HAORAN YAN

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SUMMARY

I am a highly motivated student pursuing double majors in Applied Mathematics and Statistics, and Data Science. My research interests lie at the intersection of statistics and mathematics, where I focus on traditional statistical methods and neural networks in image processing, dynamic learning problems, and optimization methods in finance.

EDUCATION

University of California, Santa Barbara *Fall 2020 - Spring 2024*
B.S. in Applied Mathematics
B.S. in Statistics and Data Science
Overall GPA: 3.95

RESEARCH AND PROJECTS

Multiple Stopping Investment Decision Optimization in Bond Ladder Portfolios Mar 2024 - present
Supervised by Prof. Gareth W. Peters *UCSB, Department of Statistics*

- Developed a closed-form approximation within the Loss Distribution Approach framework for multiple stopping events, facilitating the computation of dynamic search tables for optimal investment decisions.
- Applied the Nelson-Siegel model to approximate the yield curve, employing Maximum Likelihood Estimation for realizations. Constructed a Shiny app to visualize and interact with the dynamic bond ladder portfolio decision-making.
- Conducted a series expansion for the density of the stopped portfolio process using truncated lognormal and Gamma distributions, approximated convolutions by Laguerre polynomials.

Physics-Based Machine Learning Methods for Data-Driven Controllers for Systems with Nonlinear Dynamics from Video Observations Sept 2023 - present
Supervised by Prof. Paul J. Atzberger *UCSB, Department of Mathematics, Department of Mechanical Engineering*

- Simulated dynamic pendulum behavior using Gaussian kernels/blobs and applied Diffusion Maps to effectively capture and analyze the system's underlying dynamics through latent space representations.
- Enhanced the similarity index by incorporating random Fourier features, which improved the accuracy of image pair similarity measurements and refined the quality of latent embeddings.
- Developed and tested a Multi-Layer Perceptron (MLP) model integrated with a custom loss function and the Velocity Verlet integration scheme, leading to more precise predictions of optimal force applications in the system.

Integration of Gaussian Processes in Cell Image Segmentation Mar 2023 - present
Supervised by Prof. Mengyang Gu *UCSB, Department of Statistics*

- Developed and Applied a fast and robust Gaussian Processes method for cell image smoothing.
- Modified the Laplacian of Gaussian (LoG) method by integrating it with Gaussian Processes to find cell centers and retrieve refined cell masks, with all functions custom-written in R.
- Conducted an extensive literature review on fast GP techniques, conventional computer vision methods, and advanced machine learning models to guide the development and evaluation of segmentation strategies.

Deep Learning Approaches for Crystallography Diffraction Pattern Analysis Jan 2024 - Jun 2024
Supervised by Dr. Derek Mendez *Stanford, SLAC National Accelerator Laboratory*

- Trained a deep residual network on GPU clusters to predict beam centers and tilt degrees with diffraction images.
- Experimented with various models, including CNN, U-Net, ResNet and Vision Transformers, to benchmark and enhance prediction accuracy.

- Conducted comprehensive evaluations and optimization of model architectures, leading to enhanced accuracy in predicting experimental beam centers and tilt degrees. The outcomes were documented in a detailed report and showcased in a poster presentation, underscoring the advancements made in crystallography diffraction pattern analysis.

Portfolio Optimization and Analysis in the Fixed Income Market Sept 2023 - Mar 2024
Supervised by Prof. Gareth W. Peters *UCSB, Department of Statistics*

- Calculated optimal asset allocations by constructing portfolios based on the global minimum variance and maximum Sharpe Ratio methodologies.
- Applied bootstrapping techniques and the Nelson-Siegel model to forecast yield curves, which were then used to implement and analyze homogeneous bond laddering strategies.
- Produced a comprehensive analytical report evaluating the performance, risk, and return of various investment strategies over a simulated investment horizon.

Bayesian Modeling of Prosodic Profiles Sept 2022 - Jun 2024
Supervised by Prof. John Du Bois and Ph.D. candidate Ryan Ka Yau Lai *UCSB, Department of Linguistics*

- Developed Bayesian models using generalized Poisson and truncated distributions, implementing Markov Chain Monte Carlo (MCMC) techniques to estimate parameters for predicting the unit length and positional attributes of intonation units in American English.
- Co-authored a short paper: Lai, R. K.-Y., Liu, L., **Yan, H.**, and DuBois J. W. (2023). From position to function: Exploring word distributions within intonation units in American English conversation. Proceedings of the 27th Workshop on the Semantics and Pragmatics of Dialogue (SEMDIAL 2023 – Marilogue).

Literature Review in Topology Apr 2022 - Sept 2022
Supervised by Dr. Genuho Lim *UCSB, Department of Mathematics*

- Conducted a comprehensive literature review on the Borsuk-Ulam Theorem, summarizing key proofs and exploring its applications in graph theory, which were compiled into a detailed review paper: https://arxiv.org/abs/2405.05273

WORK EXPERIENCE

Research Assistant Aug 2024 - Oct 2024
University of California, Santa Barbara *Mathematics Department (NSF Funded)*

- Continued research on nonlinear dynamic learning, with a focus on developing models to analyze complex systems.

Research Assistant June 2023 - Sept 2023
University of California, Santa Barbara *Computational Uncertainty Quantification Lab (Funded)*

- Applied gradient-tracking methods to reconstruct cell masks for segmentation in R, leveraging U-Net architectures.
- Conducted a comprehensive review of neural network approaches and particle-linking algorithms to identify potential enhancements for segmentation techniques.

Grader Oct 2022 - Mar 2023
University of California, Santa Barbara *Mathematics Department*

- Created detailed grading rubrics for a mathematical proof course, ensuring consistency and fairness in evaluation, and provided comprehensive feedback to enhance students' understanding of proof techniques.

Data Operational Analyst Intern July 2021 - Nov 2021
Bytedance, Beijing *Overseas Math Education Department*

- Conducted A/B testing to analyze user behavior for an overseas education app, deriving actionable insights that informed strategic decisions for product development and user engagement.
- Collected and managed large datasets using SQL, automating data pipelines to ensure accurate and efficient data retrieval for daily operations within the app.

- Developed and maintained a versatile data management platform, providing daily statistical visualizations and reports to support cross-functional teams in monitoring KPIs and optimizing the app's performance in international markets.

PRESENTATIONS

UCSB Statistics and Data Science Capstone Presentation Jun 2024
University of California, Santa Barbara *Statistics Department*

- Predicting the Geometry of X-Ray Crystallography Diffraction Images Using Computer Vision.

UCSB Acturial Science Capstone Presentation Apr 2024
University of California, Santa Barbara *Statistics Department*

- FICC ETF and Bond Portfolio Optimization.

SKILLS

Technical Skills:
Python, R, RStan, SQL, MATLAB, Excel

Mathematics and Statistics:
Advanced Linear Algebra, Ordinary/Partial Differential Equations, Real Analysis, Complex Analysis, Topology, Numerical Analysis, Stochastic Processes, Optimization, Time Series

Languages:
Mandarin, English