Statistica Sinica: Preprint
doi:10.5705/ss.202016.0378

The naive importance sampling estimator, based on samples from a single importance density, can be numerically unstable. Instead, we consider generalized importance sampling estimators where samples from more than one probability distribution are combined. We study this problem in the Markov chain Monte Carlo context, where independent samples are replaced with Markov chain samples. If the chains converge to their respective target distributions at a polynomial rate, then under two finite moment conditions, we show a central limit theorem holds for the generalized estimators. Further, we develop an easy to implement method to calculate valid asymptotic standard errors based on batch means. We also provide a batch means estimator for calculating asymptotically valid standard errors of Geyer's (1994) reverse logistic estimator. We illustrate the method using a Bayesian variable selection procedure in linear regression. In particular, the generalized importance sampling estimator is used to perform empirical Bayes variable selection and the batch means estimator is used to obtain standard errors in a high-dimensional setting where current methods are not applicable.