香港中文大學理學院
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Science Faculty 60th Anniversary Distinguished Science Lecture

Ranking Inferences Based on the Top Choice of Multiway Comparisons

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This paper considers ranking inference of n items based on the observed data on the top choice among M randomly selected items at each trial. This is a useful modification of the Plackett-Luce model for M-way ranking with only the top choice observed and is an extension of the celebrated Bradley-Terry-Luce model that corresponds to M = 2. Under a uniform sampling scheme in which any M distinguished items are selected for comparisons with probability p and the selected M items are compared L times with multinomial outcomes, we establish the statistical rates of convergence for underlying n preference scores using both l2-norm and l∞-norm, with the minimum sampling complexity. In addition, we establish the asymptotic normality of the maximum likelihood estimator that allows us to construct confidence intervals for the underlying scores. Furthermore, we propose a novel inference framework for ranking items through a sophisticated maximum pairwise difference statistic whose distribution is estimated via a valid Gaussian multiplier bootstrap. The estimated distributions are then used to construct simultaneous confidence intervals for the differences in the preference scores and the ranks of individual items. They also enable us to address various inference questions on the ranks of these items. Extensive simulation studies lend further support to our theoretical results. A real data application illustrates the usefulness of the proposed methods convincingly.
(Joint work with Zhipeng Lou, Weichen Wang, and Mengxin Yu)

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