6.251/15.081J Recitation 5

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1 Examples

Example 1.1. [1], exercise 4.5.

Example 1.2. [1], exercise 4.22.

Example 1.3. [1], exercise 4.28.

Example 1.4. [1], exercise 4.31.

Example 1.5. (Modified from [2], chapter 3). Recall the following LPs considered during the first recitation. Formulate the dual for each part. For **(a)** and **(b)**, show explicitly that the primal unboundedness criterion derived implies dual infeasibility. For **(c)** and **(d)**, show that the optimal value of the dual equals the optimal value of the primal.

(a) *Minimizing a linear function over an affine set.*

$$\begin{array}{ll} \text{minimize} & \boldsymbol{c}^T\boldsymbol{x} \\ \text{subject to} & A\boldsymbol{x} = \boldsymbol{b}. \end{array}$$

(b) *Minimizing a linear function over a halfspace.*

$$\begin{array}{ll} \text{minimize} & \boldsymbol{c}^T\boldsymbol{x} \\ \text{subject to} & \boldsymbol{a}^T\boldsymbol{x} \leq b, \end{array}$$

where $\boldsymbol{a} \neq 0$.

(c) *Minimizing a linear function over a rectangle.*

$$\begin{array}{ll} \text{minimize} & \boldsymbol{c}^T\boldsymbol{x} \\ \text{subject to} & \boldsymbol{l} \leq \boldsymbol{x} \leq \boldsymbol{u}, \end{array}$$

where $\boldsymbol{l} \leq \boldsymbol{u}$.

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(d) *Minimizing a linear function over the standard simplex.*

$$\begin{array}{ll} \text{minimize} & \boldsymbol{c}^T \boldsymbol{x} \\ \text{subject to} & \mathbf{1}^T \boldsymbol{x} = 1 \\ & \boldsymbol{x} \geq 0. \end{array}$$

References

[1] Bertsimas, D.; Tsitsiklis, J.N. *Introduction to Linear Optimization.* Athena Scientific, 1997.

[2] Boyd, S., Vandenberghe, L. *Convex Optimization.* Course reader. Stanford University, 2001.