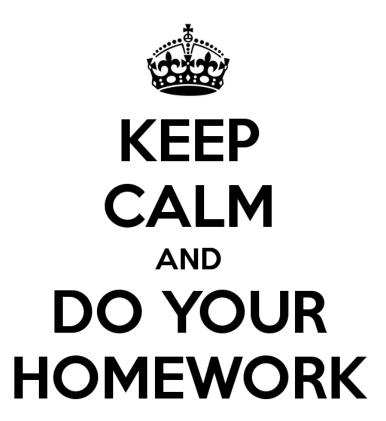
## Homework for convex optimization



Mengjie Chen

## **Dantzig selector**

Objective function:

$$\min_{\beta} \qquad \sum_{j=1}^{p} |\beta_j|$$
 such that 
$$||X^T(X\beta-y)||_{\infty} \leq \lambda$$

- Recast the problem into a linear programming.
- Use R interface of a linear programming solver (such as rmosek, rcplex, Rglpk, clpAPI).
- Follow the examples in Convex\_demo.pdf.

## Lasso

Objective function:

$$\hat{\beta}^{\mathsf{lasso}} = \arg\min||y - X\beta||_2^2 + \lambda||\beta||_1^2$$

- Implement any algorithm (from class or from the literature) using a convex optimization package.
- Benchmark the performance with lasso functions in *glmnet* package and benchmark with your Dantzig selector implementation. You can use one or more simulated datasets with at least n=200 and p>500. Define your problem and define the metrics that you use to evaluate performance.
- My glmnet in python doesn't work, so I use Sklearn.linear\_mode
  Write a reproducible report with R markdown.

## Markowitz portfolio optimization

- Suppose there are p assets held over a fixed period and let  $\beta_j$  denote the amount invested in the j-th asset. Let R be a p-variate random variable denoting the relative price change of each asset. We assume R has mean  $\mu_R$  and covariance  $\Sigma_R$ .
- Markowitz (1952) proposed choosing the asset allocation which solves

$$\min eta \qquad \qquad eta^T \Sigma_R eta \ eta^T \mu_R \geq l \ eta^T eta = 1 \ eta \geq 0$$

 Can you implement Markowitz portfolio optimization using R interface of a quandratic programming solver?