Improving Bayesian Synthetic Likelihood via Transformations

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Abstract
Bayesian synthetic likelihood (BSL) is a complementary method to approximate Bayesian computation (ABC) for likelihood-free inference. For a wide class of models in high-dimensional settings, BSL can outperform ABC in terms of computational efficiency by making a parametric assumption (normal-like) on the model summary statistic. In this work, we improve BSL in various ways using transformations. Firstly, we improve the computational efficiency using a whitening transformation to de-correlate summary statistics. We show theoretically that the synthetic likelihood with a diagonal covariance matrix requires to increase the number of simulations only linearly with the number of statistics, as opposed to quadratically for the standard synthetic likelihood with a full covariance. Secondly, we improve the flexibility using transformation kernel density estimation for modelling the marginal distributions of the summary statistics, relaxing the normality assumptions. These transformations can be combined for simultaneously improving efficiency and flexibility.

* This work is led by Masters student Jacob Priddle, and is in collaboration with David Frazier (Monash University) and Scott Sisson (University of New South Wales).