# BRYSON G. KAGY

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## EDUCATION

**North Carolina State University** *2019-Present*
PhD Advisor: Seth Sullivant
Master's in Mathematics, May 2021
Qualifying exams in Combinatorics, Algebra, and Linear algebra/Lie Theory

**Georgia Institute of Technology** *2015-2019*
B.S. Mathematics with Pure Mathematics concentration, May 2019
B.S. Physics, May 2019
Science and Math Research Training (SMaRT) Program

## RESEARCH INTERESTS

algebraic statistics, algebraic combinatorics, algebraic geometry, polyhedral geometry, graphical models, graph theory, cluster algebras, coexter groups ,game theory, fair division.

## CURRENT RESEARCH PROJECTS

**North Carolina State University** Spring 2022

- Advisor: Seth Sullivant
- Generalized a characterization of idenitifibilty of phylogentic mixture mixtures models. Specifically, characterizing when the underlying model is JC, K2P, K3P, SSM instead of an underlying General Markov model.

**University of Hawaii Algebraic Methods in Phylogenetics Workshop** Summer 2024

- As part of a working group, looking at quintets and their uses on the coalescence model in identifying root locations, 2 cycle hybridization, and level 1 networks in general

**American Mathematical Society's Mathematics Research Communities** Summer 2024

- Working group formed at MRC on algebraic combinatorics
- Looking at the Poset formed by tubes of the cycle graph, trying to understand its structure with the goal of proving it is a lattice

**Institute of Mathematical and Statistical Innovation** Fall 2023

- Phylogenetics Working group started at IMSI
- Applying incomplete u-statistics to multiple Phylogenetic models.

**Institute of Mathematical and Statistical Innovation** Fall 2023

- Colored Graphical Models Working group started at IMSI
- Looking at Colored Guassian graphical models and trying to characterize the maximum likely threshold of classes of graphs, especially ones with threshold 1.

**Institute of Mathematical and Statistical Innovation** Fall 2023

- Game Theory Working group started at IMSI
- Looking at characterizing types of correlated polytopes for classes of games such as zero sum games.

## TECHNICAL STRENGTHS

**Computer Languages** Java, LaTeX, Polymake, Macaulay2, Maple, Python

## AWARDS AND HONORS

Spring 2019 North Carolina State University Provost Fellowship
2017-2018 Georgia Institute of Technology School of Mathematics Outstanding Math Major Award

## WORKSHOPS AND CONFERENCES

**Workshops**
Fall 2024 ICERM semester program- "Theory, Methods, and Applications of Quantitative Phylogenomics"
Summer 2024 University of Hawaii Algebraic Methods in Phylogenetics Workshop
Summer 2024 AMS MRC on Algebraic Combinatorics
Fall 2023 IMSI long program - Algebraic Statistics and Our Changing World
Summer 2022 Joint MSRI-BIRS Graduate Summer School - Sums of Squares Method in Geometry, Combinatorics and Optimization

**Conferences**
2024 International Symposium on Symbolic and Algebraic Computation, Poster: "A Description of the Polyhedral Geometry of Equidistant Phylogenetic Networks"
2024 Graduate Student Meeting in Applied Algebra and Combinatorics, Poster: "A Description of the Polyhedral Geometry of Equidistant Phylogenetic Networks"
2024 Graduate Students Combinatorics Conference, Talk: "A Description of the Polyhedral Geometry of Equidistant Phylogenetic Networks"
2024 Graduate Recruitment Weekend , Talk: "A Description of the Polyhedral Geometry of Equidistant Phylogenetic Networks"
2024 Joint Mathematics Meeting, Talk in AMS Special Session on Algebraic Approaches to Mathematical Biology: "A Description of the Polyhedral Geometry of Equidistant Phylogenetic Networks"
2019 Joint Mathematics Meeting, Poster: "Fair Division for Drawing Legislative Districts"
2019 National Conference on Undergraduate Research, Talk: "Fair Division for Drawing Legislative Districts"
2018 SIAM LA-TX conference, Talk: "Fair Division for Drawing Legislative Districts"
2018 Joint Mathematics Meeting, Poster: "One-Bit Johnson-Lindenstrauss Lemma"
2017 Young Mathematicians Conference, Poster: "One-Bit Johnson-Lindenstrauss Lemma"

## PAST RESEARCH PROJECTS

**North Carolina State University** Fall 2022

- Advisor: Seth Sullivant
- Characterized the cone of distance functions of phylogenetic equidistant circular split networks. Gave both a facet and extreme ray description. Preprint at arxiv.org/abs/2402.11032

**Institute of Mathematical and Statistical Innovation** Fall 2023

- In collaboration with Mark Curiel, Sameer K. Deshpande, and Joe Johnson
- Part of questions and consulting project at IMSI
- Did preliminary work on identifying equivalent regression trees. Goal was for a fixed set of data points, which different regression trees gave the same partition of those data points.
- Preprint at arxiv.org/abs/2402.13961. To appear in Algebraic Statistics.

**Carnegie Mellon University** Summer 2018

- Advisor: Dr. David Offner and Dr. Jessica De Silva

- Summer Undergraduate Applied Mathematics Institute (SUAMI)
- Analyzed a protocol by Zeph Landau and Francis Su that ensured fair legislative districting through concepts of fair division. We proved their protocol must return a result to a party that is within 2 districts of their geometric target, a measure of fairness. Preprint at arxiv.org/abs/1811.05705.

**Georgia Institute of Technology** Summer 2017

- Advisor: Dr. Michael Lacey
- Georgia Institute of Technology Impact Math REU
- Created a one-bit Johnson-Lindenstrauss Lemma where just the sign of each part of the measurements is taken. We found bounds for how many one-bit measurements are required to maintain the structure between points, showing it is not more than in the linear case. Preprint at arxiv.org/abs/1903.02123.

**Georgia Institute of Technology** Fall 2018 - Spring 2019

- Advisor: Dr. Michael Lacey
- Reading Course and Designing Data Analysis Course Worked through Guth's book on Polynomial Methods and their applications to combinatorics, algebra, and incidence geometry. Planned out and complied notes to create a new course about the math of data analysis.

## TEACHING EXPERIENCES

**North Carolina State University** Summer 2020-Present

- Instructor of Record for MA 111 Pre-Calculus, MA 141 Calculus 1, MA 241 Calculus 2, MA 103 Intro to Contemporary Math. Wrote and gave lectures, held office hours, wrote tests.
- For MA 103, chose what topics were taught which were were Voting Theory, Graph theory, Fair division, and Cryptography.

## OUTREACH

**North Carolina Governor's Honors School Instructor** Summer 2023-Summer 2024

- 4 week summer program for gifted high schoolers from across the state
- Designed and gave my own course on graph theory and combinatorics. Gave an introductory exposure to proofs as well Advised multiple groups on their final cornerstone math research projects.

**Mathapalooza Exhibit** Fall 2018-Spring 2019

- Event at Atlanta Science Festival 2019
- Advisor: Dr. Evans Harrell
- Designed a new exhibit for the Atlanta Science Festival. Mathapalooza was an immersive public event with math puzzles, stage shows and art installations aimed to foster math appreciation in Atlanta students.

**Seven Bridges of Königsberg Show** Fall 2018

- Math in Motion Exhibition
- Advisor: Dr. Evans Harrell
- Created and presented interactive exhibits explaining foundational concepts in graph theory. These demonstrations accompanied original composition and dance performances at public venues around Atlanta.