

Ray Bai

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Academic Employment

- 2020- Assistant Professor of Statistics, University of South Carolina
- 2018-2020 Postdoctoral Researcher in Biostatistics and Informatics, University of Pennsylvania
Supervisors: Yong Chen and Mary Boland

Education

- 2014-2018 PhD in Statistics, University of Florida
Dissertation: Bayesian High-Dimensional Models with Scale-Mixture Shrinkage Priors
Advisor: Malay Ghosh
- 2014-2016 Master of Statistics, University of Florida
Project: Irrigation Forecasting in Southwest Florida
Advisor: Nikolay Bliznyuk
- 2010-2012 MS in Applied Mathematics, University of Massachusetts Amherst
- 2003-2007 BA in Economics and Government, Cornell University

Publications

(____ = student author, * = co-first author)

1. Deshpande, S. K., **Bai, R.**, Balocchi, C., Starling, J. E., and Weiss, J. (2025+). VCBART: Bayesian trees for varying coefficients. *Bayesian Analysis* (in press).
2. Zhao, Z., Li, Y., Luo, X., and **Bai, R.** (2025+). A unified three-state model framework for analysis of treatment crossover in survival trials. *Statistics in Biopharmaceutical Research* (in press).
3. Wang, S.-H., **Bai, R.**, and Huang, H.-H. (2025). Two-step mixed-type multivariate Bayesian sparse variable selection with shrinkage priors. *Electronic Journal of Statistics* (in press).
4. Wang, S., Shin, M., and **Bai, R.** (2024). Generative quantile regression with variability penalty. *Journal of Computational and Graphical Statistics*, **33**(4): 1202-1213.
5. Liu, Q., Huang, X., and **Bai, R.** (2024). Bayesian modal regression based on mixture distributions. *Computational Statistics & Data Analysis*, **199**: 108012.
6. Wang, S., Shin, M., and **Bai, R.** (2024). Fast bootstrapping nonparametric maximum likelihood for latent mixture models. *IEEE Signal Processing Letters*, **31**: 870-874.

7. **Bai, R.**, Boland, M. R., and Chen, Y. (2023). Scalable high-dimensional Bayesian varying coefficient models with unknown within-subject covariance. *Journal of Machine Learning Research*, **24**(259): 1-49.
8. **Bai, R.***, Moran, G. E.*, Antonelli, J. L.*, Chen, Y., and Boland, M. R. (2022). Spike-and-slab group lassos for grouped regression and sparse generalized additive models. *Journal of the American Statistical Association*, **117**(537): 184-197.
9. Meeker, J. R., Burris, H. H., **Bai, R.**, Levine, L. D., and Boland, M. R. (2022). Neighborhood deprivation increases the risk of post-induction cesarean delivery. *Journal of the American Medical Informatics Association*, **29**(2): 329-334.
10. **Bai, R.** and Ghosh, M. (2021). On the beta prime prior for scale parameters in high-dimensional Bayesian regression models. *Statistica Sinica*, **31**(2): 843-865.
11. **Bai, R.**, Ročková, V., and George, E. I. (2021). Spike-and-slab meets LASSO: a review of the spike-and-slab LASSO. In Tadesse, M. G. and Vannucci, M. (Eds.), *Handbook of Bayesian Variable Selection*, 81-108. Chapman & Hall/CRC Press.
12. Meeker, J. R., Canelón, S. P., **Bai, R.**, Levine, L. D., and Boland, M. R. (2021). Individual- and neighborhood-level risk factors for severe maternal morbidity. *Obstetrics & Gynecology*, **137**(5): 847-854.
13. Boland, M. R., Liu, J., Balocchi, C., Meeker, J., **Bai, R.**, Mellis, I., Mowery, D. L., and Herman, D. (2021). Association of neighborhood-level factors and COVID-19 infection patterns in Philadelphia using spatial regression. *AMIA Annual Symposium Proceedings*, **2021**: 545-554.
14. **Bai, R.** and Ghosh, M. (2019). Large-scale multiple hypothesis testing with the normal-beta prime prior. *Statistics*, **53**(6): 1210-1233.
15. **Bai, R.** and Ghosh, M. (2018). High-dimensional multivariate posterior consistency under global-local shrinkage priors. *Journal of Multivariate Analysis*, **167**: 157-170.
16. Duerr, I., Merrill, H. R., Wang, C., **Bai, R.**, Boyer, M., Dukes, M. D., and Bliznyuk, N. (2018). Forecasting urban water demand with statistical and machine learning methods using large space-time data: A comparative study. *Environmental Modelling and Software*, **102**: 29-38.

