Title: Optimal Rates of (Locally) Differentially Private Heavy-tailed Multi-Armed Bandit

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Abstract:

In this paper we investigate the problem of stochastic multi-armed bandits (MAB) in the (local) differential privacy (DP/LDP) model. Unlike previous results that assume bounded/sub-Gaussian reward distributions, we focus on the setting where each arm’s reward distribution only has (1+𝑣)-th moment with some 𝑣∈(0,1]. In the first part, we study the problem in the central 𝜖-DP model. We first provide a near-optimal result by developing a private and robust Upper Confidence Bound (UCB) algorithm. Then, we improve the result via a private and robust version of the Successive Elimination (SE) algorithm. Finally, we establish the lower bound to show that the instance-dependent regret of our improved algorithm is optimal. In the second part, we study the problem in the 𝜖-LDP model. We propose an algorithm that can be seen as locally private and robust version of SE algorithm, which provably achieves (near) optimal rates for both instance-dependent and instance-independent regret. Our results reveal differences between the problem of private MAB with bounded/sub-Gaussian rewards and heavy-tailed rewards. To achieve these (near) optimal rates, we develop several new hard instances and private robust estimators as byproducts, which might be used to other related problems. Finally, experiments also support our theoretical findings and show the effectiveness of our algorithms.

Bio:

Yulian Wu is a first-year Ph.D. candidate in Computer Science at [King Abdullah University of Science and Technology (KAUST)](https://www.kaust.edu.sa/en), advised by Prof. [Di Wang](https://shao3wangdi.github.io/). She is a member of [Privacy-Awareness, Responsibility and Trustworthy (PART) Lab](https://cemse.kaust.edu.sa/part). Prior to this, she recieved her Master degree from Statistics under supervision of Prof. [Zhou Yu](https://faculty.ecnu.edu.cn/_s35/wz2/main.psp) in 2021 and Bachelor degree from Mathematics and Applied Mathematics in 2018 both at [East China Normal University](https://www.ecnu.edu.cn/).

Her research interests lie in differential privacy, multi-armed bandits, reinforcement learning and trustworthy issues in bioinformatics.

