Department of Biostatistics and Medical Informatics Seminar

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Friday, October 16, 2026
12:00-1:00 pm – Morgridge Hall Seminar Room 7560

Zoom Meeting: 966 3372 9112
https://uwmadison.zoom.us/j/96633729112?pwd=tHFc9i1dAAgmXe05uWtw8wXBIQZxGB.1 **Passcode: 621125**

Gradient-Augmented AI Calibration for Covariate Adjustment in Randomized Trials.

Abstract: Pretrained AI models learn from vast clinical and medical knowledge and can encode rich prognostic information into predictions for patient outcomes, which can be used to improve the efficiency of treatment-effect estimation in randomized trials. However, predictions from AI models can be random and noisy, and data adaptation is often needed for better predictive accuracy. In this work, we develop a general calibration framework based on augmented inverse-probability weighted (AIPW) estimation in multi-arm trials combining in-context learning and data adaptation. Specifically, we propose GRACIAS, which combines repeated AI-generated outcome predictions based on randomly sampled examples/demonstrations with low-rank features obtained from model gradients. Separate Oaxaca–Blinder least-squares regressions within each treatment arm further calibrate these features on a common basis, and the resulting outcome models enter the AIPW estimator. Under simple randomization, this construction simultaneously minimizes asymptotic variance within the chosen linear calibration space for every zero-sum treatment contrast. We further extend the calibration framework and its optimality to covariate-adaptive randomization. Simulations and analyses of 21 randomized trials demonstrate precision gains from calibration relative to directly using AI predictions, with additional improvements from gradient-augmented calibrations. These results connect flexible AI prediction with classical regression adjustment and provide a principled framework for using AI-derived information to improve treatment-effect estimation.

Bio: Dr. Muxuan Liang is an Assistant Professor in the Department of Biostatistics at MD Anderson Cancer Center. He received his Ph.D. in Statistics from the University of Wisconsin–Madison in 2018, so today's visit is also a special return to the place where his academic journey in statistics began. After completing his Ph.D., he worked as a Data Scientist at Google and later as a postdoctoral research fellow at Fred Hutchinson Cancer Research Center. His research focuses on developing statistical and machine learning methods for personalized decision-making, causal inference, transfer learning, and multimodal learning, with the broader goal of improving individualized decisions in biomedical and clinical research.

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