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MCMC or Reservoir computing? A direct sampling approach

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Assume that we would like to estimate the expected value of a function f with respect to a density π by using an importance density function q. We prove that if π and q are close enough under KL divergence, an independent Metropolis sampler estimator that obtains samplers from π with proposal density q, enriched with a variance reduction computational strategy based on control variates, achieves smaller asymptotic variance than the one from importance sampling. We illustrate our results in challenging option pricing problems that require Monte Carlo estimation. Furthermore, we propose an automatic sampling methodology based on adaptive independent Metropolis that can successfully reduce the asymptotic variance of an importance sampling estimator and we demonstrate its applicability in a Bayesian inference problems.

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