Andrew J. Holbrook, Ph.D.

Associate Professor of Biostatistics
UCLA Fielding School of Public Health
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Research Interests

Bayesian statistics and machine learning; dimension reduction; imaging statistics; viral epidemiology

Dissertation: *Geometric Bayes*; Babak Shahbaba, Ph.D. (advisor) and Daniel L. Gillen, Ph.D. (co-advisor)

Training and Education

2018-2020, Postdoctoral Scholar, Biomathematics and Human Genetics, UCLA

2015-2018, Ph.D., Statistics, UC Irvine

2013-2015, M.S., Statistics, UC Irvine

2005-2009, B.A., Classical Languages and German (*with Honors*), UC Berkeley

Positions

2025-present, Associate Professor, Department of Biostatistics, UCLA

2023-present, Member, Center for Quantum Science and Engineering, UCLA

2022-present, Member, California NanoSystems Institute, UCLA

2020-2025, Assistant Professor, Department of Biostatistics, UCLA

Awards and Academic Honors

- NSF CAREER Award (2023)
- Toffler Scholar Award, The Karen Toffler Charitable Trust (2023)
- Mitchell Prize (Honorable Mention), International Society for Bayesian Analysis (2022)
- NIH K25 Award (2020)
- Savage Award (Honorable Mention), International Society for Bayesian Analysis (2018)
- Carl W. Cotman Young Investigator Award, UCI MIND (2018)
- UC Irvine Graduate Dean's Dissertation Fellowship Award (2017-2018)
- UCI MIND Aging Fellowship (2015-2017)
- Robert L. Newcomb 1st Year Graduate Student Award, UC Irvine Department of Statistics (2014)

Funded Projects

- Cure Alzheimer's Fund (PI) 09/01/2024 - 08/31/2026, $402,500.
  Novel AI Decodes Aging Neurons
- The Kavli Foundation (PI) 09/01/2024 - 08/31/2027, $150,000.
  Novel AI Decodes Aging Neurons
- NSF DMS 2236854 (Sole-I) 07/01/2023 - 06/30/2028, $549,227.
  CAREER: Data-Centric Evolutionary Contagion Models with Parallel and Quantum Parallel Computing
- The Karen Toffler Charitable Trust, 2023, $20,000.
  Toffler Scholar Award
- NSF DMS 2152774 (Sole-I) 07/01/2022 - 06/30/2025, $300,000.
  Accelerating Bayesian Dimension Reduction for Dynamic Network Data with Many Observations

- NIH K25 AI153816 (Sole-I) 06/01/2020 - 05/31/2025, $532,335.
  Big Data Predictive Phylogenetics with Bayesian Learning

Book Chapters

2. Glatt-Holtz N, **Holbrook A**, Krometis J, Mondaini C, **Sheth A**. "Sacred and profane: from the involutive theory of MCMC to helpful Hamiltonian hacks." To appear in Brooks, S., Gelman, A., Jones, G.L., and Meng, X.L. (Eds.). *Handbook of Markov Chain Monte Carlo*, Second Edition (2024): Chapman & Hall/CRC.

1. **Holbrook A**, Nishimura A, Ji X, Suchard M. "Computational statistics and data science in the twenty-first century." In Piegorsch, W.W., Levine, R.A., Zhang, H.H., and Lee, T.C.M. (Eds.). *Computational Statistics in Data Science*, (2022): John Wiley & Sons.

Refereed Publications

30. **Sheth A**, Smith A, **Holbrook A**. *Sparse Bayesian multidimensional scaling(s)*. Computational Statistics, vol. 41, no. 12, 2026.

29. Baele G, Ji X, Hassler G, McCrone J, Shao Y, Zhang Z, **Holbrook A**, Lemey P, Drummond A, Rambaut A, Suchard M. *BEAST X for Bayesian phylogenetic, phylogeographic and phylodynamic inference*. Nature Methods, vol. 22, pp. 1653-1656, 2025.

28. Lin C, Chen K, Lemey P, Suchard M, **Holbrook A**, Hsieh M. *Quantum speedups for multiproposal MCMC*. Bayesian Analysis (in press), 2025.

27. **Williams R**, Nalisnick E, **Holbrook A**. *Scalable generative modeling of weighted graphs*. Transactions of Machine Learning Research, 2025.

26. Glatt-Holtz N, Harris R, **Holbrook A**, Krometis J, Kurniawan Y, Ringer H, Whitehead J. *Embracing uncertainty in "small data" problems: estimating earthquakes from historical anecdotes*. Journal of Geophysical Research: Machine Learning and Computation, vol. 2, no. 3, e2025JH000667, 2025.

