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. The team has expanded so that I am now working with my NASA mentor and an outside postdoc towards a publication. 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 - 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 *(linear & generalized linear models)*, Foundations of Statistical Inference, Statistical Programming *(in R)*, Advanced Topics in Statistical Machine Learning. | Dissertation on Bayesian proteomics co-supervised by Oliver Crook and Charlotte Deane. | Departmental supervisor is François Caron.

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

Jun 2020 - **Astrobiology Statistics Research**, *NASA Ames Research Center - Biospheric Science Branch*, Mountain View, California, Diana Gentry.
Project: Statistical Classification of Biosignature Information. | Investigating how multiple life-detection measurements can be algorithmically combined into a robust biogenic or abiogenic classification of a sample. | Modeling element composition and isotope fractionation data with statistical machine learning classification algorithms. | Found 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. | Methods used: (in Python) Principal Component Analysis, K-Nearest Neighbors, Logistic regression, Linear Support Vector Machines, Gaussian Naïve Bayes.

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 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.

Dec 2019 - **Independent Statistics Research**.
Project: Normal linear Markov process with applications to polygenic inheritance. | 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. | Developed a written manuscript - aiming for a conference proceeding.

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 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.

Conferences

Dec 2020 **Algorithmic detection of elemental biosignatures**, *American Geophysical Union Fall Meeting*.
Presented a research poster 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 a research poster.

Skills

Computational Expertise: Python (incl. NumPy, SciPy, Scikit-learn, Pandas, Matplotlib, Seaborn), R (incl. tidyverse), Excel. | Fluency: Git, Linux, MATLAB, Octave. | Some experience: Mathematica, C, C++, Java, Julia.

Mathematical Statistics, Probability, Statistical Machine Learning, Linear Algebra, Calculus, Differential Equations.

Scientific Molecular and Cellular Biology, Genetics, Spectroscopy, Biochemistry, Organic Chemistry, Mathematical Physics, Mechanics, Optics, Electronics, Electricity and Magnetism.

Presentation LaTeX, Jupyter Notebook, Markdown, HTML, 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 | 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.

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 problem sets for *Special Relativity*. | Full-time paid position. | 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

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. | Won a photography competition (£60) for capturing how the pandemic has affected life at the college.

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.

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