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CORRECTION
VARIABLE TRANSFORMATION TO OBTAIN GEOMETRIC ERGODICITY IN THE RANDOM-WALK METROPOLIS ALGORITHM

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The last sentence of Section 3.1 is incorrect and cannot be fixed (the rest of Section 3.1 is correct, as is Section 3.2 which uses it). It is not true that, in general, the random-walk Metropolis algorithm for Bayesian inference in exponential families with conjugate priors on natural parameters satisfies the Jarner-Hansen curvature condition.

Poisson regression provides a simple counterexample. Consider the log likelihood for two independent Poisson random variables y_1 and y_2

$$l(\theta) = y_1\theta_1 - e^{\theta_1} + y_2\theta_2 - e^{\theta_2}.$$

We assume $y_1 > 0$ and $y_2 > 0$ and use flat priors. So the log likelihood is the log unnormalized posterior and the log unnormalized density of the equilibrium distribution of the Markov chain.

Consider a sequence θ_n with components $\theta_{1,n} \to \infty$, with $\theta_{1,n} > 0$ for all n, and $\theta_{2,n} = -\theta_{1,n}^2$. It is easily seen that

$$\frac{\nabla l(\theta_n)}{|\nabla l(\theta_n)|} \cdot \frac{\theta_n}{|\theta_n|} \to 0,$$

where the dot indicates inner product and $|\cdot|$ denotes the Euclidean norm. And this shows the Jarner-Hansen curvature condition fails for this model.

Since this counterexample is a special case of Poisson regression, we see that geometrically ergodic Markov chain Monte Carlo for Bayesian inference for Poisson regression with conjugate priors on natural parameters remains an open research question.

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