25. Didier G, Glatt-Holtz N, **Holbrook A**, Magee A, Suchard M. *On the surprising effectiveness of a simple matrix exponential derivative approximation, with application to global SARS-CoV-2*. Proceedings of the National Academy of Sciences, vol. 121, no. 3, e2318989121, 2024.

24. **Su E**, Weiss R, Nouri-Mahdavi K, **Holbrook A**. *A spatially varying hierarchical random effects model for longitudinal macular structural data in glaucoma patients*. Annals of Applied Statistics, vol. 18, no. 4, pp. 3444-3466, 2024.

23. Glatt-Holtz N, **Holbrook A**, Krometis J, Mondaini C. *Parallel MCMC algorithms: theoretical foundations, algorithm design, case studies*. Transactions of Mathematics and its Applications, vol. 8, no. 2, 2024.

22. Magee A, **Holbrook A**, Pekar J, Caviedes-Solis I, Matsen F IV, Baele G, Wertheim J, Ji X, Lemey P, Suchard M. *Random-effects substitution models for phylogenetics via scalable gradient approximations*. Systematic Biology, vol. 73, no. 3, pp. 562-578, 2024.

21. Tustison N, Yassa M, Rizvi B, Cook P, **Holbrook A**, Sathishkumar M, Tustison M, Gee J, Stone J, Avants B. *ANTsX neuroimaging-derived structural phenotypes of UK Biobank*. Scientific Reports, vol. 14, no. 8848, 2024.

20. **Holbrook A**. *A quantum parallel Markov chain Monte Carlo*. Journal of Computational and Graphical Statistics, vol. 32, no. 4, pp. 1402-1415, 2023.

19. Zhang Z, Nishimura A, Trovão S, Cherry J, **Holbrook A**, Ji X, Lemey P, Suchard M. *Accelerating Bayesian inference of dependency between mixed-type biological traits*. PLOS Computational Biology, vol. 19, no. 8, e1011419, 2023.

18. **Holbrook A**. *Generating MCMC proposals by randomly rotating the regular simplex*. Journal of Multivariate Analysis, vol. 194, 105106, 2023.

17. Hassler G, Gallone B, Aristide L, Allen W, Tolkoff M, **Holbrook A**, Baele G, Lemey P, Suchard M. *Principled, practical, flexible, fast: a new approach to phylogenetic factor analysis*. Methods in Ecology and Evolution, vol. 13, pp. 2181-2197, 2022.

16. **Holbrook A**, Ji X, Suchard M. *From viral evolution to spatial contagion: a biologically modulated Hawkes model*. Bioinformatics, vol. 38, no. 7, pp. 1846-1856, 2022.

15. **Holbrook A**, Ji X, Suchard M. *Bayesian mitigation of spatial coarsening for a Hawkes model applied to gunfire, wildfire and viral contagion*. Annals of Applied Statistics, vol. 16, no. 1, pp. 573-595, 2022.

14. Tustison N, Cook P, **Holbrook A**, Johnson H, Muschelli J, Devanyi G, Duda J, Das S, Cullen N, Gillen D, Yassa M, Stone J, Gee J, Avants B. *ANTsX: A dynamic ecosystem for quantitative biological and medical imaging.* Scientific Reports, vol. 11, no. 9068, 2021.

13. **Holbrook A**, Loeffler C, Flaxman S, Suchard M. *Scalable Bayesian inference for self-excitatory stochastic processes applied to big American gunfire data.* Statistics and Computing, vol. 31, no. 4, 2021.

12. **Holbrook A**, Lemey P, Baele G, Dellicour S, Brockmann D, Rambaut A, Suchard M. *Massive parallelization boosts big Bayesian multidimensional scaling.* Journal of Computational and Graphical Statistics, vol. 30, no. 1, pp. 11-24, 2021.

11. Shahbaba B, Lan S, Streets J, **Holbrook A**. *Nonparametric Fisher geometry with application to density estimation.* Proceedings of the 36th Conference on Uncertainty in Artificial Intelligence (UAI), PMLR vol. 124, pp. 101-110, 2020.

10. **Holbrook A**, Tustison N, Marquez F, Roberts J, Yassa M, Gillen D. *Anterolateral entorhinal cortex thickness as a biomarker for early detection of Alzheimer's disease.* Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring, vol. 12, no. 1, 2020.

