Optimal Bayesian design for models with intractable likelihoods via supervised learning methods

Markus Hainy, Johannes Kepler University Linz

Optimal Bayesian experimental design is often computationally intensive due to the need to approximate many posterior distributions for datasets simulated from the prior predictive distribution. The issues are compounded further when the statistical models of interest do not possess tractable likelihood functions and only simulation is feasible. We employ supervised learning methods to facilitate the computation of utility values in optimal Bayesian design. This approach requires considerably fewer simulations from the candidate models than previous approaches using approximate Bayesian computation. The approach is particularly useful in the presence of models with intractable likelihoods but can also provide computational advantages when the likelihoods are manageable. We consider the two experimental goals of model discrimination and parameter estimation. The methods are applied to find optimal designs for models in epidemiology and cell biology.