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Title: « Optimal Rates for M-Estimators with Self-Concordant Losses »

Abstract:

We demonstrate how the use of generalized self-concordance of the loss leads to statistically optimal rates for M-estimators in regression and classification settings with i.i.d. observations. We consider two classes of losses: (i) the class self-concordant losses in the proper sense, that is, with the third derivative uniformly bounded by the 3/2 power of the second [NN94]; (ii) the richer class of quasi-self-concordant losses where the power is removed. The latter class, introduced in [Bac10], includes conditional generalized linear models such as logistic and Poisson regression, and some losses suitable for robust estimation. In both cases, we derive the "sample complexity of the Cramér-Rao bound", i.e. the sample size n sufficient for the non-asymptotic version of this bound to be satisfied. This sample complexity turns out to be O(D) for the losses of the first class, where D and roughly O(dD) for the losses of the second class, where d is the dimension of the parameter, and D is the effective dimension of the parametric model which takes into account misspecification.

We then explore the implications of these results for l2-regularized estimators in Hilbert spaces and l1-regularized estimators under sparsity assumptions.