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: Mathematical biochemistry: Sex Differences in Cell Metabolism and Comodulation of Neurotransmitters in the Brain
- **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

- **FDA QSP Research Fellow** Present
  Developing a QSP model for patients with PNH to provide insights into the underlying mechanisms of the disease, effects of current treatments, and potential therapeutic interventions.
  Responsibilities: virtual population generation, parameter estimation & calibration, sensitivity analysis, intensive literature review, QSP model generation, and presenting work in project team meetings.
- **Simulations Plus QSP Modeling Intern** Summer 2024
  Supported the development of the BIOLOGXsym platform, a QST software focused on complex macromolecule liver safety. My primary focus was incorporating the downstream effects of Nivolumab on the adaptive immune system and its impact on liver toxicity within BIOLOGXsym.
  Responsibilities: data fitting, parameter estimation, sensitivity analysis, intensive literature review and subsequent integration of key mechanisms in model, and presenting work in project team meetings.
- **Johnson & Johnson Clinical Pharmacology and Pharmacometrics Intern** Summer 2023
  Supported the development of co-stimulatory combinations of T cell redirectors for treatment of lymphoma through mechanistic mathematical modeling.
  Responsibilities: data fitting, parameter estimation, intensive literature review and subsequent integration of key mechanisms in model, and presenting work in project team meetings.

Publications

Graduate Work

- [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 Clinical Gastroenterology and Hepatology.
- [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.

Undergraduate Work

- [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

- 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

Sex Differences in Oxidative Stress Management

- ISoP QSP Special Interest Group Student Symposium - 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

Comodulation of Neurotransmitters in the Brain

- SIAM Dynamical Systems - Oral Presentation — Summer 2025
- Society of Mathematical Biology Annual Meeting - Oral Presentation — Summer 2023
- Dynamical Systems in the Life Sciences - Oral Presentation — Summer 2023

Outreach and Service

- Association for Women in Mathematics (AWM) — Present
  Chapter Officer, Duke Mathematics Department
  Coordinate community-building events, talks, and academic enrichment opportunities.
- 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
  A group that seeks to support and empower women in the field of clinical pharmacology by fostering a collaborative community, promoting personal and career development, and advocating for gender equity within the ASCPT scientific community.
- 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).
- 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

- **Duke University** `Fall 2024`
  Instructor of Record
  Math 112L: *Laboratory Calculus I*
  Prepared and presented lectures three days per week and co-designed exams and homework with a team of graduate instructors.
- **Duke University** `Fall 2022`
  Instructor of Record
  Math 111L: *Laboratory Calculus I*
  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.
- **Duke University** `Fall 2021`
  Teaching Assistant
  Math 111L: *Laboratory Calculus I*
  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