THE UNIVERSITY OF CHICAGO | DEPARTMENT OF STATISTICS

MASTER'S THESIS PRESENTATION

KE XU

Department of Statistics
The University of Chicago

(Ⅰ) Metric Entropy Approaches in Estimating Instability of Inverse Problems and (Ⅱ) a Bayesian Latent Variable Framework in Multivariable Mendelian Randomization

WEDNESDAY, May 3, 2023, at 10:30AM
Jones Laboratory, Room 304

ABSTRACT

Part 1: In the first part, we explore the application of metric entropy to estimate instability in inverse problems, emphasizing examples and applications. The study commences with an overview of metric entropy and instability of inverse problems followed by an in-depth analysis of various techniques to obtain instability estimates employing metric entropy. Specific instances discussed encompass the Radon transform, generalized Radon transform, generalized Ray transform, and local tomography. Furthermore, we delve into statistical inverse problems and the application of metric entropy approaches to derive convergence rates. The metric entropy methodology elucidates the connection between the regularity of parameter and measurements spaces, the smoothing properties of forward operators, and the instability of inverse problems.

Part 2: Mendelian randomization (MR) is a widely used statistical technique employed to infer causal relationships between exposures and outcomes using genetic variants. Considerable efforts have been devoted to addressing two challenges: pleiotropy and weak instrument bias. In this work, we propose a unified latent variable causal model that that leverages information from various genetic contexts and is robust to violations of MR assumptions. We develop a scalable and flexible Gibbs sampler to facilitate model estimation and evaluate our approach using numerical experiments and real data. Simulation results and comparisons with existing techniques demonstrate the effectiveness of our proposed method. Part of this work is conducted jointly with PhD candidate Yihao Lu at the University of Chicago.