Introduction to Causal Inference
february 2023

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meetings: online via zoom. Monday evenings - 19:00 to 21:45
prerequisites: no distinct prerequisites other than a genuine interest on the subject.

i. aim
Causality has long been a primary issue of interest for both philosophy and science. Recent developments on the topic paved the way for a wider utilisation of causal inference methods in various fields, including machine learning, economics, and epidemiology. This lecture formation intends to provide an introduction to the basics of causality. By implementing and interpreting causal inference methods, we will try to develop an interdisciplinary and practical understanding of causal analysis.

keywords: Causality. Causal inference. Potential outcomes. Bayesian Networks. Structural Causal Models. Interventions. *Do*-calculus. Counterfactuals.

ii. content
This is a less quantitative version of a 14-week course. The lecture series consists of three modules, which aim to address the following issue: why we do what we do, when we are deriving a causal inference. In this context, we will employ why and how questions to probe different causal inference frameworks and methods.

iii. course plan
The meetings will be held online, via zoom. Discussions will be primarily in Turkish. However, since all the material is in English, fluency in both languages is required. I will provide the readings on a weekly basis. Some weekly assignments will be offered to implement our findings.

iv. course schedule
Module I - 3 weeks

week 1: Introduction and framing. Model-building. Causality.

[**reading 01**] Williamson, T. (2018). Model-Building. *Doing Philosophy* (pp. 127-140). Oxford University Press.
[**reading 02**] Illari, P., & Russo, F. (2014). Prelude to Causality. *Causality: Philosophical Theory Meets Scientific Practice* (pp. 3-23). Oxford University Press.
[**reading 03**] Beebee, H. (2014). Causation. In B. Dainton & H. Robinson (eds.), *The Bloomsbury Companion to Analytic Philosophy* (pp. 312-335). Bloomsbury.

week 2: Probability: Frequentism vs. Bayesianism. Statistical Inference. Causal Inference. Potential outcomes. Simpson's Paradox.

[**reading 01**] Neal, B. (2020). Why You Might Care. *Introduction to Causal Inference from a Machine Learning Perspective* [PDF].
[**reading 02**] Koller, D. & Friedman, N. (2009). Probability Theory. *Probabilistic Graphical Models: Principles and Techniques* (pp. 15-25). MIT Press.
[**reading 03**] Pearl, J., Glymour, M., & Jewell, N. P. (2016). Probability and Statistics. *Causal Inference in Statistics* (pp. 7-24). Wiley.

week 3: Graph Theory. Bayesian Networks. Directed Acyclic Graphs. The ladder of causation.

[**reading 01**] Pearl, J. & Mackenzie, D. (2018). The Ladder of Causation. *The Book of Why: The New Science of Cause and Effect* (pp. 23-51). Penguin.
[**reading 02**] Darwische, A., (2010). Bayesian Networks. *Communications of the ACM, 53*(12), 80-90. https://doi.org/10.1145/1859204.1859227

Module II - 4 weeks

week 4: Causal Models. Reichenbach's common cause principle. Selection bias.

[**reading 01**] Pearl, J. & Mackenzie, D. (2018). From Evidence to Causes: Reverend Bayes Meets Mr. Holmes. *The Book of Why: The New Science of Cause and Effect* (pp. 93-133). Penguin.
[**reading 02**] Neal, B. (2020). The Flow of Association and Causation in Graphs. *Introduction to Causal Inference from a Machine Learning Perspective* [PDF].

week 5: Confounding. d-separation.

[**reading 01**] Pearl, J. & Mackenzie, D. (2018). Confounding and Deconfounding: Or, Slaying the Lurking Variable. *The Book of Why: The New Science of Cause and Effect* (pp. 135-165). Penguin.
[**reading 02**] Pearl, J. (2009). The d-Separation Criterion. *Causality: Models, Reasoning, and Inference* (pp. 16-20). Cambridge University Press.

week 6: Randomized trials. Observational studies. Backdoor path criterion.

[**reading 01**] Pearl, J. & Mackenzie, D. (2018). The Skillful Interrogation of Nature: Why RCTS Work. *The Book of Why: The New Science of Cause and Effect* (pp. 143-150). Penguin.
[**reading 02**] Neal, B. (2020). Randomized Experiments. *Introduction to Causal Inference from a Machine Learning Perspective* [PDF].

week 7: Interventions. Front-door adjustment. Controls.

[**reading 01**] Pearl, J. & Mackenzie, D. (2018). Beyond Adjustment: The

Conquest of Mount Intervention. *The Book of Why: The New Science of Cause and Effect* (pp. 219-257). Penguin.
[**reading 02**] Cinelli, C., Forney, A., & Pearl, J. (2022). A Crash Course in Good and Bad Controls. *Sociological Methods & Research, 0*(0). https://doi.org/10.1177/00491241221099552

Module III - 3 weeks

week 8: *Do*-calculus.

[**reading 01**] Pearl, J. (2019). On the Interpretation of $do(x)$. *Journal of Causal Inference, 7*(1), 20192002. https://doi.org/10.1515/jci-2019-2002

week 9: Counterfactuals.

[**reading 01**] Pearl, J. & Mackenzie, D. (2018). Counterfactuals: Mining Worlds That Could Have Been. *The Book of Why: The New Science of Cause and Effect* (pp. 259-297). Penguin.
[**reading 02**] Williamson, T. (2009). Knowledge of Counterfactuals. *Royal Institute of Philosophy Supplement, 64*, 45-64. doi:10.1017/S135824610900006X

week 10: Final remarks. Wrapping things up.

[**reading 01**] Pearl, J., (2019). The Seven Tools of Causal Inference, with Reflections on Machine Learning. *Communications of the ACM, 62*(3), 54-60. https://doi.org/10.1145/3241036