

# Mariah C. Boudreau

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## Personal Details

### Ph.D. Candidate

Mathematical Sciences  
University of Vermont  
Burlington, VT USA

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## Research Interests

Mathematical modeling for biological applications, stochastic modeling and model philosophy.

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## Education

### Ph.D. in Mathematical Sciences | 2019 - present

University of Vermont, Burlington, VT

- Advisors: Chris Danforth and Laurent Hébert-Dufresne
- Quantitative and Evolutionary STEM Training Program Trainee (NSF Funded Traineeship)

### Bachelor of Science in Mathematics | 2015 - 2019

Saint Michael's College, Colchester, VT

- Minor in Computer Science, Minor in Statistics
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## Professional Experience

### Graduate Research Assistant | June 2023 - present

University of Vermont, Burlington, VT

Conducting data analysis on blood work data for the Lived Experience Measured Using Rings study.

**Graduate Teaching Assistant** | August 2019 - May 2020 & August 2022 - May 2023

Mathematics Department, University of Vermont, Burlington, VT

Taught MATH 017: Applications of Finite Math in 2019-2020. Taught MATH 019: Fundamentals of Calculus I in 2022-2023.

**Contractor** | May 2022 - July 2022

Institute for Disease Modeling at the Bill and Melinda Gates Foundation, Seattle, WA

Assisted in the parameterization and development of an open-source human papillomavirus population model. Began developing a within host model for human papillomavirus induced lesions in a cervical skin layer.

**Graduate Research Assistant** | August 2020 - May 2022

University of Vermont, Burlington, VT

Worked on one project pertaining to the sensitivity of final outbreak predictions for probability generating functions (PGFs) when applied to epidemics. A different one expands on time-dependent PGFs to understand early epidemic uncertainty and incorporate intervention strategies.

**QuEST Coding Workshop Teaching Assistant** | August 2021

University of Vermont, Burlington, VT

Coordinated and taught first year Ph.D. students the fundamentals of coding in R and calculus basics.

**Technical Services Intern** | June 2019 - August 2019

Mylan, Saint Albans, VT

Analyzed sampling, mass balance and other essential functions at the Mylan Saint Albans manufacturing plant.

**Dartmouth Summer Research Student** | June 2018 – August 2018

Dartmouth College, Hanover, NH

Participated in a research experience for undergraduates to research mathematical applications in signal processing. The research project was a simplified version of a multi-measurement vector problem. The goal was to understand the fundamentals of how multiple audio signals could be used together to construct a clear signal of a single conversation. Presented this research at the end of the program at a colloquium.

**BU SIBS Participant** | June 2017 - July 2017

Boston University, Boston, MA

Participated in a program to learn about the field of biostatistics. Presented a research project at the end of program to BU Biostatistics Faculty. This research project utilized data from the National Health Interview Survey of the CDC. The relationship between amounts of milk consumed during one's life was compared to being diagnosed with osteoporosis. The title of the presentation given was "Got Milk?".

**Peer Tutor** | 2016 - 2019

Saint Michael's College, VT

Tutored students in a Calculus I, & II course.

**Math Student Assistant** | 2016 - 2019

Saint Michael's College, VT

Created posters and promotional information. Assisted in registration for events. Co-organized the Math weekly social events and colloquium events.

**Work Study** | 2016-2017

Academic Enrichment Commons, Saint Michael's College, VT

Assisted students with inquiries about peer tutors, testing areas and other student support services.

**Math Grader** | 2016 - 2016

Saint Michael's College, VT

Graded homework for a Calculus II course.

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## Publications and other writings

**M.C. Boudreau**, A.J. Allen, N.J. Roberts, A. Allard, & L. Hébert-Dufresne | September 2023

*Temporal and probabilistic comparisons of epidemic interventions*

Bull. of Math. Biol. 85, 118 (2023)

R.M. Stuart, J.A. Cohen, C.C. Kerr, R.G. Abeysuriya, M. Zimmerman, D.W. Rao, **M.C. Boudreau**, & D.J. Klein | February 2023

*HPVsim: An agent-based model of HPV transmission and cervical disease*

MedRxiv

A.J. Allen, **M.C. Boudreau**, N.J. Roberts, A. Allard, & L. Hébert-Dufresne | February 2022

*Predicting the diversity of early epidemic spread on networks*

Phys. Rev. Research 4, 013123

**M.C. Boudreau**, C.M. Danforth, J.G. Young, & L. Hébert-Dufresne | In Progress

Working title: *Sensitivity analysis of stochastic polynomials, and its application to epidemic forecasting and random graphs*

Draft available upon request

**M.C. Boudreau**, J.A. Cohen, & L. Hébert-Dufresne | In Progress

Working title: *Epithelium dynamics model with master equations: a case study with Human Papillomavirus*

Draft available upon request

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## Conferences attended

**NetSci 2019** | June 2019

**NetSci 2020** | August 2020

**Complex Network Winter Workshop** | January 2021

**University of Vermont Virtual Student Research Conference** | April 2021

## Presentations

### **Sensitivity analysis of stochastic polynomials, and its application to epidemic forecasting and random graphs** | August 2023

Contagions on Complex Social Systems Workshop, Burlington, VT

This presentation detailed previous work of a preliminary sensitivity analysis on probability generating functions as models for epidemic forecasting.

