**Harvard School of Public Health**

**Epidemiology 202 - Methods II: Elements of Epidemiologic Research**

**Fall 2 2022**

**Tuesday and Thursday 9:45-11:15 and 11:30-1:00**

**Kresge G1**

**Instructor**

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**Office Hour: Tuesdays 2:00-3:00 in Kresge 505 and by appointment**

**Head Teaching Fellow**

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**Teaching Fellows**

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**Credits**

**2.5 credits**

**Course Description**

EPI202 is a seamless continuation of EPI201. This course builds on the material from EPI201 and extends to concepts of statistical inference, data analysis methods, and causal inference in epidemiologic research. Principles and methods are illustrated with examples and reviewed through homework and in-class exercises. This course is designed primarily for doctoral students majoring in Epidemiology and related fields and those interested in a research career requiring a rigorous foundation in the design, conduct, and analysis of epidemiologic studies.

**Learning Objectives**

At the completion of the course students will be able to:

1. Describe, compute and interpret measures of disease frequency and measures of association and effect by hand and using statistical software packages such as SAS, Stata or R.
2. Conduct statistical inferential procedures, including computation and interpretation of p-values and confidence intervals by hand and using statistical software packages such as SAS, Stata or R.
3. Evaluate, analyze and interpret data arising in matched and unmatched case-control and cohort studies using crude and stratified analysis methods as appropriate in the presence of confounding and/or effect modification.
4. Conduct and interpret linear and logistic regression models based on epidemiologic data.
5. Understand and apply principles of sensitivity and specificity of measures of exposure and/or outcome.
6. Conduct analyses corrected for misclassification of exposure given data from a validation study.
7. Identify the critical assumptions for causal inference from observational data.
8. Critically evaluate epidemiologic studies for potential non-exchangeability by applying the concepts of the counterfactual basis of confounding and the presence of other sources of bias.
9. Use causal diagrams to represent a priori subject-matter knowledge, assumptions, and epidemiologic biases.
10. Describe the strengths, limitations, and theoretical basis of epidemiologic study designs.
11. Critically analyze published epidemiologic studies for methodologic strengths, limitations, data quality and interpretation of study findings.

*This course covers MPH competencies #1-4 as required by the Council on Education in Public Health.*

**Course Structure:**

**Lectures**

Weekly lecture material is pre-recorded and posted on the course Canvas Site in short chunks. The recordings will be the primary presentation of the didactic course material. Copies of the slides used in the presentations will be available for download. The class will meet on Tuesday and Thursday mornings (9:45-11:15 AM and 11:30-1:00 PM in Kresge G1). During these interactive class sessions, we will review the key points of the week’s material and work on problems that apply and extend to the material presented in the pre-recorded videos. During these sessions, there will be ample opportunity to ask questions and discuss course material. Students are expected to participate in these sessions actively. On the week of the midterm and final examinations, the Tuesday sessions will be devoted to reviewing the course content covered on the upcoming exam. We will record class sessions; however, since the interactive sessions include some small group work, the recordings may be of limited value.

**Lab Sessions**

Lab sessions are held on Thursday afternoons and Friday throughout the day. Registration in a lab session is required to remain in the class. You will review homework assignments, work on new problems, and discuss essential class concepts. While attendance in a lab is not required, we highly recommend it. Students are expected to attend the lab session that they are assigned to optimize the class size for interactive learning. Lab sessions are interactive and participatory and are not recorded.

**Canvas Course Website:**

The Canvas site is an important learning tool for this course where students will access pre-recorded lecture videos, homework assignments, additional problem sets, and discussion materials, submit course assignments and share other resources with the class. Students will also complete weekly self-assessment questions and the midterm and final examinations on the Canvas site. Course announcements will be posted on the site. Since the Canvas site is the official source of course information, you are strongly encouraged to check the course website daily and/or make sure that Canvas notifications about announcements and Canvas Conversations are sent to your primary e-mail address.

**Readings**

Textbooks are available at various book sellers online. Modern Epidemiology is available as an electronic text through Countway library. Epidemiology: An introduction is available online at the link below.

Lash TL, VanderWeele TJ, Haneuse S, Rothamn KJ. Modern Epidemiology (4th ed.) Philadelphia, PA: Wolters-Kluwer, 2021 (ISBN-13: 978-1-4511-9328-2) <http://id.lib.harvard.edu/alma/99155293309703941/catalog>

Hernán MA, Robins JM. Causal Inference: What If. Boca Raton: Chapman & Hall/CRC. <http://www.hsph.harvard.edu/miguel-hernan/causal-inference-book/>

Students requiring a review of basics concepts may use:

Rothman KJ. Epidemiology: An Introduction (2nd ed.) New York, NY: Oxford University Press, 2012 (ISBN-10 0199754551).

