 12/8	21. Selection bias	Kenah (2023)
M 12/10	22. Survival analysis	HR 17

Readings are written as chapters or sections in the course textbook (HR) or papers on Carmen.

In each class period, we will work on an assignment due 11:59 pm one week later (e.g., assignment started in-class on Monday is due 11:59 pm the following Monday). All due dates will be posted on Carmen. *No late assignments will be accepted unless an extension has been granted before the due date at the discretion of the instructor.*

Office of Student Life Disability Services

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. 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.

If you are ill and need to miss class, including if you are staying home and away from others while experiencing symptoms of a viral infection or fever, please let me know immediately. In cases where illness interacts with an underlying medical condition, please consult with Student Life Disability Services to request reasonable accommodations.

You can connect with Student Life Disability Services at:

- Email: slds@osu.edu
- Telephone: 614-292-3307
- Website: <https://slds.osu.edu>

Mental Health Services

As a student, you may experience a range of issues that can cause barriers to learning, 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 <https://ccs.osu.edu> or calling 614-292-5766. CCS is located on the 4th Floor of the Younkun Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

Religious Beliefs or Practices Accommodations

Ohio State has had a longstanding practice of making reasonable academic accommodations for students' religious beliefs and practices in accordance with applicable law. In 2023, Ohio State updated its practice to align with new state legislation. Under this new provision, students must be in early communication with their instructors regarding any known accommodation requests for religious beliefs and practices, providing notice of specific dates for which they request alternative accommodations within 14 days after the first instructional day of the course. Instructors in turn shall not question the sincerity of a student's religious or spiritual belief system in reviewing such requests and shall keep requests for accommodations confidential.

With sufficient notice, instructors will provide students with reasonable alternative accommodations with regard to examinations and other academic requirements with respect to students' sincerely held religious beliefs and practices by allowing up to three absences each semester for the student to attend or participate in religious activities. Examples of religious accommodations can include, but are not limited to, rescheduling an exam, altering the time of a student's presentation, allowing make-up assignments to substitute for missed class work, or flexibility in due dates or research responsibilities. If concerns

arise about a requested accommodation, instructors are to consult their tenure initiating unit head for assistance.

A student's request for time off shall be provided if the student's sincerely held religious belief or practice severely affects the student's ability to take an exam or meet an academic requirement and the student has notified their instructor, in writing during the first 14 days after the course begins, of the date of each absence. Although students are required to provide notice within the first 14 days after a course begins, instructors are strongly encouraged to work with the student to provide a reasonable accommodation if a request is made outside the notice period. A student may not be penalized for an absence approved under this policy.

If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the [Civil Rights Compliance Office](#) (policy: [Religious Holidays, Holy Days and Observances](#)).

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 3335-5-48.7 \(B\)](#)). For additional information, see the [Code of Student Conduct](#).

Intellectual Diversity

Ohio State is committed to fostering a culture of open inquiry and intellectual diversity within the classroom. This course will cover a range of information and may include discussions or debates about controversial issues, beliefs, or policies. Any such discussions and debates are intended to support understanding of the approved curriculum and relevant course objectives rather than promote any specific point of view. Students will be assessed on principles applicable to the field of study and the content covered in the course. Preparing students for citizenship includes helping them develop critical thinking skills that will allow them to reach their own conclusions regarding complex or controversial matters.

Grievances and Solving Problems

A student who encounters a problem related to his/her educational program has a variety of avenues available to seek resolution. According to University Policies, if you have a problem with this class, you should seek to resolve the grievance concerning a grade or academic practice by speaking first with the instructor or professor. Then, if necessary, you may take your case to the department chairperson. Specific procedures are outlined in [Faculty Rule 3335-8-23](#), the [CPH Graduate Student Handbook](#), and the [CPH Undergraduate Student Handbook](#). Grievances against graduate, research, and teaching assistants should be submitted first to the supervising instructor, then to the chairperson of the assistant's department.

Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct

The Ohio State University is committed to building and maintaining a community to reflect diversity and to improve opportunities for all. All Buckeyes have the right to be free from harassment, discrimination, and sexual misconduct. Ohio State does not discriminate on the basis of age, ancestry, color, disability, ethnicity, gender, gender identity or expression, genetic information, HIV/AIDS status, military status,

national origin, pregnancy (childbirth, false pregnancy, termination of pregnancy, or recovery therefrom), race, religion, sex, sexual orientation, or protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment. Members of the university community also have the right to be free from all forms of sexual misconduct: sexual harassment, sexual assault, relationship violence, stalking, and sexual exploitation.

To report harassment, discrimination, sexual misconduct, or retaliation and/or seek confidential and non-confidential resources and supportive measures, contact the Civil Rights Compliance Office:

- Online reporting form at <https://civilrights.osu.edu/>
- Call 614-247-5838 or TTY 614-688-8605
- Email civilrights@osu.edu

The university is committed to stopping sexual misconduct, preventing its recurrence, eliminating any hostile environment, and remedying its discriminatory effects. All university employees have reporting responsibilities to the Civil Rights Compliance Office to ensure the university can take appropriate action to this end:

- All university employees, except those exempted by legal privilege of confidentiality or expressly identified as a confidential reporter, have an obligation to report incidents of sexual assault immediately.
- The following employees have an obligation to report all other forms of sexual misconduct as soon as practicable but at most within five workdays of becoming aware of such information: 1. Any human resource professional (HRP); 2. Anyone who supervises faculty, staff, students, or volunteers; 3. Chair/director; and 4. Faculty member.

Alignment of Course Assessments with Degree Program Competencies

	Labs	Data Analyses
Interdisciplinary PhD in Biostatistics Learning Goals		
Understands the theoretical foundations of statistical methods (1)	✓	
Critique general scientific research articles and assess the appropriateness of the statistical applications and methodology involved (2)	✓	✓
MS-Biostatistics Specialization Competencies		
Address problems arising in public health and medicine through appropriate statements of hypotheses, study design, data collection, data management, statistical analysis, and interpretation of results (7)	✓	✓
Recognize strengths and weaknesses of study designs, data sources, and analytic methods (8)	✓	✓
Use computational methods to effectively analyze complex public health and medical data (10)	✓	✓
MPH-Biostatistics Specialization Competencies		
Address problems arising in public health and medicine through appropriate statements of hypotheses, study design, data collection, data management, statistical analysis, and interpretation of results (1)	✓	✓
Recognize strengths and weaknesses of study designs and data sources commonly encountered in public health (2)	✓	✓
Identify strengths and weaknesses of standard analytic methods (3)	✓	✓