ETM 645 - HW#3

Scott Schultz

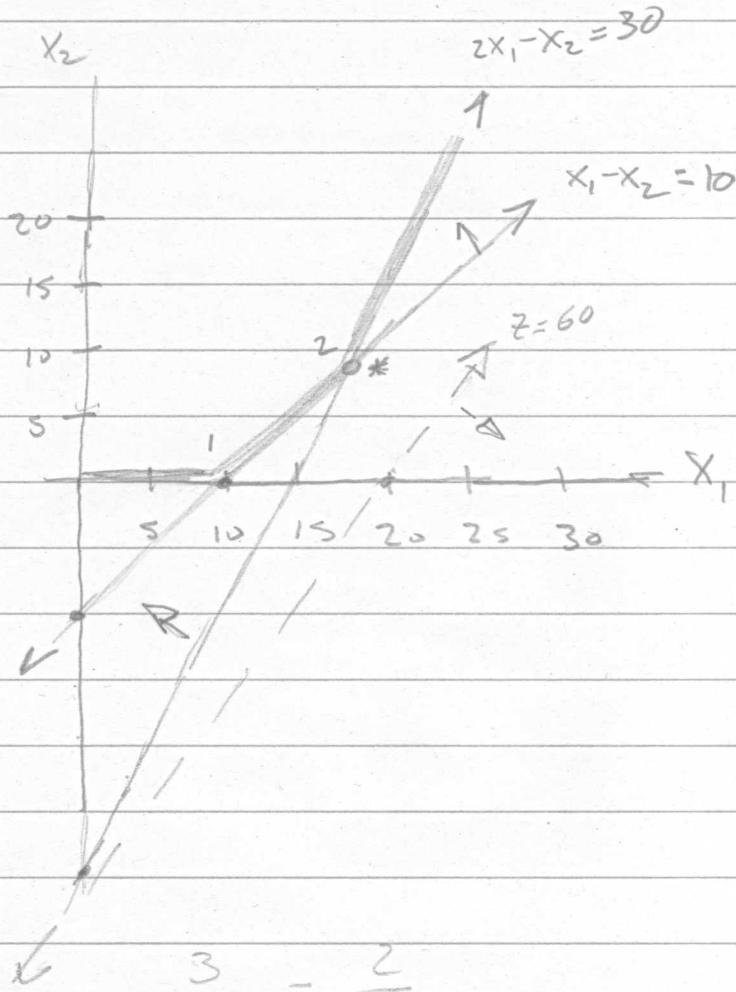
6.7-7

MAX $Z = 3x_1 - 2x_2$

s.t. $2x_1 - x_2 \le 30$

$x_1 - x_2 \le 10$

$x_1, x_2 \ge 0$



$\frac{3}{-c_2} = \frac{2}{-1}$

a) $c_1x_1 - 2x_2 = x_1 - x_2$

$c_1 = 2$ $\quad \frac{c_1}{1} = \frac{-2}{-1}$

$c_1x_1 - 2x_2 = 2x_1 - x_2$

$c_1 = 4$

$\therefore c_1$ Range $[4, 2]$

$3x_1 - c_2x_2 = x_1 - x_2$

$c_2 = 3$

$3x_1 - c_2x_2 = 2x_1 - x_2$

$\frac{3}{2} = \frac{c_2}{-1}$

$c_2 = -\frac{3}{2}$

$\therefore c_2$ Range $[-3, -\frac{3}{2}]$

The objective function allowable range for c2 in Z = 3x1 - c2x2 is from:
Z = 3x1 - 3x2
to
Z = 3x1 - 3/2(x2)

