Rank Aggregation Using a Weighted Mallows Distance Model

Eric McCord-Snook
University of Virginia
esm7ky@virginia.edu

One way to improve the accuracy of judgments is to receive feedback from multiple experts and average the results. In this way, factors such as variance and bias in a single expert can be removed from the end result. The caveat to this is, of course, there must be a well-defined, objective way to combine the input from the experts. Rank aggregation is the problem of trying to combine several ordinal ranking judgments from different experts into a single, average ranking. In order to define an aggregate ranking, however, we must first have a notion of distance between rankings. Several such distance metrics have been proposed, perhaps none more well-known than the traditional Kemeny distance, also known as Kendall's tau. The Kemeny distance is computed simply as the number of pairwise disagreements between two rankings. In other words, each time two rankings order two items differently, 1 is added to the distance, while when the order of two items is the same, nothing is added.

Mathematically, a ranking can be viewed as a permutation of a set of n items, which, without loss of generality, can be mapped to the natural numbers $\{1,2,\ldots,n\}$. In fact, one key property of a distance metric between rankings is that it is agnostic to any renaming of the elements. This allows us to always relabel elements in the rankings lists we are comparing such that one of them is the identity, i.e. the permutation $(1, 2, \ldots, n)$.

In this paper, we present a weighted Mallows model for representing distances between rankings for rank aggregation, and give an algorithm for computing these distances. We show empirically that this model yields different results than the traditional Kemeny distance-based method of rank aggregation.