I. Course Description

This doctoral seminar introduces students to the conceptual foundations of essential issues in epidemiologic methodology. The focus is on how and why a given method, design, or approach might help us explain population health. The emphasis is on the strengths, limitations, and potential alternatives for a given approach. The origins, use, and potential of both classic and cutting-edge methods are considered. Examples and readings are aimed at both clinical/biologic and social/behavioral track students.

II. Course Prerequisites

None

III. Course Goals and Objectives

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

- Understand the concept of causal inference in epidemiology, the different approaches that underpin this concept, and how to ask meaningful research questions for causal inference.
- Understand the concept of identification and how it is different from statistical estimation.
- Define the main types of bias (confounding, selection bias, measurement error), understand alternative approaches to dealing with them, and recognize situations in which those approaches are appropriate.
- Understand the concepts of effect modification and mediation, and implement general approaches for their analysis.
- Apply classic epidemiologic study designs (cohort, case-control, cross-sectional, ecological) and their variants, knowing their particular strengths and limitations.
IV. Methods of Instruction and Work Expectations

The class will meet twice a week. Most topics will be covered over two days. Generally, the first meeting will be an instructor or guest-speaker led discussion of the week’s topic, including discussion of assigned background readings. The second meeting will entail a more thorough doctoral-level discussion of assigned readings and consideration of how a given method or concept might be implemented in an actual epidemiological study.

Students are required to attend each class having read the assigned material and prepared for group discussion and debate.

Homework assignments will be handed out at the end of weeks 2, 4, 6, 8, 10 and 12, and will be due before the end of weeks 3, 5, 7, 9, 11, and 13. The take-home final exam will be handed out at the beginning of week 14 and will be due at the beginning of the last day of class.

V. Course Text and Readings

One text is required:

Additionally, a number of papers and book chapters are also required. These will be made available to students through the course shared folder in Dropbox.

Reading in the course text are denoted as ME3

Reading assignments marked with an asterisk (*) are optional; you will not be expected to read this material, though you may benefit by doing so.

Introduction to Epidemiological Inference

ME3 – Chapter 1 Introduction
Taubes G. Epidemiology faces its limits. Science 1995;269:164-9

Counterfactuals and Other Causal Models

ME3 – Chapter 2 Causation and Causal Inference

Causal Effects in Observational Studies: Exchangeability, Identifiability, Positivity


**Directed Acyclic Graphs**

ME3 – Chapter 12 Causal diagrams


**Confounding**

ME3 – Chapter 9 Validity in Epidemiologic Studies, pp. 129-134 (Confounding)


**Selection Bias**

ME3 – Chapter 9 Validity in Epidemiologic Studies, pp. 134-137 (Selection bias)


**Measurement Bias**

ME3 – Chapter 9 Validity in Epidemiologic Studies, pp. 137-146 (Information bias)


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.


**Effect Modification**

ME3 – Chapter 5 Concepts of Interaction


**Mediation**


Kaufman JS, MacLehose RF, Kaufman S. A further critique of the analytic strategy of adjusting for covariates to identify biologic mediation. Epidemiol Perspect Innov 2004;1:4


**Hypothesis Testing, P-Values & Precision**

ME3 – Chapter 10 Precision and Statistics in Epidemiologic Studies

Poole C. Low P-values or narrow confidence intervals: which are more durable? Epidemiology 2001;12:291-4.


