ABSTRACTS: AMSI-SSAI Lecturer 2012 - Professor Christian P. Robert

Public Lecture: Simulation as a universal tool for statistics

Statistics is a child of Mathematics in that it relies on mathematical models and uses methods validated by mathematical theorems. It is also an offspring of Computer Science in that it cannot produce answers on realistic problems without the help of advanced computational devices. Computer simulation, that is the computer reproduction of randomness, is presumably the most ubiquitous of these tools, with the additional appeal of being validated by probability theory.
In this talk, I will introduce the basics of computer-based simulation like uniform simulation and accept-reject algorithms, then present some more advanced methods like simulated annealing, Markov chain Monte Carlo methods, and likelihood-free methods, with illustrations ranging from Sudokus to cosmological background noise (CMB) to ancestral trees of Pygmy tribes.
This is a public lecture, suitable for those without any technical background.

Rao-Blackwellisation of sampling schemes

Casella and Robert (1996, Biometrika) presented a general Rao-Blackwellisation principle for accept-reject and Metropolis-Hastings schemes that leads to significant decreases in the variance of the resulting estimators, but at a potential high cost in computing and storage. Adopting a completely different perspective, we introduce instead a universal scheme that guarantees variance reductions in all Metropolis-Hastings based estimators while keeping the computing cost under control. The principle relates to the availability of an unbiased estimator of the acceptance probability. In a second if related part, we consider the implications of the fact that parallel raw-power can be exploited by a generic Metropolis--Hastings algorithm if the proposed values are independent. In particular, we present improvements to the independent Metropolis--Hastings algorithm that significantly decrease the variance of any estimator derived from the MCMC output, for a null computing cost since those improvements are based on a fixed number of target density evaluations. Furthermore, those techniques do not jeopardize the Markovian convergence properties of the algorithm, since they are based on the Rao--Blackwell principles of Gelfand and Smith (1990), already exploited in Casella and Robert (1996). We illustrate those improvements both on a toy normal example and on a classical probit regression model, but stress the fact that they are applicable in any case where the independent Metropolis-Hastings is applicable. Extensions to the random walk Metropolis--Hastings algorithm will also be discussed.

These are joint works with Randal Douc (Paristech-Telecom), available as http://arxiv.org/abs/0904.2144 v2 and Pierre Jacob (Paris-Dauphine & CREST) and Murray Smith (NIWA, NZ), available as http://arxiv.org/abs/1010.1595

A related presentation is available as http://www.slideshare.net/xianblog/talk-in-telecomparis-nov-15-2011

Approximate Bayesian computation (ABC): advances and limitations

The lack of closed form likelihoods has been the bane of Bayesian computation for many years and, prior to the introduction of MCMC methods, a strong impediment to the propagation of the Bayesian paradigm. We are now facing models where an MCMC completion of the model towards closed-form likelihoods seems unachievable and where a further degree of approximation appears unavoidable. In this talk, I will present the motivation for approximative Bayesian computation (ABC)

methods, the consistency results already available, the various Monte Carlo implementations found in the current literature, as well as the inferential, rather than computational, challenges set by these methods. A recent advance based on empirical likelihood will also be discussed.
A related presentation is available as http://www.slideshare.net/xianblog/abc-in-roma

ABC methods for Bayesian model choice

Approximate Bayesian computation (ABC) have become a essential tool for the analysis of complex stochastic models. Having implemented ABC-based model choice in a wide range of phylogenetic models in the DIY-ABC software (Cornuet et al., 2008), we first present theoretical background as to why a generic use of ABC for model choice is ungrounded, since it depends on an unknown amount of information loss induced by the use of a summary statistic (Robert et al., 2011). We then present necessary and sufficient conditions on the summary statistics for ABC based model choice procedure to be consistent, a solution that avoids the call to additional empirical verifications of the performances of the ABC procedure as those available in DIYABC and advocated in Ratman et al. (2011).

These are joint works with J.M. Cornuet (CBGP, Montpellier), J.M. Marin (Montpellier), N. Pillai (Harvard) and J. Rousseau (Paris-Dauphine & CREST), available as:

http://arxiv.org/abs/1101.0955
http://arxiv.org/abs/1102.4432
http://arxiv.org/abs/1110.4700

A related presentation is available as http://www.slideshare.net/xianblog/seminar-at-princeton-university