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MIXED DOMAIN ASYMPTOTICS FOR GEOSTATISTICAL PROCESSES

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Abstract: Geostatistics is one of the three main branches of spatial statistics, with the maximum likelihood method is widely used for parameter estimation. The asymptotic properties of maximum likelihood estimators are often considered under the increasing domain asymptotic framework or the infill asymptotic framework. A third framework, the mixed domain asymptotic framework, has the advantage of incorporating both local and global properties of the covariance structure. In this study, we establish the asymptotic properties of maximum likelihood estimators under the mixed domain asymptotic framework. In addition to the asymptotic framework, the sampling design and the form of the covariance functions are also important factors for the asymptotic properties of maximum likelihood estimators. Here, general conditions are imposed to ensure the consistency and asymptotic normality of these estimators. The imposed conditions are verified for some commonly used covariance functions. The resulting asymptotics provides novel insights into the convergence rates of parameter estimators under mixed domain asymptotics, as well as some useful guidelines for data analysis in practice. Simulation studies are conducted to examine the finite-sample properties of maximum likelihood estimators, and a yearly precipitation anomaly data set is analyzed for illustration.

Key words and phrases: Asymptotic framework, covariance function, sampling design, spatial dependence parameter, spatial statistics.

1. Introduction

Geostatistics is widely accepted as one of the three main branches of spatial statistics, and various models have been proposed to analyze different types of geostatistical data sets (Cressie (1993); Schabenberger and Gotway (2005); Diggle and Ribeiro (2007)). The likelihood-based approach is often used for parameter estimation in geostatistics. The theoretical properties of parameter estimators are typically studied under two asymptotic frameworks, namely, the increasing domain asymptotic framework and the infill asymptotic framework. In the former case, the spatial domain expands, while the density of the sampling locations stays constant. Under increasing domain asymptotics, the consistency

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