ETM645 – HW#6

Scott Schultz

11.1-2 X_i – 1 if Eve performs task i, otherwise
– 0 if Steven performs task i

$$\text{Min} \quad 4.5X_M + 7.8X_C + 3.6X_D + 2.9X_L$$
$$+\ 4.9(1-X_M) + 7.2(1-X_C) + 4.3(1-X_D) + 3.1(1-X_L)$$

$$\text{S.T.} \quad X_1 + X_2 + X_3 + X_4 = 2$$

$$X_i = 0 \text{ or } 1$$

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11.1-4

$\text{Max } \Sigma X_i p_i$

$\text{s.t. } \Sigma X_i C_i \le 100$

$X_1 + X_2 \le 1$

$X_3 + X_4 \le 1$

$X_3 \le X_1 + X_2$

$X_4 \le X_1 + X_2$

$X_i = 0 \text{ or } 1$

11.3-4

y_{ij} - 1 if prod of toy i setup in fact j
0 otherwise

X_{ij} - units of production of toy i in fact. j

Toy 1	Toy 2	
50/hr	40/hr	Fac 1 Prod Rate
40/hr	25/hr	Fac 2 " "

$\text{Max Profit} = 10X_{11} + 10X_{12} + 15X_{21} + 15X_{22} - 50{,}000\,y_{11} - 50{,}000\,y_{12} - 80{,}000\,y_{21} - 80{,}000\,y_{22}$

S.T.

$\frac{1}{50}X_{11} + \frac{1}{40}X_{21} \le 500$ Fac 1 Cap

$1/40\,X_{12} + \frac{1}{25}X_{22} \le 700$ Fac 2 Cap

$y_{11} + y_{12} \le 1$ Only One Fact For Toy 1

$y_{21} + y_{22} \le 1$ " Toy 2

$\left.\begin{array}{l} y_{11} + y_{22} \le 1 \\ y_{12} + y_{21} \le 1 \end{array}\right\}$ Cannot Build In Two Different Facs.

$\left.\begin{array}{l} X_{11} \le M y_{11} \\ X_{12} \le M y_{12} \\ X_{21} \le M y_{21} \\ X_{22} \le M y_{22} \end{array}\right\} M \ge 700$

