DATA*6600 Case Study 4

Presentation Due: Thursday, August 4th, 10:00am

Proposal Due: Tuesday, August 9th, 11:59pm

Case Study 4 will be broken down into two components:

1) A presentation
2) A proposal

For your presentation, you will select a causal inference method not discussed in this module and make a **12-minute** presentation to introduce the method to the class (12 minute presentation, 3 minute question period). In your presentation, make sure to answer the following questions:

a) What type of question is this method used to answer? (e.g., causal mediation would look at the direct and indirect effects of a treatment on an outcome through a mediating variable or in other words, it would be applied to examine the mechanism of the causal effect of a treatment on an outcome)
b) Briefly, how is the method applied?
c) How does the method assume causality? (e.g., how are confounders accounted for?)
d) What assumptions are necessary for this method to be applied?
e) Are there any advantages/limitations to this method?

Your topic can be any method not discussed in the module and you can use textbook resources or paper resources. Feel free to choose a topic from the list below (with suggested resources to get you started):

- Marginal structural models
    - Causal Inference: What If - Chapter 12 (Hernan & Robins, 2020)
    - Association, Causation, and Marginal Structural Models (Robins, 1999)
    - Marginal Structural Models and Causal Inference in Epidemiology (Robins, Hernan & Brumback, 2000),
    - Marginal structural models in clinical research: when and how to use them? (Williamson & Ravani, 2017)
- Causal forest
    - Estimation and Inference of Heterogeneous Treatment Effects using Random Forest (Wager & Athey, 2018)
    - Using Causal Forests to Predict Treatment Heterogeneity: An Application to Summer Jobs (Davis & Heller, 2017)
- Propensity scores for categorical or ordinal treatments
    - Causal Inference with General Treatment Regimes (Imai & Van Dyck, 2004)
    - Utilizing Propensity Score Methods for Ordinal Treatments and Prehospital Trauma Studies (Greene, 2017)
    - Propensity score matching for multiple treatment comparisons in observational studies (Liu, Nickleach & Lipscomb, 2013)
- Causal Bayesian network
    - A tutorial on bayesian networks for psychopathology researchers (Briganti, Scutari & McNelly, 2022)
    - Tutorial of the probabilistic methods Bayesian networks and influence diagrams applied to medicine (Nistal-Nuno, 2018)

- G-estimation and structural nested models
    - Causal Inference: What If: Chapter 14 (Hernan & Robins, 2020)
    - Structural Nested Models and G-estimation: The Partially Realized Promise (Vansteelandt & Joffe, 2014)
    - G-Estimation of Structural Nested Models: Recent Applications in Two Subfields of Epidemiology (Picciotto & Neophytou, 2016)
- G-computation/g-formula
    - Causal Inference: What If: Chapter 13 (Hernan & Robins, 2020)
    - Implementation of G-computation on a simulated data set: demonstration of a causal inference technique (Snowden, Rose & Mortimer, 2011)
- Targeted maximum likelihood estimation (or targeted learning)
    - Targeted maximum likelihood estimation for causal inference in observational studies (Schuler & Rose, 2017)
    - Targeted maximum likelihood estimation for a binary treatment: A tutorial (Luque-Fernandez et al., 2018)
    - Targeted maximum likelihood estimation: A gentle introduction (Gruber & Van Der Laan, 2009)

Please email me your top 3 choices for the causal inference method you will cover by Friday, July 22nd. I will give the topics out based on a first come first serve basis.

For your proposal, you will discuss how your selected causal inference method from your presentation can be applied to one of the following observational studies to answer a causal inference question:

- Elison-Davies, Wardell, J. D., Quilty, L. C., Ward, J., & Davies, G. (2021). Examining correlates of cannabis users' engagement with a digital intervention for substance use disorder: An observational study of clients in UK services delivering Breaking Free Online. Journal of Substance Abuse Treatment, 123, 108261–108261. https://doi.org/10.1016/j.jsat.2020.108261
- Voci, Zawertailo, L., Baliunas, D., Masood, Z., & Selby, P. (2020). Is cannabis use associated with tobacco cessation outcome? An observational cohort study in primary care. *Drug and Alcohol Dependence*, *206*, 107756–107756. https://doi.org/10.1016/j.drugalcdep.2019.107756

Note if your causal inference method cannot directly be applied to the study as it is, then you can discuss how the study could be extended for the method to be applied (e.g., do you need to add an extra time period? Is there a different way you would measure the treatment? Are there any variables you would consider adding?).

The proposal should be a maximum of **3-4 pages in length** (excluding title page, references, figures, tables) with single spaced 12-point font and should include the following information:

a) Title page (including title, name, course name)
b) Brief background to the question or problem you will address and the research gap to be filled
c) A statement of the specific project objective
d) Brief overview of the observational study (i.e., how the data was collected, what variables are included, etc.). **Note: If you are extending the study to include time periods or variables, include this information here.**
e) Overview of proposed methods for statistical analysis (make sure to discuss which variables you will include in analyses and how they will be included)
f) Ethical considerations of your proposed work

g) Conclusion consisting of a brief statement about the anticipated broader significance of your proposed project

Please email me the observational study you will write the proposal on by Friday, July 29th. If you are planning to extend the study in any way in order to accommodate your causal inference method, you can include this in the email as well.