SEMINARIO

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Applications of Optimal Transport in Causal Inference

Abstract: Understanding the true effect of a treatment variable, A, on a response variable, Y, is a fundamental challenge across diverse fields, particularly when unknown confounding factors, U, influence both. The appropriate framework for addressing this is causal inference, which distinguishes causal relationships from spurious correlations through a flexible model of endogenous and exogenous variables, essentially as a problem of massive incomplete data. This framework includes the counterfactual model, which has become popular in Machine Learning both for explaining algorithmic decisions and for defining individual notions of fairness, often more intuitive than typical group fairness conditions. However, computing these counterfactuals is frequently infeasible in practice, as it relies on an underlying causal model that is unknown and difficult to discover.

We propose an alternative approach based on optimal transport techniques to design realistic and computable counterfactuals in the absence of a known causal model. We define transport models as collections of joint probability distributions and establish their connection to causal counterfactuals. This optimal transport approach opens a path toward new inferential tools that are not limited to discrete scenarios, but also successfully address the more complex case of continuous treatments.

Joint work with Eustasio del Barrio Tellado.

[1] Pedro C. Álvarez-Esteban, Eustasio del Barrio, Juan A. Cuesta-Albertos, and Carlos Matrán (2016) A fixed-point approach to barycenters in Wasserstein space}, Journal of Mathematical Analysis and Applications, 441(2), 744-762.
[2] Lucas de Lara, Alberto González-Sanz, Nicholas Asher, and Jean-Michel Loubes (2024) Transport-based counterfactual models}, Journal of Machine Learning Research, 25(135), 1-59.
[3] Larry Wasserman (2020) Conservative inference for counterfactuals, Journal of the American Statistical Association, 115(529), 123-135.

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