

# Kellin N. RUMSEY

## Statistician | Scientist

+1 480 600 2557 @ knrumsey@lanl.gov  
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My research focuses on uncertainty quantification, particularly in the areas of model calibration, emulation 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	<b>Statistics   University of New Mexico, ALBUQUERQUE, NM</b> <ul style="list-style-type: none"><li>Cumulative GPA : 4.13 / 4.00</li><li>Dissertation : Methods of Uncertainty Quantification for Physical Parameters</li><li>Advisors : Gabriel Huerta and Lauren Hund</li></ul>
M.Sc. July 2020	<b>Computer Science   University of New Mexico, ALBUQUERQUE, NM</b> <ul style="list-style-type: none"><li>GPA : 4.08 / 4.00 (CS courses only)</li></ul>
B.Sc. August 2015	<b>Mathematics   University of Arizona, TUCSON, AZ</b> <ul style="list-style-type: none"><li>Focus in Probability and Statistics</li><li>Minors in Computer Science and Chemical Engineering</li></ul>

## RESEARCH EXPERIENCE

Present August 2020	<b>Los Alamos National Laboratory   Scientist, LOS ALAMOS, NM</b> <ul style="list-style-type: none"><li>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.</li><li>Developed an extension for Bayesian MARS models, allowing for accurate and efficient non-linear regression under a broad class of likelihoods.</li><li>Working on a machine learning procedure to combine the strengths of Bayesian MARS and deep Neural Networks.</li></ul>
July 2020 July 2016	<b>Sandia National Laboratories   Statistical Sciences Intern, ALBUQUERQUE, NM</b> <ul style="list-style-type: none"><li>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.</li><li>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.</li><li>Created an R-package for Uncertainty Quantification for use across the labs.</li></ul>
July 2020 October 2017	<b>Centers for Research Excellence in Science and Technology   Statistical Consultant, ALBUQUERQUE, NM</b> <ul style="list-style-type: none"><li>Worked as a consultant to aid with the statistical analysis of large scale survey data.</li><li>Aided in the design of a large survey and wrote a RShiny application to facilitate the collection and analysis of data.</li></ul>

## PUBLICATIONS

- Rumsey, K. N., Francom, D., & Vander Wiel, S. (2023). Discovering active subspaces for high-dimensional computer models. *Journal of Computational and Graphical Statistics, just-accepted*, 1-46.
- Collins, G., Francom, D., & Rumsey, K. N. (2024). Bayesian projection pursuit regression. *Statistics and Computing*, 34(1), 29.

3. Lin, J. Y., et al. (2023). Non-melanoma skin cancer in solid organ transplant recipients with skin of color. *Journal of the American Academy of Dermatology*.
4. **Rumsey, K. N.**, Huerta, G., & Tucker, J. D. (2023). A localized ensemble of approximate Gaussian processes for fast sequential emulation. *Stat*, 12(1), e576.
5. 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.
6. 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.
7. **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.
8. 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.
9. 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).
10. 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*.
11. 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.
12. 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.
13. **Rumsey, K. N.**, & Huerta, G. (2021). Fast matrix algebra for Bayesian model calibration. *Journal of Statistical Computation and Simulation*, 91(7), 1331-1341.
14. **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.
15. 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.
16. 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)*.

## SUBMITTED OR IN PREPARATION

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1. Grosskopf, M., **Rumsey, K.**, Lawrence, E., & Biswas, A. (2023). A Partitioned Sparse Variational Gaussian Process for Fast, Distributed Spatial Modeling. (*Submitted to CoDA*).
2. **Rumsey, K.**, Francom, D., & Shen, A. (2023). Generalized Bayesian MARS : Tools for Emulating Stochastic Computer Models. *arXiv preprint arXiv:2306.01911*. (*Submitted to JUQ*).
3. **Rumsey, K. N.**, Hardy, Z. K., Ahrens, C., & Vander Wiel, S. *arXiv preprint arXiv:2311.18146*. (*Submitted to Technometrics*).
4. **Rumsey, K.**, Vander Wiel, S., Sigeti, D., & Hutchings, G. (in progress). Driving Subspaces for Optimal Dimension Reduction. (*In preparation*).

## SELECTED PRESENTATIONS

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1. Rumsey, Kellin. "Discovering Active Subspaces for High-Dimensional Computer Models" *INFORMS 2023*, October 2023
2. Rumsey, Kellin. "Fast Distributed Spatial Modeling for Large Scale Climate Models" *JSM*, August 2023
3. Rumsey, Kellin. "Generalized Bayesian MARS", *JSM Speed Session on Bayesian Modeling*, August 2021
4. Rumsey, Kellin. "Robust inference for Physical Parameters in BMC", *UNM Shared Knowledge Conference*, November 2019
5. Rumsey, Kellin. "A Dynamic Bayesian Approach to Influenza Modeling", *UNM SIAM Chapter Meeting*, October 2019
6. Rumsey, Kellin. "Probability of Prior Coherency and Moment Penalization", *Sandia Martians Symposium (End of program : selected)*, August 2019
7. Gabriel Huerta and Kellin Rumsey "Dealing with nuisance parameters in BMC", *UARK Spring Lecture Series*, April 2019
8. Rumsey, Kellin. "Dealing with nuisance parameters in BMC : Regularization vs Modularization", *Albuquerque Chapter ASA Meeting*, April 2017

## SOFTWARE AND COMPUTING

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**Proficient** R • Julia • MATLAB • ~~TeX~~ • 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.
- **leapgp** : (Author)  
<https://github.com/knrumsey/leapgp>  
A localized ensemble of approximate GPs. An R package for performing fast sequential emulation of 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.
- **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

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

## HONORS AND AWARDS

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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

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### › 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* (4)
- › *Technometrics* (1)
- › *Statistical Analysis and Data Mining* (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)  
Andy worked on an extension of BASS to allow for robust regression using  $t$  likelihoods.
- › **Gavin Collins** (2021-2022)  
Gavin implemented the first Bayesian version of projection pursuit.
- › **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).  
Grant is working on algorithms for efficiently approximating the “cut-posterior” for modular Bayesian inference.