A data-dependent weighted LASSO under Poisson noise

Rebecca Willett, University of Wisconsin-Madison

Xin Jiang

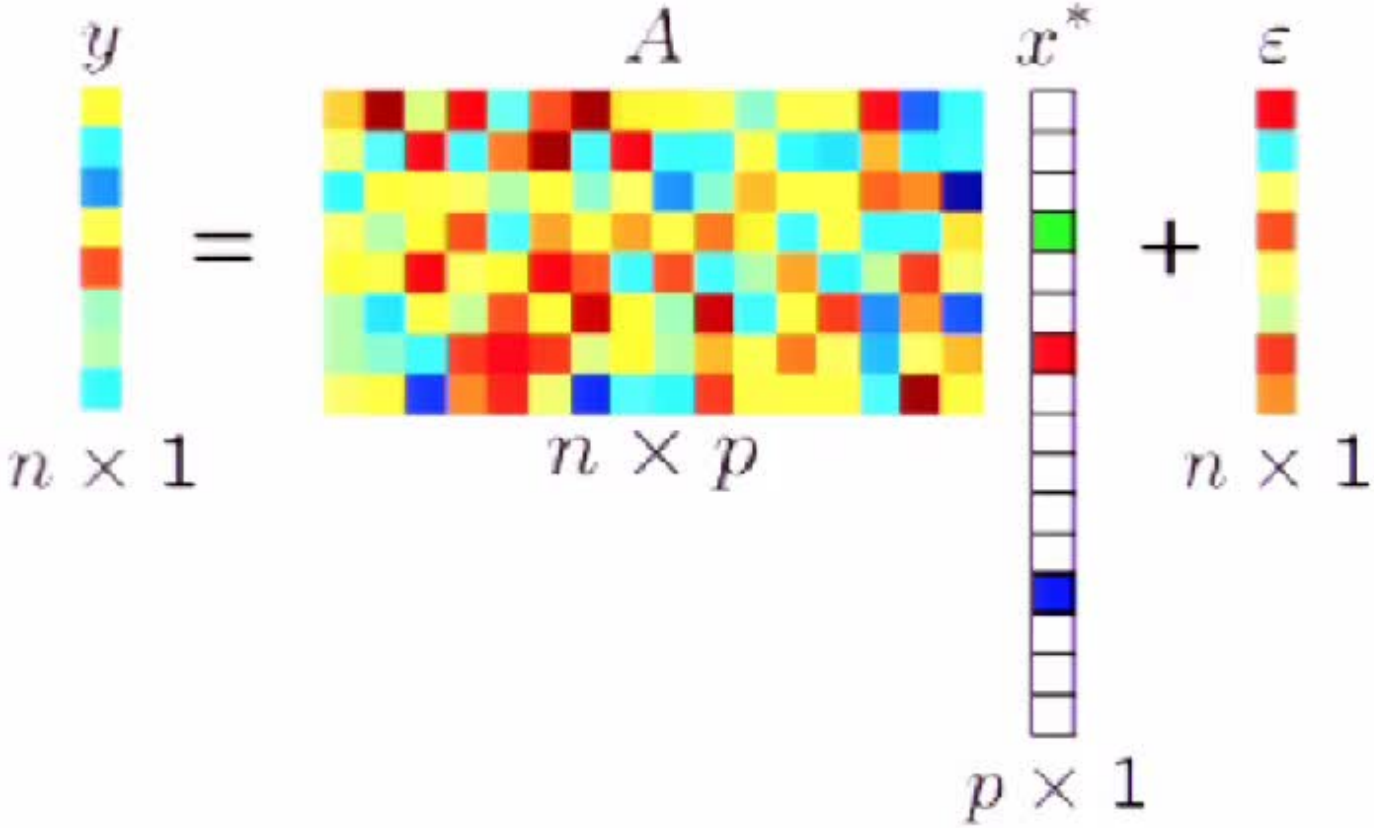
Patricia Reynaud-Bouret

Weighted LASSO

Vincent Rivoirard

Laure Sansonnet

The LASSO for sparse inverse problems



The LASSO estimator:

