Management Sciences Topics: Convex Optimization
Homework 4: Due April 18rd (11:59 pm)

(You can directly use any properties, theorems, examples or facts from the lectures.)

Problem 1: Apply the Extra Gradient method to solve the (overlapping group regularized logistic regression) problem in Problem 2 of Homework 3. You need to use the same dataset and the same setup of the problem. Plot the primal objective values in each iteration.

The code for this problem is `extra_gradient.m` and `problem1.m`. The result is shown as follows.

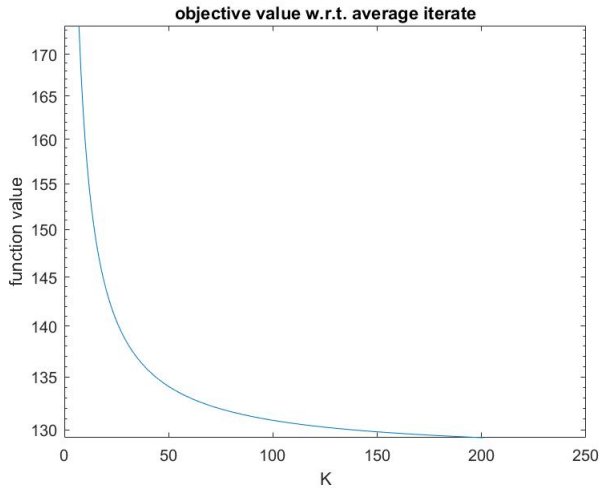

Figure 1: Primal objective value for problem 1.

Problem 2: Apply both the Extra Gradient method and the Primal-Dual Subgradient method to the following two-person-zero-sum problem.

$$\min_{\mathbf{x}\in\mathcal{X}} \max_{\mathbf{y}\in\mathcal{Y}} \mathbf{y}^\top A\mathbf{x}$$

where A is an $m \times n$ matrix, $\mathcal{X} \subset \mathbb{R}^n$ and $\mathcal{Y} \subset \mathbb{R}^m$ are simplexes in their own space. You need to download the matrix A from ICON. It is in the file named "two-person-zero-sum.mat".

The code for this problem is `projection_on_simplex.m`, `problem2.m`. The result is shown as follows, where the left plot is the result of extra gradient method and the right is of primal-dual subgradient method.

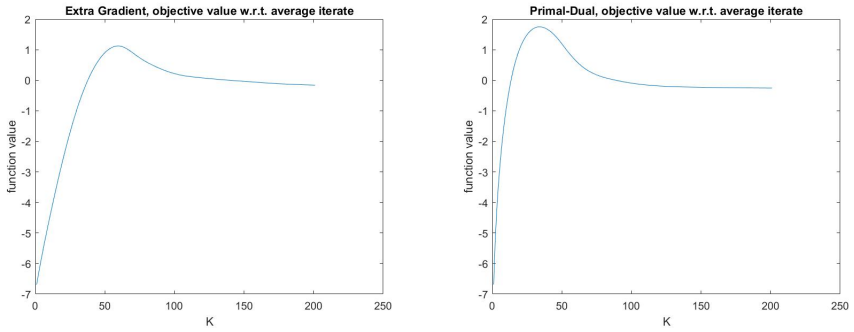

Figure 2: Primal objective value for problem 2, where the left plot is the result of extra gradient method and the right is of primal-dual subgradient method.

Problem 3: Apply the level-set method to solve the following Danzig Selector problem

$$\begin{aligned} \min_{\mathbf{x}_+, \mathbf{x}_-} \quad & \mathbf{1}^\top (\mathbf{x}_+ + \mathbf{x}_-) \\ \text{s.t.} \quad & 0 \leq \mathbf{x}_+, \mathbf{x}_- \leq 10 \\ & -10 \leq A^\top (A(\mathbf{x}_+ - \mathbf{x}_-) - b) \leq 10, \end{aligned}$$

where A and b are the feature matrix and the output vector of the dataset "triazines" from LIBSVM library. You must use the scaled version ("triazines_scale"). `https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/regression.html#triazines` Use the Extra Gradient method