SYLLABUS & COURSE INFORMATION

SCHOOL OF PUBLIC HEALTH
UNIVERSITY OF MINNESOTA

PUBH 8341, SECTION 001

Advanced Epidemiologic Methods: Concepts
Fall 2019

COURSE & CONTACT INFORMATION

Credits: 3
Meeting Day(s): Tuesdays, Thursdays
Meeting Time: 9:45am - 11:00am
Meeting Place: Mayo 1250

Instructor:	Richard MacLehose, PhD	Susan Mason, PhD
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Office Hours:	By appointment	By appointment (tinyurl.com/smmappointments)
Office Location:	441 West Bank Office Building	340 West Bank Office Building

COURSE DESCRIPTION

This doctoral seminar introduces students to the conceptual foundations of epidemiologic methodology. The focus is on causal inference, what is required to estimate causal effects, and the strengths and weaknesses of different study designs in this endeavor. Examples and readings are aimed at both clinical/biologic and social/behavioral track students.

COURSE PREREQUISITES

None. A general background in basic epidemiologic concepts is recommended.

COURSE GOALS & OBJECTIVES

Upon completion of this course the student should be able to:

- Describe the causal inference framework that underpins modern epidemiologic thinking. List the criteria that must be met for causal effects to be identified.
- Define the types of biases that threaten our ability to estimate causal effects (confounding, selection bias, measurement error), understand alternative approaches to dealing with them, and recognize situations in which those approaches are appropriate.
- Define effect modification and interaction and implement general approaches for their analysis.
- Articulate the strengths and limitations of classic epidemiologic study designs (randomized control trial, cohort, case-control, cross-sectional), and best practices in using each design.
- Describe the relationships between estimation of causal effects and statistical estimation.

METHODS OF INSTRUCTION AND WORK EXPECTATIONS

Course Workload Expectations
PubH 8341 is a 3 credit course. The University expects that for a 3-credit course, you will spend a minimum of 9 hours per week attending class, reading, studying, completing assignments, etc. over the course of a 15-week term. Thus, this course requires approximately 135 hours of effort spread over the course of the term in order to earn an average grade.

The class will meet twice a week. Most topics will be covered over 1-2 weeks. Students are required to arrive prepared for class, including having done the assigned readings any assigned pre-class exercises. **It is expected that students will complete readings and work through assigned exercises from the lectures and readings by the Tuesday of each week** to ensure that they fully understand the material and are prepared for weekly quizzes.

There are **8 homework assignments**, worth 50% of the final grade total. These will be assigned on the Thursdays listed below and are due in class the following Thursday at the beginning of class. Homework assignments should be completed individually, but students are allowed to consult with one another on problems.

In-class quizzes will be administered at the beginning of most weeks. These quizzes will be based on the assigned pre-class exercises and/or readings for the class. **12 quizzes will be given during the semester**. The scores on the lowest 2 quizzes will be discarded and the remaining 10 quizzes will be worth 10% of the final grade.

There is no attendance grade, but **it is expected that students will attend all classes** unless there are extenuating circumstances. There will be no make-up quizzes offered, although students may miss up to 2 quizzes without penalty, since the lowest 2 quiz scores will be dropped. Students who are unable to come to class on days that homework is due should plan to email their homework to the instructors by the beginning of class or send their homework in with a classmate.

Learning Community
School of Public Health courses ask students to discuss frameworks, theory, policy, and more, often in the context of past and current events and policy debates. Many of our courses also ask students to work in teams or discussion groups. We do not come to our courses with identical backgrounds and experiences and building on what we already know about collaborating, listening, and engaging is critical to successful professional, academic, and scientific engagement with topics.

In this course, students are expected to engage with each other in respectful and thoughtful ways.

In group work, this can mean:

- Setting expectations with your groups about communication and response time during the first week of the semester (or as soon as groups are assigned) and contacting the TA or instructor if scheduling problems cannot be overcome.
- Setting clear deadlines and holding yourself and each other accountable.
- Determining the roles group members need to fulfill to successfully complete the project on time.
- Developing a rapport prior to beginning the project (what prior experience are you bringing to the project, what are your strengths as they apply to the project, what do you like to work on?)

In group discussion, this can mean:

- Respecting the identities and experiences of your classmates.
- Avoid broad statements and generalizations. Group discussions are another form of academic communication and responses to instructor questions in a group discussion are evaluated. Apply the same rigor to crafting discussion posts as you would for a paper.
- Consider your tone and language, especially when communicating in text format, as the lack of other cues can lead to misinterpretation.

Like other work in the course, all student to student communication is covered by the Student Conduct Code (https://z.umn.edu/studentconduct).

COURSE TEXT & READINGS

Two texts are required. Both are available free of charge online.

