Modeling animal epidemics: A penalized simulated maximum likelihood approach to estimate parametes for stochastic differential equations

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Abstract

We consider the problem of estimating parameters of stochastic differential equations (SDEs) with discrete-time observations that are either completely or partially observed. The transition density between two observations is generally unknown. We propose an importance sampling approach with an auxiliary parameter which improves approximation of the transition density. We embed the auxiliary importance sampler in a penalized maximum likelihood framework which produces more accurate and efficient parameter estimates. Simulation studies in three different models illustrate promising improvements of the new penalized simulated maximum likelihood method. The new procedure is designed for the challenging case when some state variables are unobserved and moreover, observed states are sparse over time, which commonly arises in ecological studies. We apply this new approach to two epidemics of chronic wasting disease in mule deer. This work is co-authored by Chihoon Lee and Libo Sun.