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Empirical geometry of multivariate data: a deconvolution approach

Let $\{Y_j : j = 1, \ldots, n\}$ be independent observations in $\mathbf{R}^m$ with common distribution Q. Suppose that $Y_j = X_j + \xi_j, j = 1, \ldots, n$, where $X_j, \xi_j, j = 1, \ldots, n$ are independent, $X_j, j = 1, \ldots, n$ have common distribution P and $\xi_j, j = 1, \ldots, n$ have common distribution μ, so that $Q = P * \mu$. The problem is to recover hidden geometric structure of the support of P based on the independent observations Y_j, contaminated by random errors ξ_j. We suggest deconvolution methods of statistical estimation of the box-counting dimension and the hierarchical cluster tree of the support of P with exponential convergence rates. The exponential rate holds even in the case of the spherically symmetric Gaussian noise ξ_j with unknown variance of the components.