

Advancing Quantitative Methodology through Mathematical Application: Some Experiences and Lessons from Past Cases

Abstract

Mathematical tools play a central role for innovations in quantitative methodology for neural, behavioral and social sciences. In this seminar, drawing from Professor Zhang's past research examples, he will demonstrate how innovative methodologies can be developed through customized application of appropriate mathematical tools to well-formulated methodological questions in i) brain and neurosciences, ii) psychological and social sciences, and iii) statistical and learning sciences. Included in the array of demonstrations will be i) analysis techniques for single-neuron recording and for ERP recording in visual perception, motor planning, decision-making, and reward learning in the brain; ii) signal detection theory, causal analysis, reaction-time analysis, voting and preference aggregation, social choice theory, and game theory in behavioral sciences; and iii) regularized learning such as reproducing kernel Banach space methods, knowledge space and formal concept analysis in machine learning. The seminar will close with the method of information geometry (the differential geometric study of statistics) as a potentially unifying framework for statistical inference, adaptive intelligence, and information sciences.