

# Jesse Murray

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## Personal statement

I am interested in pursuing computational biology research. I have developed a strong research passion for mathematical modeling and statistical analyses of large, complex datasets, particularly relating to biology. In my undergraduate research project, I obtained new results about verbal problem-solving from the large and unprocessed eye-tracking data of an original experiment that I designed and oversaw. In my summer research, I deployed statistical machine learning models to reveal algorithmic bio-signatures to inform the instrumentation protocols of life-detection missions. I am highly motivated, as evidenced by my informal research projects, which generally apply a novel approach or seek to answer a real-world question with mathematical modeling and programming. In my Master's, I am deepening my statistics, machine learning, and computational skills, which I believe will be integral to my Doctorate research thereafter.

## Education

- Oct. 2020 - Sept. 2021 **Master of Science in Statistical Science**, *University of Oxford*, United Kingdom.  
Coursework: Statistical Machine Learning, Bayes Methods, Foundations of Statistical Inference, Applied Statistics (*linear & generalized linear models*), Computational Statistics, Statistical Programming, Stochastic Models in Mathematical Genetics, Advanced Topics in Statistical Machine Learning. | Dissertation on Bayesian proteomics co-supervised by [Oliver Crook](#) and [Charlotte Deane](#). | Departmental supervisor is [François Caron](#). | Distinction on all submitted work to-date, perfect score on the collection exam.
- 2016 - 20 **Bachelor of Science in Physics**, *Drew University*, Madison, New Jersey.  
Summa Cum Laude - GPA 4.000/4.000 | Minor in Mathematics | Additional coursework: Statistics, Modeling and Simulation, 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.  
Went to college at a competitive music conservatory before changing career paths.

## Research Experience

- June 2020 - **Astrobiology Statistics Research**, *NASA Ames Research Center - Biospheric Science Branch*, Mountain View, California, [Diana Gentry](#).  
Project: Statistical Classification of Biosignature Information. | Current outcome: First author of a conference poster. | Investigating how multiple life-detection measurements can be algorithmically combined into a robust biogenic or abiogenic classification of a sample. | Modeling element composition, isotope fractionation, and spectral data with statistical machine learning classification algorithms. | Discovered that combinations of chemical biosignatures can make accurate classifications and potentially improve the instrumentation protocols of life-detection missions. | Expanding the project to include spectral data through collaboration with postdoc [Sunanda Sharma](#). | Continuing the research from a paid full-time summer internship.
- Dec. 2019 - **Independent Statistics Research**.  
Project: Normal linear Markov model with applications to polygenic inheritance. | Current outcome: First author of a conference paper. | Extending the normal linear model into a Markov process with a normally distributed initial state. | Important properties of the model are derived: the conditional distribution of any ancestor or descendant's score, exponential functions for the convergence to the population distribution, a reversible stationary distribution. | Introduction of a novel measure of mobility and information loss, visualizations through probability kernels that make predictions over any number of generations. | Verified against two separate datasets of human height.
- May 2019 - June 2020 **Eye-Tracking Research**, *Drew University*, Minjoon Kouh.  
Project: Gaze sequences reveal how people gradually arrive at a solution to a word puzzle (anagram) | Current outcome: First author of a conference poster. | Designed and ran an original eye-tracking experiment of 29 participants. | Formed and led a small research team of undergraduate students and high school volunteers. | Structured and analyzed 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. | All 2020 phase II experiments (spring and fall) unfortunately had to be cancelled due to the pandemic, delaying publication efforts.
- 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**, *Displayed on [jessebmurray.github.io](https://jessebmurray.github.io)*.  
Completed about a half-dozen small research projects that apply computational simulation, data analysis, or mathematical modeling to real-world situations. | Some examples include: Machine Learning to predict COVID-19 cases within counties from US census data, Modeling the growth of non-decomposed waste in US landfills, Exploring a proposed musical tuning algorithm.

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## Conferences

- July 2021 **Normal linear Markov model with applications to polygenic inheritance**, *Statistics 2021 Canada, 6th Canadian Conference in Applied Statistics*, Paper publication, First author.  
Contributed Paper Session 1. | Meeting of the Institute of Mathematical Statistics | Currently under review for selection to be published in the Springer Conference Proceedings.
- Dec. 2020 **Algorithmic detection of elemental biosignatures**, *American Geophysical Union Fall Meeting*, Poster publication, First author.  
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*, Poster publication, First author.  
Undergraduate neuroscience conference.

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## Skills

- Computational Expertise: Python (Scikit-learn, NumPy, SciPy, Pandas, Matplotlib, Seaborn, some exp. with PyTorch), R, Excel. | Fluency: Git, Linux, MATLAB, Octave. | Some experience: Mathematica, C, C++, Java, Julia.
- Mathematical Statistics, Probability, Statistical Machine Learning, Linear Algebra, Calculus, Differential Equations.
- Presentation  $\text{\LaTeX}$ , Jupyter Notebook, Markdown, HTML, Powerpoint, Microsoft Word.
- Musical Cello, Piano, Music Theory, Improvisation, Absolute Pitch.

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## 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 | 5 - 6 hours per week. | Leader of *Quant Camp*, a program for students to show up and receive help on any quantitative problems across the range of coursework.
- July 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 tutored students in *Special Relativity*. | Full-time paid position. | Made a time-travel simulator spreadsheet, which calculated effects of special relativity and put them into real-life terms.

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## Additional and volunteer experience

- Oct. 2020 - **Graduate Common Room Committee Member**, *University of Oxford*, Christ Church college.  
Elected photographer & social media officer in Michaelmas term. | Created and ran a LinkedIn group for graduate students and alumni.
- 2019 **President**, *Math Club*, Drew University.  
Revamped the undergraduate club. | Promoted the club with posters of beautiful and real-world math puzzles. | Initiated weekly meetings to solve the problems and present projects. | Launched a professor-talk-series for quantitative professors to give unique academic talks, around 25+ attendance.
- Jan. 2019 - **Science contributor**, *Wikipedia*.  
Made hundreds of contributions to mathematics and science-related articles. | Received a Wikipedia award for contributions to pages around *Industrial processes*. | Interviewed and featured in the Mashable article: "The guardians of Wikipedia's climate page".
- Fall 2018 **Volunteer internship**, *Morristown Medical Center, Emergency Department*.  
Assisted medical staff with patient intake and evaluation. | Total of 50 hours over the semester.

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## Awards, Scholarships, and Societies

- Awards Marshall C. Harrington Prize in Physics and Astronomy (for 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