# Bayesian inference for controlled branching processes through MCMC and ABC methodologies

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**Abstract**

A controlled branching process (CBP) is a generalization of the classical Bienaymé–Galton–Watson branching process, and, in the terminology of population dynamics, is used to describe the evolution of populations in which a control of the population size at each generation is needed. For this process, theoretical considerations have been tackled in several papers but few dealt with statistical issues. In this work, we deal with the problem of estimating the offspring parameters for a CBP from a Bayesian viewpoint. The sampling scheme will be that only the generation-by-generation population size is observed. It is an important task due that usually, in the nonparametric framework, the branching process theory has assumed that the entire family tree is needed to be observed in order to make inferences on the offspring distribution and its main parameters. To this end, we first consider a traditional Markov chain Monte Carlo (MCMC) method, which is the Gibbs sampler. Then, Approximate Bayesian Computation (ABC) methods are considered. During last decade, ABC methods are been developing as an alternative to such more traditional MCMC methods. These likelihood-free techniques are very well-suited to models for which the likelihood of the data are either mathematically or computationally intratable but it is easy to simulate from them, so that they are very appropriate for studying the inference of CBPs. We will compare the performance of the three methods by a simulated example.

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