Advanced Epidemiologic Methods: Concepts
Fall 2018

I. 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.

II. Course Prerequisites
None. A general background on basic epidemiologic concepts is recommended.

III. Course Goals and 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.
IV. Methods of Instruction and Work Expectations

The class will meet twice a week. Most topics will be covered over multiple days. **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 also independently work through exercises and examples from the lectures and readings to ensure that they fully understand the material.

There are 8 homework assignments, worth 60% 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 are to be completed individually.

V. Course Outline/Weekly Schedule

*Assigned readings on each topic are listed in Section VI below*

<table>
<thead>
<tr>
<th>WEEK</th>
<th>DATE</th>
<th>TOPIC</th>
<th>INSTRUCTOR</th>
<th>HOMEWORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sep 4</td>
<td>Introduction to Epidemiologic Inference</td>
<td>R+S</td>
<td></td>
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<tr>
<td></td>
<td>Sep 6</td>
<td>Measures of Disease Frequency</td>
<td>S</td>
<td></td>
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<tr>
<td>2</td>
<td>Sep 11</td>
<td>Measures of Effect and Association</td>
<td>S</td>
<td></td>
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<tr>
<td></td>
<td>Sep 13</td>
<td>Counterfactuals and Identifiability</td>
<td>S</td>
<td>HW 1 Assigned</td>
</tr>
<tr>
<td>3</td>
<td>Sep 18</td>
<td>Confounding and DAGs (I)</td>
<td>S</td>
<td></td>
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<tr>
<td></td>
<td>Sep 20</td>
<td>Confounding and DAGs (II)</td>
<td>S</td>
<td>HW 2 Assigned</td>
</tr>
<tr>
<td>4</td>
<td>Sep 25</td>
<td>Confounding and DAGs (III)</td>
<td>S</td>
<td></td>
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<tr>
<td></td>
<td>Sep 27</td>
<td>Confounding and DAGs (IV)</td>
<td>S</td>
<td>HW 3 Assigned</td>
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<tr>
<td>5</td>
<td>Oct 2</td>
<td>Selection Bias (I)</td>
<td>S</td>
<td></td>
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<td></td>
<td>Oct 4</td>
<td>Selection Bias (II)</td>
<td>S</td>
<td>HW 4 Assigned</td>
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<td>6</td>
<td>Oct 9</td>
<td>Measurement Bias (I)</td>
<td>R</td>
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<td>Oct 11</td>
<td>Measurement Bias (II)</td>
<td>R</td>
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<td>7</td>
<td>Oct 16</td>
<td>Review</td>
<td>R&amp;S</td>
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<td></td>
<td>Oct 18</td>
<td>MIDTERM (20% of final grade)</td>
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<tr>
<td>8</td>
<td>Oct 23</td>
<td>Effect Modification (I)</td>
<td>S</td>
<td></td>
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<tr>
<td></td>
<td>Oct 25</td>
<td>Effect Modification (II)</td>
<td>S</td>
<td>HW 5 Assigned</td>
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<tr>
<td>9</td>
<td>Oct 30</td>
<td>Estimation and Hypothesis Testing (I)</td>
<td>R</td>
<td></td>
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<td></td>
<td>Nov 1</td>
<td>Estimation and Hypothesis Testing (II)</td>
<td>R</td>
<td>HW 6 Assigned</td>
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<tr>
<td>10</td>
<td>Nov 6</td>
<td>Estimation and Hypothesis Testing (III)</td>
<td>R</td>
<td></td>
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<td></td>
<td>Nov 8</td>
<td>Estimation and Hypothesis Testing (IV)</td>
<td>R</td>
<td>HW 7 Assigned</td>
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<tr>
<td>11</td>
<td>Nov 13</td>
<td>Randomized Trials</td>
<td>R</td>
<td></td>
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<tr>
<td></td>
<td>Nov 15</td>
<td>Cohort Studies</td>
<td>R</td>
<td></td>
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<tr>
<td>12</td>
<td>Nov 20</td>
<td>Case-Control Studies (I)</td>
<td>R</td>
<td></td>
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<td>Nov 22</td>
<td>THANKSGIVING</td>
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<tr>
<td>13</td>
<td>Nov 27</td>
<td>Case-Control Studies (II)</td>
<td>R</td>
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<td></td>
<td>Nov 29</td>
<td>Case-Control Studies/Matching (III)</td>
<td>R</td>
<td>HW 8 Assigned</td>
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<td>14</td>
<td>Dec 4</td>
<td>Other Topics</td>
<td>R</td>
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<tr>
<td></td>
<td>Dec 6</td>
<td>Review</td>
<td>R+S</td>
<td></td>
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<tr>
<td>15</td>
<td>Dec 11</td>
<td>FINAL EXAM (20% of final grade)</td>
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VI. Course Text and Readings

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


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.

**Week 1, Class 1: Introduction to Epidemiological Inference**

ME3 – Chapter 2 Causation and Causal Inference starting at “Philosophy of Scientific Inference” (p. 18)

**Week 1, Class 2: Measures of Disease Frequency**

ME3 – Chapter 3 Measures of Occurrence

**Week 2, Class 1: Measures of Effect and Association**

CI – Chapter 1 A Definition of Causal Effect
ME3 – Chapter 4 Measures of Effect and Measures of Association


**Week 2, Class 2: Counterfactuals and Identifiability**

CI – Chapter 2 Randomized Experiments
CI – Chapter 3 Observational Studies


* Commentaries on Maldonado and Greenland by Dawid, Shafer, Elwert and Winship, and Kaufman and Kaufman.

**Weeks 3-4: Confounding and DAGs**

ME3 – Chapter 12 Causal diagrams
CI – Chapter 6 Graphical representation of causal effects
CI – Chapter 7 Confounding


**Week 5: Selection Bias**

CI – Chapter 8 Selection bias


**Week 6: Measurement Bias**

CI – Chapter 9 Measurement bias

ME3 – Chapter 9 Validity in Epidemiologic Studies, pp. 137-146 (section on 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.


**Week 7: EXAM**

**Week 8: Effect Modification**

ME3 – Chapter 5 Concepts of Interaction

CI – Chapter 4 Effect modification

CI – Chapter 5 Interaction


**Week 9-10: 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.


**Week 11, Class 1: Randomized Trials**

ME3 Chapter 6 (read through subsection ‘Experimental Studies’ pp 87-93)


**Week 11, Class 2: Cohort Studies**

ME3 – Chapter 7 (Cohort Studies, pp. 100-110)


**Week 12-13: Case-Control Studies**

ME3 – Chapter 8 (Case-control Studies, pp. 111-122)


* ME3 – pp. 171-182 [Matching]
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 total grade for the course is a weighted average of homework assignments, the midterm exam and the final exam:

- Homework assignments (8) comprise 60% of the total grade
- Midterm exam is 20% of the total grade
- Final exam is 20% of the total grade

Numeric grades map to letter grades as per the table to the right.

<table>
<thead>
<tr>
<th>Class Points</th>
<th>Letter Grade</th>
</tr>
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<tbody>
<tr>
<td>&gt;94</td>
<td>A</td>
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<tr>
<td>90-94</td>
<td>A-</td>
</tr>
<tr>
<td>87-89</td>
<td>B+</td>
</tr>
<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>

Late policy
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.

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.

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: http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html.

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:
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. Disability Services (DS) 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 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](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](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, 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".

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