Sparse Sieve MLE

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Abstract

The Dantzig selector is traditionally used for point estimation by least squares when the number of parameters exceeds the number of observations. This paper uses it to obtain smaller standard errors in a sieve maximum likelihood estimation in a panel setting. We assume correctly specified likelihood-based models for each cross section and the Bernstein polynomial serves as a copula sieve capturing dependence between them. This estimator has smaller standard errors asymptotically than the conventional QMLE but, in finite samples, the number of parameters in the sieve is close to the sample size and may exceed it. At the same time, most of the sieve parameters are close to zero. We propose an estimator that uses the Dantzig selector to find the sparsest vector of the sieve parameters satisfying the first order conditions of the MLE up to a given tolerance level. We show in simulations that our estimator produces a sparse sieve MLE with finite-sample properties very similar to the non-sparse alternative, and substantially better the QMLE. Thus the sparsity imposed by the Dantzig selector is innocuous with respect to the non-asymptotic behavior of the sieve MLE; it also permits a substantial increase in computational efficiency compared to the unrestricted sieve MLE. As a theoretical motivation for the good performance of sparse SMLE, we provide an oracle inequality relating the risk of the sparse estimator with that of an infeasible estimation where an oracle tells us which coefficients are insignificant. We also study the parameter path behavior for various tolerance levels and consider a version of a double Dantzig selector which resolves the arbitrariness in choosing the tolerance level.

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