

# **Proximal Causal Inference with Many Negative Controls and High-Dimensional Covariates**

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## **Abstract**

Proximal causal inference offers a principled framework for addressing unmeasured confounding through the use of negative-control information. By linking observed data structures to latent sources of confounding, proximal methods provide an important alternative to conventional adjustment when key confounders are not directly measured. Despite this promise, practical implementation remains challenging. Valid and informative negative controls may be difficult to identify, and modern biomedical and epidemiologic studies often contain large numbers of candidate proxy variables and measured covariates. Directly incorporating such high-dimensional information into proximal analyses may lead to unstable bridge estimation, numerical fragility, and reduced interpretability. This talk will discuss emerging strategies for improving the stability and applicability of proximal causal inference in settings with complex confounding structures. The focus will be on how information from multiple proxy variables and high-dimensional covariates may be summarized into lower-dimensional representations suitable for proximal analysis, while retaining information relevant to causal identification and estimation. Preliminary numerical investigations will be used to illustrate the potential advantages and limitations of these approaches. Overall, the talk aims to connect proximal causal inference, perturbation-based thinking, and dimension-reduction ideas, and to highlight open methodological questions for valid and stable causal estimation in observational studies.