

Kellin N. RUMSEY

Statistician | Scientist

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My research focuses on uncertainty quantification, particularly in the areas of model calibration, emulation, dimension reduction, and sensitivity analysis. Using Bayesian statistics, I have developed new tools and algorithms that enhance our understanding of complex physical systems. Recently, I have extended Bayesian MARS to better handle stochastic computer models and introduced active subspace methods for analyzing high-dimensional computer models. I have also expanded sparse variational Gaussian processes to enable high-fidelity exascale computation for state-of-the-art climate simulations. Through these contributions, I am committed to pushing the boundaries of UQ to enable more accurate predictions and informed decision-making.

EDUCATION

Ph.D. July 2020	Statistics University of New Mexico, ALBUQUERQUE, NM <ul style="list-style-type: none">Cumulative GPA : 4.13 / 4.00Dissertation : Methods of Uncertainty Quantification for Physical ParametersAdvisors : Gabriel Huerta and Lauren Hund
M.Sc. July 2020	Computer Science University of New Mexico, ALBUQUERQUE, NM <ul style="list-style-type: none">GPA : 4.08 / 4.00 (CS courses only)
B.Sc. August 2015	Mathematics University of Arizona, TUCSON, AZ <ul style="list-style-type: none">Focus in Probability and StatisticsMinors in Computer Science and Chemical Engineering

RESEARCH EXPERIENCE

Present April 2022	Los Alamos National Laboratory Scientist, LOS ALAMOS, NM <ul style="list-style-type: none">Developed algorithms for efficient discovery of active subspaces in high-dimensions.Extended and generalized active subspace methods for optimal dimension reduction and for the joint analysis of adjacent computer models.Deployed convolutional neural networks (CNN) to estimate Gaussian process parameters for global climate models, developing specialized algorithms to train the CNN's in situ.
April 2022 August 2020	Los Alamos National Laboratory Postdoctoral Researcher, LOS ALAMOS, NM <ul style="list-style-type: none">Developing randomized, hierarchical and in-situ algorithms for the deployment of large scale Gaussian processes in climate and space weather applications using Julia, OpenMPI and high performance computing.Developed an extension for Bayesian MARS models, allowing for accurate and efficient non-linear regression under a broad class of likelihoods.Working on a machine learning procedure to combine the strengths of Bayesian MARS and deep Neural Networks.
July 2020 July 2016	Sandia National Laboratories Statistical Sciences Intern, ALBUQUERQUE, NM <ul style="list-style-type: none">Developed robust procedures for the Bayesian calibration of physics-based computer models for estimation of physical parameters and designed randomized algorithm for fast approximations to Gaussian processes in sequential settings.Worked in teams to handle challenging problems highly relevant to national security using methods including mixed-effects models, accelerated aging models, Bayesian belief networks and machine learning algorithms.Created an R-package for Uncertainty Quantification for use across the labs.

- Worked as a consultant to aid with the statistical analysis of large scale survey data.
- Aided in the design of a large survey and wrote a RShiny application to facilitate the collection and analysis of data.

PUBLICATIONS (STATISTICAL METHODS)

