Joseph R. Mathews

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Research Interests

Computational complexity; Bayesian Inference; Sequential Monte Carlo methods; Markov chain Monte Carlo algorithms; Randomized Algorithms

Education

 Aug. 2019 - May 2024 (Expected)
Ph.D., Duke University in Statistical Science, Advisor: Scott C. Schmidler Dissertation Topic: Computational Complexity of Sequential Monte Carlo Algorithms
B.S., Austin Peay State University in Mathematics

Research Publications

Journal Articles



J. Marion, **J. Mathews**, and S. Schmidler, "Finite sample L_2 bounds for sequential Monte Carlo and adaptive path selection," *In preparation*, 2022.

2 J. Marion, J. Mathews, and S. Schmidler, "Finite sample complexity of sequential Monte Carlo estimators," *Submitted to the Annals of Statistics*, 2022. *O* URL: https://doi.org/10.48550/arXiv.1803.09365.

J. Mathews, S. Bhattacharya, S. Sen, and I. Das, "Multiple inflated negative binomial regression for correlated multivariate count data," *Dependence Modeling*, vol. 10, pp. 290–307, 1 2022. *O* URL: https://doi.org/10.1515/demo-2022-0149.



J. Mathews and S. Schmidler, "Finite sample complexity of sequential Monte Carlo estimators on multimodal target distributions," *Submitted to the Annals of Applied Probability*, 2022. *O* URL: https://doi.org/10.48550/arXiv.2208.06672.

Books and Chapters



J. Mathews, S. Sen, and I. Das, "Doubly-inflated negative binomial model using Gaussian copula," in 2018 Springer Proceedings: Modern Statistical Methods for Spatial and Multivariate Data, N. Diawara, Ed., Springer Nature Switzerland AG, 2019, pp. 147–161.

Research Experience

May 2020 – Present

Finite Sample Complexity Bounds for Sequential Monte Carlo Methods, Department of Statistical Science, Duke University

Derived computational complexity bounds for sequential Monte Carlo algorithms in a variety of settings, such as sampling from multimodal and logconcave probability distributions as well as adaptive sequential Monte Carlo schemes. Ongoing work includes deriving algorithmic lower bounds for sequential Monte Carlo algorithms on different model problems.

Research Experience (continued)

May 2022 – Present	Modeling HIV-1 broadly neutralizing antibodies (bnAbs) Mutations, Duke Human Vaccine Institute, Duke University
	Designed sampling algorithm to compute the probability of transitioning from an inferred unmutated common ancestor (UCA) to target HIV-1 broadly neutral- izing antibody (bnAb) under a forward simulation model for the somatic hyper- mutation process.
Jan. 2018 – May 2019	Modeling Multivariate Inflated Count Data , Department of Mathematics and Statistics, Austin Peay State University
	Helped design and implement a mixture model for multivariate count data ex-

hibiting multiple inflation points using Copula models. Also extended this model to the regression setting. Applied both models to observed and simulated data.

Employment History

Jan. 2020 – Present	Teacher's Assistant, Department of Statistical Science, Duke University.
Jan. 2015 – May 2019	Peer Tutor, Academic Support Center, Austin Peay State University.
Aug. 2018 – May 2019	Peer Tutor Subject Area Supervisor, Academic Support Center, Austin Peay State University.
Jan. 2015 – May 2016	Structured Learning Assistant Leader, Academic Support Center, Austin Peay State University.

Teaching Experience

Aug. 2022 – Dec. 2022	Teacher's Assistant, Bayesian Methods and Modern Statistics (Graduate) , Department of Statistical Science, Duke University.
	Led two weekly lab sections. This included introducing and reviewing Bayesian statistical concepts, helping students with R and Stan programming questions, and grading lab reports. Held office hours weekly to help students with homework and prepare for exams.
Jan. 2022 – May 2022	Teacher's Assistant, Bayesian Methods and Modern Statistics (Under- graduate), Department of Statistical Science, Duke University.
	Led weekly lab sections. This involved preparing notes to review concepts cov- ered in the lecture and helping students with coding in R. Held office hours weekly to help students with homework and prepare for exams.
Jan. 2019 – Dec. 2021	Teacher's Assistant, Data Analysis and Statistical Inference , Department of Statistical Science, Duke University.
	Led weekly lab sections. This involved introducing students to the program- ming language R, reviewing concepts introduced in lecture, and helping groups with a data analysis final project. Held office hours weekly to help students with homework and prepare for exams, graded homework and lab reports, and oc- casionally lectured if instructor was unavailable.

Presentations

March 2022	J. Mathews and S. Schmidler. "Computational Complexity of Sequential Monte Carlo Samplers on Multimodal Target Distributions". Reading In Statistical Science Seminar, Duke University, Durham, NC.
June 2018	J. Mathews, S. Sen, and I. Das. "Doubly-inflated negative binomial model using Gaussian copula". Poster Presentation at Southern Regional Council on Statistics (SRCOS) Conference, Virginia Beach, VA.
Skills	
Coding	Proficient: Python, R, Stan, LTEX Familiar: Matlab, C++, Mathematica, Bash
Misc.	Teaching, training, Academic research, Github
Reference	es

Available upon request