Bocconi

Università Commerciale Luigi Bocconi

Department of Decision Sciences
Statistics Seminar

On frequentist false discovery rate of Bayesian multiple testing procedures

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Abstract

In many high dimensional statistical settings, a central task is to identify active variables among a large number of candidates. This task appears in a wide variety of applied fields such as genomics, neuro-imaging, astrophysics, among others. For the practitioner, a key concern is not to make too many `false positives', which correspond to declaring as active an inactive variable. Given a multiple testing procedure, a typical aim is then to control its false discovery rate (FDR), that is the average number of false positives.

In this talk, we consider this question for a popular Bayesian procedure, namely the posterior distribution arising from a spike-and-slab prior, where the sparsity parameter is calibrated by an empirical Bayes approach, in the canonical sparse sequence model (the procedure is very fast as implemented in the R-Package EBaythresh of Johnstone and Silverman). I will introduce some commonly used Bayesian Multiple Testing procedures (BMTs) based on posterior distributions. We then ask whether such procedures control the FDR at a given target level, for any possible true sparse signal. That is, we consider the question of whether BMTs give a uniform control over any sparse vector of the pointwise (i.e. frequentist) false discovery rate.

We find that the answer is positive for natural BMTs based on empirical spike-and-slab posterior distributions, although some of those can be slightly `conservative'. We also demonstrate that certain BMTs are not too conservative, in the sense that they achieve a sharp FDR control at the desired target level when non-zero coordinates of the sparse signal are suitably large, while controlling the FDR up to a constant of the target level uniformly over arbitrary sparse signals.

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