1. **Rumsey, K. N.**, Hardy, Z. K., Ahrens, C., & Vander Wiel, S. (2024) Co-Active Subspace Methods for the Joint Analysis of Adjacent Computer Models *Technometrics*.
2. **Rumsey, K. N.**, Francom, D., & Shen, A. (2024). Generalized Bayesian MARS : Tools for Stochastic Computer Model Emulation. *SIAM/ASA Journal on Uncertainty Quantification*, 12(2), 646-666.
3. **Rumsey, K. N.**, Francom, D., & Vander Wiel, S. (2023). Discovering active subspaces for high-dimensional computer models. *Journal of Computational and Graphical Statistics*, 1-46.
4. Collins, G., Francom, D., & **Rumsey, K. N.** (2024). Bayesian projection pursuit regression. *Statistics and Computing*, 34(1), 29.
5. **Rumsey, K. N.**, Huerta, G., & Tucker, J. D. (2023). A localized ensemble of approximate Gaussian processes for fast sequential emulation. *Stat*, 12(1), e576.
6. **Rumsey, K.**, Grosskopf, M., Lawrence, E., Biswas, A., & Urban, N. (2022, October). A hierarchical sparse Gaussian process for in situ inference in expensive physics simulations. In *Applications of Machine Learning 2022* (Vol. 12227, pp. 126-138). SPIE.
7. Grosskopf, M., Lawrence, E., Biswas, A., Tang, L., **Rumsey, K.**, Van Roekel, L., & Urban, N. (2021). In-situ spatial inference on climate simulations with sparse Gaussian processes. In *ISAV'21 : In Situ Infrastructures for Enabling Extreme-Scale Analysis and Visualization*, pp. 31-36.
8. **Rumsey, K. N.**, & Huerta, G. (2021). Fast matrix algebra for Bayesian model calibration. *Journal of Statistical Computation and Simulation*, 91(7), 1331-1341.
9. **Rumsey, K. N.**, Huerta, G., Brown, J., & Hund, L. (2020). Dealing with measurement uncertainties as nuisance parameters in Bayesian model calibration. *SIAM/ASA Journal on Uncertainty Quantification*, 8(4), 1287-1309.
10. Hund, L., Schroeder, B., **Rumsey, K. N.**, & Huerta, G. (2018). Distinguishing between model-and data-driven inferences for high reliability statistical predictions. *Reliability Engineering & System Safety*, 180, 201-210.
11. Hund, L., Schroeder, B., **Rumsey, K. N.**, & Murchison, N. (2017). Robust approaches to quantification of margin and uncertainty for sparse data. *Sandia National Lab.(SNL-NM), Albuquerque, NM (United States)*.

PUBLICATIONS (APPLIED SCIENCE)

1. Coffman, C. N., Carroll-Portillo, A., Alcock, J., Singh, S. B., **Rumsey, K.**, Braun, C. A., ... & Lin, H. C. (2024). Magnesium Oxide Reduces Anxiety-like Behavior in Mice by Inhibiting Sulfate-Reducing Bacteria. *Microorganisms*, 12(7).
2. Birg, A., Coffman, C., **Rumsey, K.**, Lin, H., & Kanagy, N. (2024). Bismuth Subsalicylate Reverses High Fat Diet-Induced Increases in Portal Venous Flow.
3. Lin, J. Y., Wang, J., Mishra, K., Osmani, S., **Rumsey, K.**, Singh, P. P., & Barbosa, N. S. (2024). Non-melanoma skin cancer in solid organ transplant recipients with skin of color. *Journal of the American Academy of Dermatology*, 90(1), 159-160.
4. Scruggs, C. E., Heyne, C. M., & **Rumsey, K. N.** (2023). Understanding questions and concerns about potable water reuse : An analysis of survey write-in responses. *AWWA Water Science*, 5(2), e1333.
5. Carroll-Portillo, A., **Rumsey, K. N.**, Braun, C. A., Lin, D. M., Coffman, C. N., Alcock, J. A., ... and Lin, H. C. (2023). Mucin and agitation shape predation of Escherichia coli by lytic coliphage. *Microorganisms*, 11(2), 508.
6. Lin, J., **Rumsey, K.**, Stepenaskie, S., & Durkin, J. R. (2021). Dermatologists are more likely than oncologists to prescribe skin-directed therapies for early-stage cutaneous T-cell lymphoma : A retrospective review. *Dermatology Online Journal*, 27(10).
7. Scruggs, C. E., Lozoya, S., **Rumsey, K. N.**, Bronson, K., & Chavez, P. (2021). Voluntary public campaigns to benefit the environment : Assessing the effectiveness of the There Is No Poop Fairy Campaign. *Journal of Planning Education and Research*.
8. Distler, L. N., Scruggs, C. E., Cruz, M. P., & **Rumsey, K. N.** (2021). Public engagement on water reuse beyond community surveys. *Journal-American Water Works Association*, 113(4), 56-68.
9. Distler, L. N., Scruggs, C. E., & **Rumsey, K. N.** (2020). Arid inland community survey on water knowledge, trust, and potable reuse. II : Predictive modeling. *Journal of Water Resources Planning and Management*, 146(7), 04020046.

