

Personal statement

I am deeply interested in computational biology research after having developed a research passion for mathematical modeling and statistical analyses of large, complex datasets, particularly in the biological domain. In undergrad, my research obtained new results about verbal problem-solving from the large and unprocessed eye-tracking data of an original experiment. At NASA, I deployed statistical machine learning models to reveal algorithmic bio-signatures, which could inform the instrumentation protocols of life-detection missions. The team has expanded so that I am now working with my NASA mentor and an outside postdoc towards publication. Furthermore, I have completed numerous smaller projects, with the broad theme of applying a novel approach or answering an original question with mathematical modeling or programming. This includes a Markov chain model of polygenic inheritance, which enables novel intergenerational-movement calculations that have real-world implications. In my Master's at Oxford, I am deepening my skills in statistical, machine learning, and other computational methodologies, which I believe will be integral parts of my dissertation and doctorate research thereafter.

Education

- Oct 2020 - Sep 2021 **Master of Science in Statistical Science**, *University of Oxford*, United Kingdom.
Coursework: Stochastic Models in Mathematical Genetics, Computational Statistics, Statistical Machine Learning, Bayes Methods, Applied Statistics, Foundations of Statistical Inference, Statistical Programming (*in R*), Advanced Simulation Methods, Advanced Topics in Statistical Machine Learning. | Dissertation with an academic supervisor (three months) | Christ Church college placement. | Current departmental supervisor is François Caron.
- 2016 - 20 **Bachelor in Physics**, *Drew University*, Madison, New Jersey.
Summa Cum Laude - GPA 4.000/4.000 | Minor in Mathematics | Additional coursework: Statistics, Simulation and Modeling, Molecular and Cellular Biology, Biochemistry, Organic Chemistry I & II, Biological Psychology. | GRE - Jan 2020 - 169/170 Quantitative, 165/170 Verbal, 5/6 Analytical Writing.
- 2015 - 16 **Cello Program**, *The Juilliard School*, New York, New York.
Studied cello for a year at a competitive music program before transitioning career paths. | Example coursework: Music Theory, Advanced Ear Training, Music History, Piano, Ethics, and Chamber Music. | SAT - 770/800 Math, 750/800 Critical Reading, 800/800 Writing.

Research Experience

- Jun 2020 - **Astrobiology Statistics Research**, *NASA Ames Research Center - Biospheric Science Branch*, Mountain View, California, Diana Gentry.
Project: Statistical Classification of Biosignature Information. | Implemented machine learning classification algorithms of element composition and isotope fractionation data. | Demonstrated how combinations of chemical biosignatures can make accurate classifications and uniquely inform the instrumentation protocols of life-detection missions. | Expanding project to include spectral data, working with postdoc Sunanda Sharma. | Tools used: (In Python) Principal Component Analysis, K-Nearest Neighbors, Logistic regression, Linear Support Vector Machines, Gaussian Naïve Bayes, k-Means Clustering. | Presented research poster to NASA Ames and to the New Jersey Space Grant Consortium.
- May 2019 - Jun 2020 **Eye-Tracking Research**, *Drew University*, Minjoon Kouh.
Project: Gaze sequences reveal how people gradually arrive at a solution to a word puzzle (anagram) | Designed and ran an original eye-tracking experiment of 30 participants. | Formed and led a small research team of undergraduate students and high school volunteers. | Structured and analyzed the raw eye-tracking coordinate-time-series data (90 million rows). | Obtained new results about how the beginnings and ends of solution words are significantly more informative than their middles. | Spring 2020 phase II experiments unfortunately still postponed due to the pandemic, delaying publication efforts.
- Dec 2019 - **Independent Statistics Research**.
Project: Polygenic Markov Chain | Created a Markov chain model based on a normally distributed population reproducing under a linear regression model, analogized to polygenic inheritance. | Validity of model checked with data on the heights of parents and their adult children. | The models enables novel transition kernels to be calculated numerically, which correspond highly to those of height data as well as - surprisingly - family income data ($R^2 = 0.96$).
- Summer 2017 **Atmospheric Chemistry Research**, *Drew University*, Ryan Hinrichs.
Adsorption rates of Pinene onto dust and sand samples under varying temperatures and relative humidities. | Skills and technologies used: Infrared spectroscopy, Gaussian, IGOR Pro.

