Approximate Bayesian Computation with Deep Learning and Conformal prediction

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Abstract
Approximate Bayesian Computation (ABC) methods are commonly used to approximate posterior distributions in models with unknown or computationally intractable likelihoods. Classical ABC methods are based on nearest neighbor type algorithms and rely on the choice of so-called summary statistics, distances between datasets and a tolerance threshold. Recently, methods combining ABC with more complex machine learning algorithms have been proposed to mitigate the impact of these "user-choices".

In this talk, I will present you the first, to our knowledge, ABC method completely free of summary statistics, distance, and tolerance threshold. Moreover, in contrast with usual generalizations of the ABC method, it associates a confidence interval (having a proper frequentist marginal coverage) with the posterior mean estimation (or other moment-type estimates).

This method, named ABCD-Conformal, uses a neural network with Monte Carlo Dropout to provide an estimation of the posterior mean (or other moment type functionals), and conformal theory to obtain associated confidence sets. I will compare its performances with other ABC methods on several examples, and show you that it is efficient for estimating multidimensional parameters, while being "amortized".

Keywords: Likelihood-free inference; Approximate Bayesian computation; Convolutional neural networks; Dropout; Conformal prediction; probability matching criterion.

Reference:
M. Baragatti, B. Cloez, D. Métivier, I. Sanchez. *Approximate bayesian computation with deep learning and conformal prediction.* Preprint at ArXiv: 2406.04874, 2024.