Available online: <http://ezp-prod1.hul.harvard.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2114235&site=ehost-live&scope=site>

Additional required readings will be available on the course website.

**Policy on Collaboration**:

Many students learn best when working in a group setting. We encourage collaborative learning in this course. You may discuss homework assignments with other students. However, all written work that you submit for grading must be your own, in your own words, reflecting your understanding of the homework assignment. Homework assignments should not be prepared by copying, paraphrasing, or summarizing someone else’s work.

[Code of Conduct | Student Handbook | Harvard T.H. Chan School of Public Health](https://www.hsph.harvard.edu/student-handbook/code-of-conduct/)

**Grading Criteria**

5 Homework Assignments (30%)

Weekly lecture questions (10%)

1 Midterm Exam (25%)

1 Final Exam (35%)

**Students’ progress in the course will be evaluated in the following ways:**

**Homework Assignments:** The homework assignments (four in total) involve exercises to apply the concepts covered in the lecture, class discussions, and course readings. The homework assignments must be submitted as a PDF through the course website by 9:30 AM on the Thursday dates indicated on the syllabus and listed on the Canvas site. Homework assignments uploaded after they are due will receive an automatic 10 percentage point reduction per each 24-hour period they are late.

**Weekly self-assessment questions:** The weekly self-assessment questions are available on the course Canvas site, together with the lecture video chunks. The questions are based on the video recordings and readings for the week. To receive credit, students must complete the weekly self-assessment questions before Thursday each week (9:30 AM). Students receive full credit for completing the quiz on time.

**Midterm and Final Examination**: The midterm and final examinations will require applying the concepts and skills developed in the course. Both exams will be in-class, closed-book examinations. The use of course notes, textbooks, or other resources, apart from an English language dictionary, a calculator, statistical software of your choice, and the “EPI 202 Roadmap” containing key formulas, is not permitted. Exams will be held in person during class and accessed from the Canvas website. The midterm exam will be on **Thursday, November 17, 2022,** and thefinal exam will be **Thursday, December 15, 2022**. The final exam will also be offered on **Wednesday, December 14, 2022,** at 5:30 PM in Kresge G1. Students must sign an academic integrity pledge acknowledging that they will not use any resources other than those supplied with the exam (apart from a calculator) and will not discuss any aspect of the exam with anyone until the course instructors inform them that the last student has taken the examination. Interactive review sessions will be held during class on Tuesday each examination week.

**Harvard Chan Policies and Expectations**

**Inclusivity Statement**

Diversity and inclusiveness are fundamental to public health education and practice. Students are encouraged to have an open mind and respect differences of all kinds. I share responsibility with you for creating a learning climate that is hospitable to all perspectives and cultures; please contact me if you have any concerns or suggestions.

**Bias Related Incident Reporting**

The Harvard Chan School believes all members of our community should be able to study and work in an environment where they feel safe and respected. As a mechanism to promote an inclusive community, we have created an anonymous bias-related incident reporting system. If you have experienced bias, please submit a report [here](https://reportinghotline.harvard.edu/) so that the administration can track and address concerns as they arise and to better support members of the Harvard Chan community.

**Title IX**

The following policy applies to all Harvard University students, faculty, staff, appointees, or third parties: [Harvard University Sexual and Gender-Based Harassment Policy.](http://hwpi.harvard.edu/files/title-ix/files/harvard_sexual_harassment_policy.pdf) Procedures [For Complaints Against a Faculty Member](http://hwpi.harvard.edu/title-ix/complaints-against-faculty-member-hsph)

Procedures[For Complaints Against Non-Faculty Academic Appointees](http://hwpi.harvard.edu/title-ix/complaints-against-non-faculty-academic-appointees-hsph)

**Academic Integrity**

Each student in this course is expected to abide by the Harvard University and the Harvard T.H. Chan School of Public Health School's standards of Academic Integrity. All work submitted to meet course requirements is expected to be a student's own work. In the preparation of work submitted to meet course requirements, students should always take great care to distinguish their own ideas and knowledge from information derived from sources.

Students must assume that collaboration in the completion of assignments is prohibited unless explicitly specified. Students must acknowledge any collaboration and its extent in all submitted work. This requirement applies to collaboration on editing as well as collaboration on substance.

Should academic misconduct occur, the student(s) may be subject to disciplinary action as outlined in the Student Handbook. See the [Student Handbook](https://www.hsph.harvard.edu/student-handbook/) for additional policies related to academic integrity and disciplinary actions.

