Philip Bretz

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Goal

I want to apply my mathematical knowledge and technical skills to real world problems. As a graduate student, my favorite projects involve multidisciplinary teams working together on complex problems. I love learning from others with different skillsets and using my own specialties to meaningfully contribute to a project's success. I will bring that mathematical experience and enthusiasm for problem solving to any place I work.

Education

Mathematics PhD, *University of Oklahoma*   08/2017 – present
I am researching failure prediction in granular media using a combination of topological methods, Bayesian statistics, and machine learning. GPA 4.0. Expected graduation May 2022.

Mathematics BS, *University of Oklahoma*   08/2013 – 05/2017
I graduated with honors with a focus in applied mathematics. I was the recipient of the National Merit Scholarship, the President's Scholarship, and the Eugene Springer Scholarship. Department GPA 4.0.

Skills

Mathematical Foundation
Statistics (esp. Bayesian), Data Analysis, Machine Learning, Probability, Topological Data Analysis

Coding Experience
R, Python, Matlab, C++

Interdisciplinary Communication
I excel at translating technical ideas into actionable items

Teamwork
I have experience managing groups and working with people outside my field

Problem Solving
I attack a problem from all angles until I achieve satisfactory results

Adaptability
When an approach is not working, I do not hesitate to try something new or gain insight from colleagues with different perspectives

Assets

SECRET Security Clearance, *Valid through 2022*

Professional Experience

Instructor, *University of Oklahoma* 2016 – present
As an instructor at the University, I have taught math classes of 20-40 students at all levels up to advanced calculus. I love communicating complex mathematical concepts to students in a way they can understand, whether they are an enthusiastic freshman or an experienced senior.

Supervisor, *University of Oklahoma* 2015 – present
I began working as a tutor in the University's math help center in 2015. Since then, the director of the math help center has entrusted me with supervising undergraduate tutors. I began supervising 5 tutors in advanced calculus and worked my way up to supervising around 20 tutors in advanced calculus, linear algebra, and differential equations.

Analysis Research Assistant, 2017
University of Oklahoma Health Sciences Center
I worked with Dr. Barbara Norton on a PCORI (Patient-Centered Outcomes Research Institute) grant project researching health issues in local communities. Through clustering analysis of survey responses, we identified the key health concerns of a group of community leaders. I conducted a literature review to find solutions which we then presented to the group.

Innovation Intern, *Commander, U.S. Pacific Fleet* 2014
I worked under Dave Yoshihara in N9WAR (Warfare Readiness Assessment). My primary project focused on implementing innovation programs and culminated in a brief for the Commander. I was granted a SECRET level security clearance, valid through 2022.

Projects (Visit My Website for More Details)

Earthquake Prediction
I am working with my advisor, Dr. Miroslav Kramar, and a team from multiple universities on predicting failure events in granular media. From simulations of shearing force applied to granular media, we have used topological data analysis to examine how the force network changes over time. I have contributed by preprocessing the data with Fourier analysis and Bayesian filtering to isolate important features and then using Bayesian changepoint detection to identify different regimes and machine learning to predict the time to next failure. The techniques we use are not only applicable to modeling earthquakes, but for predicting failure events in any time evolving network.

Game Theoretic Risk Analysis
Using Bayesian techniques, I analyzed risk associated with the Kelly Criterion strategy in a simple betting game. I found optimal risk-mitigation strategies in cases where the underlying parameters of the game are unknown, and possibly even time varying.

Modeling Crowd Movement
After teaching myself Matlab, I constructed a finite element method numerical solver which I applied to variations on convection-diffusion equations, with the ultimate goal of modeling crowd movement on irregular regions.

Prime Analysis, *Published*
A colleague and I conducted a rigorous analysis and proof for bounds on the prime-counting function. We published the results in the Ball State Undergraduate Mathematics Research journal and presented at the Joint Math Meetings 2015.

Interests

Halite AI Contest
Halite is a coding contest by Two Sigma where each contestant writes an artificial intelligence bot that competes in a simple game. I have been working on a bot that uses machine learning to assess rudimentary strategies.

Woodworking
I enjoy the mixture of creativity and precision required by woodworking. As with any project, the outcome is a result of careful planning, but also the ability to react to changes and mistakes as they come.