

### MITx: 15.053x Optimization Methods in Business Analytics

Bookmarks

- General Information
- Week 1
- ▶ Week 2
- ▼ Week 3

#### Lecture

Lecture questions due Sep 27, 2016 at 19:30 IST

### Recitation

### **Problem Set 3**

Homework 3 due Sep 27, 2016 at 19:30 IST

Week 3 > Problem Set 3 > Problem 1

## PART A

(1/1 point)

$$egin{array}{ll} \max & 32x_1+12x_2+22x_3+24x_4+18x_5+13x_6 \ & \mathrm{s.t.:} \ & 5x_1+9x_2+7x_3+8x_4+6x_5+4x_6 \leq 200 \ & x_1,x_2,x_3 \in \{0,1\} \ & 0 \leq x_4,x_5,x_6 \leq 100 \end{array}$$

Which of the statements or constraints below is (by itself) equivalent to the statement "If  $x_1=1$ , then  $x_2=0$ "? HINT: three of the choices are correct.

- lacksquare If  $x_2=0$  then  $x_1=1$
- lacksquare If  $x_2=1$  then  $x_1=0$
- $lacksquare x_1=1$  or  $x_2=1$
- $\mathbf{v} \quad x_1 = 0 \text{ or } x_2 = 0$

■ Bookmark

- $x_1-x_2\leq 0$
- $x_1+x_2\geq 1$
- $x_1 \neq x_2$



You have used 1 of 3 submissions

# PART B

(1/1 point)

Which of the statements or constraints below is (by itself) equivalent to the statement " $x_2=1$  or  $x_3=0$  but not both"? HINT: two of the answers are correct.

- $\quad \square \ \ x_2 = (1-x_3)$
- $x_2 \neq x_3$

- $-x_2-x_3\leq 0$
- lacksquare If  $x_2=1$  then  $x_3=1$



You have used 1 of 3 submissions

### PART C

(1/1 point)

Add a binary variable  $w_1$ , and add two constraints that ensure that if  $w_1=1$  then  $x_5+x_6\geq 70$ , and if  $w_1=0$  then  $x_5+x_6\leq 69$ . Select the two correct constraints from below.

$$lacksquare x_5 + x_6 \geq 70 + M(1-w_1), w_1 \in \{0,1\}$$

$$extbf{Y} extbf{x}_5 + x_6 \geq 70 - M(1 - w_1), w_1 \in \{0, 1\}$$

$$lacksquare x_5 + x_6 \leq 69 + M(1-w_1), w_1 \in \{0,1\}$$

$$extbf{Y} extbf{x}_5 + x_6 \leq 69 + Mw_1, w_1 \in \{0,1\}$$

 $lacksquare x_5 + x_6 \leq 69 - Mw_1, w_1 \in \{0,1\}$ 



You have used 1 of 3 submissions

## PART D

(1/1 point)

Add 3 binary variables  $w_2, w_3$ , and  $w_4$ , and 4 constraints so as to ensure that at least one of the constraints  $x_4 \le 92, x_5 \ge 40$ , and  $x_6 \le 74$  are satisfied. Select the 4 correct constraints below.

- $x_4 \le 92-M(1-w_2)$
- $lacksquare x_5 \geq 40 + M(1{ ext{-}}w_3)$
- $extstyle x_5 \geq 40 M(1 w_3)$
- $x_6 \leq 74 + M(1-w_4)$
- $\quad \square \quad x_6 \leq 74 \text{--} M(1 \text{--} w_4)$

$$w_1 + w_3 + w_4 \ge 1, w_2, w_3, w_4 \in \{0, 1\}$$

$$lacksquare w_1+w_3+w_4\leq 1, w_2, w_3, w_4\in\{0,1\}$$



You have used 1 of 3 submissions

## PART E

(1/1 point)

Add a single integer variable  $w_5$  and a constraint that ensures that  $x_6$  is divisible by 2 but not divisible by 4. Equivalently, the remainder when dividing by 4 must be 2. Which of the following constraints satisfies these conditions? Select only one of them.

$$igcup x_6 + 2w_5 = 4, w_5 \geq 0, w_5 \in {f Z}$$

$$ullet x_6 - 2w_5 = 4, w_5 \geq 0, w_5 \in {f Z}$$

$$ullet x_6 - 4w_5 = 2, w_5 \geq 0, w_5 \in \mathbf{Z}$$

$$ullet x_6 + 4w_5 = 2, w_5 \geq 0, w_5 \in {f Z}$$

None of the choices

You have used 1 of 2 submissions

## PART F

(1/1 point)

Add three binary variables  $w_6, w_7$ , and  $w_8$  and two constraints that ensures that  $x_6 = 13$  or 39 or 88. Select the two correct constraints from below.

$$lacksquare x_6 = 13w_6 - 39w_7 - 88w_8$$

$$w_6 + w_7 + w_8 \ge 1, w_6, w_7, w_8 \in \{0, 1\}$$

$$lacksquare w_6 + w_7 + w_8 \leq 1, w_6, w_7, w_8 \in \{0,1\}$$

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You have used 1 of 3 submissions

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