Representativeness of reconstructed rankings from Bayesian pairwise comparisons methods

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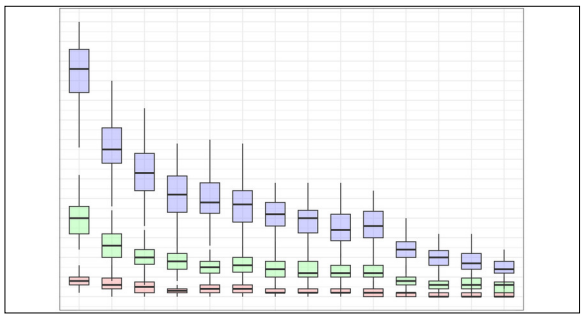
Introduction: Reconstructing rankings from pairwise comparison data is a common task in statistics and machine learning, especially in settings where absolute judgments are not available or costly to obtain. Bayesian methods provide a framework for this problem by modelling latent item utilities and explicitly quantifying uncertainty in reconstructed rankings. Although statistical properties of these models have been studied well, the degree to which such reconstructed rankings accurately reflect the representativeness remains insufficiently understood.

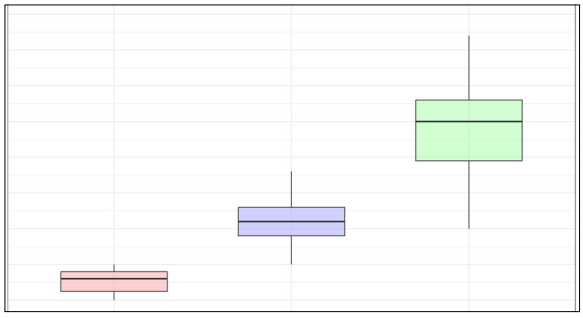
Approach: In this paper, we examine the representativeness of rankings reconstructed from Bayesian pairwise comparison models. We used controlled experimental settings with known ground-truth utility structures. We analyse to which extent reconstructed rankings preserve the true ordering of items under varying conditions, such as different utility configurations, comparison matrix constructions, and multiple-groups cases. We evaluate representativeness through rank-based similarity measures derived from the Kendall rank correlation coefficient.

Result: Our results demonstrate that representativeness is strongly influenced by the underlying utility preferences, sample size, and inequality in the comparison data. The number of pairwise comparisons has a substantial impact on preserving the true ranking, while the number of Bayesian samples is mostly insignificant. In addition, imbalanced group structures reduce the rankings' representativeness, while partial improvement can be achieved through rebalancing.

Number of swapped pairs by number of participants and different number of ideas
Own presentment



Distribution of swapped pairs of comparison matrices with non-transitive relations
Own presentment



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