Department of Decision Sciences

Statistics Seminar

Models and Computational Methods for Bayesian Density Regression

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Abstract

There is considerable interest in studying how the distribution of an outcome varies with a set of predictors. Bayesian nonparametric dependent mixture models provide a useful direction to flexibly address this goal, however many representations are characterized by intractable computational methods and difficult interpretation. To address these issues, I will discuss a flexible class of predictor-dependent Gaussian mixture models, which relies on a constructive characterization of the stick-breaking representation via a set of continuation-ratio logistic regressions, facilitating analytical derivation of routine-use algorithms in Bayesian inference. These models have appealing theoretical properties in asymptotic contexts, but their considerable flexibility comes at a cost in terms of efficiency and parsimony. Motivated by quantitative risk assessment studies in toxicology applications, I will additionally introduce a class of convex mixture regression models that allow the entire distribution of an health outcome to be unknown and changing with the dose of a potentially adverse exposure. In particular the model relies on a flexible characterization of the density at the extreme dose levels, and expresses the conditional density at each intermediate dose as a convex combination of the extremal densities. This formulation massively reduces dimensionality compared to unstructured predictor-dependent Gaussian mixture models, without substantially affecting flexibility in a wide range of toxicology studies.

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