Probabilistic inference in relational models

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In the propositional setting, the marginal problem is to find a (maximum-entropy) distribution that has some given marginals. We study this problem in a relational setting and make the following contributions. First, we show a duality between the resulting relational marginal problems and the maximum likelihood estimation of the parameters of relational models, which generalizes a well-known duality from the propositional setting. Second, by exploiting the relational marginal formulation, we present a statistically sound method to learn the parameters of relational models that will be applied in settings where the number of constants differs between the training and test data. Furthermore, based on a relational generalization of marginal polytopes, we characterize cases where the standard estimators based on feature's number of true groundings needs to be adjusted and we quantitatively characterize the consequences of these adjustments. Third, we prove bounds on expected errors of the estimated parameters, which allows us to lower-bound, among other things, the effective sample size of relational training data.