GAUSSIAN APPROXIMATION AND BOOTSTRAP FOR HIGH-DIMENSIONAL SPATIAL DATA

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ABSTRACT. In this paper, we establish a high-dimensional CLT for the sample mean of p-dimensional spatial data observed over irregularly spaced sampling sites in $\mathbb{R}^d$, allowing the dimension p to be much larger than the sample size n. We adopt a stochastic sampling scheme that can generate irregularly spaced sampling sites in a flexible manner and include both pure increasing domain and mixed increasing domain frameworks. To facilitate statistical inference we develop the spatially dependent wild bootstrap (SDWB) and justify its asymptotic validity in high dimensions by deriving error bounds that hold almost surely conditionally on the stochastic sampling sites. Our dependence conditions on the underlying random field cover a wide class of random fields such as Gaussian random fields and continuous autoregressive moving average random fields. Through numerical simulations and a real data analysis, we demonstrate the usefulness of our bootstrap-based inference in several applications, including joint confidence interval construction for high-dimensional spatial data and change-point detection for spatio-temporal data.

Key words: change-point analysis, irregularly spaced spatial data, high-dimensional CLT, wild bootstrap, spatio-temporal data