Causal Interaction in Factorial Experiments: Application to Conjoint Analysis

Social scientists use conjoint analysis, which is based on randomized experiments with a factorial design, to analyze multidimensional preferences in a population. In such experiments, several factors, each with multiple levels, are randomized to form a large number of possible treatment conditions. To explore causal interaction in factorial experiments, we propose a new definition of causal interaction effect, called the average marginal interaction effect (AMIE). Unlike the conventional interaction effect, the relative magnitude of the AMIE does not depend on the choice of baseline conditions, making its interpretation intuitive even for high-order interaction. We show that the AMIE can be nonparametrically estimated using the ANOVA regression with weighted zero-sum constraints. These two properties enable us to directly regularize the AMIEs by collapsing levels and selecting factors within a penalized ANOVA framework. This reduces false discovery rate and further facilitates interpretation. Finally, we apply the proposed methodology to the conjoint analysis of ethnic voting behavior in Africa and find clear patterns of causal interaction between politicians' ethnicity and their prior records. The proposed method is implemented through the open-source software. The paper is available at https://imai.princeton.edu/research/int.html
Kosuke Imai is Professor in the Department of Politics and the Center for Statistics and Machine Learning at Princeton University. At Princeton, he served as the founding director of the Program in Statistics and Machine Learning. Outside of Princeton, Imai is currently serving as the President of the Society for Political Methodology and was elected fellow in 2017. After obtaining a B.A. in Liberal Arts from the University of Tokyo (1998), Imai received an A.M. in Statistics (2002) and a Ph.D. in political science (2003) from Harvard University. Imai’s research area is political methodology and more generally applied statistics in the social sciences. He has extensively worked on the development and applications of statistical methods for causal inference with experimental and observational data. Other areas of his methodological research are survey methodology and computational algorithms for data-intensive social science research. His substantive applications range from the randomized evaluation of Mexican universal health insurance program to the study of public opinion and insurgent violence in Afghanistan. Imai is the author of a recently published textbook, Quantitative Social Science: An Introduction (Princeton University Press, 2017).

*Refreshments will be served following the seminar in 1181 Comstock Hall.*