

STATISTICS COLLOQUIUM

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A Class of Adaptive EM-based Importance Sampling Algorithms for Efficient and Robust Posterior and Predictive Simulation

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ABSTRACT

A class of adaptive sampling methods is introduced for efficient posterior and predictive simulation. The proposed methods are robust in the sense that they can handle target distributions that exhibit non-elliptical shapes such as multimodality and skewness. The basic method makes use of sequences of importance weighted Expectation Maximization steps in order to efficiently construct a mixture of Student- t densities that approximates accurately the target distribution – typically a posterior distribution, of which we only require a kernel – in the sense that the Kullback-Leibler divergence between target and mixture is minimized. We label this approach *Mixture of t by Importance Sampling and Expectation Maximization* (MitISEM). The constructed mixture is used as a candidate density for quick and reliable application of either Importance Sampling (IS) or the Metropolis-Hastings (MH) method. The MitISEM algorithm performs well in exploring non-elliptical shapes of posterior and predictive distributions, in estimating predictive likelihoods and forecasting Value at Risk, for several examples of statistical and econometric models. We also introduce three extensions of the basic MitISEM approach. First, we propose a method for applying MitISEM in a *sequential* manner, so that the candidate distribution for posterior simulation is cleverly updated when new data become available. Our results show that the computational effort reduces enormously, while the quality of the approximation remains almost unchanged. This sequential approach can be combined with a tempering approach, which facilitates the simulation from densities with multiple modes that are far apart. Second, we introduce a *permutation-augmented* MitISEM approach, for importance sampling from posterior distributions in mixture models without the requirement of imposing identification restrictions on the model's mixture regimes' parameters. Third, we propose a *partial* MitISEM approach, which aims at approximating the marginal and conditional posterior distributions of subsets of model parameters, rather than the joint. This division can substantially reduce the dimension of the approximation problem, which facilitates the application of adaptive importance sampling for posterior simulation in more complex models with larger numbers of parameters. Our results indicate that the proposed methods can substantially reduce the computational burden in econometric models like mixture GARCH models and a mixture instrumental variables model.