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Multiple Testing with Empirical Bayes Spike-and-Slab Posterior Distributions

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Zoom Meeting ID: 955 1081 5772
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Virtual Coffee session before the seminar at 11:30AM EST

Abstract: Bayesian posterior distributions that allow for variable selection are often used in practice to address multiple testing questions. Besides their empirical success, they have been advocated among others by Bradley Efron for use in combination with empirical Bayes estimators of unknown prior parameters. In this talk we consider three popular multiple testing procedures based on posterior distributions: ell-values (also called 'local FDR'), cumulative ell-values (e.g. Sun and Cai 2007) and q-values (Storey 2003). While simple decision-theoretic arguments show that these procedures are optimal from a purely Bayesian point of view "if the prior is correct", it is natural to wonder whether their use is well-founded from a frequentist point of view. In a sparse normal means setting, we demonstrate that these procedures behave optimally in a number of ways, if a spike-and-slab prior is chosen with a weight calibrated using marginal maximum likelihood in an Empirical Bayes fashion. On the one hand, we prove that their frequentist FDR (False Discovery Rate) is uniformly controlled: it goes to zero slowly for the ell-value procedure, and stays close to a user-specified nominal level for the q-value procedure. On the other hand, we study the power through the FNR (False Negative Rate). We investigate multiple testing minimax rates and prove that sharp adaptive minimaxity for the multiple testing risk is achieved by Empirical Bayes-calibrated ell-value procedures. Based on joint works with Etienne Roquain (Sorbonne) and Abraham Kweku (Paris-Saclay).

Bio: Ismaël Castillo is Professor of Statistics at Sorbonne University in Paris, France. He obtained his PhD in Statistics at Orsay University (now Paris-Saclay University) under the supervision of Elisabeth Gassiat. He was a postdoc at VU Amsterdam with Aad van der Vaart and then a CNRS researcher in Paris. His research interests include high-dimensional inference, Bayesian nonparametrics and uncertainty quantification.