# Probability and Statistics

## Bayesian Inference for Ranks

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Ranking and comparing items are very useful ways for collecting informa-tion about preferences in many areas, including marketing and politics. The Mallows rank model is among the most successful approaches to analyse rank data, but its computational complexity has limited its use to a partic-ular form based on Kendall distance. We develop computationally tractable methods for Bayesian inference in Mallows models with any right-invariant distance. Our method performs inference on the consensus ranking of the items, also when based just on incomplete rankings, such as top-k items or pairwise comparisons. We prove that items which none of the assessors has ranked, do not influence the maximum a posteriori consensus ranking, and can therefore be ignored. When assessors have unequal preferences, we propose a mixture model for clustering assessors in homogeneous subgroups, with cluster-specific consensus rankings. We develop approximate stochastic algorithms that allow a fully probabilistic analysis, leading to coherent quantifications of uncertainties. We make probabilistic predictions on the class membership of assessors based on their ranking of just some items and predict missing individual preferences, as needed in recommendation systems. We test our approach using several experimental and benchmark datasets.

This is joint work with Elja Arjas, Oystein Sorensen, Valeria Vitelli and Marta Crispino.