

Problem 3

Consider the optimisation problem in (1) below.

$$\begin{array}{ll}\min & c_1x_1 + c_2x_2 \\ \text{subject to} & a_1x_1 + a_2x_2 \leq b_1 \\ & a_3x_1 + a_4x_2 \leq b_2 \\ & x_1 \geq 0 \\ & x_2 \geq 0\end{array}\tag{1}$$

This can be re-written can be using matrix notation as in (2).

$$\begin{array}{ll}\min & \mathbf{c}^T \mathbf{x} \\ \text{subject to} & \mathbf{A} \mathbf{x} \leq \mathbf{b} \\ & \mathbf{x} \geq 0\end{array}\tag{2}$$

where

$$\begin{aligned}A &= \begin{bmatrix} a_1 & a_2 \\ a_3 & a_4 \end{bmatrix} \\ b &= \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} \\ c &= \begin{bmatrix} c_1 \\ c_2 \end{bmatrix} \\ x &= \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}\end{aligned}$$

[c1 c2] [x1 x2]

This matrix arrangement is important, as this is how we will input our LP into Python. We are going to solve the simple LP in (3) below. Note that x_1 has no lower or upper bound, and that x_2 only has a lower bound.

$$\begin{array}{ll}\min & -x_1 + 4x_2 \\ \text{subject to} & -3x_1 + x_2 \leq 6 \\ & x_1 + 2x_2 \leq 4 \\ & x_2 \geq -3\end{array}\tag{3}$$

Open up a Jupyter notebook and replicate the example in figure 1.