Psychologists decipher how we think

Psychologists increasingly wrestle with how to model one of the most sophisticated processing units of all — the human brain.

In the cognitive sciences, models are very diverse; they can range from closed-form equations with a few parameters to simulation-based models with many parameters. Selecting among competing models — for example, those of the same psychological process — can be a challenge, yet it is one of the fundamental tasks of scientific inquiry.

To aid the selection process, Ohio State University psychologists Mark Pitt, Ph.D., and Jay Myung, Ph.D., have introduced several sophisticated methods adapted from statistics and computer science.

"In our latest work, we're developing ways to optimize experimental design. Simulating some of the cognitive models we study requires many thousands of iterations to generate a single data point, which itself is repeated many more thousands of times to complete a full simulation," said Dr. Pitt. "By using the Ohio Supercomputer Center's supercomputers, we can complete in hours what might take days to accomplish on a PC."

They've also developed methods for analyzing model behavior called landscaping and parameter space partitioning, which, instead of comparing models on their ability to fit a single data set, takes a bird's eye view of how two models are related to each other.

"Mathematical modeling in psychology is not widespread, simply because there are not a lot of models in the field itself," said Dr. Pitt. "Our goal in developing these tools is to help researchers gain better insight into model behavior, and, ultimately, better understand how the mind works." ■

Project leads: Mark Pitt, Ph.D., & Jay Myung, Ph.D., The Ohio State University
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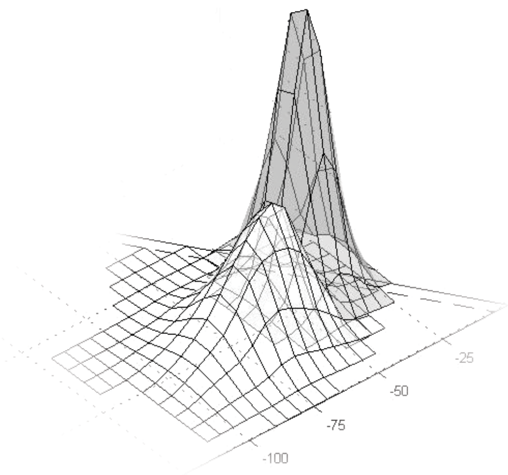

above: Distributions depicting the representativeness of data sampled from two models of categorization. The solid line denotes the decision threshold under one criterion, and the broken line denotes the criterion when the decision is adjusted for the complexity of the model.

Analyzing politics through computation

As a political scientist, Professor Luke Keele's expertise in applying statistical techniques to social sciences serves him well.

"There's a lot more computing and statistical analysis in political science than people realize," said Dr. Keele, who teaches American politics and researches political methodology at The Ohio State University. To the uninitiated, his research appears far removed from elections, campaign trails or policy decision-making processes.

For example, Dr. Keele examines discrete choice models and time series models, and he's studying the properties of matching estimators. In political science, these are used to, respectively, predict individuals' decisions, such as voting choices; forecast the future behavior of variables, such as the influence potential running mates may have on voter appeal; and calculate probability based on a person's level of knowledge, for random variables that have discrepancies.

Recently, Dr. Keele has been developing a way to randomize experimental data collected conveniently. Because these samples of convenience do not represent the entire population, they are considered biased. However, the statistical tests most often used in political science assume that the data were generated randomly. This can lead to serious errors in the conclusions.

By running thousands of simulations using the software program R on the Ohio Supercomputer Center's Itanium 2 Cluster, Dr. Keele proved that randomized tests reduce errors when classic statistical tests are used with experimental data.

"These simulations would take several days to complete on my office computer," Dr. Keele said. "OSC's powerful resources help me get results faster while maintaining my productivity." ■

Project lead:
Luke Keele, Ph.D., The Ohio State University
Funding source:
The Ohio State University