Katherine **Goode**

Research and Development Statistician

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I'm a research and development statistician at Sandia National Labs. My research interests include model assessment, explainable machine learning, and data visualization. I enjoy consulting and collaborating with scientists on data analyses.

Education

Iowa State University — *Ames, IA*

Doctor of Philosophy, Statistics — *2016-2021*

- Dissertation: Visual Diagnostics for Explaining Machine Learning Models
- Major Professor: Dr. Heike Hofmann

University of Wisconsin, Madison — *Madison, WI*

Master of Science, Statistics — *2013-2015*

Lawrence University — *Appleton, WI*

Bachelor of Arts, Mathematics — *2009-2013*

- Graduated Magna Cum Laude
- Senior Capstone: An Explanation of Double-Error-Correcting BCH Codes

Awards

Sandia National Laboratories Up and Coming Innovator Award — *2023*

Midwest Statistical Machine Learning Colloquium Poster Award — *2019*

Awarded for 'Using LIME to Interpret a Random Forest Model with an Application to Bullet Matching Data'

ISU Department of Statistics Dan Mowrey Consulting Excellence Award — *2018*

Awarded in recognition of outstanding contributions in the area of statistical consulting while working toward a graduate degree.

ISU Department of Statistics Award for Experiential Development — *2017*

Presented to a graduate student for excellent performance in multiple statistical efforts (teaching and consulting) as part of the graduate program.

Experience

Senior Member of Technical Staff — *Sandia National Laboratories*

Statistical Sciences Department — *Dec 2021 - Current*

- Research and development statistician

Postdoctoral Researcher — *Sandia National Laboratories*

Statistical Sciences Department — *Sep 2021 - Dec 2021*

- Performed research on inverse models with functional data
- Implemented shape analysis methods with national security data

Research and Development Intern — *Sandia National Laboratories*

Statistical Sciences Department — *Dec 2019 - Sep 2021*

- Performed research on neural networks explainability with functional data
- Applied explainability methods to machine learning models

Graduate Research Assistant — *Iowa State University*

Natural Resource Ecology and Management — *Jan 2021 - June 2021*

- Developed R Shiny application to predict taxonomy of fish eggs using random forests
- Assisted in writing manuscript to present the application
- Advised by Dr. Michael Weber and Dr. Philip Dixon

Statistical Consultant *Iowa State University*

Agriculture Experiment Station *May 2016 - Dec 2020*

- Senior consultant from May 2018 to May 2020
- Helped with administrative decisions
- Trained and mentored new consultants
- Provided statistical support on research projects for graduate students, professors, and staff from the colleges of agriculture and life sciences, engineering, human sciences, liberal arts and sciences, and veterinary medicine
- Assisted with the implementation of analyses in R, SAS, JMP, and SPSS

Graduate Research Assistant *Iowa State University*

Department Natural Resource Ecology and Management *May 2019 - Aug 2019*

- Assisted with analysis of toxicology study of monarch butterfly larvae exposed to insecticides
- Wrote R code to compute profile confidence intervals for dose response curve models
- Collaboration with Dr. Steven Bradbury and PhD Student Niranjana Krishnan

Data Analyst *Lawrence University*

Research Administration Office *2015*

- Analyzed data from a study to compare the academic success and mood towards the university of undergraduates from freshman to sophomore years
- Performed statistical analyses using SPSS

Data Collection Assistant *Lawrence University*

Research Administration Office *Sep 2014 May 2015*

- Assisted with the data collection for a study on the evaluation of warning lights installed at a busy crosswalk on the university campus
- Used Tracker software to determine the deceleration rate of vehicles from videos taken of cars approaching the crosswalk