Papers Under Revision or Under Review

(____ = student author, * = co-first author)

1. **Bai, R.**, Lin, L., Boland, M. R., and Chen, Y. (2025+). A robust Bayesian Copas selection model for correcting and quantifying the impact of publication bias. *Under revision*.
2. **Bai, R.***, Liu, X.*, Lin, L., Liu, Y., Kimmel, S. E., Chu, H., and Chen, Y. (2025+). A Bayesian selection model for correcting outcome reporting bias with application to a meta-analysis on heart failure interventions. *Under revision*.
3. **Bai, R.** (2025+). Bayesian group regularization in generalized linear models with a continuous spike-and-slab prior. *Under revision*.
4. Zgodic, A., **Bai, R.**, Zhang, J., Olejua, P., and McLain, A. C. (2025+). Sparse high-dimensional linear mixed modeling with a partitioned empirical Bayes ECM algorithm. *Under revision*.
5. Wang, S., Chakraborty, S., Qin, Q., and **Bai, R.** (2025+). Neural-g: A deep learning framework for mixing density estimation. *Submitted*.

6. Zgodic, A., Bai, R., Zhang, J., Wang, Y., Rorden, C., and McLain, A. C. (2025+). Quantifying predictive uncertainty of aphasia severity in stroke patients with sparse heteroscedastic Bayesian high-dimensional regression. *Submitted*.

Advising

Past PhD Students

Zile Zhao (PhD 2025)

Dissertation: Methods and Applications for Bayesian Semiparametric Survival Analysis

First job: Postdoctoral Fellow, Moffitt Cancer Center (Tampa, FL)

Shijie Wang (PhD 2024)

Dissertation: New Deep Learning Approaches to Classical Statistical Problems

First job: Applied Scientist, Gauss Labs (Palo Alto, CA)

Winner of James D. Lynch Graduate Student Research Award

Current PhD Students

Sijian Fan (expected 2025)

Dissertation: Methods and Applications for Statistical Matrix Completion

Fanghua Chen (expected 2028, co-advising with Ting Fung Ma)

Member of Doctoral Committee

Department of Statistics

Yizhou Cai (PhD expected 2026), Jiasong Duan (PhD expected 2026), Qingyuan Hong (PhD expected 2025), Jihyun Kim (PhD expected 2025), Xin Zhi (PhD expected 2025), Yuchen Mao (PhD 2024), Zehao Yu (PhD 2024), Qingyang Liu (PhD 2023), Yang He (PhD 2023), Shan Zhong (PhD 2022), Zhen Yang (PhD 2022)

Other Departments

Peter Olejua (PhD in Biostatistics, expected 2026), Anja Zgodic (PhD in Biostatistics, 2023), Chrisogonas Odhiambo (PhD in Computer Science, 2022)

Undergraduate Honors Thesis Students

Thesis director for Leah Wood (BS in Statistics, expected 2025)

Second reader for Harrison Cassel (BS in Statistics, 2024)

*Other Student Supervisions**

(* I mentored these students on research projects but was not their primary supervisor)

Qingyang Liu (PhD in Statistics, 2023, University of South Carolina)

Anja Zgodic (PhD in Biostatistics, 2023, University of South Carolina)

Winner of ENAR Distinguished Student Paper Award

Hung-Tien Huang (BS in Computer Science, 2023, University of South Carolina)

Xin Zhi (PhD candidate in Statistics at University of South Carolina)

Liyan Xiong (PhD candidate in Biostatistics at University of South Carolina)

Dayuan Wang (PhD candidate in Biostatistics at University of Florida)

Funding

National Science Foundation, Division of Mathematical Sciences, Award 2015528 (2022-2024). Collaborative Research: Bayesian and Semi-Bayesian Methods for Detecting Relationships in High Dimensions. Role: **PI**. Amount: \$93,831.

University of South Carolina Big Data Health Science Center Pilot Project grant (2023-2024). Leveraging Side Information for Improved Prediction and Inference in Computational Drug Repositioning. Role: **PI**. Amount: \$20,000.

University of South Carolina McCausland Fellowship Research Award (2023-2024). New Methods for Bayesian Semiparametric Survival Analysis. Role: **PI**. Amount: \$10,000.

University of South Carolina ASPIRE-I, Track 1 (2022-2023). Scalable Bayesian Survival Analysis with Informative Cluster Size. Role: **PI**. Amount: \$13,583.