**Accommodations for Students with Disabilities**

Harvard University provides academic accommodations to students with disabilities. Any requests for academic accommodations should ideally be made before the first week of the semester, except for unusual circumstances, so arrangements can be made. Students must register with the Local Disability Coordinator in the Office for Student Affairs to verify their eligibility for appropriate accommodations. Contact Colleen Cronin [ccronin@hsph.harvard.edu](mailto:ccronin@hsph.harvard.edu) in all cases, including temporary disabilities.

**Religious Holidays, Absence Due to**

According to Chapter 151c, Section 2B, of the General Laws of Massachusetts, any student in an educational or vocational training institution, other than a religious or denominational training institution, who is unable, because of his or her religious beliefs, to attend classes or to participate in any examination, study, or work requirement on a particular day shall be excused from any such examination or requirement which he or she may have missed because of such absence on any particular day, provided that such makeup examination or work shall not create an unreasonable burden upon the School. See the [student handbook](https://www.hsph.harvard.edu/student-handbook/) for more information.

**Grade of Absence from Examination**  
A student who cannot attend a regularly scheduled examination must request permission for an alternate examination from the instructor in advance of the examination. See the [student handbook](https://www.hsph.harvard.edu/student-handbook/) for more information.

**Final Examination Policy**

No student should be required to take more than two examinations during any one day of finals week. Students with more than two examinations scheduled during a particular day during the final examination period may take their class schedules to the director for student affairs for assistance in arranging an alternate time for all exams in excess of two. Please refer to the [student handbook](https://www.hsph.harvard.edu/student-handbook/) for the policy.

**Course Evaluations**

Constructive feedback from students is a valuable resource for improving teaching. The feedback should be specific, focused, and respectful. It should also address aspects of the course and teaching that are positive and those that need improvement.

Completion of the evaluation is a requirement for each course. Your grade will not be available until you submit the evaluation. In addition, registration for future terms will be blocked until you have completed evaluations for courses in prior terms.