$X_{ij} \ge 0$

$y_{ij} = 0 \text{ or } 1$

$\forall i,j$

1 0
1 0
or
0 1
0 1
Not
1 0
0 1

Profit

```
! ETM 645
! Problem 11.1-4
!

Max 17 x1 + 10 x2 + 15 x3 + 19 x4 + 7 x5 + 13 x6 + 9 x7

ST
    43 x1 + 28 x2 + 34 x3 + 48 x4 + 17 x5 + 32 x6 + 23 x7 <= 100
       x1 +    x2                                         <= 1
                       x3 +    x4                         <= 1
    -1 x1 -    x2 +    x3                                 <= 0
    -1 x1 -    x2         +    x4                         <= 0
END

INT x1
INT x2
INT x3
INT x4
INT x5
INT x6
INT x7


LP OPTIMUM FOUND AT STEP      7
 OBJECTIVE VALUE =   41.4375000


 NEW INTEGER SOLUTION OF    41.0000000     AT BRANCH      0 PIVOT       7
 RE-INSTALLING BEST SOLUTION...

        OBJECTIVE FUNCTION VALUE

        1)      41.00000

  VARIABLE        VALUE          REDUCED COST
        X1         1.000000        -17.000000
        X2         0.000000        -10.000000
        X3         1.000000        -15.000000
        X4         0.000000        -19.000000
        X5         0.000000         -7.000000
        X6         0.000000        -13.000000
        X7         1.000000         -9.000000


       ROW   SLACK OR SURPLUS     DUAL PRICES
        2)         0.000000          0.000000
        3)         0.000000          0.000000
        4)         0.000000          0.000000
        5)         0.000000          0.000000
        6)         1.000000          0.000000

 NO. ITERATIONS=        7
 BRANCHES=    0 DETERM.=  1.000E    0
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11.4-7 $X_i = 1$ if fire station located in tract i
0 if not

$Y_{ij} = 1$ if tract j serviced by fire station in tract i
0 otherwise

MIN $\sum\sum Y_{ij} \cdot RT_{ij} \cdot F_j$ where RT is response time, F is fire frequency