National Science Foundation, Division of Mathematical Sciences, Award 2038080 (2021-2026). RTG: Mathematical Foundation of Data Science at University of South Carolina. PI: Linyuan Lu, University of South Carolina. Role: **Senior Personnel**. Amount awarded to RB: \$10,932.

Honors and Awards

McCausland Faculty Fellow, University of South Carolina College of Arts and Sciences, 2023-2026

Graduate School Fellow, University of Florida, 2014-2018

Student Paper Competition Award, Section on Bayesian Statistical Science, Joint Statistical Meetings, 2018

Anderson Scholars Faculty Honoree, University of Florida, 2016

Teaching

University of South Carolina

Undergraduate Courses Taught

STAT 515: Statistical Methods I, Fall 2024, Spring 2025

STAT 517: Advanced Statistical Models, Fall 2022, Fall 2024

Graduate Courses Taught

STAT 714: Linear Statistical Models, Fall 2020, Fall 2021, Fall 2022

STAT 718: High-Dimensional Data, Spring 2021, Spring 2023

STAT 721: Stochastic Processes, Spring 2022, Spring 2024

Courses Developed and Revised

STAT 718: High-Dimensional Data

New special topics class covering methodology and algorithms for high-dimensional data, supervised learning, unsupervised learning, and deep learning

STAT 721: Stochastic Processes

Course revised to place more emphasis on contemporary topics and applications such as reinforcement learning, Bayesian nonparametrics, spatial statistics, and financial mathematics

Independent Studies Supervised

STAT 798: Introduction to Causal Inference, Summer 2024

STAT 798: Advanced Algorithms in Bayesian Computing, Spring 2024

STAT 399: Advanced Topics in Stochastic Processes, Spring 2022

University of Florida

Courses Taught

STA 3024: Introduction to Statistics II, Spring 2016

Courses Served as Teaching Assistant

STAT 2023: Introduction to Statistics I, Fall 2015

Software Development

(* I am the primary author and maintainer of the following software products)

SSGL (R package): Spike-and-Slab Group Lasso for Group-Regularized Generalized Linear Models

MBSP (R package): Multivariate Bayesian Model with Shrinkage Priors

NVCSL (R package): Nonparametric Varying Coefficient Spike-and-Slab Lasso

MtMBSP (R package): Mixed-type Multivariate Bayesian Regression with Shrinkage Priors

NormalBetaPrime (R package): Normal Beta Prime Prior

Presentations

Invited Seminar Talks and Guest Lectures

1. Department of Statistical Sciences, Wake Forest University, February 2025
2. Division of Biostatistics and Bioinformatics, Pennsylvania State University, October 2024
3. Department of Mathematics and Statistics, McGill University, September 2024
4. Department of Statistics & Operations Research, University of North Carolina at Chapel Hill, March 2024
5. South Carolina SmartState Center for Healthcare Quality, University of South Carolina, March 2023
6. Department of Statistics, University of Georgia, February 2023
7. School of Mathematics & Statistics, University of Glasgow, December 2022
8. Department of Statistics, Virginia Tech, November 2022
9. School of Mathematical and Statistical Sciences, Clemson University, October 2022
10. Department of Mathematical Sciences, University of Cincinnati, April 2022
11. Department of Biostatistics, Virginia Commonwealth University, November 2021
12. Department of Statistics, University of South Carolina, October 2021
13. School of Statistics, University of Minnesota, October 2021
14. Department of Statistics, University of California, Davis, April 2021
15. School of Mathematical and Statistical Sciences, Arizona State University, January 2020
16. Department of Statistics, Florida State University, January 2020
17. Department of Mathematics & Statistics, San Diego State University, January 2020
18. Department of Statistics, University of California, Santa Cruz, January 2020
19. Department of Statistics, University of South Carolina, January 2020
20. Graduate Group in Genomics and Computational Biology, University of Pennsylvania, December 2019
21. Statistics Student Seminar, University of Florida, April 2019
22. PennCIL Lab, University of Pennsylvania, March 2018

