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THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON STATISTICS

Assessing the causal effects of a stochastic intervention in time series data

By

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Abstract

The methodological development of this article is motivated by the need to address the following scientific question: does the issuance of heat alerts prevent adverse health effects? Our goal is to address this question within a causal inference framework in the context of time series data. A key challenge is that causal inference methods require the overlap assumption to hold: each unit (i.e., a day) must have a positive probability of receiving the treatment (i.e., issuing a heat alert on that day). In our motivating example, the overlap assumption is often violated: the probability of issuing a heat alert on a cooler day is near zero. To overcome this challenge, we propose a stochastic intervention for time series data which is implemented via an incremental time-varying propensity score (ItvPS). The ItvPS intervention is executed by multiplying the probability of issuing a heat alert on day t—conditional on past information up to day t—by an odds ratio δt. First, we introduce a new class of causal estimands, which relies on the ItvPS intervention. We provide theoretical results to show that these causal estimands can be identified and estimated under a weaker version of the overlap assumption. Second, we propose nonparametric estimators based on the ItvPS and derive an upper bound for the variances of these estimators. Third, we extend this framework to multisite time series using a spatial meta-analysis approach. Fourth, we show that the proposed estimators perform well in terms of bias and root mean squared error via simulations. Finally, we apply our proposed approach to estimate the causal effects of increasing the probability of issuing heat alerts on each warm-season day in reducing deaths and hospitalizations among Medicare enrollees in 2837 US counties.

***Date : 24 July 2024 (Wednesday)**

Time : 4:00p.m.-5:00p.m.

***Venue : Room 2404 (Lift 17/18)**

All are Welcome!