

STATS 700-002 Class 10.
Variational phylodynamic inference

Aaron King and Edward Ionides

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Outline

Ki, & Terhorst (2022). Variational phylodynamic inference using pandemic-scale data. *Molecular Biology and Evolution*, 39(8), msac154.
<https://doi.org/10.1093/molbev/msac154>.

1. How is variational inference applied to phylodynamic models?
2. The role of automatic differentiation.

Bayesian vs non-Bayesian phylodynamic inference

- ▶ To what extent do you agree with the assertion that phylogenetic uncertainty is not reflected in frequentist point estimates but is included in Bayesian estimates?

Variational inference

Fourment M, Darling AE. 2019. Evaluating probabilistic programming and fast variational Bayesian inference in phylogenetics. *PeerJ*. 7:e8272.

Fourment M, Magee AF, Whidden C, Bilge A, Matsen FA IV, Minin VN. 2020. 19 dubious ways to compute the marginal likelihood of a phylogenetic tree topology. *Syst Biol*. 69(2):209–220.

Zhang C. 2020. Improved variational Bayesian phylogenetic inference with normalizing flows. *Advances in neural information processing systems*, Vol. 33. p. 18760–18771.

Zhang C, Matsen FA IV. 2019. Variational Bayesian phylogenetic inference. In 7th International Conference on Learning Representations, ICLR 2019; 2019 May 6–9

Approximations

- ▶ “A divide-and-conquer strategy where distant subtrees of a very large phylogeny are assumed to evolve approximately independently.”
- ▶ “Assume that topological estimates of these subtrees are an accurate reflection of their distribution under the prior.”

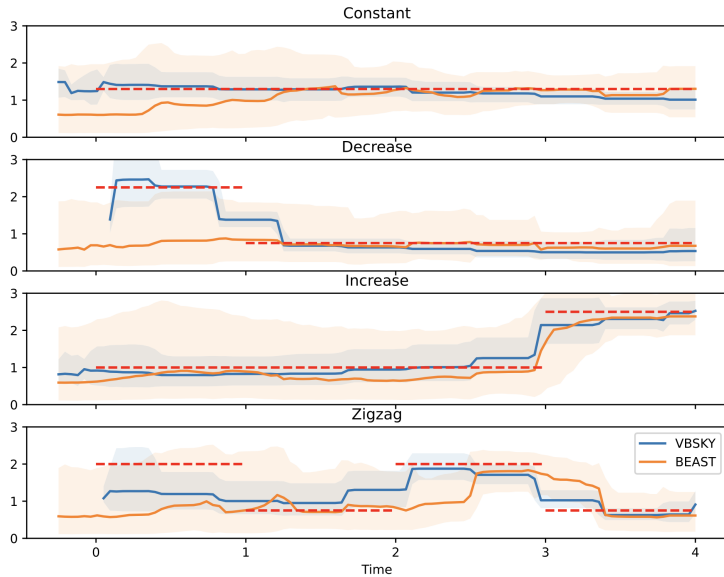


FIG. 1. Median of the medians and the equal-tailed 95% credible intervals of the posteriors of the effective reproductive number over time of the 10 simulations for each scenario using VBSKY and BEAST. The dotted line is the true effective reproductive number over time.



FIG. 2. Posterior of R for Florida, Michigan, and the USA using biased sampling and a strong prior on s . For each method the posterior median and equal-tailed 95% credible interval are shown. The dotted line is $R = 1$.

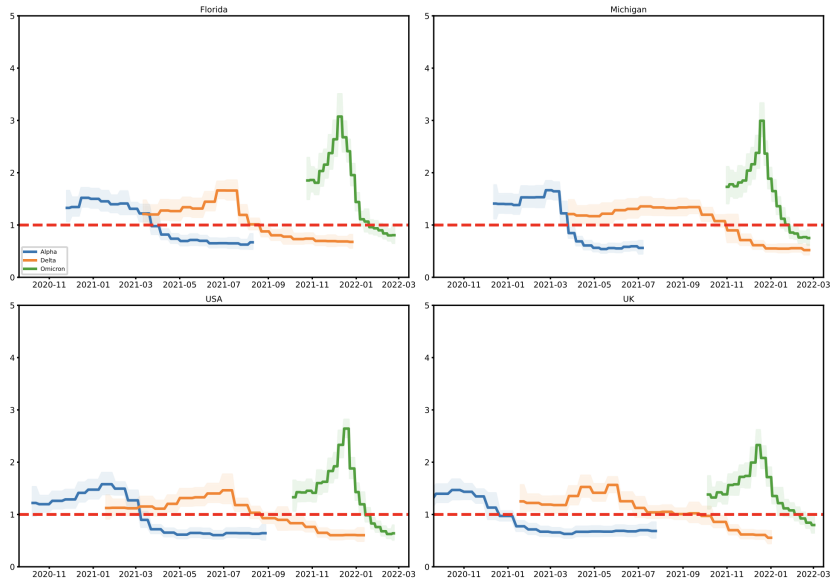


FIG. 3. The posterior median and equal-tailed 95% credible interval of R for the Alpha, Delta, Omicron variants.