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Adaptive estimation in the nonparametric random coefficients binary choice model by needlet thresholding

Eric Gautier (CREST, ENSAE), Erwan Le Pennec (INRIA Saclay - Ile de France)

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In this article we consider the estimation of the joint distribution of the random coefficients and error term in the nonparametric random coefficients binary choice model. In this model from economics, each agent has to choose between two mutually exclusive alternatives based on the observation of attributes of the two alternatives and of the agents, the random coefficients account for unobserved heterogeneity of preferences. Because of the scale invariance of the model, we want to estimate the density of a random vector of Euclidean norm 1. If the regressors and coefficients are independent, the choice probability conditional on a vector of $d-1$ regressors is an integral of the joint density on half a hyper-sphere determined by the regressors. Estimation of the joint density is an ill-posed inverse problem where the operator that has to be inverted in the so-called hemispherical transform. We derive lower bounds on the minimax risk under $\xL^p$ losses and smoothness expressed in terms of Besov spaces on the sphere $\mathbb{S}^{d-1}$. We then consider a needlet thresholded estimator with data-driven thresholds and obtain adaptivity for $\xL^p$ losses and Besov ellipsoids under assumptions on the random design.

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