- Hernán MA, Robins JM. *Causal Inference*. Chapman & Hall/CRC, 2015. Available online at: http://www.hsph.harvard.edu/miguel-hernan/causal-inference-book/ (Readings are denoted CI)
- Rothman, Kenneth J., Sander Greenland, and Timothy L. Lash. 2012. *Modern Epidemiology, 3rd edition* (mid-cycle revision). New York: Lippincott Williams & Wilkins. [Note: this 2012 mid-cycle revision is mostly the same as the 3rd edition from 2008] (Readings are denoted ME3)

Additional readings (e.g., journal articles) are also required, as indicated on the reading list below. These will be made available to students through the course shared folder in Dropbox.
Reading assignments marked with an asterisk (*) are optional but highly recommended.

COURSE OUTLINE/WEEKLY SCHEDULE

Week/Instructor	Topic	Readings	Activities/Assignments
Week 1: Sept 3-Sept 5 Susan	• Introduction to Epidemiologic Inference • Measures of Disease Frequency	• ME3 – Chapter 2 starting at "Philosophy of Scientific Inference" (p. 18) • ME3 – Chapter 3	
Week 2: Sept 10-Sept 12 Susan	• Measures of Effect and Association • Counterfactuals and Identifiability	• CI – Chapters 1-3 • ME3 – Chapter 4 • Greenland, S. Interpretation and choice of effect measures in epidemiologic analyses. *American Journal of Epidemiology* 125.5 (1987): 761-768. • Poole, C. On the origin of risk relativism. *Epidemiology* 21.1 (2010): 3-9. • Hernán MA. Does water kill? A call for less casual causal inferences. *Annals of Epidemiology* 2016; 26(10):674-80. • Messer LC, Oakes JM, Mason S. Effects of socioeconomic and racial segregation on preterm birth: a cautionary tale of structural confounding. *American Journal of Epidemiology* 2010; 171: 664-673. • * Greenland S, Robins JM. Identifiability, exchangeability, and epidemiological confounding. *Int J Epidemiol* 1986;15:413-9. • * Maldonado G, Greenland S. Estimating causal effects. *Int J Epidemiol*. 2002 Apr 1;31(2):422-9. • * Commentaries on Maldonado and Greenland by Dawid, Shafer, Elwert and Winship, and Kaufman and Kaufman.	• Tues: Quiz 1 • Thurs: HW 1 Assigned
Week 3: Sep 17-Sep 19 Susan	• Effect Modification	• CI – Chapters 4-5 • ME3 – Chapter 5 • VanderWeele TJ, Knol MJ. A tutorial on interaction. Epidemiol. Methods 2014; 3(1): 33–72 • * Bhavnani D, Goldstick JE, Cevallos W, Trueba G, Eisenberg JNS. Synergistic effects between rotavirus and coinfecting pathogens on diarrheal disease: Evidence from a community-based study in northwestern Ecuador. American Journal of Epidemiology 2012; 176(5): 387-395. • * Vanderweele TJ. Invited commentary: Assessing mechanistic interaction between coinfecting pathogens for diarrheal disease. American Journal of Epidemiology 2012; 176(5): 396-399.	• Tues: Quiz 2 • Thurs: HW 1 Due; HW 2 Assigned
Week 4: Sep 24-Sep 26	• Confounding and DAGs	• ME3 – Chapter 12 • CI – Chapters 6-7	• Tues: Quiz 3

Susan		• Greenland S, Morgenstern H. Confounding in health research. *Annu Rev Public Health* 2001;22:189-212 • Hernán MA, Hernández-Díaz S, Werler MM, Mitchell AA. Causal knowledge as a prerequisite for confounding evaluation: an application to birth defects epidemiology. *Am J Epidemiol* 2002;155:176-84. • * Lewis M, Kuerbis A. An overview of causal directed acyclic graphs for substance abuse researchers. *Journal of Drug and Alcohol Research* 2016*;* 5: 1-8. [SEVERAL STUDENTS RECOMMENDED THIS PAPER FOR UNDERSTANDING DAGS] • * VanderWeele TJ, Hernán MA, Robins JM. Causal directed acyclic graphs and the direction of unmeasured confounding bias. *Epidemiology* 2008;19:720-8. • * Hernán MA, Clayton D, Keiding N. The Simpson's paradox unraveled. *Int J Epidemiol* 2011;40:780-5. • * Robins JM. Data, Design, and Background Knowledge in Etiologic Inference. *Epidemiology* 2001;12:313-320.	• Thurs: HW 2 Due; HW 3 Assigned
Week 5: Oct 1-Oct 3 Susan	• Confounding and DAGs, continued		• Tues: Quiz 4 • Thurs: HW 3 Due; HW 4 Assigned
Week 6: Oct 8-Oct 10 Susan	• Selection Bias	• CI – Chapter 8 • Cole SR, Platt RW, Schisterman EF, Chu H, Westreich D, Richardson D, Poole C. Illustrating bias due to conditioning on a collider. *Int J Epidemiol* 2010;39:417-20. • Hernandez-Diaz S, Schisterman E, Hernan MA. The birth weight "paradox" uncovered? American Journal of Epidemiology 2006; 164(11): 1115-1120. • Flanders WD, Klein M. Properties of 2 counterfactual effect definitions of a point exposure. Epidemiology. 2007 Jul 1;18(4):453-60. • * Porta M, Vineis P, Bolúmar F. The current deconstruction of paradoxes: one sign of the ongoing methodological "revolution". European journal of epidemiology. 2015 Oct 1;30(10):1079-87.	• Tues: Quiz 5 • Thurs: HW 4 Due
Week 7: Oct 15-Oct 17	• Review • MIDTERM (20% of final grade)	• N/A	
Week 8: Oct 22-Oct 24 Rich	• Measurement Bias	• CI – Chapter 9 Measurement bias • ME3 – Chapter 9 Validity in Epidemiologic Studies, pp. 137-146 (section on Information bias) • Dosemeci M, Wacholder S, Lubin JH. Does nondifferential misclassification of exposure always bias a true effect	• Tues: Quiz 6 • Thurs: HW 5 Assigned

