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 modeling approaches to support drug development.

Education

Duke University Expected May 2026
PhD in Mathematics, Advisor: *Professor Michael C. Reed*
Thesis: *Mechanistic Mathematical Models of Sex Differences and Oxidative Stress in Health and Disease*

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 and Research Experience

PhD Researcher, Duke University Present
- Created mechanistic models of hepatic oxidative stress management to study sex differences and the effects of estradiol supplementation in pre- and post-menopausal women.
- Incorporated and parameterized estradiol effects on glutathione metabolism to uncover mechanisms of sex-dependent differences in acetaminophen toxicity.
- Investigated the interaction of serotonin and dopamine in Parkinson's Disease, revealing how such interactions alter serotonin levels.
- Characterized dynamics of neurotransmitter co-modulation to study cross-talk between serotonin and histamine pathways.

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

FDA QSP Research Fellow Present
- Developed QSP models of the Alternative Complement Pathway to investigate drug mechanisms in Paroxysomal Nocturnal Hemoglobinuria (PNH).
- Calibrated models to accurately predict biomarker outcomes in Phase 3 clinical trials of multiple complement pathway inhibitors.
- Incorporated PopPK submodules to mechanistically link exposure-response and analyze drug mechanisms.
- Analyzed Phase 3 trial data and integrated with literature to improve model predictive performance.

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 novel mechanisms of immunological synapse formation into a mechanistic model of T cell redirectors for lymphoma treatment.
- Implemented and tested co-stimulation hypotheses within the model framework to evaluate potential combination strategies.
- Parameterized other mechanistic processes influencing T cell redirector activity using preclinical datasets to improve predictive accuracy.
- Communicated 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. *Gastro Hep Advances*. https://doi.org/10.1016/j.gastha.2025.100800.

[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.

Preprints

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

[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.

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 (Honorable Mention) `Summer 2024 (Summer 2025)`

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

Women in Science Identity Group — Present
Founding Member, ASCPT

Triangle Contest in Mathematical Modeling (TriCoMM) — Present
Co-organizer, Duke Mathematics Departments

Triangle Area Graduate Mathematics Conference (TAGMaC) — 2021-2025
Co-organizer, Duke-UNC-NCSU Mathematics Departments

Association for Women in Mathematics (AWM) — 2021-2025
Chapter Officer, Duke Mathematics Department

Semester REU — Spring 2024
Graduate Student Support, Duke Mathematics Department

Teaching

Laboratory Calculus II — Fall 2024
Instructor of Record, Duke University

Laboratory Calculus I — Fall 2022
Instructor of Record, Duke University

Laboratory Calculus I — Fall 2021
Teaching Assistant, Duke University

Other Technical Skills

Programming Languages: Matlab, Python, R, SAS
Data Science: Regression, Classification, Ensemble Learning, Inference, neural networks