



THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON STATISTICS

**Agentic AI: Mathematical Framework, Statistical Theory,
Optimization Algorithms, and Applications**

By

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Abstract

Multi-agent systems represent a critical technical pathway for advancing artificial intelligence from content generation to autonomous task execution. However, the absence of rigorous mathematical foundations severely limits the interpretability, optimality, and trustworthiness of such systems. This talk systematically addresses the theoretical foundations and practical applications of multi-agent learning. First, we establish a formal mathematical framework for multi-agent learning, providing axiomatic definitions of state spaces, action spaces, policy mappings, and value functions. Second, we develop the statistical theory of multi-agent learning under the nonlinear expectation framework, including the strategic law of large numbers and the strategic central limit theorem, which provide rigorous probabilistic characterizations of asymptotic policy optimality. Third, we derive the Bellman optimality equation in multi-agent settings and construct the core algorithmic framework of policy iteration and value iteration. Furthermore, we demonstrate the application of these theoretical results to mathematical optimization and statistical inference problems. Finally, we present practical deployments in domestic chip reliability detection and ride-hailing dispatch test. This talk aims to provide a complete theoretical chain from mathematical framework to engineering application for multi-agent artificial intelligence.

bio: Xiaodong Yan is a Professor and Doctoral Supervisor at Xi'an Jiaotong University. He is a recipient of the National Young Talent Program and the university's Category-A Young Top-Notch Talent Support Plan. His research focuses on statistical learning for Agentic AI. He has been awarded the "Huawei Spark Prize" and the "DiDi Gaia Scholar" distinction. His academic work has been published in prestigious general science journals including PNAS, leading statistics and economics journals such as JRSSB, AOS, JASA, and JOE, as well as top artificial intelligence conferences including NeurIPS, ICML, and AAAI. He has authored five textbooks published by Higher Education Press and other publishers, including 《Machine Learning》, 《Foundations of Data Science Practice — Based on R》, 《Introduction to Data Science — Based on Python》, and 《Time Series Analysis for Data Science》.

Date : 15 June 2026 (Monday)

Time : 10:00a.m.

Venue : Room 2463 (near Lift 25/26)

All are welcome!