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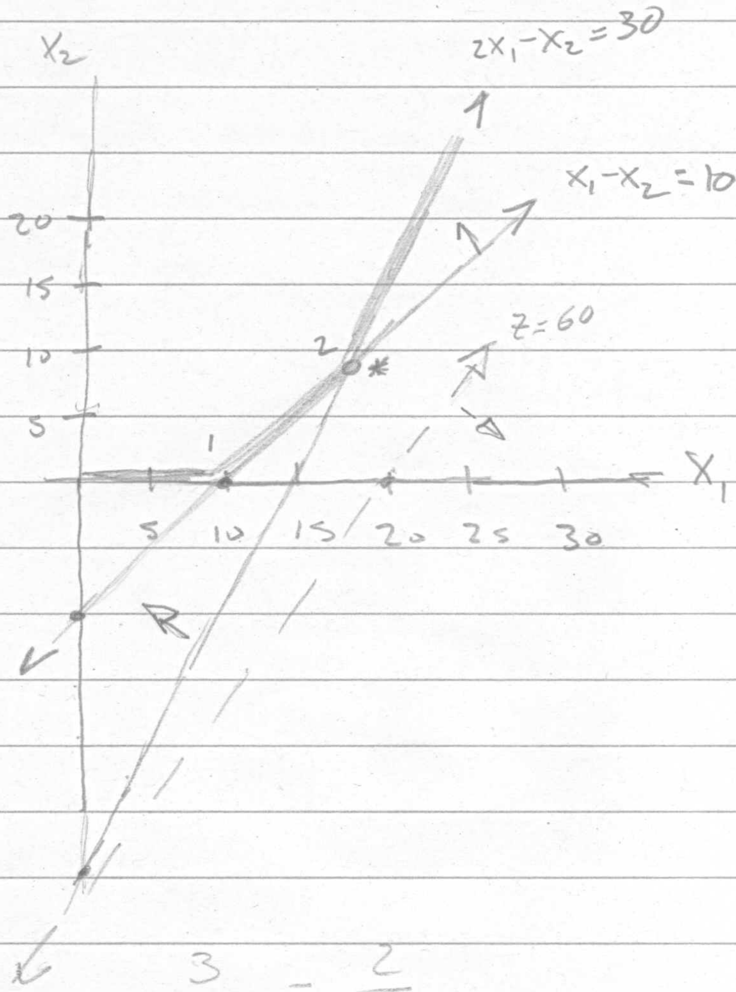
$x_1, x_2 \ge 0$

a) $c_1 x_1 - 2x_2 = x_1 - x_2$

$c_1 = 2$ $\qquad \frac{c_1}{1} = \frac{-2}{-1}$



$c_1 x_1 - 2x_2 = 2x_1 - x_2$

$c_1 = 4$

$\therefore c_1$ Range $[4, 2]$

$3x_1 - c_2 x_2 = x_1 - x_2$

$c_2 = 3$

$\frac{3}{-c_2} = \frac{2}{-1}$

$3x_1 - c_2 x_2 = 2x_1 - x_2$

$\frac{3}{2} = \frac{c_2}{-1}$

$c_2 = -\frac{3}{2}$

$\therefore c_2$ Ranges $[-3, -\frac{3}{2}]$

6.7-7

c) b_1 RANGES

OBSERVE CORNER POINT 2 COINCIDES WITH CORNER POINT 1 WHEN (10,0) IS A POINT ON THE LINE $2x_1 - x_2 = b_1$
$\therefore b_1 = 20$

WHEN THE CONSTRAINT 1 LINE MOVES AWAY FROM THE ORIGIN; THE CORNER POINT WILL NOT SHIFT TO ANOTHER CORNER.
$\therefore b_1 = \infty$

b_1 RANGES = $[20, \infty]$

---

b_2 RANGES

OBSERVE AS CONSTRAINT 2'S RHS DECREASES, CORNER POINT 2 MOVES TOWARDS THE UPPER RIGHT, BUT NEVER SWITCHES TO A DIFFERENT CORNER POINT $\therefore b_1 = -\infty$

WHEN THE RHS OF CONSTRAINT 2 INCREASES, THE CORNER POINT WILL SHIFT TO A DIFFERENT CORNER POINT AT (15,0). WHEN (15,0) IS A POINT ON THE LINE $x_1 - x_2 = b_2$ THEN $b_2 = 15$
b_2 RANGES = $[-\infty, 15]$

```
! Problem 6.7-7 a)

Max 3 x1 - 2 x2

s'
  2 x1 - x2 <= 30
    x1 - x2 <= 10
end

 LP OPTIMUM FOUND AT STEP      2

        OBJECTIVE FUNCTION VALUE

        1)      40.00000

  VARIABLE        VALUE          REDUCED COST
        X1        20.000000          0.000000
        X2        10.000000          0.000000


       ROW   SLACK OR SURPLUS     DUAL PRICES
        2)         0.000000          1.000000
        3)         0.000000          1.000000

 NO. ITERATIONS=       2


 RANGES IN WHICH THE BASIS IS UNCHANGED:

                           OBJ COEFFICIENT RANGES
 VARIABLE         CURRENT        ALLOWABLE         ALLOWABLE
                   COEF          INCREASE          DECREASE
       X1        3.000000        1.000000          1.000000
       X2       -2.000000        0.500000          1.000000

                           RIGHTHAND SIDE RANGES
      ROW         CURRENT        ALLOWABLE         ALLOWABLE
                    RHS          INCREASE          DECREASE
        2       30.000000        INFINITY         10.000000
        3       10.000000        5.000000          INFINITY
```

