Stratified sampling and bootstrapping for approximate Bayesian computation

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Abstract
Approximate Bayesian computation (ABC) is computationally intensive for complex model simulators. To exploit expensive simulations, data-resampling via bootstrapping was used with success in [1] to obtain many artificial datasets at little cost and construct a synthetic likelihood. When using the same approach within ABC to produce a pseudo-marginal ABC-MCMC algorithm, the posterior variance is inflated, thus producing biased posterior inference. Here we use stratified Monte Carlo to considerably reduce the bias induced by data resampling. We also show that it is possible to obtain reliable inference using a larger than usual ABC threshold, by employing stratified Monte Carlo. Finally, we show that with stratified sampling we obtain a less variable ABC likelihood. In our paper [2] we consider simulation studies for static (Gaussian, g-and-k distribution, Ising model) and dynamic models (Lotka-Volterra). For the Lotka-Volterra case study, we compare our results against a standard pseudo-Marginal ABC and find that our approach is four times more efficient and, given limited computational budget, it explores the posterior surface more thoroughly. A comparison against state-of-art sequential Monte Carlo ABC is also reported.
[This is joint work with Richard Everitt]

References

[1] R. G. Everitt (2017). Bootstrapped synthetic likelihood. arXiv:1711.05825.

[2] U. Picchini, R.G. Everitt (2019). Stratified sampling and resampling for approximate Bayesian computation. arXiv:1905.07976.