**Instrumental Variables**


Bayesian Theory & Analysis

ME3 – Chapter 18 Introduction to Bayesian statistics


Randomized Clinical Trials


Group Randomized Trials


Review of Cohort and Case-Control Studies

ME3 – Chapters 7 (Cohort Studies, pp 100-110) and 8 (Case-control Studies, pp. 111-122)


Matching

ME3 pp. 171-182 [Matching]

Hybrid Study Designs

ME3 pp. 122-126 [Variants of the case-control design]


Observational Multilevel Studies


Ecologic Studies

ME3 – Chapter 25 Ecologic Studies

VI. Course Outline/Weekly Schedule

<table>
<thead>
<tr>
<th>WEEK</th>
<th>DATE</th>
<th>TOPIC</th>
<th>INSTRUCTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sep 2</td>
<td>Introduction to Epidemiologic Inference</td>
<td>Oakes, Alonso</td>
</tr>
<tr>
<td></td>
<td>Sep 4</td>
<td>Counterfactuals and other causal models (I)</td>
<td>Oakes</td>
</tr>
<tr>
<td>2</td>
<td>Sep 9</td>
<td>Counterfactuals and other causal models (II)</td>
<td>Alonso</td>
</tr>
<tr>
<td></td>
<td>Sep 11</td>
<td>Causal effects in observational studies: exchangeability, identifiability, positivity (I)</td>
<td>Alonso</td>
</tr>
<tr>
<td>3</td>
<td>Sep 16</td>
<td>Causal effects in observational studies: exchangeability, identifiability, positivity (II)</td>
<td>Oakes</td>
</tr>
<tr>
<td></td>
<td>Sep 18</td>
<td>Directed acyclic graphs (I)</td>
<td>Alonso</td>
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<tr>
<td>4</td>
<td>Sep 23</td>
<td>Directed acyclic graphs (II)</td>
<td>Alonso</td>
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<tr>
<td></td>
<td>Sep 25</td>
<td>Confounding (I)</td>
<td>Oakes</td>
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<tr>
<td>5</td>
<td>Sep 30</td>
<td>Confounding (II)</td>
<td>Alonso</td>
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<tr>
<td></td>
<td>Oct 2</td>
<td>Selection bias (I)</td>
<td>Alonso</td>
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<tr>
<td>6</td>
<td>Oct 7</td>
<td>Measurement bias</td>
<td>Alonso</td>
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<td></td>
<td>Oct 9</td>
<td>Selection bias (II)</td>
<td>Oakes</td>
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<tr>
<td>7</td>
<td>Oct 14</td>
<td>Effect modification (I)</td>
<td>Oakes</td>
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<td></td>
<td>Oct 16</td>
<td>Hypothesis testing, p-values, precision (I)</td>
<td>Oakes</td>
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<tr>
<td>8</td>
<td>Oct 21</td>
<td>Effect modification (II)</td>
<td>Alonso</td>
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<tr>
<td></td>
<td>Oct 23</td>
<td>Mediation (I)</td>
<td>MacLehose</td>
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<tr>
<td>9</td>
<td>Oct 28</td>
<td>Mediation (II)</td>
<td>Alonso</td>
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<tr>
<td></td>
<td>Oct 30</td>
<td>Hypothesis testing, p-values, precision (II)</td>
<td>Alonso</td>
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<tr>
<td>10</td>
<td>Nov 4</td>
<td>Bayesian analysis</td>
<td>Chu</td>
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<td></td>
<td>Nov 6</td>
<td>Instrumental variables</td>
<td>Oakes</td>
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<td>11</td>
<td>Nov 11</td>
<td>Review of cohort and case-control studies</td>
<td>Alonso</td>
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<td></td>
<td>Nov 13</td>
<td>Randomized clinical trials</td>
<td>Neaton</td>
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<tr>
<td>12</td>
<td>Nov 18</td>
<td>Group randomized trials</td>
<td>Oakes</td>
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<td></td>
<td>Nov 20</td>
<td>Matching</td>
<td>Oakes</td>
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<tr>
<td>13</td>
<td>Nov 25</td>
<td>Hybrid study designs</td>
<td>Alonso</td>
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<td></td>
<td>Nov 27</td>
<td>THANKSGIVING DAY</td>
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<tr>
<td>14</td>
<td>Dec 2</td>
<td>Ecologic studies</td>
<td>Alonso</td>
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<tr>
<td></td>
<td>Dec 4</td>
<td>Observational multilevel studies</td>
<td>Oakes</td>
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</tbody>
</table>
VII. Evaluation and Grading

Letter grades and associated points are awarded in this course as follows below. These will appear in the student’s official transcript. See http://www1.umn.edu/usenate/policies/gradingpolicy.html for details.

