Abstract

We study the problem of constructing an order over a set of elements given noisy samples. We consider two models for generating the noisy samples; in both, the distribution of samples is induced by an unknown state of nature: a permutation ρ. In *Mallow's model*, r permutations π_i are generated independently from ρ, each with probability proportional to $e^{-\beta d_K(\rho,\pi_i)}$, where $d_K(\rho,\pi_i)$ is the Kemeny distance between ρ and π_i - the number of pairs they order differently. In the *noisy comparisons* model, we are given a tournament, generated from ρ as follows: if i is before j in ρ, then with probability $1/2+\gamma$, the edge between them is oriented from i to j. Both of these problems were studied by Braverman and Mossel [BM09]; they showed how to construct a maximum-likelihood permutation when the noise parameter (β or γ, respectively) is constant. In this work, we obtain algorithms that work in the presence of stronger noise ($\beta^2 r = \tilde{\Omega}\left(\frac{1}{\log^2 n}\right)$ or $\gamma = \tilde{\Omega}\left(\frac{1}{\log^{1/6} n}\right)$, respectively). In Mallow's model, our algorithm works for a relaxed solution concept: *likelier than nature*. That is, rather than requiring that our output maximizes the likelihood over the entire domain, we guarantee that the likelihood of our output is, w.h.p., greater than or equal to that of the true state of nature (ρ). An interesting feature of our algorithm is that it handles noise by adding more noise.