S.T. $\sum_i X_i = 2$ (EXACTLY 2 STATIONS

$Y_{ij} \le X_i \quad \forall i, \forall j$ (MUST BE SERVICED BY TRACT WITH FIRE STATION

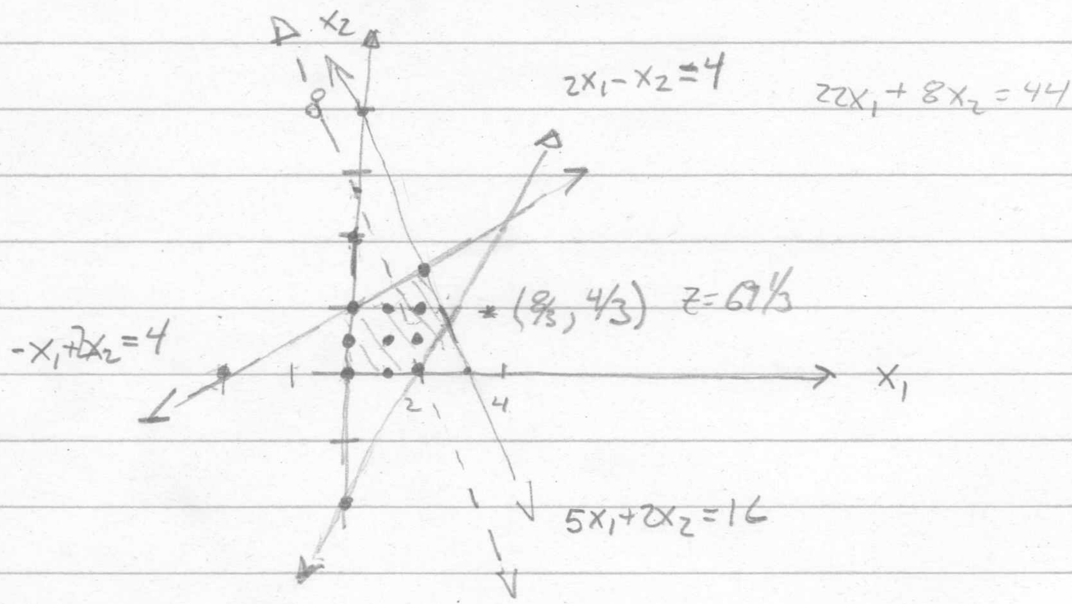
$\sum_j Y_{ij} \ge 1 \quad \forall i$ (EACH TRACK SERVICED BY AT LEAST ONE STATION

$X_i = 0$ or 1

$Y_{ij} = 0$ or 1

ETM645 - HW#6 SCHULTZ

11.5-2



INTERSECT $2x_1 - x_2 = 4$ $\qquad x_2 = 2x_1 - 4$

$5x_1 + 2x_2 = 16$

$5x_1 + 2(2x_1 - 4) = 16$

$5x_1 + 4x_1 - 8 = 16$

$x_1 = \frac{24}{9} = \frac{8}{3}$

$x_2 = \frac{4}{3}$

LP RELAXATION: $X_1 = \frac{8}{3}$, $X_2 = \frac{4}{3}$, $Z = 691$

ROUNDED LP SOLUTION

TRY $X_1 = 2$, $X_2 = 2$ FEASIBLE, $Z = 440 + 160 = 600$

$X_1 = 2$, $X_2 = 1$ FEASIBLE, $Z = 440 + 80 = 520$

$X_1 = 3$, $X_2 = 2$ INFEASIBLE

$X_1 = 3$, $X_2 = 1$ INFEASIBLE

IP* $x_1 = 2$, $x_2 = 3$ $Z = 440 + 240 = 680$*

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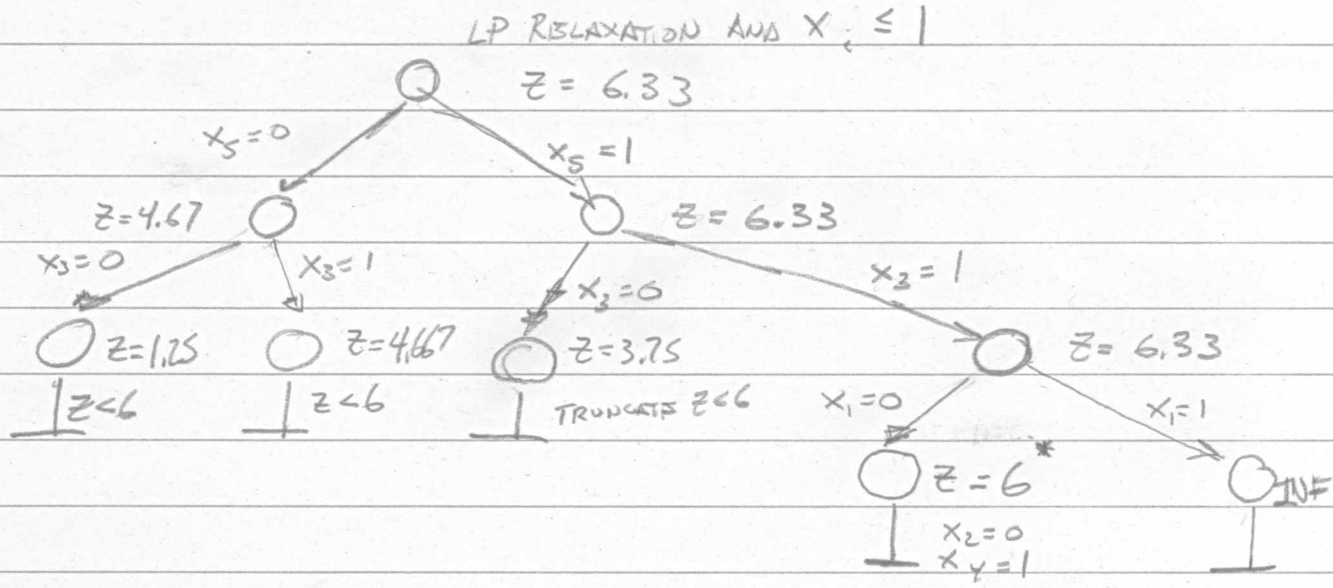
11.6-1

$$\begin{aligned} \text{MAX} \quad & 2x_1 - x_2 + 5x_3 - 3x_4 + 4x_5 \\ \text{S.T.} \quad & 3x_1 - 2x_2 + 7x_3 - 5x_4 + 4x_5 \le 6 \\ & x_1 - x_2 + 2x_3 - 4x_4 + 2x_5 \le 0 \\ & x_i \text{ is binary} \end{aligned}$$



ETM 645 - HW#3

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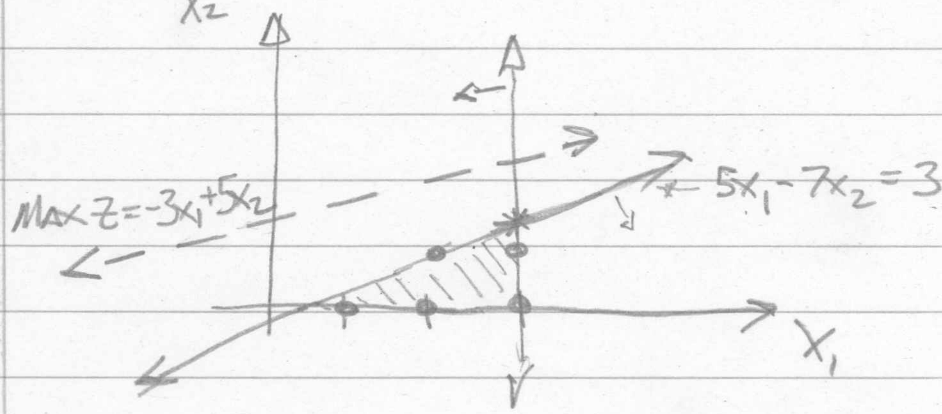
11.7-1



LP Relaxation, Optimal Solution $X_1 = 3$, $X_2 = \frac{12}{7}$

MIP

Sub 1 $\quad X_2 \le 1$

Max $Z = -3X_1 + 5X_2$

s.t. $\quad 5X_1 - 7X_2 \ge 3$

$X_1 \le 3$

$X_2 \le 1$

$X_i \ge 0$

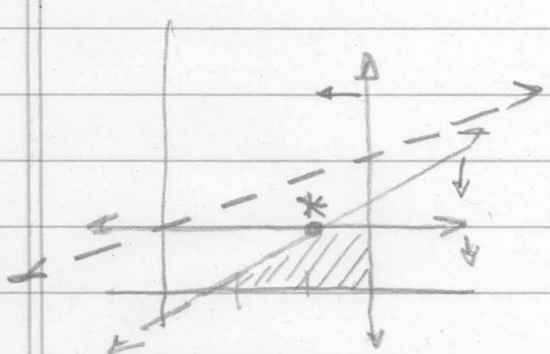
$X_2 \ge 2$

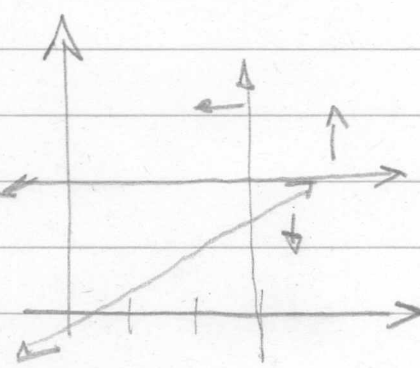
Max $Z = -3X_1 + 5X_2$

$5X_1 - 7X_2 \ge 3$

$0 \le X_1 \le 3$

$2 \le X_2 \le 3$





No Feasible Region

LP Relaxation, Opt. Solution

$X_1 = 2$, $X_2 = 1$.
$Z = -1$

Ans. Is Integer, $\therefore$ Optimal For IP Original