Jesse Murray

✉ jesse.murray@stats.ox.ac.uk
jessemurray.com

Personal statement

I am deeply interested in computational biology research after having developed a strong research passion for mathematical modeling and statistical analyses of large, complex datasets, particularly in the biological domain. In undergrad, 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. 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 a publication. Furthermore, I am a highly motivated researcher who has completed numerous extracurricular projects, which generally apply a novel approach or answer an original question with mathematical modeling and programming. In my Master's at Oxford, I am deepening my skills in statistics, machine learning, and other computational methodologies, which I believe will be integral parts of my Master's 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. │ 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, 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. 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. │ Implementing machine learning classification algorithms to reveal complex biosignatures in 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. │ Continuing the research from a paid full-time summer internship. │ Expanding the project through a collaboration with postdoc Sunanda Sharma to include spectral data. │ Tools used: (in Python) Principal Component Analysis, K-Nearest Neighbors, Logistic regression, Linear Support Vector Machines, Gaussian Naïve Bayes, k-Means Clustering. │ Selected to be on the panel for an upcoming NASA astrobiology outreach event. │ Presented a 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 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. │ Spring 2020 phase II experiments unfortunately remain postponed due to the pandemic, delaying publication efforts.
Dec 2019 -	**Independent Statistics Research**. Project: Markov chain model of polygenic inheritance. │ The novel mathematical model is shown – by the analyses of a *Nature* publication and direct statistical tests of a historic dataset – to accurately describe the inheritance of human stature, with complete confirmation in the case of stable population variance. │ Important properties of the Markov chain are derived: the conditional distribution of any ancestor or descendant's score, exponential functions of convergence in expectation and variance to the population distribution, a time-reversible stationary distribution. │ A new measure of mobility and information loss is proposed and novel probability kernels are introduced that can make important predictions over any number of generations. │ 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 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 include: Machine Learning to Predict COVID-19 Cases from US Census Data, Modeling the Growth of Non-decomposed Municipal Solid Waste in 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 a research poster. |

Skills

Computational	Expertise: Python (NumPy, Scikit-learn, Pandas, SciPy, Matplotlib, Seaborn), R (tidyverse), Excel.	Fluency: Git, MATLAB, Octave, C.	Some experience: Linux, Mathematica, Java, SQL, Julia.
Mathematical	Statistics, Probability, Statistical Machine Learning, Linear Algebra, Multivariable 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. | 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. | 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

2019	**President**, *Math Club*, Drew University. Fully revamped the undegraduate club.	Hung up posters in the math and science building of beautiful, applied math problems, and initiated weekly meetings to discuss and solve the problems.	Also initiated student presentations of original projects and research.	Launched a professor-talk-series in which quantitative professors gave unique and interesting academic lectures – record breaking attendance.	Redesigned the electoral process to be the superior Condorcet method of ranked choice voting.
2019 -	**Science contributor**, *Wikipedia*. Made hundreds of contributions to mathematics and science-related articles.	Contributions are generally improvements to scientific writing, making connections between related topics, and adding important information.	After receiving a Wikipedia award for my many contributions around the topic of *Industrial processes*, I was interviewed for an article in *Mashable* on climate change, which is releasing in November 2020.
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