Publications

1. Goode, K., Ries, D., & McClernon, K. (2024). Characterizing climate pathways using feature importance on echo state networks. *Statistical Analysis and Data Mining: The ASA Data Science Journal*, *17*(4), e11706. https://doi.org/https://doi.org/10.1002/sam.11706
2. McClernon, K., Goode, K., & Ries, D. (2024). A comparison of model validation approaches for echo state networks using climate model replicates. *Spatial Statistics*, 100813.
3. McCombs, A. L., Stricklin, M. A., Goode, K., Huerta, J. G., Shuler, K., Tucker, J. D., Zhang, A., Sweet, L., & Ries, D. (2024). Inverse prediction of PuO2 processing conditions using bayesian seemingly unrelated regression with functional data. *Frontiers in Nuclear Engineering*, *3*, 1331349.
4. Ries, D., Goode, K., McClernon, K., & Hillman, B. (2024). Using feature importance as exploratory data analysis tool on earth system models. *Geoscientific Model Development Discussions*, *2024*, 1–35. https://doi.org/10.5194/gmd-2024-133
5. Goode, K., Weber, M. J., & Dixon, P. M. (2023). WhoseEgg: Classification software for invasive carp eggs. *PeerJ Life and Environment*, *11*.
6. Ausdemore, M. A., McCombs, A., Ries, D., Zhang, A., Shuler, K., Tucker, J. D., Goode, K., & Huerta, J. G. (2022). A probabilistic inverse prediction method for predicting plutonium processing conditions. *Frontiers in Nuclear Engineering*, *1*. https://doi.org/10.3389/fnuen.2022.1083164
7. Goode, K., Weber, M. J., Matthews, A., & Pierce, C. L. (2022). Evaluation of a random forest model to identify invasive carp eggs based on morphometric features. *North American Journal of Fisheries Management*. https://doi.org/https://doi.org/10.1002/nafm.10616
8. Goode, K., & Hofmann, H. (2021). Visual diagnostics of an explainer model: Tools for the assessment of LIME explanations. *Statistical Analysis and Data Mining: The ASA Data Science Journal*, *14*(2), 185–200. https://doi.org/https://doi.org/10.1002/sam.11500
9. Ball, E. E., Goode, K. J., & Weber, M. J. (2020). Effects of transport duration and water quality on age-0 walleye stress and survival. *North American Journal of Aquaculture*, *82*(1), 33–42. https://doi.org/https://doi.org/10.1002/naaq.10114
10. Dixon, P. M., Goode, K., & Lay, C. (2020). *Profile likelihood confidence intervals for ECx*. https://dr.lib.iastate.edu/entities/publication/7e0d7d0a-f514-4642-9814-c3b7bd821cc0
11. Goode, K., Ries, D., & Zollweg, J. (2020). Explaining neural network predictions for functional data using principal component analysis and feature importance. *AAAI FSS-20: Artificial Intelligence in Government and Public Sector*. https://doi.org/10.48550/ARXIV.2010.12063

Talks

1. Goode, K., Acquesta, E., Diaz, C., Krishnakumar, R., & Prudencio, E. (2024). A framework for evaluating the maturity level of machine learning explanations. *JSM*, Portlant, Oregon.
2. Goode, K., Ries, D., & McClernon, K. (2024). Characterizing climate pathways using echo state networks and feature importance. *WNAR*, Fort Collins, Colorado.
3. Goode, K., Ries, D., & McClernon, K. (2024, April). Characterizing climate pathways using echo state networks and feature importance. *Montana State University Statistics Department Seminar*.
4. Goode, K., Ries, D., McClernon, K., & Shand, L. (2023). Characterizing climate pathways using feature importance on echo state networks. *Albuquerque Chapter of the American Statistical Association Annual Meeting*, Santa Fe, New Mexico.
5. Goode, K., Ries, D., McClernon, K., & Shand, L. (2023). Characterizing climate pathways using feature importance on echo state networks. *Joint Statistical Meetings: Topic-Contributed Session "Deep Learning for Climate Change: Forecasts, Mitigation, and Adaption"*, Toronto, Canada.
6. Goode, K., Ries, D., McClernon, K., & Shand, L. (2023). Characterizing climate pathways using feature importance on echo state networks. *Sandia National Labs Machine Learning/Deep Learning Workshop*, Albuquerque, New Mexico.
7. Goode, K., Ries, D., McClernon, K., & Shand, L. (2023). Feature importance with deep echo state models. *SIAM Conference on Mathematical and Computational Issues in the Geosciences*, Bergen, Norway.
8. Goode, K., Tucker, J. D., & Ries, D. (2022). Functional inverse prediction with elastic shape analysis. *Joint Statistical Meetings*, Washington D.C.
9. Goode, K., Tucker, J. D., Ries, D., & Hofmann, H. (2022). An explainable pipeline for machine learning with functional data. *8th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS Congress 2022)*, Oslo, Norway.
10. Goode, K., Ries, D., & Zollweg, J. (2020, November). Explaining neural networks with functional data using PCA and feature importance. *AAAI 2020 Fall Symposium on AI in the Government and Public Sector*.
11. Goode, K., & Hofmann, H. (2019). Visual diagnostics of a model explainer: Tools for the assessment of LIME explanations from random forests. *Joint Statistical Meetings*, Denver, Colorado.
12. Goode, K. (2019). A review and discussion of residuals for mixed models. *NCCC-170 Meeting*, University of Illinois Champaign–Urbana.

Posters

1. Goode, K., Ries, D., McClernon, K., & Shand, L. (2023). Validating climate pathways using feature importance on echo state networks. *Confernece on Data Analysis*, Santa Fe, New Mexico.
2. Goode, K., Ries, D., Tucker, J. D., & Shand, L. (2022). Feature importance with deep echo state models for long-term climate forecasting. *Climate Informatics*, Asheville, North Carolina.
3. Goode, K., & Hofmann, H. (2019). Using LIME to interpret a random forest model with an application to bullet matching data. *Midwest Statistical Machine Learning Colloquium*, Ames, Iowa.
4. Goode, K., & Hofmann, H. (2019). Using LIME to interpret a random forest model with an application to bullet matching data. *Iowa State University Graduate and Professional Student Research Conference*, Ames, Iowa.
5. Goode, K., & Rey, K. (2018). Introducing ggResidpanel: An r package for easy visualization of residuals. *Kansas State University Conference on Applied Statistics in Agriculture*, Manhattan, Kansas.

