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Rejoinder

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We thank the discussants for their valuable commentary on our paper. A common theme was the value in making modern statistical methods more widely known in the physical sciences. Below, we comment on specific issues raised by the discussants.

1 Algorithm Efficiency

Skilling and Sivia rightly point out the poor efficiency of our MCMC algorithm. We've continued to attack the speed problem, and are pleased to report significant progress.

The main culprit was the proposal strategy for bounded parameters. We wanted distributions which vanish outside the allowed region, since this greatly simplifies correcting for unequal proposal probabilities. The scaled Beta fits nicely; moreover, there are simple analytic expressions for the parameter values which give a target mean and variance,

$$\begin{aligned} \alpha &= \left[\frac{\mu(1-\mu)}{\sigma^2} - 1\right]\mu \\ \beta &= \left[\frac{\mu(1-\mu)}{\sigma^2} - 1\right](1-\mu), \end{aligned} \tag{1}$$

as long as $\alpha > 0$ and $\beta > 0$.[1] However, these formulae are non-unimodal when $\alpha < 1$ or $\beta < 1$, exhibiting proposal probabilities which diverge near the boundaries. This caused a computational instability, since the most extreme values were the most often proposed. We circumvented this by requiring both α and β to be greater than one, yielding a unimodal distribution.

More seriously, our original approach is suboptimal even without this numerical instability. The support of the distribution covered the entire domain, leading to huge proposed jumps when near the boundaries. We eliminated this problem with a new paradigm for bounded proposals. Pick a "jump" distance J: the limit is either J, or the boundary, whichever is closer. Explicitly, we generate candidates X' from current value X as follows:

$$\frac{X' - (X - JA)}{J(A+B)} \sim \mathrm{Beta}(\alpha = A+1, \beta = B+1) \tag{2}$$

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[1]These conditions can always be met by requesting a smaller target variance.

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