SELECTED TALKS

1. **Bayesian MARS : Emulation, Sensitivity, and Dimension Reduction.** *JSM*, August 2024
2. **Dimension Reduction and Sensitivity Analysis : New Subspace Methods for Complex Computer Models.** *Weapons Systems Capability Review*, April 2024
3. **A Partitioned Sparse Variational Gaussian Process for Fast, Distributed Spatial Modeling.** *SIAM/ASA Conference on Uncertainty Quantification*, March 2024
4. **Discovering Active Subspaces for High-Dimensional Computer Models.** *INFORMS 2023*, October 2023
5. **Fast Distributed Spatial Modeling for Large Scale Climate Models.** *JSM*, August 2023
6. **Generalized Bayesian MARS.** *JSM Speed Session on Bayesian Modeling*, August 2021
7. **Quantifying Leverage at the Point of Attack**, with Brandon DeFlon. *NFL Big Data Bowl Finals*, February 2020
8. **Robust inference for Physical Parameters in BMC.** *UNM Shared Knowledge Conference*, November 2019
9. **A Dynamic Bayesian Approach to Influenza Modeling.** *UNM SIAM Chapter Meeting*, October 2019
10. **Probability of Prior Coherency and Moment Penalization.** *Sandia Martians Symposium (End of program : selected)*, August 2019
11. **Local Approximate Gaussian Processes.** *Sandia Martians Symposium*, July 2019
12. **Dealing with nuisance parameters in BMC**, with Gabriel Huerta. *UARK Spring Lecture Series*, April 2019
13. **Classification and outlier detection with functional extremal depth.** *Time Series Data Mining Research Group*, February 2019
14. **Dealing with nuisance parameters in BMC : Regularization vs Modularization.** *Albuquerque Chapter ASA Meeting*, April 2017

SOFTWARE AND COMPUTING

Proficient R • Julia • MATLAB • \LaTeX • SAS • Java • Markdown • OpenMPI • RShiny • UNIX

Familiar Python • C • C++ • MySQL • Visual Basic

I have experience building and maintaining packages for R and Julia, some of which are publicly available.

- **duqling** : (Author)
<https://github.com/knrumsey/duqling>
An R package for reproducible UQ research.
- **concordance** : (Author)
<https://github.com/knrumsey/concordance>
An R package for performing concordance analyses and the discovery of active subspaces for high dimensional computer models.
- **GBASS : Generalized Bayesian MARS** (Author)
<https://github.com/knrumsey/GBASS>
An implementation of a generalized Bayesian MARS, which allows for robust, quantile and flexible likelihood regression.
- **khaos** (Author)
<https://github.com/knrumsey/khaos>
An sparse Bayesian polynomial chaos expansion. The method is largely based on Shao et al. (2017), but with several substantial modifications and improvements.
- **leapgp** : (Author)
<https://github.com/knrumsey/leapgp>
A localized ensemble of approximate GPs. An R package for performing fast sequential emulation of computer models.
- **BASS : Programming Repository for In-Situ Modeling** (Contributor)
<https://cran.r-project.org/web/packages/BASS/index.html>
BASS is an R package for fitting Bayesian Adaptive Spline Surface models available on CRAN with a development version available on GitHub.
- **PRISM : Programming Repository for In-Situ Modeling** (Contributor)
<https://github.com/lanl/PRISM>
A toolkit, written mostly in the Julia language, for fitting statistical models inside simulations as they run. The models and algorithms focus on scalability using sparsity, fast estimation like variational inference, and parallelism.
- **quack : Quantification of Uncertainty and Calibration.** (Author)
<https://github.com/knrumsey/quack>
Functions to facilitate efficient and robust UQ. Provides R implementation for the methods and ideas in my dissertation.

