23ème Congrès de Chimiométrie, Université de Bretagne Occidentale, Brest, Juin 2022.

Uncertainty quantification for marginal computations

Jean-Michel Marin[1] Christian Robert[2] Judith Rousseau[3]
[1] University of Montpellier, jean-michel.marin@umontpellier.fr
[2] University Paris Dauphine and University of Warwick, xian@ceremade.dauphine.fr
[3] University of Oxford, judith.rousseau@stats.ox.ac.uk

Keywords: Bayesian model choice, marginal likelihood, noise-contrastive estimation, Bridge sampling, weighted likelihood bootstrap

The marginal likelihood (also called the evidence) plays a central role in Bayesian model selection. It is defined as the integral over the parameter space of the likelihood times the prior density. In this talk, we show that this integration problem can be rewritten as a classification task and how we can take benefit of that point. We consider the situation where the calculation of the likelihood is tractable.

We recall the noise-contrastive estimation method introduced by [1] and completed by [2]. The calculating of the integrated likelihood is reduced to the estimation of the intercept of a well-chosen pseudo-logistic regression model. We highlight that this strategy is equivalent the bridge sampling methodology [3] and [4] and we introduce a modified version of the weighted likelihood bootstrap approach [5] to derive measures of uncertanty on the estimation of the marginal likelihood. The weighted likelihood bootstrap approach is a well known method to approximate a posterior distribution for a parameter of interest defined via either an estimating equation or a likelihood, known to be robust to model mispecification. Our proposal is a modification of the weighted likelihood bootstrap algorithm associated to the pseudo-logistic regression model.

We show through some examples how effective our approach is in validating Bridge Sampling estimates of the marginal likelihood.

References

[1] Geyer, C. Estimating normalizing constants and reweighting mixtures in markov chain monte carlo. Technical Report 568, School of Statistics, University of Minnesota, 1994.

[2] Gutmann M. and Hyvarinen A. Noise-Contrastive Estimation of Unnormalized Statistical Models, with Applications to Natural Image Statistics. Journal of Machine Learning Research 13, 307-361, 2012.

[3] Meng, X.-L. and Schilling, S. Warp Bridge Sampling. Journal of Computational and Graphical Statistics, 11, 3, 552-586, 2002.

[4] Meng, X.-L. and Wong, W.H. Simulating ratios of normalizing constants via a simple identity: a theoretical exploration. Statistica Sinica, 6, 831-860, 1996.

[5] Newton , M. and Raftery, A. Approximate Bayesian Inference with the Weighted Likelihood Bootstrap. Journal of the Royal Statistical Society. Series B, 56, 3-48, 1994.