9. Ji X, Zhang Z, **Holbrook A**, Nishimura A, Baele G, Rambaut A, Lemey P, Suchard M. *Gradients* do *grow on trees: a linear-time O(N)-dimensional gradient for statistical phylogenetics.* Molecular Biology and Evolution, vol. 37, no. 10, pp. 3047-3060, 2020.

8. Lan S, **Holbrook A**, Elias G, Fortin N, Ombao H, Shahbaba B. *Flexible Bayesian Dynamic Modeling of Correlation and Covariance Matrices.* Bayesian Analysis, vol. 15, no. 4, pp. 1199-1228, 2020.

7. **Holbrook A**, Lumley T, Gillen D. *Estimating prediction error for complex samples.* Canadian Journal of Statistics, vol. 48, no. 2, pp. 204-221, 2020.

6. Tustison N, **Holbrook A**, Avants B, Roberts J, Cook P, Reagh Z, Stone J, Gillen D, Yassa M. *Longitudinal mapping of cortical thickness measurements: an Alzheimer's Disease Neuroimaging Initiative-based evaluation study.* Journal of Alzheimer's Disease, vol. 71, no. 1, pp. 165-183, 2019.

5. Li L, **Holbrook A**, Shahbaba B, Baldi P. *Neural network gradient Hamiltonian Monte Carlo.* Computational Statistics, vol. 34, no. 1, pp. 281-299, 2019.

4. **Holbrook A**. *Differentiating the pseudo determinant.* Linear Algebra and its Applications, vol. 548, pp. 293-304, 2018.

3. **Holbrook A**, Lan S, Vandenberg-Rodes A, Shahbaba B. *Geodesic Lagrangian Monte Carlo over the space of positive definite matrices: with application to Bayesian spectral density estimation.* Journal of Statistical Computation and Simulation, vol. 88, no. 5, pp. 982-1002, 2018.

2. **Holbrook A**, Vandenberg-Rodes A, Fortin N, Shahbaba B. *A Bayesian supervised dual-dimensionality reduction model for simultaneous decoding of LFP and spike train signals.* Stat Journal, vol. 6, no. 1, pp. 53-67, 2017.

1. Grill J, **Holbrook A**, Pierce A, Hoang D, Gillen D. *Attitudes toward Potential Participant Registries.* Journal of Alzheimer's Disease, vol. 56, no. 3, pp. 939-946, 2017.

Alumni

2. Guillermina Senn, graduate researcher visiting from Norwegian University of Science and Technology (2024-2025)

1. Erica Su, Ph.D., Dissertation: *Bayesian Spatial Longitudinal Modeling for Local Rates of Glaucoma Progression* (2023)

Current Ph.D. Students

- Ryan O'Dell
- Ami Sheth
- Richard Williams
- Jasen Zhang

Doctoral Committee Service

- Kyle Wu, UCLA Biostatistics (Chair: Sudipto Banerjee)
- Daniel Zhou, UCLA Biostatistics (Chair: Sudipto Banerjee)
- Yucai Shao, UCLA Biostatistics (Chair: Marc Suchard)
- Pratyusa Datta, UCLA Biostatistics (Chair: Marc Suchard)

- Filippo Monti, UCLA Biostatistics (Chair: Marc Suchard)

Software

- BEAST X: Open-source and cross-platform BEAST software combines molecular phylogenetic reconstruction with complex trait evolution, divergence-time dating and coalescent demographics in an efficient statistical inference engine (https://github.com/beast-dev/beast-mcmc).
- RCPPXSIMD: C++ header-only library files provide modern, portable C++ wrappers for SIMD intrinsics and parallelized, optimized math implementations (SSE, AVX, NEON, AVX512). By placing this library in our R package, we offer an efficient distribution system for Xsimd through CRAN (https://cran.r-project.org/package=RcppXsimd).
- MASSIVEMDS: Open-source, high-performance computing software enables Bayesian multidimensional scaling with GPU and vectorized/multi-core CPU. Available as R package, standalone C++ library or with Java API (https://github.com/suchard-group/MassiveMDS).
- HPHAWKES: Open-source, high-performance computing software enables Bayesian inference for the Hawkes process with GPU and vectorized/multi-core CPU. Available as R package, standalone C++ library or with Java API (https://github.com/suchard-group/hawkes).

