THE UNIVERSITY OF CHICAGO

Department of Statistics

BAHADUR MEMORIAL LECTURES

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Total Variation Regularization Part 2

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Stevanovich Center, MS 112, 5727 S. University Avenue

ABSTRACT

Let $Y \in \mathbb{R}^n$ be a vector of independent observations with unknown mean $f^0 := \mathbb{E}Y$. For $f \in \mathbb{R}^n$, let $\text{TV}(f) := \sum_{i=2}^n |f_i - f_{i-1}|$ or, more generally, let $\text{TV}(f)$ be total variation over a graph. It may also be a version of total variation in higher dimensions. We consider the total variation regularized estimator

$$\hat{f} := \arg \min_{f \in \mathbb{R}^n} \left\{ \|Y - f\|_2^2/n + 2\lambda \text{TV}(f) \right\},$$

where $\lambda > 0$ is a tuning parameter. We aim at showing that $\hat{f}$ adapts to the number of constant pieces of f^0. To this end, we will introduce the concept "effective sparsity" (which plays a role similar to "restricted eigenvalue") and show how it can be derived. This requires some bounds from empirical process theory. We will moreover use combinatorial arguments such as counting paths on graphs.

The results can be extended to other loss functions, for instance logistic loss when Y is a vector of binary observations. In that case we place the total variation penalty on the log-odds ratio.

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