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July 3, 2023

Dear Dr. Jones and Dr. Liang,

I am writing to submit our manuscript titled "Variance-Reduced Stochastic Optimization for Efficient Inference of Hidden Markov Models" for consideration in the Journal of Computational and Graphical Statistics.

Our manuscript addresses the issue of efficient parameter estimation in hidden Markov models (HMMs). HMMs are widely used to model time-series data sets across various applied disciplines. Advancements in data collection technology have resulted in a surge of high-frequency and large time-series data sets, but fitting HMMs to these larger data sets using existing packages can be prohibitively time-consuming. For example, HMMs are particularly common in the field of ecological statistics, where biologging data sets can be collected over several days at frequencies of over fifty hertz. We expect this issue to worsen in the future as data collection methods continue to improve.

Our manuscript introduces a novel inference method for HMMs based on variance-reduced stochastic optimization and the expectation-maximization algorithm. We provide a theoretical analysis demonstrating the convergence of our algorithm, and we show its practical performance using both a simulation study and case study of eight killer whales off the coast of western Canada. Our manuscript is written for readers with a strong background in statistics, but it introduces the Baum-Welch algorithm and variance-reduced optimization methods for non-experts in computing. It combines statistical inference, numerical optimization, and ecological applications, which we believe makes it an ideal fit for the Journal of Computational and Graphical Statistics.

The research presented in this paper has not been previously published and is not under consideration by any other journal. All authors have reviewed the manuscript and consent to its submission to the Journal of Computational and Graphical Statistics. We declare no competing interests.

Thank you for considering our manuscript for publication. We appreciate the opportunity to contribute to the Journal of Computational and Graphical Statistics. Please direct all correspondence regarding this manuscript to me at [evan.sidrow@stat.ubc.ca](mailto:evan.sidrow@stat.ubc.ca).

Sincerely,

Evan Sidrow