- 2017 - **Independent Research Projects**, *Available to view on jessemurray.com*.
Completed about a half-dozen small research projects that apply computational simulation, data analysis, and mathematical modeling to real world situations. | Some examples are Machine Learning to Predict COVID-19 Cases from US Census Data, Simulating the Growth of US Landfills, Proposed Musical Tuning Algorithm, etc.

Conferences

- Dec 2020 **Algorithmic detection of elemental biosignatures**, *American Geophysical Union Fall Meeting*.
Accepted for research poster presentation at the Planetary Sciences session: *Getting the Most Out of Data in Astrobiology: Overcoming the Too Little, Too Rare, and Too Different*.
- Mar 2020 **Gaze sequences reveal how people gradually arrive at a solution to a word puzzle (anagram)**, *Brain and Behavior Conference - University of Scranton*.
Presented research poster.

Skills

- Computational Expertise: Python (NumPy, Scikit-learn, Pandas, SciPy, Matplotlib, Seaborn), R, Excel | Fluency: Git/GitHub, MATLAB, Octave, C | Some experience: Mathematica, Java, Julia, HTML, and SQL.
- Mathematical Statistics, Probability, Machine Learning Algorithms, Linear Algebra, Multivariable Calculus, Differential Equations, Mathematical Physics, Electrodynamics, Classical Mechanics.
- Presentation L^AT_EX, Jupyter Notebook, Markdown, Powerpoint, Microsoft Word
- Musical Cello, Piano, Music Theory, Improvisation, Absolute Pitch.

Teaching Experience

- 2017 - 20 **University Tutor**, *Center for Academic Excellence*, Drew University.
Physics I & II, Calculus I, II, & III, Pre-Calculus, Statistics, Astronomy, Biology, Chemistry, Organic Chemistry | Led 'Quant Camp' - a drop-in session for quantitative skills in which I explained problems to groups of students.
- Jul 2020 **Research and Teaching Assistant**, *New Jersey Governor's School in the Sciences*.
Project: Implementing machine learning with iRobot hardware for human detection. | Graded and answered students' questions about Special Relativity problem sets. | Made a time-travel simulator spreadsheet, which calculated and put into real-life terms the energy requirements and length contraction under special relativity.

Additional and volunteer experience

- 2019 **President**, *Math Club*, Drew University.
Completely redesigned the club. | Put up posters of beautiful and real-life math problems, began weekly meetings to discuss and solve them. | Began presentations of original projects and research. | Created a talk series in which quantitative professors gave fun and informative lectures. | Changed electoral process to use Condorcet method of ranked choice voting.
- 2019 - **Science contributor**, *Wikipedia*.
Hundreds of contributions to mathematics and science-related articles. | Improving the clarity of the writing, and drawing connections between related topics. | After contributions were noticed, I was interviewed for an article in *Mashable* on the scientific communication of climate change, releasing in November 2020.
- Fall 2018 **Volunteer**, *Morristown Medical Center, Emergency Department*.
Assisted medical staff with patient intake and evaluation.

Awards, Scholarships, and Societies

- Awards Marshall C. Harrington Prize in Physics and Astronomy (for completion of an outstanding research project) - Spring 2020 | Arnold S. Boxer Memorial Prize in Physics - Spring 2019 | John F. Ollom Prize in Physics - Spring 2017
- Scholarships Weddell Family Scholarship - Spring 2018 | Dean's Transfer Scholarship - Fall 2016
- Societies Pi Mu Epsilon - Spring 2020 | Sigma Pi Sigma - Spring 2019 | Phi Beta Kappa - Spring 2018