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March 14, 2026

Dear Application Committee,

I, Daniele Bracale, am writing to apply for the job position *Postdoc Researcher* at Stanford Computer Science. I am currently a fifth-year Ph.D. student in the Department of Statistics, University of Michigan. I am expecting to graduate in Winter 2026. I am happy to apply for this position, as it is an ideal match for my goals.

I have devoted the majority of my Ph.D. studies to tackling problems that lie at the crossroads of statistical theory and contemporary machine learning, such as Reinforcement Learning. I have been fortunate to be advised by Prof. Moulinath Banerjee and Prof. Yuekai Sun, whose skillful guidance has helped me learn the importance of core ideas from statistics and develop a keen sense for their applications.

One of my primary research areas is **dynamic pricing**, where I have developed statistically principled models and algorithms to address a range of problems in online decision making, finance, and operations research. Through these efforts, I discovered a rich intersection between dynamic pricing and **shape-constrained statistics**, which forms a conceptual bridge between the worlds of online optimization and nonparametric statistics. In particular, I have identified the role of s-concave demand functions in dynamic pricing as a unifying framework that includes the well-studied log-concavity literature (log-concavity is s-concavity with $s = 0$). This perspective powered my theoretical understanding and yielded practical insights into the predictive power and limitations of modern dynamic pricing algorithms. Two works related to this area have appeared in the prestigious Journal of Transactions on Machine Learning Research and the International Conference on Learning Representations, and one additional work is currently under review at the International Conference on Machine Learning, which is a top-tier conference for machine learning research.

Beyond dynamic pricing, I have been deeply engaged in the study of **performative prediction**. In today's world, data often arises from distributions influenced by prior model deployments, creating a feedback loop between learning and decision making. This dependence challenges the classical i.i.d. assumption, complicating inference and raising fundamental questions about stability and generalization under distribution shift. In addressing these issues, I have drawn on insights from **optimal transport** theory, which provides a powerful lens for analyzing the

efficacy of standard estimation tools in transfer learning by revealing both their potential and their limitations. Two works in this direction have been published in the International Conference on Artificial Intelligence and Statistics.

Beyond applications in machine learning, I have also pursued the **theoretical foundations of neural networks**. In particular, my work has characterized the limiting distributions of functional neural networks as the number of neurons grows to infinity, providing a rigorous understanding of how these models behave in high-capacity regimes. I have also derived continuity and smoothness guarantees that link the choice of activation functions to the regularity properties of the induced function spaces. These works have been published in prestigious venues: Neural Information Processing Systems and the International Conference on Learning Representations.

In 2024 I had the opportunity to have an internship at **Johnson & Johnson**, Biosense Webster MedTech. I have collaborated with statisticians and data engineers to explore statistical and data science applications in clinical and nonclinical medical device settings. My primary project involved developing a **statistical model to generate Prediction Intervals for recommending clinical devices** to medical professionals. This model was rigorously developed with theoretical proofs ensuring statistical guarantees, such as convergence and probability coverage. These theoretical results were further validated through simulation studies. We proposed a methodology and applied it to a real dataset provided by J&J. Our work has been accepted at the MedTech Data Science Showcase 2024 conference as a poster presentation.

Given my solid background in theoretical statistics, probability theory, machine learning, reinforcement learning, optimal transport, and applications of these methodologies in clinical and nonclinical medical device settings, I believe I would be an appropriate addition to your esteemed university in Stanford Computer Science. I have attached all the required documentation, and I am happy to provide any additional documents if needed.

Sincerely,

Daniele Bracale