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Two-component mixtures: some theory and applications

Finite mixture models are used in many fields of statistical applications either because modelling considerations suggest some kind of underlying heterogeneity or simply because they provide a flexible class of distributions that lies somewhere between parametric and nonparametric models. The simplest nontrivial case is a mixture of two components. The talk will discuss some interesting theoretical aspects of these and then go on to discuss some recent applications. The problem of testing the null hypothesis of no mixture against a two-component mixture alternative is surprisingly rich and irregular due to the standard regularity conditions (e.g. non-singular Fisher information matrix) being violated so various common statistics (e.g. the log-likelihood ratio) have very unusual large-sample behavior. We discuss recent work deriving this behavior for mixtures from a 1-parameter exponential family and provide some guidance about how to proceed in practice. We then go on to discuss some applications of the humble two-component mixture to other areas of methodology involving multiple testing and high-dimensional feature selection. We conclude by presenting some case studies and some simulation results.