Copula based factorization in Bayesian multivariate infinite mixture models

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Abstract
Bayesian nonparametric models based on infinite mixtures of density kernels have been recently gaining in popularity due to their flexibility and feasibility of implementation even in complicated modeling scenarios. However, these models have been rarely applied in more than one dimension. Indeed, implementation in the multivariate case is inherently difficult due to the rapidly increasing number of parameters needed to characterize the joint dependence structure accurately. In this paper, we propose a factorization scheme of multivariate dependence structures based on the copula modeling framework, whereby each marginal dimension in the mixing parameter space is modeled separately and the marginals are then linked by a nonparametric random copula function. Specifically, we consider nonparametric univariate Gaussian mixtures for the marginals and a multivariate random Bernstein polynomial copula for the link function, under the Dirichlet process prior. We show that in a multivariate setting this scheme leads to an improvement in the precision of a density estimate relative to the commonly used multivariate Gaussian mixture. We derive weak posterior consistency of the copula-based mixing scheme for general kernel types under high-level conditions, and strong posterior consistency for the specific Bernstein?Gaussian mixture model.