

Colloquium

***Designing Penalty Functions for
Grouped and Hierarchical
Selection***

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Abstract:

Extracting useful information from high-dimensional data is an important focus of today's statistical research and practice. Penalized loss function minimization has been shown to be effective for this task. Quasi-norms on model parameters are frequently used as a penalty. Classical examples are AIC and BIC where the L0 quasi-norm (model dimension) is used as a penalty. More recently, penalization by the L1-norm (lasso) has enjoyed a lot of attention. L1-penalized estimates are cheaper to compute (convex optimization) and lead to more stable model estimates than their L0 counterparts.

In this talk, I will present the Composite Absolute Penalties (CAP) family of penalties. CAP penalties allow given grouping and hierarchical relationships between the predictors to be expressed. They are built by defining groups of variables and combining the properties of norm penalties at the across group and within group levels. Grouped selection occurs for non-overlapping groups. Hierarchical variable selection is reached by defining groups with particular overlapping patterns. Under easily verifiable assumptions, CAP penalties are convex: an attractive property from a computational stand-point. Within this subfamily, unbiased estimates of the degrees of freedom (df) exist so the regularization parameter is selected without cross-validation. Simulation results show that CAP improves on the predictive performance of the LASSO for cases with p much larger than n and mis-specified groupings.

This is joint work with Peng Zhao and Bin Yu.