

Quantifying the effectiveness of linear preconditioning in Markov chain Monte Carlo

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Linear transformation of the state variable (linear preconditioning) is a common technique that often drastically improves the practical performance of a Markov chain Monte Carlo algorithm. Despite this, however, the benefits of linear preconditioning are not well-studied theoretically, and rigorous guidelines for choosing preconditioners are not always readily available. Mixing time bounds for various samplers have been produced in recent works for the class of strongly log-concave and Lipschitz target distributions and depend strongly on a quantity known as the condition number. We study linear preconditioning for this class of distributions, and under appropriate assumptions we provide bounds on the condition number after using a given linear preconditioner. We provide bounds on the spectral gap of RWM that are tight in their dependence on the condition number under the same assumptions. Finally we offer a review and analysis of popular preconditioners. Of particular note, we identify a surprising case in which preconditioning with the diagonal of the target covariance can actually make the condition number *increase* relative to doing no preconditioning at all. ArXiv: <https://arxiv.org/abs/2312.04898>