### **Temporal and probabilistic forecasts of epidemic interventions** | May 2023

SIAM Dynamical Systems 2023 Conference, Portland, OR

This presentation detailed work from a preprint which expands a probability generating function time evolution model to incorporate intervention strategies and ways to compare them. This work was in collaboration with Andrea J. Allen, Nicholas J. Roberts, Antoine Allard and Laurent Hébert-Dufresne.

### **Network analysis and its application to biology** | April 2023

University of Vermont MATHCounts, Burlington, VT

This presentation gave an introduction to networks and their applications to biology, such as neural networks, forest fires and epidemics.

### **Modeling epidemic interventions with probability generating functions** | April 2021

University of Vermont Virtual Student Research Conference, Online

The poster presentation described an expansion of a probability generating function time evolution model that incorporates intervention strategies. This work was in collaboration with Andrea J. Allen, Nicholas J. Roberts, Antoine Allard and Laurent Hébert-Dufresne.

### **Network analysis and its application to biology** | January 2021

University of Vermont 4-H Teen Science Cafe, Online

This presentation gave an introduction to networks and their applications to biology applications such as neural networks, forest fires and epidemics.

### **Ski resort network analysis** | January 2021

Complex Networks Winter Workshop 2020, Online

This presentation showcased network analysis techniques applied to Utah ski resorts to see if there were trend among popular ski resorts. This work was in collaboration with Alexander Caouette, Jeremy Côté and Nicholas J. Roberts.

### **Probabilistic epidemic forecasting using probability generating functions, and its robustness to data quality, error, biases, and noise** | September 2020

University of Vermont Computer Science Research Day, Online

This presentation detailed a preliminary sensitivity analysis on probability generating functions as models for epidemic forecasting.

**Probabilistic epidemic forecasting using probability generating functions, and its robustness to data quality, error, biases, and noise** | September 2020

NetSci 2020 Conference, Online

This poster presentation detailed a preliminary sensitivity analysis on probability generating functions as models for epidemic forecasting.

**Network analysis and its application to epidemiology** | April 2019

Academic Symposium at Saint Michael's College, VT

This presentation detailed my honors thesis research on how network theory is used to understand the spread of disease.

**Dartmouth research experience: variations of the MMV problem** | September 2018

Student Summer Research Projects Colloquium at Saint Michael's College, VT

This presentation described my research while participating in Dartmouth Mathematics' Research Experience for Undergraduates.

**A Bostonian summer: BU SIBS experience and research** | September 2017

Student Summer Research Projects Colloquium at Saint Michael's College, VT

This presentation described my research and experience while participating in the Summer Institute for Training in Biostatistics at Boston University.

**Brahmagupta's famous area** | April 2017

Academic Symposium at Saint Michael's College, VT

This presentation detailed mathematician Brahmagupta's famous formula for the area of a cyclic quadrilateral. It was a part of a research project for the course, History of Mathematics.

**Neural networks in autism** | April 2016

Academic Symposium at Saint Michael's College, VT

This presentation explored how the application of graph theory in neural networks help to explain traits of autism.

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## Relevant Coursework

### Mathematics:

Applied Graph Theory, Differential Equations, Advanced Ordinary Differential Equations, Partial Differential Equations, Linear Algebra, Abstract Algebra I & II, Algebraic Topology, Numerical Analysis, Numerical Partial Differential Equations, Real Analysis I

### Complex Systems:

Principles of Complex Systems, Modeling of Complex Systems I & II,

### Statistics:

Probability and Statistics, Applied Regression Analysis, Bayesian Statistics, Mathematical Statistics and Methods, Applied Statistical Methods, Biological Data and Statistics

**Other:**

One Health: Zoonoses, Philosophy of Science, Technology, and Environment, Philosophy of the Mind, Free Will, and Neuroethics

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**Skills****Programming:**

Python, R, L<sup>A</sup>T<sub>E</sub>X, MATLAB, Java, C++

**Other:**

Statistical analysis, collaboration, problem solving, positive attitude, conversational French

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**Service****Joint Peer Review** | July 2023

Physical Review Research

**Volunteer Ski Patrol** | March 2021 - Present

Assist with mountain operations and first-aid at Bolton Valley Ski Resort.

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**Other interests**

Hiking, skiing, ski patrolling, Crossfit and learning more about Vermont.

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