**Issued: Nov. 10, 2009** **IE/MA/OR505 HW 10** **Due: Nov. 17, 2009**

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# Exercises

(1) Consider the problem

$$\begin{array}{ll} \text{minimize} & z = 2x_1 + x_2 \\ \text{subjectto} & x_1 + 2x_2 = 4 \\ & x_1,\ x_2 \geq 0. \end{array}$$

(a) Plot the feasible region. Suppose the current point is $x = (2, 1)^T$. Define the corresponding affine scaling mapping, find the transformed linear program, and plot its feasible region.

(b) Do the same as in (a) for $x = (3, \frac{1}{2})^T$.

(2) Use the primal affine scaling method to solve the problem

$$\begin{array}{ll} \text{minimize} & z = 2x_1 + x_2 + 3x_3 \\ \text{subjectto} & x_1 + 2x_2 - x_3 = 1 \\ & x_1 + x_2 + x_3 = 1 \\ & x_1,\ x_2,\ x_3 \geq 0. \end{array}$$

Start from the point $x_0 = (0.25, 0.5, 0.25)^T$. At each iteration use a step length that is 0.99 of the maximum step to the boundary. Terminate when the relative improvement in the objective is below $10^{-5}$.

(3) (for PhD Students) Prove that the projected steepest-descent direction for the primal problem is the solution to

$$\begin{array}{ll} \underset{p}{\text{minimize}} & \|p + c\| \\ \text{subjectto} & Ap = 0. \end{array}$$