

Dual Problem (Example)

$$\begin{array}{llllll} \max & -2x_1 & +3x_2 & +x_3 & & \\ & x_1 & -x_2 & +x_3 & \leq & 10 \\ & 2x_1 & -3x_2 & -x_3 & \leq & 10 \\ & & +6x_2 & +2x_3 & \leq & 10 \\ & & & x_1, x_2, x_3 & \geq & 0 \end{array}$$

Example

- Dual Decision Variables $\vec{y} = \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix}$

$$\begin{array}{rcccccl} \max & -2x_1 & +3x_2 & +x_3 & & \\ & x_1 & -x_2 & +x_3 & \leq & 10 \\ & 2x_1 & -3x_2 & -x_3 & \leq & 10 \\ & & +6x_2 & +2x_3 & \leq & 10 \\ & & & x_1, x_2, x_3 & \geq & 0 \end{array}$$

- Dual Problem:

$$\min \quad 10y_1 \quad +10y_2 \quad +10y_3$$

$$y_1 \quad +2y_2 \quad \geq \quad -2$$

$$-y_1 \quad -3y_2 \quad +6y_3 \quad \geq \quad 3$$

$$y_1 \quad -y_2 \quad +2y_3 \quad \geq \quad 1$$

$$y_1, \quad y_2, \quad y_3 \quad \geq \quad 0$$

Example-2

$$\begin{array}{llll} \text{max.} & x_1 + 2x_2 & & \\ \text{s.t.} & -2x_1 + x_2 & \leq & -2 \\ & x_2 & \leq & 4 \\ & x_1 - 2x_2 & \leq & -2 \\ & x_1 & \leq & 4 \\ & x_1, x_2 & \geq & 0 \end{array}$$

Example-3

$$\begin{array}{llll} \text{maximize} & 2x_1 + 3x_2 - 5x_3 & & \\ \text{s.t.} & x_1 - x_2 & \leq & 5 \\ & -x_1 + x_3 & \leq & 6 \\ & -2x_1 + x_3 & \leq & 2 \\ & -x_1 + x_2 & \leq & 4 \\ & x_1, x_2, x_3 & \geq & 0 \end{array}$$