SPPH681A: CAUSAL INFERENCE IN PUBLIC HEALTH SCIENCES

INSTRUCTORS

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PLACE AND TIME

- Weekly 3-hour lectures on Mondays, 1 to 4 pm, SPPH B136
- Weekly 1-hour tutorials TBD

COURSE DESCRIPTION

Causal inference from observational data is a common task in public health sciences. Epidemiology, health services research, studies in occupational and environmental health share a methodological framework for causal inference developed over the past three decades. This 3-credit course offers in-depth coverage of causal inference methodology.

The purpose of the course is to develop knowledge, skills and competency in applying methods of causal inference to observational data. The course formally defines fundamental concepts of causality, causal effect and confounding, and explicates conditions for attributing observed differences to causal relationship. Specifically, the course covers causal diagrams, counterfactual reasoning, and practical methods for estimating causal effects. In complementing tutorials, DAGitty will be used for creating, editing, and analyzing causal diagrams. Stata will be used for estimating effects; alternatively, students may apply their knowledge in R programming learnt in previous courses.

RATIONALE FOR TAKING THIS COURSE

The course addresses a recognized need for a graduate-level teaching that links concepts and practical skills in making causal inference in epidemiology, health services research, and studies in occupational and environmental health. The course starts with introducing the concept of causal effect and then explicates conditions for attributing observed associations to causal relationship. The course offers learning of causal methodology through practical applications to real data.

Learning from the course, students will be able to produce causal diagrams for thesis projects, to refine research questions, to identify variables for adjustment, to detail the plan of analysis, and to estimate direct and indirect treatment effects with data from their own projects. The course will benefit those who analyze data from registries, records of routine care, hospital discharges, or from study cohorts.

PREREQUISITES

Prerequisites: SPPH500, SPPH 503, and SPPH548 is strongly recommended. Working knowledge of statistical software is recommended.

LEARNING OBJECTIVES

On completion of the course, students will be able to

(1) explain the formal framework for drawing causal inferences
(2) develop directed acyclic graphs and identify a minimal sufficient adjustment set
(3) estimate total, direct and indirect treatment effects from observational data
(4) express and interpret causal queries through counterfactuals quantities.

COURSE STRUCTURE

The course combines lectures, discussions and tutorials, in-class and homework assignments, and relies on course reading materials.

EVALUATION OF LEARNING

Evaluation will be conducted using a combination of marks for 12 in-class assessments (maximum 24% of the total mark), six homework assignments (36%), and final homework assignment (40%).

In-class assignments

Each class involves assessment of the learning progress in class. The assessment tools will include a combination of multiple choice tests and short writing exercises covering the content from lectures, in-class discussions and required readings. The assessments provide an opportunity for students to evaluate their own progress through the course and help strengthen their understanding of core concepts and methods. Each test is worth 2 points (maximum 24 points for 12 tests).

Homework assignments

Bi-weekly homework assignments will involve various aspects of data analysis and preparing short reports. The quality of each report will be judged by clarity of presentation, suitability of methods, and interpretation of results. Each assignment is worth 6 points (maximum 36 points for 6 assignments).

A final homework assignment will involve data analysis and paper preparation. The paper should contain the following sections: Introduction, Methods, Results, Discussion, and References. Results should be presented in an organized fashion, such as in table or graphical formats. Computer outputs should be edited to eliminate irrelevant or redundant material. The quality of the report will be judged by the suitability of methods, correct computing, interpretation of results, and clarity of presentation (maximum 40 points).

PREPARATION

The student is expected to be prepared for topics discussed in class. Sufficient time should be allocated for reading of required and assigned texts.

