

THE UNIVERSITY OF CHICAGO

Computational and Applied Mathematics & Statistics Student Seminar

---

Wenxuan Guo

Econometrics and Statistics
University of Chicago

Experimental Design When N Equals One

Friday, November 20, 2026
12:30 PM
Jones 303

ABSTRACT

Abstract: N-of-1 trials, or time-series experiments, are widely used in clinical research and online platforms. Yet the theoretically optimal design for estimating many treatment effects remains unclear. We propose a simple Markovian framework for experimental design in which the treatment assignment process is governed by possibly time-varying transition matrices. This formulation encompasses many existing N-of-1 designs and provides a principled way to control temporal dependence in treatment assignment through Markov transition probabilities. Under a finite-order impulse-response model, we formulate the design objective as minimizing the estimation error of ordinary least squares estimators for target treatment effects, and propose practical design optimization procedures. To characterize the optimal temporal structure, we focus on two structured design classes, random-switch and cycle-switch designs, and establish a complete large-T asymptotic theory for the optimal designs in both classes. Our results justify the robustness of i.i.d. Bernoulli designs in N-of-1 trials and quantify how the optimal design depends on the target estimand, including cumulative and lag-specific treatment effects. Simulations demonstrate the effectiveness and robustness of the proposed designs across multiple scenarios.