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Priors that Assign Infinitesimal Mass: Closing Longstanding, Open Problems in Statistical Decision Theory via Nonstandard Analysis

Wednesday, January 24th, 2024
11:50 AM
96 Frelinghuysen Road, CoRE Building, Room 431

Zoom Meeting: Meeting ID: 969 0606 4706
Password: 745339

https://rutgers.zoom.us/j/96906064706?pwd=ZklvbExpRVBJQ3c5dUhhYTFuR2ZrZz09

Light refreshments will be served in Hill 452, 11:15am

Abstract: In this talk, I'll summarize recent work exploiting tools in mathematical logic to resolve longstanding open problems in statistical decision theory. I'll focus on an exact characterization of admissibility in terms of Bayes optimality in the nonstandard extension of the original decision problem, as introduced by Duanmu and Roy (Ann. Statist. 49(4): DOI:10.1214/20-AOS2026). Unlike the consideration of improper priors or other generalized notions of Bayes optimality, the nonstandard extension is distinguished, in part, by having priors that can assign "infinitesimal" mass in a sense that is made rigorous using results from nonstandard analysis. With these additional priors, we find that, informally speaking, a decision procedure δ_0 is admissible in an ordinary statistical decision problem if and only if, in the problem's "nonstandard extension", the nonstandard extension of δ_0 is Bayes optimal among the extensions of standard decision procedures with respect to a nonstandard prior assigning at least infinitesimal mass to every standard parameter value. We use this theorem to give further characterizations of admissibility, one related to Blyth's method and another related to a condition due to Stein that characterizes admissibility under regularity. Our results imply that Blyth's method is a sound and complete method for establishing admissibility. Buoyed by this result, we revisit the univariate two-sample common-mean problem, and show that the Graybill--Deal estimator is admissible among a certain class of unbiased decision procedures.

Bio: Daniel Roy is Canada CIFAR AI Chair, Founding Faculty, and Research Director of the Vector Institute, and Associate Professor in the Department of Statistical Sciences at the University of Toronto, with a cross appointment in Computer Science. Roy's research spans machine learning, mathematical statistics, and theoretical computer science. Roy is a recipient of the NSERC Discovery Accelerator Supplement, Ontario Early Research Award, and a Google Faculty Research Award. Roy serves as an action editor for the Journal of Machine Learning Research and Transactions of Machine Learning Research, and on senior program committees of the leading ML conferences. Prior to joining Toronto, Roy was a Research Fellow of Emmanuel College and Newton International Fellow of the Royal Society and Royal Academy of Engineering, hosted by the University of Cambridge. Roy completed his doctorate in Computer Science at the Massachusetts Institute of Technology, where his dissertation was awarded the MIT EECS Sprowls Award, given to the top dissertation in computer science each year.