Allison Cruikshank

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Overview

I am a fifth-year PhD candidate in Mathematics at Duke University, where I develop mechanistic mathematical models to represent human physiological processes and address questions in medicine. I plan to pursue a career in the pharmaceutical or biotech industry after completing my PhD in May 2026, with a particular interest in applying QSP to drug development.

Education

Duke University Expected May 2026
PhD in Mathematics, Advisor: *Professor Michael C. Reed*
Thesis: *Mechanistic Modeling to Investigate Sex Differences in Oxidative Stress Management*

University of Nebraska-Lincoln May 2021
BS in Mathematics and Biochemistry with Highest Distinction
Thesis: *A Mathematical Model of Pancreatic Cancer Growth and Response to Treatment*
Advisor: *Professor Huijing Du*

Professional Experience

Mathematical Modeling Consultant, Zyphore Therapeutics Present
- Designed and calibrated mechanistic models of metabolic processes to support drug discovery strategy.
- Delivered modeling insights in cross-functional team meetings to align computational and experimental objectives.

FDA QSP Research Fellow Present
- Developed QSP models of the Alternative Complement Pathway to simulate drug mechanisms in Paroxysomal Nocturnal Hemoglobinuria (PNH).
- Calibrated models to accurately predict biomarker outcomes in Phase 3 clinical trials of multiple complement pathway inhibitors.
- Analyzed Phase 3 trial data and integrated it with literature to improve model predictive performance.
- Applied global sensitivity analysis to identify pathway drivers of biomarker outcomes.

Simulations Plus QSP Modeling Intern Summer 2024
- Integrated the downstream effects of Nivolumab on the adaptive immune system and its impact on liver toxicity within BIOLOGXsym, a QST software designed for large molecule liver safety.
- Generated and analyzed virtual patient populations to evaluate how T cell variability influences different mechanisms of Nivolumab-related liver toxicity.
- Parameterized drug-induced liver toxicity mechanisms using LAMPs organ-on-a-chip experimental data to support translational safety modeling.
- Collaborated with cross-functional platform development teams to expand BIOLOGXsym's predictive capabilities for biologics safety assessment.

Johnson & Johnson Clinical Pharmacology and Pharmacometrics Intern Summer 2023
- Incorporated and parameterized novel mechanisms of immunological synapse formation into a mechanistic model of T cell redirectors for lymphoma treatment.
- Integrated additional hypothesized mechanisms of co-stimulation into the model framework to explore potential combination strategies.

- Parameterized other mechanistic processes influencing T cell redirector activity using preclinical datasets to improve predictive accuracy.
- Presented modeling progress in project team meetings to cross-functional collaborators.

Publications

[2025] Mizuki Suzuki, Hwi Young Kim, Michael C Reed, Frederik Nijhout, **Allison Cruikshank**, et al. Elevated Homocysteine is Associated with Liver Fibrosis in MASLD in a Sex- and Menopause-Specific Manner. Under Review at Gastro Hep Advances.

[2025] **Allison Cruikshank**, Michael C. Reed, H. Frederick Nijhout. A Mathematical Model of Oxidative Stress: Sex Differences and Cystathionine β-Synthase Deficiency. Under Review at Mathematical Biosciences.

[2025] Michael C. Reed, Ayako Suzuki, **Allison Cruikshank**, Mizuki Suzuki, H. Frederick Nijhout. Differential effects of synthetic estrogen on serum homocysteine levels before and after menopause. Under Review at PLoS One.

[2024] Sergio Mena, **Allison Cruikshank**, Janet Best, H. Frederick Nijhout, Michael C. Reed, Parastoo Hashemi. Modulation of Serotonin Transporter Expression by Escitalopram under Inflammation; Implications for SSRI Effectiveness. *Communications Biology.* https://doi.org/10.1038/s42003-024-06240-3.

[2024] **Allison Cruikshank**, Michael C. Reed, H. Frederick Nijhout. Sex differences in glutathione metabolism and acetaminophen toxicity. *Metabolism and Target Organ Damage.* https://doi.org/10.20517/mtod.2023.44.

[2024] Anna Marie Buchanan, Sergio Mena, Iman Choukari, Aditya Vasa, Jesseca N. Crawford, Jim Fadel, Nick Maxwell, Lawrence Reagan, **Allison Cruikshank**, Janet Best, H. Frederick Nijhout, Michael Reed, Parastoo Hashemi. Serotonin as a Biomarker of Toxin-Induced Parkinsonian. *Molecular Medicine.* https://doi.org/10.1186/s10020-023-00773-9.