		toward the null value? *Am J Epidemiol* 1990;132:746-8. • Vanderweele T, Hernán MA. Results on differential and dependent measurement error of the exposure and the outcome using signed directed acyclic graphs. Am J Epidemiol 2012;175:1303-10. • *Flegal KM, Keyl PM, Nieto FJ. Differential misclassification arising from nondifferential errors in exposure measurement. *Am J Epidemiol* 1991;134:1233-44.	
Week 9: Oct 29-Oct 31 Rich	• Estimation and Hypothesis Testing	• ME3 – Chapter 10 Precision and Statistics in Epidemiologic Studies • CI – Chapter 10 Random Variability • Poole C. Low P-values or narrow confidence intervals: which are more durable? *Epidemiology* 2001;12:291-4. • Amrhein V, Trafimow D and Greenland S. Inferential statistics are descriptive statistics. Pre-print. • Greenland, Sander, et al. "Statistical tests, P values, confidence intervals, and power: a guide to misinterpretations." *European journal of epidemiology* (2016): 1-14. • Rothman KJ. Curbing type I and type II errors. *Eur J Epidemiol* 2010;25:223-4. • Stang A, Poole C, Kuss O. The ongoing tyranny of statistical significance testing in biomedical research. *Eur J of Epidemiol* 2010;25:225-230 • Greenland S. The need for cognitive science in methodology. AJE. 2017; 186(6): 639-45.	• Tues: Quiz 7 • Thurs: HW 5 Due; HW 6 Assigned
Week 10: Nov 5-Nov 7 Rich	• Estimation and Hypothesis Testing, continued • Logical Fallacies		• Tues: Quiz 8 • Thurs: HW 6 Due; HW 7 Assigned
Week 11: Nov 12-Nov 14 Rich	• Randomized Trials • Cohort Studies	• ME3 Chapter 6 (read through subsection 'Experimental Studies' pp 87-93) • DeMets DL. Statistical issues in interpreting clinical trials. *J Intern Med* 2004;255:529-37. • Mansournia MA, Higgins JP, Sterne JA, Hernán MA. Biases in randomized trials: a conversation between trialists and epidemiologists. Epidemiology. 2017 Jan 1;28(1):54-9. • * Kaufman JS, Kaufman S, Poole C. Causal inference from randomized trials in social epidemiology. *Soc Sci Med* 2003;57:2397-409. • ME3 – Chapter 7 (Cohort Studies, pp 100-110) • Kolata G. Hormone studies: What went wrong? *New York Times*. April 22, 2003 • Hernan MA, Alonso A, Logan R, Grodstein F, Michels KB, Willett W, Mason JE, Robins JM. Observational Studies Analyzed Like Randomized Experiments: An Application to	• Tues: Quiz 9

		Postmenopausal Hormone Therapy and Coronary Heart Disease. Epidemiology 2008; 19(6): 766-779. • Hernán, M. A., Sauer, B. C., Hernández-Díaz, S., Platt, R., & Shrier, I. (2016). Specifying a target trial prevents immortal time bias and other self-inflicted injuries in observational analyses. *Journal of Clinical Epidemiology*, *79*, 70-75.	
Week 12: Nov 19-Nov 21 Rich	• Case-Control Studies	• ME3 – Chapter 8 (Case-control Studies, pp. 111-122) • Langholz, Bryan. Case-control studies= odds ratios: blame the retrospective model. *Epidemiology* 2010; 21(1): 10-12. • Knol MJ, Vandenbroucke JP, Scott P, Egger M. What do case-control studies estimate? Survey of methods and assumptions in case-control research. *Am J Epidemiol* 2008;168:1073-81. • Vandenbroucke JP, Pearce N. Case-control studies: basic concepts. *Int J Epidemiol* 2012;41:1480-9. • ME3 – pp. 171-182 [Matching]	• Tues: Quiz 10 • Thurs: HW 7 Due; HW 8 Assigned
Week 13: Nov 26 THANKSGIVING Rich	• Case-Control Studies		• Tues: Quiz 11
Week 14: Dec 3-Dec 5 Rich	• Case-Control Studies • Matching • Catching Up • Review		• Tues: Quiz 12; HW 8 Due
Week 15 Dec 10	• FINAL EXAM (20% of final grade)		