Invited Talks

32. Joint Meetings of 2025 Taipei International Statistical Symposium and the 13th ICSA International Conference, *Advances in Causality, Reinforcement Learning, and Business Analytics*, "Quantum speedups for multiproposal MCMC" (Taipei, TW; Dec 2025)

31. University of California, Riverside, Department of Statistics, "Quantum parallel Markov chain Monte Carlo(s)" (Riverside, CA; Nov 2025)

30. University of Toronto, *The Fast and the Curious 2: MCMC in Action*, "Quantum speedups for multiproposal MCMC" (Toronto, ON; Sep 2025)

29. EcoSta 2025, *Quantum-Enhanced Computing: Pioneering Techniques for Statistical Innovation*, "Quantum speedups for multiproposal MCMC" (Tokyo, JP; Aug 2025)

28. Biostatistics Symposium of Southern California, "Evaluating longitudinal cortical thickness pipelines" (Irvine, CA; Feb 2025)

27. Indiana University, Bloomington, Department of Statistics, "Quantum parallel Markov chain Monte Carlo(s)" (Bloomington, IN; Oct 2024)

26. National Institute of Statistical Sciences (NISS), *The 2nd IOF Workshop on Gun Violence: A Statistical Approach*, "Computing Hawkes processes for gun violence research" (Virtual; May 2024)

25. Duke University, Department of Statistical Sciences, "Quantum parallel Markov chain Monte Carlo(s)" (Durham, NC; Apr 2024)

24. University of Southern California, Department of Mathematics, "Quantum parallel Markov chain Monte Carlo(s)" (Los Angeles, CA; Apr 2024)

23. University of California, Irvine, workshop *Statistical and Machine Learning Applications in Biomedical Sciences*, "A Bayesian hierarchical spatially varying coefficients model for longitudinal structural data in glaucomatous eyes" (Irvine, CA; Feb 2024)

22. NASA Jet Propulsion Laboratory, Uncertainty Quantification and Statistical Analysis Group, "MCMC with multiple proposals" (Pasadena, CA; Nov 2023)

21. University of Minnesota, Institute for Research in Statistics and its Applications conference *The Fast and the Curious: Modern Markov Chain Monte Carlo*, "MCMC with multiple proposals" (Minneapolis, MN; May 2023)

20. phyloseminar.org, "From viral evolution to spatial contagion: a biologically modulated Hawkes model" (Virtual; Aug 2022)

19. ISBA World Meeting 2022, Invited Session, *Recent Advances in Bayesian Functional Analysis, Network Regression and Parallel MCMC*, "A quantum parallel Markov chain Monte Carlo" (Montréal, CA; Jun 2022)

18. EcoSta 2022, *Advances in High-Dimensional Sampling Methods*, "A quantum parallel Markov chain Monte Carlo" (Kyoto, JP; Jun 2022)

17. AMS Western Sectional Meeting, Special Session, *Mathematical Advances in Bayesian Statistical Inversion and Markov Chain Monte Carlo Sampling Algorithms*, "A quantum parallel Markov chain Monte Carlo" (Virtual; May 2022)

16. University of California, Irvine, Department of Statistics, "A quantum parallel Markov chain Monte Carlo" (Irvine, CA; Apr 2022)

15. Foxconn Quantum Computing Center, "A quantum parallel Markov chain Monte Carlo" (Taipei City, TW; Mar 2022)

14. Yale University, Department of Biostatistics, "Three challenges for spatiotemporal Hawkes modeling" (New Haven, CT; Sept 2021)

13. King Abdullah University of Science and Technology, Department of Biostatistics, "Three challenges for spatiotemporal Hawkes modeling" (Thuwal, KSA; Sept 2021)

12. Arizona State University, School of Mathematical and Statistical Sciences, "Three challenges for spatiotemporal Hawkes modeling" (Tempe, AZ; Sept 2021)"

11. JSM 2021, Invited Paper Session, *Geometry and Bayes: Better Together*, "A simple MCMC algorithm that chooses from multiple proposals at each step" (Virtual; Aug 2021)

10. Instituto de Ciencias Matemáticas (ICMAT), "From viral evolution to spatial contagion: a biologically modulated Hawkes model" (Madrid, ES; June 2021)

9. Bayesian Inference in Stochastic Processes (BISP12), "From viral evolution to spatial contagion: a biologically modulated Hawkes model" (Virtual; May 2021)

8. University of California, Los Angeles, Department of Mathematics, Applied Math Colloquium, "From viral evolution to spatial contagion: a biologically modulated Hawkes model" (Los Angeles, CA; Mar 2021)

7. University of California, Los Angeles, Department of Statistics, "Bayesian modeling of global viral diffusions at scale" (Los Angeles, CA; Dec 2020)

