

ACMS Statistics Seminar



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Washington University
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154 Hurley Hall
3:30 PM – 4:30 PM

Statistical Learning and Decision-Making from Preference Data

Learning from preference data plays an important role in a wide range of applications, including recommendation systems, ranking, and the evaluation of large language models. However, preference data are often collected through incomplete and heterogeneous comparisons, posing fundamental challenges for statistical estimation, uncertainty quantification, and decision-making. In this talk, I will discuss two recent works that address these challenges from complementary perspectives.

In the first part, I will introduce a spectral framework for ranking estimation and statistical inference based on general multiway comparisons. We develop a computationally efficient two-step spectral estimator that achieves the same asymptotic efficiency as the maximum likelihood estimator under suitable conditions. Building on its asymptotic distribution, we establish a unified framework for one-sample and two-sample ranking inference, accommodating heterogeneous comparison structures.

In the second part, I will discuss an active preference learning framework motivated by AI prompt routing, where the goal is to identify the best-performing language model for each prompt using limited pairwise preference feedback. We develop an adaptive sampling strategy that prioritizes informative comparisons and a robust policy-learning procedure that accounts for potential model misspecification. We establish minimax-optimal regret guarantees and demonstrate the effectiveness of the proposed approach on real-world large language model evaluation datasets.

Together, these works provide statistical foundations for learning reliable rankings and making efficient decisions from complex preference data.

The Department of Applied and Computational
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