Software

1. Goode, K., Ries, D., & McClernon, K. (2024). *Listenr: Explainability for echo state networks*. `https://github.com/sandialabs/listenr`
2. Goode, K., & Tucker, J. D. (2023). *Veesa: Explainable machine learning with functional data*. `https://github.com/sandialabs/veesa`
3. Goode, K. (2022). *TreeTracer: Trace plots using ggplot2*. `https://github.com/goodekat/TreeTracer/`
4. Goode, K. (2022). *Limeaid: Diagnose LIME explanations*. `https://github.com/goodekat/limeaid`
5. Goode, K., McClernon, K., Zhao, J., Zhang, Y., & Huo., Y. (2022). *Redres: Residuals and diagnostic plots for mixed models*. `https://github.com/goodekat/redres.git`
6. Goode, K., & Rey, K. (2019). *ggResidpanel: Panels and interactive versions of diagnostic plots using 'ggplot2'*. `https://CRAN.R-project.org/package=ggResidpanel`

Workshops

Industrial Math/Stat Modeling (IMSM) Workshop for Graduate Students

Asheville, NC

The Statistical and Applied Mathematical Sciences Institute (SAMSI)

July 2019

- Two week research workshop
- Worked in a research group mentored by senior statisticians from Rho Inc.
- Analyzed continuously monitored glucose data using functional data analysis
- Assisted with the writing of a report and presentation on the research analysis

Teaching

Workshops

Predictive plant phenomics graduate student statistics bootcamp

Iowa State University

Predictive Plant Phenomics Program

2018-2019

- Led a one day statistics bootcamp
- Discussed randomization, confidence intervals, and design of experiments
- Prepared slides

Instructor

STAT 101: Introduction to statistics

Iowa State University

Department of Statistics

Spring 2016

- Prepared and led lectures
- Wrote and graded exams
- Topics included summary statistics, visualization, normal distribution, hypothesis testing, confidence intervals, and JMP

MATH 107: Elementary statistics

Lawrence University

Mathematics Department

Fall 2015

- Organized the curriculum
- Prepared and graded homework and exams
- Topics included summary statistics, visualizations, randomization tests, bootstrap, normal distribution, hypothesis testing, confidence intervals, and R

Teaching Assistant

BMI 552: Regression methods for population health graduate students

University of Wisconsin, Madison

Department of Biostatistics & Medical Informatics

Spring 2015

- Taught labs
- Held office hours
- Topics included simple and multiple linear regression, logistic regression, survival analysis, and SAS

BMI 551: Introduction to biostatistics for population health graduate students

University of Wisconsin, Madison

Department of Biostatistics & Medical Informatics

Fall 2014

- Taught labs
- Held office hours
- Topics included summary statistics, visualizations, probability, normal distributions, hypothesis testing, confidence intervals, and R

STAT 301: Introduction to statistical methods for nonstatistics majors

University of Wisconsin, Madison

Department of Statistics

Summer 2014

- Prepared and led discussions
- Graded homework and exams
- Held office hours
- Topics included summary statistics, visualizations, probability, normal distributions, hypothesis testing, and confidence intervals

STAT 302: Accelerated introduction to statistical methods for statistics undergraduate majors

University of Wisconsin, Madison

Department of Statistics

Spring 2014

- Prepared and led discussions
- Graded homework and exams
- Held office hours
- Topics included summary statistics, visualizations, randomization tests, bootstrap, normal distribution, hypothesis testing, confidence intervals, and R

STAT 371: Introductory applied statistics for the life sciences

University of Wisconsin, Madison

Department of Statistics

Fall 2013

- Prepared and led discussions
- Graded homework and exams
- Held office hours and worked in the statistics help room
- Topics included summary statistics, visualizations, probability, normal distributions, hypothesis testing, confidence intervals, and R

Mentor

Academic Mentor for Minority and First Generation Undergraduates

University of Wisconsin, Madison

Center for Academic Excellence

Fall 2014 - Spring 2015

- Mentored minority and first generation undergraduate students enrolled in statistics courses
- Met weekly throughout the semester with individuals or small groups to review statistical concepts from class and make the material approachable
- Discussed and encouraged strategies for academic success

Tutor

Statistics Tutor

University of Wisconsin, Madison

Department of Statistics

Fall 2014 - Spring 2015

- Tutored undergraduate students
- Various introductory statistics courses

Service

Iowa State statistical graphics working group weekly seminar organizer — *Sep 2019 - May 2020*

Graduate student representative to ISU statistics department faculty meetings — *Sep 2018 - May 2019*

Recycling coordinator for ISU STATers (Statistics Graduate Student Organization) — *Sep 2017 - May 2019*

Treasurer and member of StatCom (Statistics in the Community) at Iowa State — *Sep 2017 - May 2019*

Skills

Working Knowledge: GitHub, JMP, LaTeX, Python, R, R Markdown, R Shiny, SAS

Basic Knowledge: C, SPSS