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A non parametric Berstein–Von Mises theorem

Given a probability mass function $\theta = \big(\theta(i)\big)_{i\in\mathbb{N}^*}$ on the set of positive integers, let the observations be independent and identically distributed according to θ. We consider the asymptotic behaviour of posterior distributions of $\big(\theta(i)\big)_{1\le i\le k_n}$ where k_n is an increasing sequence tending to infinity, n being the number of observations. Under suitable assumptions on the prior (smoothness and prior mass put on Fisher balls) and on the true probability θ_0, we prove a non parametric Bernstein–Von Mises theorem: the posterior distribution concentrates around the true θ_0 at speed $\sqrt{n}$ and its variation distance to the Gaussian distribution with variance the inverse of the Fisher information tends to zero in probability.

We use this result for the construction of confidence intervals for functionals of θ such as the Shanonn entropy or Renyi entropies. Indeed, Bernstein–Von Mises theorems hold for the posterior distribution of the plug-in estimator.