**Pass/Fail Grading:** An alternative to traditional A-F scale grades is the S/N grading scale. The “S” grade does not carry points but credit will count toward completion of student’s degree if permitted by college or program. An “N” is given for student’s exercising the S/N grading option but who fail to meet minimum course requirements. Students may change grading options without written permission as specified by the University and without penalty during the initial registration period or during the first two weeks of the semester. The grading option may not be changed after the second week of the term.

The maximum number of points a student can earn is 100. Six homework assignments demonstrating understanding of assigned readings and lectures will account for 50 points (50%) of the final grade, while a take-home final exam will account for 25 points (25%) of the final grade. Class participation will account for the remaining 25 points. Numeric grades will map to letter grades as per the table above.

<table>
<thead>
<tr>
<th>Class Points</th>
<th>Letter Grade</th>
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<tbody>
<tr>
<td>&gt;94</td>
<td>A</td>
</tr>
<tr>
<td>90-94</td>
<td>A-</td>
</tr>
<tr>
<td>87-89</td>
<td>B+</td>
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<tr>
<td>83-86</td>
<td>B</td>
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<tr>
<td>80-82</td>
<td>B-</td>
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<tr>
<td>77-79</td>
<td>C+</td>
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<tr>
<td>73-76</td>
<td>C</td>
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<tr>
<td>70-72</td>
<td>C-</td>
</tr>
<tr>
<td>70+</td>
<td>S</td>
</tr>
<tr>
<td>-</td>
<td>N/F</td>
</tr>
<tr>
<td>-</td>
<td>I</td>
</tr>
</tbody>
</table>

The University utilizes plus and minus grading on a 4.000 cumulative grade point scale in accordance with the following:

- **A** 4.000 - Represents achievement that is outstanding relative to the level necessary to meet course requirements
- **A-** 3.667
- **B+** 3.333
- **B** 3.000 - Represents achievement that is significantly above the level necessary to meet course requirements
- **B-** 2.667
- **C+** 2.333
- **C** 2.000 - Represents achievement that meets the course requirements in every respect
- **C-** 1.667
- **D+** 1.333
- **D** 1.000 - Represents achievement that is worthy of credit even though it fails to meet fully the course requirements
- **S** Represents achievement that is satisfactory, which is equivalent to a C- or better.

For additional information, please refer to: http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html.
Course Evaluation
The SPH will collect student course evaluations electronically using a software system called CoursEval: www.sph.umn.edu/courseval. The system will send email notifications to students when they can access and complete their course evaluations. Students who complete their course evaluations promptly will be able to access their final grades just as soon as the faculty member renders the grade in SPHGrades: www.sph.umn.edu/grades. All students will have access to their final grades through OneStop two weeks after the last day of the semester regardless of whether they completed their course evaluation or not. Student feedback on course content and faculty teaching skills are an important means for improving our work. Please take the time to complete a course evaluation for each of the courses for which you are registered.

Incomplete Contracts
A grade of incomplete “I” shall be assigned at the discretion of the instructor when, due to extraordinary circumstances (e.g., documented illness or hospitalization, death in family, etc.), the student was prevented from completing the work of the course on time. The assignment of an “I” requires that a contract be initiated and completed by the student before the last official day of class, and signed by both the student and instructor. If an incomplete is deemed appropriate by the instructor, the student in consultation with the instructor, will specify the time and manner in which the student will complete course requirements. Extension for completion of the work will not exceed one year (or earlier if designated by the student’s college). For more information and to initiate an incomplete contract, students should go to SPHGrades at: www.sph.umn.edu/grades.

University of Minnesota Uniform Grading and Transcript Policy
A link to the policy can be found at onestop.umn.edu.

