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Bounding the partition function of spin-systems

Let $\Lambda = \{\lambda_i : 1 \leq i \leq m\} \cup \{\lambda_{ij} : 1 \leq i \leq j \leq m\}$ be a system of non-negative reals. For any graph G, Λ induces a natural probability distribution on $\{f \colon V(G) \to [m]\}$ in which each such f is given weight $\prod_{v \in V(G)} \lambda_{f(v)} \prod_{u,v \in E(G)} \lambda_{f(u)f(v)}$ and is chosen with probability proportional to its weight. (This framework encompasses many familiar statistical physics spin-models such as Potts, Ising and hard-core.)

With Prasad Tetali, we considered the normalizing constant (or *partition function*) of the above-described distribution, in the case when all $\lambda_{ij} \in \{0, 1\}$, and we obtained an upper bound that is tight for the class of regular bipartite graphs. Here we use random graphs to extend this work to the case of general non-negative λ_{ij}.