► **RQMU : Quantification of Margins and Uncertainty.** (Author, private)

A not-publicly available R package for widespread use at Sandia National Laboratory. I built and maintained this package for 3 years while I was an intern at SNL.

OTHER EXPERIENCE

July 2020	University of New Mexico Teaching Assistant, ALBUQUERQUE, NM
August 2015	<ul style="list-style-type: none"> ► Taught six semesters of Introductory Statistics (STAT 145) and 4 semesters of Statistics for Engineers/Computer Scientists (STAT 345). ► Consistently great student reviews and received a teaching award.
August 2015	Cota Enterprises Quality Assurance Programmer, TOPEKA, KS
July 2014	<ul style="list-style-type: none"> ► Recieved certification in SAS. ► Wrote SAS programs to produce statistical analyses for pharmaceutical studies. ► Used ggplot to produce publishable figures.
August 2014	UofA Microgravity Research Team Team Member, HOUSTON, TX
August 2013	<ul style="list-style-type: none"> ► One of 14 teams selected (very competitive) to conduct research in microgravity with NASA aboard a C9 aircraft.
August 2013	Refrac Systems Material Science Engineering Intern, CHANDLER, AZ
May 2013	<ul style="list-style-type: none"> ► Became familiar with engineering environment and complex physical systems

HONORS AND AWARDS

2020	NFL Big Data Bowl	Finalist (top 6 nationally)
2019	Cross Validated StackExchange	51 / 6618
2018	University of New Mexico	Susan D.R. Outstanding TA Award
2018	ABQ Chapter of the ASA	Lee Award for Best Student Presentation
2017	ASA DataFest	Best Use of Outside Data
2017	University of New Mexico	Susan D.R. Outstanding TA Award Nominee
2016	UNM Math & Stat Department	Graduate Student of the Year
2013	Mesa Community College	NJCAA All-Academic Honors

SERVICE AND MENTORING

- **Conference Service**
 - 2023 - *Organizer* - Albuquerque Chapter of the ASA Annual Meeting
 - 2023 - *Organizer* - Advances in Computational Methods for Large Spatial Data (JSM23)
 - 2022 - *Chair* - Statistical Modeling and Machine Learning for National Security Applications (JSM22)
 - 2018 - *Panelist* - Graduate Student and Postdoc Panel (SUnMaRC)
- **Referee**
 - *Bayesian Analysis* (5)
 - *Technometrics* (3)
 - *Statistical Analysis and Data Mining* (1)
 - *SIAM/ASA Journal on Uncertainty Quantification* (1)
 - *Earth and Space Science* (1)
 - *Journal of Sports Analytics* (1)
- **Secretary** (2018-2023)
Albuquerque Chapter of the American Statistical Association
- **Co-President** (2016-2018)
Graduate and Professional Student Association, Department of Mathematics and Statistics
- **Judge** (2019)
Judged the New Mexico State Science Fair in Socorro and awarded a prize for best use of Statistics.

➤ **Mentor**

I have acted as a mentor (or co-mentor) for the following students.

- **Andy Shen** (2020-2021) - Undergraduate Student - UCLA
Andy worked on an extension of BASS to allow for robust regression using t likelihoods.
- **Gavin Collins** (2021-2022) - PhD Student - The Ohio State University
Gavin implemented the first Bayesian version of projection pursuit.
- **Andy Cox** (2023) - Undergraduate Student -
A talented undergraduate student
- **Jared DiDomenico** (2023)
Jared worked on applying the Bayesian predictive synthesis framework to the model calibration in the case of conflicting experiments.
- **Grant Hutchings** (2023-2024)
Grant is working on algorithms for efficiently approximating the “cut-posterior” for modular Bayesian inference.
- **Kendric Hood** (2024) Kendric is comparing various neural network models for anomaly detection for non-intrusive manufacturing.