**Course Schedule & Assessment of Student Learning**

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| **Weekly topics** | **Objectives** | **Readings** | **Activities/**  **Assignments** |
| **Week 1 (10/24/2022 – 10/28/2022)** | | | |
| **Statistical Inference**  **Crude Analysis**  **Philosophy of Science** | **Statistical Inference**  Formulate statistical hypotheses  Construct, calculate and interpret test statistics and confidence intervals  Explain the justification for inferential statistics in the absence of randomization  **Crude Analysis**  Construct, calculate and interpret hypothesis tests, point estimates and confidence intervals in common epidemiologic study designs  **Philosophy of Science**  Describe Carl Popper’s approach to understanding accumulation of scientific knowledge  Define a testable hypothesis in terms of empirical content and falsifiability | **Statistical Inference**  Modern Epidemiology: Chap 15 (pp. 333-342)  Epidemiology an Introduction: pp.148-152  **Crude Analysis**  Modern Epidemiology: Chapter 17 (pp. 395-397; 401-413)  Epidemiology an Introduction: pp.148-158 | **Complete all self-assessment questions:**  Due 10/27/2022 @ 9:30 AM ET  **Optional: Variance derivation module**  **Lab Session Practice Problems 1:** Complete in Lab |
| **Week 2 (10/31/2022 – 11/4/2022)** | | | |
| **Stratified Analysis of person-time data**  **Effect Measure Modification**  **Stratified analysis of count data** | **Stratified Analysis**  Evaluate the tradeoff between bias and efficiency  Construct, calculate and interpret hypothesis tests, point estimates and confidence intervals after adjusting for confounders in person-time and count data  **Effect Measure Modification**  Describe the impact of effect modification on the interpretation of summary estimates  Use data to evaluate the presence of effect modification  Construct, calculate and interpret statistical tests of heterogeneity | **Stratified Analysis**  Modern Epidemiology: Chap 18 (pp. 423-429)  Epidemiology an Introduction: pp.176-186 and 192-197  **Effect Measure Modification**  Modern Epidemiology:Chap 18 (pp 415-417; 431-436) | **Complete all self-assessment questions:**  Due 11/3/2022 @ 9:30 AM ET  **Homework 1:** Due Nov. 3 @ 9:30AM ET  **Lab Session Practice Problems 2:**  Complete in Lab |
| **Week 3 (11/7/2022 – 11/11/2022)** | | | |
| **Stratified case-control analysis**  **Matched Design**  **Matched Analysis** | Construct, calculate and interpret hypothesis tests, point estimates and confidence intervals after adjusting for confounders in case-control data  Identify and describe the utility of matching in the design and analysis of cohort and case-control studies  Evaluate the tradeoffs in increasing the control:case ratio in case-control studies  Construct, calculate and interpret hypothesis tests, point estimates and confidence intervals for matched case-control studies | Modern Epidemiology: Chapter 6 (pp 124-135) and Chapter 18 (pp 436-441)  Epidemiology an Introduction pp. 129-132 | **Complete all self-assessment questions:**  Due 11/10/2022 @ 9:30 AM ET  **Homework 2:** Due Nov. 10 @ 9:30AM ET  **Lab Session Practice Problems 3:**  The in-person lab will be canceled this week because of Veterans Day, however, a recorded lab session will be available for student viewing. |
| **Week 4 (11/14/2022 – 11/18/2022)** | | | |
| **Magnitude of Confounding Bias**  **Misclassification** | Asses the determinants of the magnitude of bias due to uncontrolled confounding  Compute and interpret the E-value  Understand the difference between measurement error and misclassification  Recognize and explain the distinction between independent versus dependent misclassification and nondifferential versus differential misclassification  Perform calculations and interpret indices of measurement accuracy including sensitivity, specificity and predictive using data from validation studies  Perform and interpret calculations of correcting estimates of measures of association by applying indices of measurement accuracy obtained from external validation studies  Explain the impact of misclassification on estimation procedures, hypothesis tests, confounding and effect modification | Walker AM. Observation and Inference Chapter 9.  VanderWeele TJ, & Ding P. Sensitivity analysis in observational research: introducing the E-value. Ann Intern Med 2017; 167: 268-274.  Mathur MB, Ding P, Riddell CA, VanderWeele TJ. (2018). Website and R package for computing E-values. Epidemiol 2018; 29:e45-e47.  <https://www.evalue-calculator.com/>  Modern Epidemiology: Chap 13 (pp. 287-299)  Epidemiology an Introduction: pp. 133-136 | **Complete all self-assessment questions:**  Due date delayed to 11/18/2022 @ 11:59 PM  **Lab Session Practice Problems 4:**  Complete in Lab  **Midterm Examination in class on Thursday 11/17/2022. The exam will include material up to the end of the Week 3 lectures.** |
| **Midterm Examination on Thursday 11/17/2022** | | | |
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| **Week 5 (11/21/2022 – 11/25/2022)** | | | |
| **Linear regression** | **Linear Regression**  Explain the relationship between exposures and outcomes in a regression framework  Use appropriate statistical software to analyze data in a linear regression framework  Interpret the results from linear regression models |  | **Thanksgiving week**  No homework or lab assignments  **Complete all self-assessment questions:**  Due date delayed to 12/1/22 @ 9:30 AM |
| **Week 6 (11/28/2022 – 12/2/2022)** | | | |
| **Logistic regression** | **Logistic regression**  Explain the relationship between exposures and outcomes in a regression framework  Recognize the relationship between stratified tabular analysis and regression models  Use appropriate statistical software to analyze data in a logistic regression framework  Interpret the results from regression models | Epidemiology an Introduction: Chapter 12 (pp. 211-234)  Optional: Modern Epidemiology Chapter 20. | **Complete all self-assessment questions:**  Due 12/1/2022 @ 9:30 AM ET  **Homework 3:** Due Dec. 1 @ 9:30 AM  **Lab Session Practice Problems 5:**  Complete in Lab |
| **Week 7 (12/5/2022 – 12/9/2022)** | | | |
| **Standardization and inverse probability weighting** | Describe the utility of standardization and its relationship to counterfactual conceptualization of causal effects  Compare, contrast and interpret the tradeoffs between different standardization weights  Interpret and contrast direct and indirect standardization  Construct, calculate and interpret standardized estimates  Apply inverse probability of treatment weights to conduct standardized analyses using different weights | Modern Epidemiology: Chapter 18 (pp 417-423)  Epidemiology an Introduction pp. 188-192  Causal Inference Chapter 2 (2.3-2.4) | **Complete all self-assessment questions:**  Due 12/8/2022 @ 9:30 AM ET  **Homework 4:** Due Dec. 8 @ 9:30 AM  **Lab Session Practice Problems 6:**  Complete in Lab |
| **Week 8 (12/12/2022 – 12/16/2022)** | | | |
| **Course Review** |  |  | **Final Examination in Kresge G1 on Wednesday 12/14/22 from 5:30-7:00 PM or in class on Thursday 12/15/2022. The exam will include material up to the end of the Week 8 lectures.** |
| **Final Examination on Thursday 12/15/2022 – Students may take the exam early on Wednesday 12/14, 2022 from 5:30-7:00 PM** | | | |

Please note, session topics and activities may be subject to change during the course. Please see the Canvas website for further details.