9th November

Professor Michele Guindani

Editor-in-Chief

Bayesian Analysis

Dear Professor Guindani,

Please find attached our resubmission of our R\* paper to Bayesian Analysis.

We thank both reviewers for their extremely useful feedback. As a result of their comments, our submission is now considerably stronger. To summarise these changes:

* We have now provided a systematic comparison of the impact of different ML classifiers on calculation of R\*. These are fully described in the point-by-point responses but, briefly, these compare how R\* is affected by classification method (in Section S7.1) and by hyperparameter choice for a given classification method (in S7.2). In Section S8, we compare the performance of our two best performing classifiers, GBMs and RFs, across two examples representing unconverged joint distributions and unconverged tails. In both examples, we compare their performance with an optimal Bayes classifier;
* As a result of the ML classifier exploration, we have added paragraphs to the introduction and the discussion covering the importance of this decision;
* In Section S6, we have added two discrete parameter examples, which compare the performance of R\* with that or Rhat on small and large discrete state spaces;
* Throughout the text, the prose has, in places, been changed to improve readability.

As a result of the experiments with different classifiers, we realised that it was preferable not to recommend a single ML classifier (before this was a GBM): rather, we now suggest using both GBMs and RFs on a given problem. This is because each method tended to perform well on different classes of problem. As a result of this change of recommendation, we changed the paper title to “R\*: A robust MCMC convergence diagnostic with uncertainty using **decision tree classifiers**” (it was previously, “R\*: A robust MCMC convergence diagnostic with uncertainty using **gradient-boosted machines**”).

Whilst responding to the reviewer comments, we noticed that, in a few places, we were previously calculating Rhat using the rank normalized folded-split-Rhat, rather than the maximum of rank normalized split-Rhat and rank normalized folded-split-Rhat as suggestd in Vehtari et al., (2020). In these few cases, we have updated the calculation. In no places did this qualitatively change the results, and we highlight any numbers in the text that have changed as a result.

We also attach a point-by-point response to each reviewer comment and highlight in the main text and supplementary any changes to the text from the previous version.

We hope that you will consider this paper for inclusion in Bayesian Analysis and look forward to hearing from you.

Yours faithfully,

Ben Lambert & Aki Vehtari

**References**

Vehtari, A., A. Gelman, D. Simpson, B. Carpenter, and P. Bürkner (2020). Rank-normalization, folding, and localization: An improved r-hat for assessing convergence of MCMC. Bayesian Analysis