Cassidy K. Buhler (she/her)

cb3452@drexel.edu cassie-buhler cassiebuhler.github.io/ cassiebuhler

About

I'm a Ph.D. candidate on the job market for a research position (e.g. post-doc, applied scientist, research scientist) and am particularly interested in roles which address environmental challenges using AI and ML.

Education

2024 **Ph.D. Business Analytics** — ***Drexel University***, Philadelphia, PA
Minor: Computational Data Science
Thesis: Advances in Optimization with Applications to Nature Conservation
Expected Graduation: June 2024

2019 **B.S. Mathematics** — ***University of Utah***, Salt Lake City, UT
Statistics Emphasis

Interests

AI for Conservation; Spatial Conservation Planning; Conservation Decision-Making; Environmental Data Science; Machine Learning; Mixed-Integer Programming; Nonlinear Programming; Operations Research;

Publications

Journal Articles

C. K. Buhler, R. S. Terry, K. G. Link, and F. R. Adler, "Do mechanisms matter? Comparing cancer treatment strategies across mathematical models and outcome objectives," *Mathematical Biosciences and Engineering*, vol. 18, no. 5, pp. 6305–6327, 2021, ISSN: 1551-0018. DOI: 10.3934/mbe.2021315.

Refereed Conference Proceedings

C. K. Buhler and H. Y. Benson, "Decision-making for land conservation: A derivative-free optimization framework with nonlinear inputs," in *Proceedings of the 38th Annual AAAI Conference on Artificial Intelligence.*, Acceptance rate 24.2%, 2024. DOI: 10.48550/arXiv.2308.11549, forthcoming.

C. K. Buhler and H. Y. Benson, "Optimal land conservation decisions for multiple species," in *Proceedings of the 52nd Northeast Decision Science Institute Annual Conference*, vol. 52, Washington, D.C., 2023, pp. 808–816.

Under Review

C. K. Buhler, H. Y. Benson, and D. F. Shanno, "Regularized step directions in nonlinear conjugate gradient methods," *arXiv preprint arXiv:2110.06308*, 2021, Under 2nd round of review at Mathematical Programming Computation. DOI: 10.48550/arXiv.2110.06308.

In Progress

C. K. Buhler and H. Y. Benson, "Efficient solution of portfolio optimization problems via dimension reduction and sparsification," *arXiv preprint arXiv:2306.12639*, Working paper. DOI: 10.48550/arXiv.2306.12639.

C. K. Buhler and H. Y. Benson, "Regularized nonlinear conjugate gradient methods for machine learning," Working paper.

Experience

2019 – Present **Doctoral Research Fellow** ***Drexel University***

Department of Decision Sciences & MIS

Led research projects in nonlinear and mixed-integer optimization with applications in machine learning and conservation decision-making.

Project Area #1: Mixed-Integer Optimization + Conservation Decision-Making

- Developed a mixed-integer nonlinear programming (MINLP) framework for spatial conservation planning as a computational tool for conservationists.
- Utilized population viability analysis to gain insight into a species' extinction risk and merged with MINLP framework to find the cheapest collection of parcels that best protect a vulnerable species.
- Framework promotes interdisciplinary work, as it allows for more complex decision inputs and can be paired with existing ecological software.

Presentations:

- *AAAI 2024, Rising Scholars Conference 2023 (MIT Sloan), INFORMS 2023, SIAM 2023, & NEDSI 2023.*

Awards/Grants:

- *DEI & Environment and Sustainability Innovation Micro-Grant 2023 (Drexel University)*
- *Graduate Student Travel Subsidy Award 2023 (Drexel University)*
- *SIAM Student Travel Award 2023*

Papers:

- *Decision-making for land conservation: A derivative-free optimization framework with nonlinear inputs.*
- *Optimal land conservation decisions for multiple species.*

Project Area #2: Nonlinear Optimization + Machine Learning

- Advanced unconstrained optimization methods for nonlinear programming, with special emphasis on large-scale machine learning problems.
- Formulated a quasi-Newton algorithm by applying hybrid cubic regularization to nonlinear conjugate gradient methods (CGM).
- Solver exhibits reduced iteration count, faster CPU runtime, and improved theoretical guarantees compared to non-regularized CGM.

Presentations: *SIAM 2021, INFORMS 2021, & INFORMS 2020.*

Award: *SIAM Student Travel Award 2021*

Papers:

- *Regularized step directions in nonlinear conjugate gradient methods.* Under review.
- *Nonlinear conjugate gradient methods for machine learning.* In progress.

2019 – Present **Instructor** ***Drexel University***

Department of Decision Sciences & MIS

- Created, organized, and delivered instructional materials for undergraduate and PhD classes/workshops.
- Earned two awards for teaching performance, along with student course evaluation scores above the college and department average.

Awards: *TA Excellence Award 2022 & TA Excellence Award (Highly Commended) 2021*

Course	Level	Quarter	Skills
BSAN 360: Programming for Data Analytics	U	Winter 2022	R
Ph.D. Programming Bootcamp	PhD	Summer 2021; Summer 2022	Python
MIS 200: Management Information Systems (Recitation Section)	U	Fall 2019; Fall 2020; Winter 2021	MS Access; Excel; HTML

*Undergraduate (U)

Experience (continued)

2020 – Present **Teaching Assistant** ***Drexel University***
Department of Decision Sciences & MIS

- Served TA for 25+ classes, assisting undergraduate, MS, MBA, Executive MBA, and PhD students.

