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Effective Sample Size for a Gaussian process under fixed domain

Effective sample size (ESS) indicates the number of equivalent “independent” samples in an autocorrelated sample. In the literature, there are different analytical definitions for ESS. However, they all have in common that it is a function of the covariance matrix. When the latter is obtained from a parametric covariance function that satisfies the regularity conditions established in Mardia & Marshall (1984), it has been studied that, for the definitions given by Griffith (2005) and Vallejos & Osorio (2014) under the increasing domain approach, the estimation of ESS is consistent and asymptotically Normal. In this paper, we study the properties of the ESS estimators under an asymptotic infill scheme, showing that none of the previous estimators is consistent. This last is directly related to the fact that the spatial range parameter cannot be estimated consistently under the infill asymptotic scheme. Moreover, we show that under the Matérn covariance function, the ESS is upper bounded even when the sample size tends to infinity, which explains the inconsistency in the estimation of the range parameter. Finally, this article provides an alternative definition of ESS, which is a function of the micro-ergodic parameter when considering the maximum likelihood estimation with data from a Gaussian process with an exponential covariance model under the fixed-domain asymptotic approach, and thus obtaining a consistent estimator of ESS. Simulation experiments were developed to evaluate the approximations provided by the proposed ESS and its statistical properties.