$$\min_x \frac{1}{2}\|y - Ax\|^2 + \gamma\|x\|_1$$

Results

- If we have tight bounds on the backprojected residuals of the form

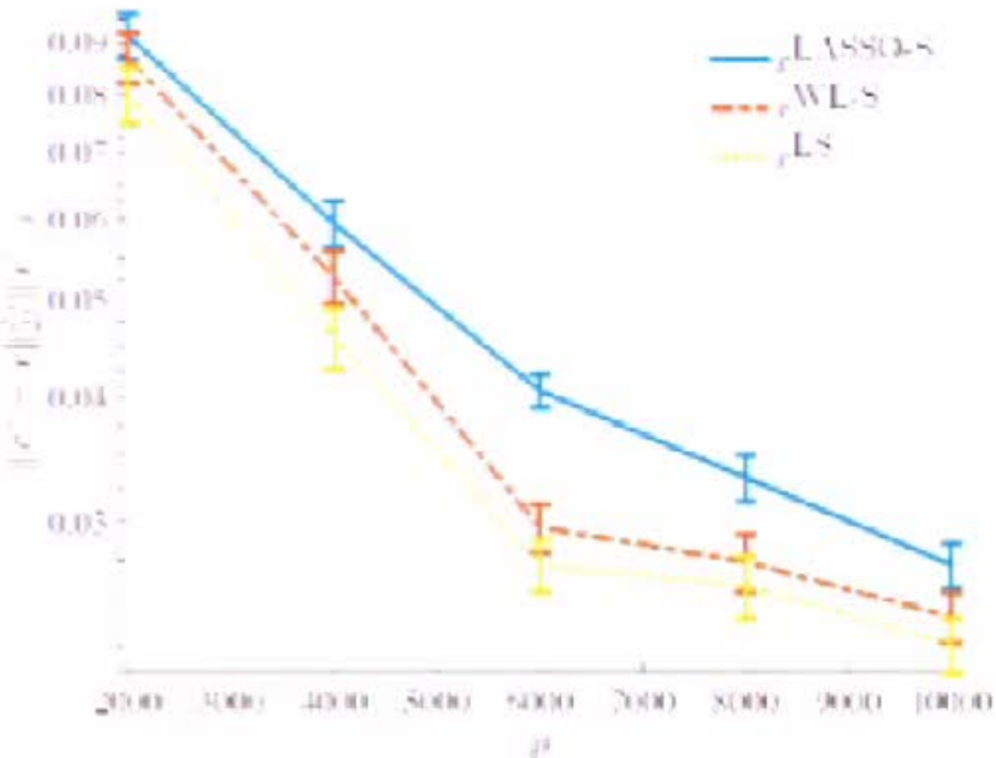
$$|\widetilde{A}^{\top}(\widetilde{y} - \widetilde{A}x^*)|_k \leq d_k,$$

then using these weights within the weighted LASSO can perform nearly as well as a support oracle.

- When there is significant variation among the d_ks, the weighted LASSO can perform significantly better than the typical unweighted LASSO.
- We have examined two example systems:
  - Bernoulli ensembles for compressive imaging: we see similar rates as in earlier minimax analyses.
  - Random convolution in genetic motif analysis: earlier analyses could not address this!

Motif rate results

	Small m	Large m
LASSO	$\frac{s\,\|x^*\|_1 \log^3 p}{m}$	$\frac{s\,\|x^*\|_1 \log^2 p}{p}$
Weighted LASSO	$\frac{\|x^*\|_1 \log p}{m}$	$\frac{s\,\|x^*\|_1 \log^2 p}{p}$



$m \propto \sqrt{p} \log p$

m is the number of parent events (blue dots)