6. Tulane University, Department of Mathematics, "Bayes in the time of Big Data" (New Orleans, LA; Nov 2020)

5. University of California, San Francisco, Department of Epidemiology and Biostatistics, "Bayesian modeling of global viral diffusions at scale" (San Francisco, CA; Nov 2020)

4. University of Auckland, Department of Statistics, Bayesianz Research Group, "Bayes in the time of Big Data" (Auckland, NZ; Nov 2020)

3. Johns Hopkins University, Department of Biostatistics, Bayesian Learning and Spatial Temporal modeling (BLAST) working group, "Bayes in the time of Big Data" (Baltimore, MD; Oct 2020)

2. JSM 2019, Savage Award Session, "Excerpts from *Geometric Bayes*" (Denver, CO; Aug 2019)

1. Statistical Methods in Imaging, "Evaluating the ANTs longitudinal cortical thickness pipeline" (Irvine, CA; Jun 2019)

Teaching

- *Methods in Biostatistics B* (Biostats 200B); Winter 2025; Department of Biostatistics, UCLA
- *Bayes Theory* (Biostats 202C); Fall 2022; Department of Biostatistics, UCLA
- *Stochastic Processes* (Biostats 270); Spring 2022, Spring 2023, Spring 2024; Department of Biostatistics, UCLA
- *Advanced Bayesian Computing* (Biostats 285); Spring 2021, Spring 2022; Department of Biostatistics, UCLA
- *Introduction to Probability and Statistics* (Stat 7); Fall 2014, Summer 2015; Department of Statistics, UC Irvine
- *Biostatistics* (Stat 8); Winter 2015; Department of Statistics, UC Irvine
- *Mathematics*; 2010-2011; Dalian American International School
- *English as a Second Language*; 2010-2011; Dalian American International School

Other Professional Experience

- Statistical consultant, Broadridge Financial Solutions (2017)
- Statistical consultant, the Alzheimer's Disease Research Center at the University of California, Irvine; Irvine, California (2015-2017)
- Statistical consultant, the Center for Statistical Consulting at the University of California, Irvine; Irvine, California (Winter and Spring 2014)

- Trainee, the Summer Institute for Training in Biostatistics at North Carolina State University and the Duke Clinical Research Institute; Raleigh, North Carolina (Summer 2013)
- Teacher, the Dalian American International School; Dalian, People's Republic of China (2010-2011)

Service and Community Involvement

- Chair, Education Policy and Curriculum Committee, UCLA Fielding School of Public Health (2025-present)
- Member, Local Organizing Committee, 14th conference of the Bayesian Nonparametric Section of ISBA (2025)
- Member, Program Committee, Joint Meetings of 2025 Taipei International Statistical Symposium and 13th ICSA International Conference
- Chair, Joint Meetings of 2025 Taipei International Statistical Symposium and 13th ICSA International Conference, session *Quantum computing in statistics*
- Member, Savage Award Committee, International Society for Bayesian Analysis (2024-2025)
- UC-HBCU Initiative Faculty Mentor (2022)
- Member, Faculty Search Committee, UCLA Department of Biostatistics (2023-2024)
- Member, Faculty Search Committee, UCLA Department of Biostatistics (2024-2025)
- Member, Master of Data Science in Health Executive Committee, UCLA Fielding School of Public Health (2023-present)
- Member, Education Policy and Curriculum Committee, UCLA Fielding School of Public Health (2023-2025)
- Chair, ISBA World Meeting 2022, session *Sampling state-of-the-arts in Bayesian computation for large-scale applications*
- NSF panelist, Division of Mathematical Sciences (2022-2023) ($\times 4$)
- Lead organizer, *Conference on philosophy of machine learning: knowledge and causality*. March 17-18, 2018 at the University of California, Irvine
- Member, American Statistical Association (2018-present)
- Member, International Society for Bayesian Analysis (2020-present)

Journal Reviewer

AISTATS

Alzheimer's & Dementia: The Journal of the Alzheimer's Association ($\times 2$)

Annals of Applied Statistics ($\times 3$)

Applied Mathematics and Computation

Bayesian Analysis ($\times 3$)

Biometrika

IEEE Transactions on Artificial Intelligence

IEEE Transactions on Industrial Electronics

Journal of Computational and Graphical Statistics ($\times 2$)

Journal of Machine Learning Research ($\times 2$)

Journal of the American Statistical Association ($\times 2$)

PLOS Computational Biology

Scandinavian Journal of Statistics

Scientific Reports

SIAM Journal on Matrix Analysis and Applications

Statistics and Computing ($\times 4$)

Technometrics

WIREs Computational Statistics