ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΩΑΝΝΙΝΩΝ

ΤΜΗΜΑ ΜΑΘΗΜΑΤΙΚΩΝ

Εβδομαδιαίο Σεμινάριο

Control Variates for Reversible Markov Chains

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A general methodology is introduced for the construction and effective application of control variates to estimation problems involving data from reversible MCMC samplers. We propose the use of a specific class of functions as control variates, and we introduce a new, consistent estimator for the values of the coefficients of the optimal linear combination of these functions. The form and proposed construction of the control variates is derived from our solution of the Poisson equation associated with a specific MCMC scenario. The new estimator, which can be applied to the same MCMC sample, is derived from a novel, finite-dimensional, explicit representation for the optimal coefficients. The resulting variance-reduction methodology is primarily applicable when the simulated data are generated by a conjugate random-scan Gibbs sampler. MCMC examples of Bayesian inference problems demonstrate that the corresponding reduction in the estimation variance is significant, and that in some cases it can be quite dramatic. Extensions of this methodology in several directions are given, including certain families of Metropolis-Hastings samplers and hybrid Metropolis-within-Gibbs algorithms. Corresponding simulation examples are presented illustrating the utility of the proposed methods. All methodological and asymptotic arguments are rigorously justified under easily verifiable and essentially minimal conditions.

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