SPH AND UNIVERSITY POLICIES & RESOURCES

The School of Public Health maintains up-to-date information about resources available to students, as well as formal course policies, on our website at www.sph.umn.edu/student-policies/. Students are expected to read and understand all policy information available at this link and are encouraged to make use of the resources available.

The University of Minnesota has official policies, including but not limited to the following:

- Grade definitions
- Scholastic dishonesty
- Makeup work for legitimate absences
- Student conduct code
- Sexual harassment, sexual assault, stalking and relationship violence
- Equity, diversity, equal employment opportunity, and affirmative action
- Disability services
- Academic freedom and responsibility

Resources available for students include:

- Confidential mental health services
- Disability accommodations
- Housing and financial instability resources
- Technology help
- Academic support

EVALUATION & GRADING

The total grade for the course is a weighted average of homework assignments, the midterm exam and the final exam

- **Homework assignments (8) comprise 50% of the total grade**
- **Quizzes (10) comprise 10% of total grade**
- **Midterm exam is 20% of the total grade**
- **Final exam is 20% of the total grade**

[Enter a detailed statement of the basis for grading here. Include a breakdown of course components and a point system for achieving a particular grade. Include expected turnaround time for grading/feedback. Please refer to the University's Uniform Grading Policy and Grading Rubric Resource at https://z.umn.edu/gradingpolicy]

Grading Scale
The University uses plus and minus grading on a 4.000 cumulative grade point scale in accordance with the following, and you can expect the grade lines to be drawn as follows:

% In Class	Grade	GPA
93 - 100%	A	4.000
90 - 92%	A-	3.667
87 - 89%	B+	3.333
83 - 86%	B	3.000
80 - 82%	B-	2.667
77 - 79%	C+	2.333
73 - 76%	C	2.000
70 - 72%	C-	1.667
67 - 69%	D+	1.333
63 - 66%	D	1.000
< 62%	F	

- A = achievement that is outstanding relative to the level necessary to meet course requirements.
- B = achievement that is significantly above the level necessary to meet course requirements.
- C = achievement that meets the course requirements in every respect.
- D = achievement that is worthy of credit even though it fails to meet fully the course requirements.
- F = failure because work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I (Incomplete).
- S = achievement that is satisfactory, which is equivalent to a C- or better
- N = achievement that is not satisfactory and signifies that the work was either 1) completed but at a level that is not worthy of credit, or 2) not completed and there was no agreement between the instructor and student that the student would receive an I (Incomplete).

Evaluation/Grading Policy	Evaluation/Grading Policy Description
Scholastic Dishonesty, Plagiarism, Cheating, etc.	You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis (As defined in the Student Conduct Code). For additional information, please see https://z.umn.edu/dishonesty The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: https://z.umn.edu/integrity. If you have additional questions, please clarify with your instructor. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam. Indiana University offers a clear description of plagiarism and an online quiz to check your understanding (http://z.umn.edu/iuplagiarism).
Late Assignments	Late homework will have 10 points deducted per day late. Homework turned in after the homework key has been posted will receive 0 points. In appropriate cases, extensions will be given on homework deadlines; these must be requested in advance.
Attendance Requirements	Students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include verified illness, participation in intercollegiate athletic events, subpoenas, jury duty, military service, bereavement, and religious observances. Such circumstances do not include voting in local, state, or national elections. For complete information, please see: http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html

CEPH COMPETENCIES

Competency	Learning Objectives	Assessment Strategies
1. Apply epidemiological methods to the breadth of settings and situations in public health practice	Apply a wide range of epidemiologic methods	Homework assignments will be assigned for most of the methods discussed in the course
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software as appropriate	Epidemiological data will be analyzed using current techniques	Homework assignments will require students to analyze examples provided by the instructor.
4. Interpret results of data analysis for public health research, policy or practice	Interpret results of all models presented in the class	Each homework will require students to interpret the results of models they have implemented
19. Communicate audience-appropriate public health content, both in writing and through oral presentation	Students should be able to present the results of their analyses in a manner sufficient to convey their work to a technical audience.	Homework will assess the ability to convey this information in a clear and concise fashion.