Bocconi
Università Commerciale Luigi Bocconi

Department of Decision Sciences
Statistics Seminar

A framework for high-dimensional Bayesian model selection consistency

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Abstract

An important property for Bayesian model selection is that the posterior probability of the data-generating model (or that amongst the considered models closest to it) converges to 1, and that the corresponding convergence rate is fast. This property suffices to guarantee model selection consistency as typically proven for frequentist methods, but is in fact a much stronger result, and is of fundamental importance for uncertainty quantifications. In finite dimensions such consistency rates are well-understood, but results for high-dimensional cases (where the number of parameters p grows with the sample size n) are less complete. We present a novel theoretical framework to establish consistency rates. It is based on first principles, intuitively straightforward and its basic arguments hold in complete generality and potentially under model misspecification. We apply the framework to canonical variable selection in linear regression and compare common prior specifications, obtaining interesting insights regarding sparsity/sensitivity tradeoffs, e.g. the effects of sparse model space priors and the prior variance. Interestingly, we find that there can be a practically significant gap between asymptotically optimal procedures and their finite n performance, hence when dedicing what method to use one should carefully consider the characteristics of the problem at hand (in particular, what's n, p, and the strength of the signal one wishes to detect).

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