Course	Level	Quarter	Skills
BSAN 360: Programming for Data Analytics	U	Spring 2021	R
MIS 612: Aligning Information Systems & Business Strategies	EMBA; MBA	Fall 2023	-
MIS 625: Management of Information Technology Operations	MBA	Fall 2023	-
OPM 200: Operations Management	U	Spring 2020; Fall 2021; Spring 2023	-
OPM 341: Supply Chain Management	U	Spring 2021; Spring 2022; Fall 2022	Excel
OPM 344: Revenue Management	U	Fall 2022	Excel
OPR 320: Linear Models for Decision Making	U	Summer 2020; Spring 2021	Excel
STAT 201: Intro to Business Statistics	U	Winter 2020; Spring 2020; Fall 2021; Summer 2022; Spring 2023; Winter 2024	Excel
STAT 202: Business Statistics II	U	Summer 2021; Spring 2023	Excel
STAT 205: Statistical Inference I	U	Spring 2020; Fall 2021	Excel
STAT 206: Statistical Inference II	U	Summer 2021	Excel
STAT 510: Intro to Statistics for Business Analytics	MBA	Summer 2023; Winter 2024	Excel
STAT 642: Data Mining for Business Analytics	MS; PhD	Winter 2023	R

**Undergraduate (U)*

2018 – 2021 **Research Assistant** ***University of Utah***
Department of Mathematics

- Advised by Professor Frederick Adler as an Research Experience for Undergraduates (REU) project.
- Developed mathematical models to understand the response of castration-resistant prostate cancer under various treatment regimens.
- Simulated the dynamics of biological systems as differential equations, formulating the models with differing mechanism complexity.
- Evaluated modern treatment regimens under this scheme and disseminated findings to academic and medical audiences.

Paper: *Do mechanisms matter? Comparing cancer treatment strategies across mathematical models.*
Award: *Undergraduate Research Scholar Designation (University of Utah).*

Experience (continued)

2018 **Computer Scientist Intern** ***United States Air Force***
Hill Air Force Base
- Conducted research related to improving software for USAF aircraft in the Software Engineering Group.
- Hired under the Premier College Intern Program (PCIP) and earned a position in the PALACE Acquire (PAQ) program.

Technical Skills

Coding

Language	*Proficiency*	*Libraries/Packages/Toolboxes*
Python	★★★★★	PyTorch, TensorFlow, Pandas, BeautifulSoup, scikit-learn, Keras, Seaborn, rasterio.
R	★★★★★	tidyverse, ggplot, rgdal, raster, rgeos, SDMTools, deSolve.
MATLAB	★★★★★	Deep Learning, Statistics & Machine Learning, Optimization, Financial, Computer Vision.

Optimization Software

Solver	*Proficiency*	*Applications*
GUROBI	★★★☆	quadratic programming, linear programming
Pyomo	★★★☆	mixed-integer nonlinear programming
CVX	★★☆☆	convex programming
CPLEX	★★☆☆	integer programming
AMPL	★★☆☆	unconstrained nonlinear programming

Basic: ★☆☆☆ *Intermediate:* ★★☆☆ *Advanced:* ★★★☆ *Expert:* ★★★★

Software

Derivative-Free Optimization for Land Conservation

A mathematical programming tool for conservationists that allows for linear and nonlinear inputs, continuous and discrete variables, and can be paired with existing ecological software.

`https://github.com/cassiebuhler/conservation-dfo`

</> R, Python, RAMAS

Conmin-CG: Hybrid Cubic Regularization of Conjugate Gradient Methods

An optimization algorithm with memoryless and matrix-free properties that solves large-scale problems more efficiently by improving step quality with cubic regularization.

`https://github.com/cassiebuhler/ConminCG`

</> C, MATLAB, and Python.

Service

2023 **Session Chair** *INFORMS Annual Meeting*
Nonlinear Optimization in Machine Learning Session.

2023 **Session Organizer** *SIAM Conference on Optimization*
Nonlinear Optimization and Applications Minisymposium.

2023 **Session Chair** *NEDSI Annual Conference*
Land, Sand, and Plastic Management Session

2022 **Panelist** *Drexel University*
Teaching Assistance Orientation Session.

Service (continued)

2019 **Mathematics Tutor - Volunteer** *Utah Prison Education Project*
Timpanogos Women's Correctional Facility

- Tutored students who are incarcerated in a Salt Lake Community College math course.

Organizations

AAAI: Association for the Advancement of Artificial Intelligence

AWM: Association for Women in Mathematics

ESA: Ecological Society of America

INFORMS: The Institute for Operations Research and the Management Sciences

SIAM: Society for Industrial and Applied Mathematics

References

Hande Benson, *Ph.D. Research Advisor*
Professor of Decision Sciences and MIS
Drexel University
hvb22 [at] drexel [dot] edu

Frederick Adler, *Undergraduate Research Advisor*
Professor of Biology and Mathematics
Director, School of Biological Sciences
University of Utah
adler [at] math [dot] utah [dot] edu