



Confidence bands for Horvitz-Thompson estimators using sampled noisy functional data

Hervé Cardot, David Degras, Etienne Josserand

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When collections of functional data are too large to be exhaustively observed, survey sampling techniques provide an effective way to estimate global quantities such as the population mean function. Assuming functional data are collected from a finite population according to a probabilistic sampling scheme, with the measurements being discrete in time and noisy, we propose to first smooth the sampled trajectories with local polynomials and then estimate the mean function with a Horvitz-Thompson estimator. Under mild conditions on the population size, observation times, regularity of the trajectories, sampling scheme, and smoothing bandwidth, we prove a Central Limit Theorem in the space of continuous functions. We also establish the uniform consistency of a covariance function estimator and apply the former results to build confidence bands for the mean function. The bands attain nominal coverage and are obtained through Gaussian process simulations conditional on the estimated covariance function. To select the bandwidth, we propose a cross-validation method that accounts for the sampling weights. A simulation study assesses the performance of our approach and highlights the influence of the sampling scheme and bandwidth choice.

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