[2023] **Allison Cruikshank**, Janet Best, H. Frederick Nijhout, Michael C. Reed. Dynamical Questions in Volume Transmission. *Journal of Biological Dynamics.* https://doi.org/10.1080/17513758.2023.2269986.

[2023] Archer Harrold, **Allison Cruikshank**, Bryan Penas, Rebecca Roston. Introducing High School Biology Students to Biochemistry with a Short, Content-Oriented Intervention. *Biochemistry and Molecular Biology Education.* https://doi.org/10.1002/bmb.21782.

Awards

Best Collaborative Project at ISoP QSP SIG Student Symposium — Summer 2025

Top 5 Data Science Project in Erdős Data Science Bootcamp — Fall 2024
Project: Thrive or Survive: Predicting the Health of Trees following Forest Fires in Washington

AWM Poster Award at SIAM Annual Meeting — Summer 2024

SIAM Student Chapter Certificate of Recognition — 2024

NSF RTG Research Assistantship *Duke Applied Math RTG* ($42,000) — Spring 2023, 2024, 2025

Select Presentations

SIAM Annual Meeting - Oral and Poster Presentation — Summer 2025
ISoP QSP Special Interest Group Student Symposium - Oral Presentation — Summer 2025
SIAM Dynamical Systems - Oral Presentation — Summer 2025
ICERM Workshop on Uncertainty Quantification - Poster — Summer 2025
University of Pittsburgh AWM Student Seminar Series - Oral Presentation — Spring 2025
Virginia Commonwealth University BioMath Seminar - Oral Presentation — Spring 2025
Duke Mathematical Biology Seminar - Oral Presentation — Spring 2025
Oregon State Math Bio Seminar - Oral Presentation — Spring 2025
Joint Mathematics Meeting - Oral Presentation — Spring 2025
AMS Fall Sectional Central Meeting - Oral Presentation — Fall 2024

AWM Workshop at SIAM Annual Meeting - Poster Summer 2024
SIAM Life Sciences Meeting - Oral Presentation Summer 2024
Association for Women in Mathematics Research Symposium - Poster Fall 2023
Society of Mathematical Biology Annual Meeting - Oral Presentation Summer 2023
Dynamical Systems in the Life Sciences - Oral Presentation Summer 2023

Outreach and Service

Society for Industrial and Applied Mathematics (SIAM) Present
Chapter Officer, Duke Mathematics Department
Organize community-building events, research talks, and career development opportunities.

Women in Science Identity Group Present
Founding Member, ASCPT
Contributed to organizing community-building events, mentoring opportunities, and advocacy efforts to promote gender equity.

Triangle Area Graduate Mathematics Conference (TAGMaC) Present
Co-organizer, Duke-UNC-NCSU Mathematics Departments
Rotating conference for mathematics graduate students in the NC Triangle area, sponsored by the AMS and SIAM chapters at Duke, UNC Chapel Hill, and NC State.

Triangle Contest in Mathematical Modeling (TriCoMM) Present
Co-organizer, Duke Mathematics Departments
Local mathematical modeling contest for undergraduate students based on the international Mathematical Contest in Modeling (MCM).

Association for Women in Mathematics (AWM) 2021–2025
Chapter Officer, Duke Mathematics Department
Coordinate community-building events, talks, and academic enrichment opportunities.

Semester REU Spring 2024
Graduate Student Support, Duke Mathematics Department
Research experience for undergraduates led by Dr. Jacob Madrid in mathematical biology and probability.

Teaching

Laboratory Calculus II Fall 2024
Instructor of Record, Duke University
Prepared and presented lectures three days per week and co-designed exams and homework with a team of graduate instructors.

Laboratory Calculus I Fall 2022
Instructor of Record, Duke University
Prepared and presented lectures three days per week and co-designed exams with the course coordinator (Professor Shira Viel) and a team of graduate instructors.

Laboratory Calculus I Fall 2021
Teaching Assistant, Duke University
Led a discussion section with a partner twice a week. Facilitated group work, answered questions, gave mini-lectures, and graded exams.

Other Technical Skills

Programming Languages: Matlab (advanced), Python (proficient), R (basic)
Data Science: Regression, Classification, Ensemble Learning, Inference, neural networks