COURSE MATERIALS

- Lecture notes and handouts of lab tutorials
- Selected articles and book chapters:

1. Susser M. Glossary: Causality in Public Health Science. Journal of Epidemiology and Community Health 2001;55(6):376-378.
2. Cattaneo. Journal of Econometrics 2010, 155:147
3. Almond D. The Quarterly Journal of Economics 2005:1031-83
4. Berkson J. Limitations of the applications of fourfold table analysis to hospital data. Int. J Epidemiol 2014: 1-5
5. Maldonado G, Greenland S. Estimating causal effects. Int J Epidemiol 2002;31(2):422-429.
6. Austin PC. Absolute risk reductions, relative risks, relative risk reductions, and numbers needed to treat can be obtained from a logistic regression model. J Clin Epidemiol 2010;63(1):2-6.
7. Greenland S. Causation and causal inference. In: Lorvic M, editor. International encyclopedia of statistical science. Berlin Heidelberg: Springer; 2011. p. 216-221.
8. Vittinghoff E, Glidden DV, McCulloch CE, Shiboski SC. Chapter 9: Strengthening Causal Inference. Regression Methods in Biostatistics. 2nd ed.: Springer; 2012. p. 331-394.

9. Elwert F. Graphical Causal Models. In: Morgan SL (ed.), Handbook of Causal Analysis for Social Research: Springer Netherlands; 2013. p. 245-273.
10. Greenland S, Pearl J. Causal diagrams. In: Lorvic M, editor. International encyclopedia of statistical science. Berlin Heidelberg: Springer; 2011. p. 208-216.
11. Greenland S, Pearl J, Robins JM. Causal Diagrams for Epidemiologic Research. Epidemiology 1999;10(1):37-48.
12. Hernán MA, Robins JM. Chapter 1: A Definition of Causal Effect. Causal Inference; 2013. p. 3-12. www.hsph.harvard.edu/faculty/miguel-hernan/causal-inference-book
13. Hernán MA, Robins JM. Chapter 3: Observational Studies. Causal Inference; 2013. p. 25-39. www.hsph.harvard.edu/faculty/miguel-hernan/causal-inference-book
14. Hernán MA, Robins JM. Estimating causal effects from epidemiological data. J Epidemiol Community Health 2006;60(7):578-586.
15. Holland PW. Statistics and Causal Inference. Journal of the American Statistical Association 1986;81(396):945-960.
16. Kaufman J, MacLehose R, Kaufman S. A further critique of the analytic strategy of adjusting for covariates to identify biologic mediation. Epidemiologic Perspectives & Innovations 2004;1(1):4-4.
17. Sobolev B, Kuramoto L. Section 2.1 and 2.2 - Waiting-time data used in this book. Analysis of waiting-time data in health services research. New York: Springer New York; 2008. p. 17-29.
18. Suzuki E, Yamamoto E, Tsuda T. On the relations between excess fraction, attributable fraction, and etiologic fraction. Am J Epidemiol 2012;175(6):567-575.
19. Textor J, Hardt J, Knüppel S. DAGitty: A Graphical Tool for Analyzing Causal Diagrams. Epidemiology 2011;22(5):745-745.
20. Textor J, Liskiewicz M. Adjustment Criteria in Causal Diagrams: An Algorithmic Perspective. 2012.
21. Vittinghoff E, Glidden DV, McCulloch CE, Shiboski SC. Chapter 10: Predictor Selection. Regression Methods in Biostatistics: Springer; 2012. p. 395-429.
22. Westreich D, Greenland S. The Table 2 Fallacy: Presenting and Interpreting Confounder and Modifier Coefficients. Am J Epidemiol. 2013;177(4):292–298
23. Miettinen O. Stratification by a multivariate confounder score. Am J Epidemiol 1976; 106: 609-620

The course readings are available through RefWorks page http://resources.library.ubc.ca/901/ on the UBC library website

The "Course Materials" folder contains list of citations and provides links to electronic copies or pdfs.

- On the Refworks page, click 'Connect to Resource' (green button).
- Log in to the Refworks account.
- If accessing Refworks off campus, provide your CWL information.

The RefWorks login is:

- Login Name: course_materials
- Password: coursematerials