VIII. Other Course Information and Policies

Grade Option Change (if applicable)
For full-semester courses, students may change their grade option, if applicable, through the second week of the semester. Grade option change deadlines for other terms (i.e. summer and half-semester courses) can be found at onestop.umn.edu.

Course Withdrawal
Students should refer to the Refund and Drop/Add Deadlines for the particular term at onestop.umn.edu for information and deadlines for withdrawing from a course. As a courtesy, students should notify their instructor and, if applicable, advisor of their intent to withdraw.

Students wishing to withdraw from a course after the noted final deadline for a particular term must contact the School of Public Health Office of Admissions and Student Resources at sph-ssc@umn.edu for further information.

Student Conduct Code:
The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community.

As a student at the University you are expected adhere to Board of Regents Policy: Student Conduct Code. To review the Student Conduct Code, please see: http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf.

Note that the conduct code specifically addresses disruptive classroom conduct, which means “engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach or student learning. The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities.”

Use of Personal Electronic Devices in the Classroom:
Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, the University establishes the right of each faculty member to determine if and how personal electronic devices are allowed to be used.
in the classroom. For complete information, please reference:

**Scholastic Dishonesty:**
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. (Student Conduct Code: http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf) If it is determined that a student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see:
http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html.

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: http://www1.umn.edu/oscai/integrity/student/index.html. If you have additional questions, please clarify with your instructor for the course. 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.

**Makeup Work for Legitimate Absences:**
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.

**Appropriate Student Use of Class Notes and Course Materials:**
Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see: http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html.

**Sexual Harassment**
"Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult Board of Regents Policy:
http://regents.umn.edu/sites/default/files/policies/SexHarassment.pdf

**Equity, Diversity, Equal Opportunity, and Affirmative Action:**
The University will provide equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy:
http://regents.umn.edu/sites/default/files/policies/Equity_Diversity_EO_AA.pdf

**Disability Accommodations:**
The University of Minnesota is committed to providing equitable access to learning opportunities for all students. The Disability Resource Center Student Services is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.
If you have, or think you may have, a disability (e.g., mental health, attentional, learning, chronic health, sensory, or physical), please contact DS at 612-626-1333 or ds@umn.edu to arrange a confidential discussion regarding equitable access and reasonable accommodations.

If you are registered with DS and have a current letter requesting reasonable accommodations, please contact your instructor as early in the semester as possible to discuss how the accommodations will be applied in the course.

For more information, please see the DS website, https://diversity.umn.edu/disability/.

**Mental Health and Stress Management:**
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 and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: http://www.mentalhealth.umn.edu.

**The Office of Student Affairs at the University of Minnesota:**
The Office for Student Affairs provides services, programs, and facilities that advance student success, inspire students to make life-long positive contributions to society, promote an inclusive environment, and enrich the University of Minnesota community.

Units within the Office for Student Affairs include, the Aurora Center for Advocacy & Education, Boynton Health Service, Central Career Initiatives (CCE, CDes, CFANS), Leadership Education and Development – Undergraduate Programs (LEAD-UP), the Office for Fraternity and Sorority Life, the Office for Student Conduct and Academic Integrity, the Office for Student Engagement, the Parent Program, Recreational Sports, Student and Community Relations, the Student Conflict Resolution Center, the Student Parent HELP Center, Student Unions & Activities, University Counseling & Consulting Services, and University Student Legal Service.

For more information, please see the Office of Student Affairs at http://www.osa.umn.edu/index.html.

**Academic Freedom and Responsibility: for courses that do not involve students in research:**

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.*

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair, your adviser, the associate dean of the college (Dr Kristin Anderson, SPH Dean of Student Affairs), or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost.

* Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students".

**Student Academic Success Services (SASS):** http://www.sass.umn.edu:

Students who wish to improve their academic performance may find assistance from Student Academic Support Services. While tutoring and advising are not offered, SASS provides resources such as individual consultations, workshops, and self-help materials.