ECIM Short Course Proposal (half day)

Title: Introduction to Bayesian Nonparametric Methods for Causal Inference

Instructors: Michael Daniels, Jason Roy

Abstract: Bayesian nonparametric (BNP) methods can be used to flexibly model joint or conditional distributions, as well as functional relationships. These methods, along with causal assumptions, can be used with the g-formula for inference about causal effects. This general approach to causal inference has several possible advantages over popular semiparametric methods, including efficiency gains, the ease of causal inference on any functionals of the distribution of potential outcomes, the use of prior information, and capturing uncertainty about causal assumption via informative prior distributions. In this workshop we review BNP methods and illustrate their use for causal inference in the setting of point treatments, mediation, and semi-competing risks. We present several data examples and discuss software implementation using R. The R code and/or packages used to run the data examples will be provided to the attendees at a specific github site.

Outline

Part I: Bayesian methods for causal inference (60 min)

- Review of Bayesian methods
- Identifiability and sensitivity analysis

Part 2: BNP models (90 min)

- Bayesian additive regression trees
- Dirichlet process mixture models
- Dependent Dirichlet process models

Part 3: Case studies (60 min)

- Application to EHR data
- Semi-competing risks

Learning Objectives

- Understand advantages of BNP for causal inference
- Understand key concepts in causal inference
- Understand key concepts in Bayesian inference
- Understand the role of identifying restrictions and sensitivity parameters
- Compute causal estimands in the presence of confounding using G-computation
- Fit BNP models in different settings
- Use R to implement the methods on one's own data

Target Audience

Students, postdocs, or professional statisticians who have familiarity with the basics of causal inference and statistics (e.g., regression modeling) who would like to learn about Bayesian

nonparametric approaches to causal problems. Familiarity with basics of Bayesian inference and/or R is helpful, but not necessary.

About the instructors:

Michael Daniels, ScD is Professor, Andrew Banks Family Endowed Chair, and Chair in the Department of Statistics at the University of Florida. His research over the past 20 years has focused on Bayesian approaches for missing data and causal inference; in terms of the former, he co-authored a research monograph on Bayesian approaches for missing data in 2008 and in terms of both, he co-authored a research monograph in 2023 with co-presenter Dr. Roy. Dr. Daniels has collaborated with Dr. Roy on numerous papers and grants involving missing data and causal inference over the past 15 years. Dr. Daniels has taught many short courses over the years on topics including Bayesian hierarchical models and Bayesian methods for missing and longitudinal data at national meetings (Joint Statistical Meetings), international meetings (Bayes Pharma), regional meetings (ENAR (of IBS) annual meeting), government agencies (U.S. Centers for Disease Control), among many others. He has given these courses around the world, including in Colombia, Chile, the Netherlands, Belgium, Canada, Australia, and Sweden.
mdaniels@stat.ufl.edu

Jason Roy, PhD, is Professor of Biostatistics and Chair of the Department of Biostatistics and Epidemiology at Rutgers School of Public Health, and Co-Director of the Center for Causal Inference. Drs Roy and Daniels have collaborated for many years, developing Bayesian approaches for causal inference and missing data. Dr Roy has taught short courses or workshops for the Joint Statistical Meetings (2018), Chicago chapter of the ASA (2019), Deming conference (2019), Non-clinical Biostatistics Conference (2021), and Harvard Catalyst (2022). He won the Statistics in Causality Education Award from ASA in 2021.
jason.roy@rutgers.edu

Book: Daniels, M., Linero, A, and Roy, J. (2023) Bayesian Nonparametric Methods for Causal Inference and Missing Data. Chapman & Hall.