Invited Conference Talks

1. 2024 ICSA Applied Statistics Symposium, Nashville, TN, June 2024
2. 2024 ICSA-Canada Chapter Symposium, Niagara Falls, ON, Canada, June 2024
3. 2024 SRCOS Summer Research Conference, Clemson, SC, June 2024
4. 2023 Joint Statistical Meetings, Toronto, ON, Canada, August 2023
5. EcoSta 2023, Tokyo, Japan, August 2023
6. Invited poster session, 2022 Joint Statistical Meetings, Washington, DC, August 2022
7. EURO 2022 Conference, Espoo, Finland, July 2022 (canceled due to illness)
8. 2022 ICSA Applied Statistics Symposium, Gainesville, FL, June 2022
9. UP-STAT 2022 Hybrid Conference, Buffalo, NY, May 2022
10. CFE-CMStatistics 2021, London, UK, December 2021
11. Fifth EAC-ISBA Conference: A Satellite Meeting of the 2020 ISBA World Meeting in Celebrating James O Berger's 70th Birthday (virtual), November 2021
12. 2021 ICSA Applied Statistics Symposium (virtual), September 2021

Contributed Talks

- 2024 ISBA World Meeting, Venice, Italy, July 2024
- 2021 Joint Statistical Meetings (virtual), August 2021
- 2021 ISBA World Meeting (virtual), June 2021
- 2019 Joint Statistical Meetings, Denver, CO, July 2019
- 2018 Joint Statistical Meetings, Vancouver, BC, Canada, July 2018

Contributed Conference Posters

- Bayes Comp 2020, Gainesville, FL, January 2020
- DBEI and CCEB Research Day, University of Pennsylvania, March 2019
- O-Bayes 2017 Meeting, Austin, TX, December 2017

Departmental Service

- Colloquium Chair, 2023-2024, 2024-2025
- Member of Graduate Committee, 2021-2022, 2022-2023, 2023-2024
- Member of Hiring Committee, 2021-2022
- Member of Data Science Degree Planning Committee, 2022
- Member of PhD Qualification Exam Committee, 2021

Service to the University of South Carolina

Member, ASPIRE Grant Review Committee, 2023
 Panelist, LGBTQ+ Graduate Student Association's Queer in Higher Ed Panel, 2023
 Member, SPARC Grant Review Committee, 2022
 Lunch Ambassador for New Faculty Orientation, 2022
 Member, Top Scholar Selection Committee, 2021-2022, 2022-2023

Professional Service

Editorial Activities

Journal reviewer for 54 papers: *Journal of the American Statistical Association* (7), *Journal of the Royal Statistical Society: Series B* (3), *The Annals of Applied Statistics* (2), *Journal of Machine Learning Research* (2), *Biometrics* (2), *Journal of Computational and Graphical Statistics* (2), *IEEE Transactions on Information Theory* (1), *Statistica Sinica* (2), *Bernoulli* (1), *Electronic Journal of Statistics* (1), *Bayesian Analysis* (3), *Scandinavian Journal of Statistics* (3), *Computational Statistics & Data Analysis* (1), *Statistics in Medicine* (4), *Statistics and Computing* (1), *Journal of the Royal Statistical Society: Series C* (1), *Statistical Methods in Medical Research* (4), *The American Statistician* (2), *Journal of Statistical Planning and Inference* (2), *Journal of Nonparametric Statistics* (1), *Lifetime Data Analysis* (1), *Metrika* (1), *Statistical Modelling* (1), *Journal of Biopharmaceutical Statistics* (1), *The R Journal* (1), *Research Synthesis Methods* (1), *Science China Mathematics* (1), *Annals of the Brazilian Academy of Sciences* (1), *BMJ Open* (1)

Judge for SBSS Student Paper Competition, 2020, 2024

Grant Reviewing

External grant reviewer for the National Science Foundation, 2020, 2021, 2022
 Panelist for the National Science Foundation, 2022

Conference Activities

Session chair, "Junior advances in Bayesian tree regression," ISBA 2022 World Meeting
 Session chair, Section on Bayesian Statistical Science, Joint Statistical Meetings, 2021, 2022
 Member of Program Committee, "Your Model is Wrong: Robustness and misspecification in probabilistic modeling," NeurIPS 2021 Workshop

Professional Society Memberships

American Statistical Association
 International Society for Bayesian Analysis
 International Biometric Society

Professional Development

Certificates

New Faculty Academy Certificate of Completion, University of South Carolina, 2022

Graduate Certificate in Business Administration, Northeastern University, 2009

Workshop Attendance

Propel Research Mentorship Program, University of South Carolina, 2022-2023

Perspectives in Statistical Modeling and Inference: A Workshop in Honor of Ed George's 70th Birthday, Philadelphia, PA, 2021

Industry Experience

2012-2014 Systems Engineer, General Dynamics Mission Systems

2007-2010 Business Analyst, State Street Bank & Trust

Computer Skills

R, C/C++, Python, MATLAB, Octave, Julia, JAGS, Stan, Windows, Linux