

# 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

AWARDED FOR 'USING LIME TO INTERPRET A RANDOM FOREST MODEL WITH AN APPLICATION TO BULLET MATCHING DATA'

2019

### ISU Department of Statistics Dan Mowrey Consulting Excellence Award

AWARDED IN RECOGNITION OF OUTSTANDING CONTRIBUTIONS IN THE AREA OF STATISTICAL CONSULTING WHILE WORKING TOWARD A GRADUATE DEGREE.

2018

### ISU Department of Statistics Award for Experiential Development

PRESENTED TO A GRADUATE STUDENT FOR EXCELLENT PERFORMANCE IN MULTIPLE STATISTICAL EFFORTS (TEACHING AND CONSULTING) AS PART OF THE GRADUATE PROGRAM.

2017

## Experience

### Senior Member of Technical Staff

Sandia National Laboratories

STATISTICAL SCIENCES DEPARTMENT

Dec 2021 - Current

- Research and development statistician
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### 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
- Prepared manuscript for submission to peer reviewed journal
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### 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
- Presented on work at internal and external events
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## Graduate Research Assistant

NATURAL RESOURCE ECOLOGY AND MANAGEMENT

- 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

Iowa State University

Jan 2021 - June 2021

## Statistical Consultant

AGRICULTURE EXPERIMENT STATION

- 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
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Iowa State University

May 2016 - Dec 2020

## Graduate Research Assistant

DEPARTMENT NATURAL RESOURCE ECOLOGY AND MANAGEMENT

- 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
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Iowa State University

Sep 2019 - Aug 2019

## Data Analyst

RESEARCH ADMINISTRATION OFFICE

- 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
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Lawrence University

2015

## Data Collection Assistant

RESEARCH ADMINISTRATION OFFICE

- 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

Lawrence University

Sep 2014 May 2015

## Publications

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1. McClernon, K., Goode, K., & Ries, D. (2024). A comparison of model validation approaches for echo state networks using climate model replicates. *Spatial Statistics*, 100813.
2. 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 PuO<sub>2</sub> processing conditions using bayesian seemingly unrelated regression with functional data. *Frontiers in Nuclear Engineering*, 3, 1331349.
3. Goode, K., Ries, D., & McClernon, K. (2023). Characterizing climate pathways using feature importance on echo state networks. *Submitted to Statistical Analysis and Data Mining*.
4. Goode, K., Weber, M. J., & Dixon, P. M. (2023). WhoseEgg: Classification software for invasive carp eggs. *PeerJ Life and Environment*, 11.
5. 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>
6. 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>
7. 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>
8. 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>
9. 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>

10. 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

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1. Goode, K., Acquesta, E., Diaz, C., Krishnakumar, R., & Prudencio, E. (2024). A framework for evaluating the maturity level of machine learning explanations. *JSM*, Portland, 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 (EC-COMAS 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

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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

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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

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

*Asheville, NC*

THE STATISTICAL AND APPLIED MATHEMATICAL SCIENCES INSTITUTE (SAMSII)

*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

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### 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
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### 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
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### 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
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## 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
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## 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
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## 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

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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

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WORKING KNOWLEDGE: GITHUB, JMP, LATEX, PYTHON, R, R MARKDOWN, R SHINY, SAS

BASIC KNOWLEDGE: C, SPSS