



The Hong Kong University of Science and Technology

Department of Mathematics

PhD THESIS EXAMINATION

**Online Decision Making with
Variance Information and Privacy Constraints**

By

Mr. Yuxuan HAN

ABSTRACT

The Multi-Armed Bandit (MAB) problem is a fundamental framework capturing the exploration vs. exploitation trade-off in sequential decision-making. Over the past decades, it has been rigorously studied and widely applied across diverse fields. This thesis explores algorithms for the MAB problem and its contextual version, incorporating variance information and privacy constraints. In the first part, we revisit the UCB-V algorithm, a variant of the canonical UCB that uses variance estimates. By providing an asymptotic characterization of arm-pulling rates, our results reveal a new phase transition phenomenon and instability results. Additionally, we offer non-asymptotic bounds in high-probability regimes, leading to a refined regret bound, previously unknown even for more complex variance-aware algorithms. The second part focuses on bandits with contextual information, which often represents user-specific data. This motivates the study of effective learning while maintaining privacy. We introduce local differential privacy (LDP), a stringent privacy notion, to contextual bandits. We design LDP algorithms for stochastic generalized linear bandits to achieve nearly optimal regret bounds. Experiments demonstrate the consistently superior performance of our algorithms under LDP constraints.

Date : 6 Dec 2024, Friday

Time : 10:00 am

Venue : Room 2504 (Lifts 25/26)

Thesis Examination Committee:

Chairman : Prof. Dit Yan YEUNG, CSE/HKUST

Thesis Supervisor : Prof. Yang WANG, MATH/HKUST

Thesis Supervisor : Prof. Can YANG, MATH/HKUST

Member : Prof. Jiheng ZHANG, MATH/HKUST

Member : Prof. Xinzhou GUO, MATH/HKUST

Member : Prof. Wei YOU, IEDA/HKUST

**External Examiner : Prof. Song LI, School of Mathematical Sciences /Zhejiang University
(via online mode)**

(Open to all faculty and students)

The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).