ETM 645 - HW#3 SCOTT SCHULTZ

6.8-1

a) SEE ATTACHED LINDO OUTPUT

b) IF ACTIVITY 1 PROFIT REDUCES FROM \$2 TO \$1,
NOT OPTIMAL BECAUSE ALLOWABLE DECREASE = \$.33
IF ACTIVITY " " INCREASES " " " \$3,
NOT OPTIMAL BECAUSE " INCREASE = \$.50

c) IF ACTIVITY 2 DECREASES PROFIT BY \$2.50,
NOT OPTIMAL BECAUSE ALLOWABLE DECREASE = \$1.0
IF " " INCREASES " " "
NOT " " " INCREASE = \$1.0

d)

C_1	X_1	X_2	Z	C_2	X_1	X_2	Z
\$1.0	0	4	20	2.0			
\$1.2	0	4	20	2.5	10	0	20
\$1.4	0	4	20	3.0	10	0	20
\$1.6	0	4	20	3.5	10	0	20
\$1.8	6	2	20.8	4.0	10	0	20
\$2.0	6	2	22	4.5	6	2	21
\$2.2	6	2	23.2	5.0	6	2	22
2.4	6	2	24.4	5.5	6	2	23
2.6	10	0	26	6.0	6	2	24
2.8	10	0	28	6.5	0	4	26
3.0	10	0	30	7.0	0	4	28

ETM645 - HW #3

SCOTT SCHULTZ

3)

a) $\min\ 10d_1^- + 6d_2^- + 4d_3^- + d_4^+$

s.t. $60x_1 + 50x_2 + 40x_3 + d_1^- - d_1^+ = 5000$ (EX CHIP DEMAND (LOTS OF 100)

$20x_1 + 35x_2 + 20x_3 + d_2^- - d_2^+ = 3000$ (GOOD CHIP DEMAND

$20x_1 + 15x_2 + 40x_3 + d_3^- - d_3^+ = 1000$ (MED CHIP DEMAND

$400x_1 + 300x_2 + 250x_3 + d_4^- - d_4^+ = 28{,}000$ (BUDGET

$x_i,\ d_i^-,\ d_i^+ \geq 0$

```
! Problem 3 - weigthed goal programming     Scott Schultz

Min 10 d1m + 6 d2m + 4 d3m + d4p

ST

   excell)  60 x1 +  50 x2 +  40 x3 + d1m - d1p = 5000
     good)  20 x1 +  35 x2 +  20 x3 + d2m - d2p = 3000
      med)  20 x1 +  15 x2 +  40 x3 + d3m - d3p = 1000
   budget) 400 x1 + 300 x2 + 250 x3 + d4m - d4p = 28000

end


LP OPTIMUM FOUND AT STEP       8

        OBJECTIVE FUNCTION VALUE

        1)      2000.000

  VARIABLE        VALUE          REDUCED COST
       D1M         0.000000          4.000000
       D2M         0.000000          6.000000
       D3M         0.000000          4.000000
       D4P      2000.000000          0.000000
        X1         0.000000         40.000000
        X2       100.000000          0.000000
        X3         0.000000         10.000000
       D1P         0.000000          6.000000
       D2P       500.000000          0.000000
       D3P       500.000000          0.000000
       D4M         0.000000          1.000000


       ROW   SLACK OR SURPLUS     DUAL PRICES
   EXCELL)         0.000000         -6.000000
     GOOD)         0.000000          0.000000
      MED)         0.000000          0.000000
   BUDGET)         0.000000          1.000000

 NO. ITERATIONS=       8
```

```
 ! Problem 3 - pre-emptive goal programming    Scott Schultz

Min d4p

ST

    xcell)  60 x1 +  50 x2 +  40 x3 + d1m - d1p = 5000
     good)  20 x1 +  35 x2 +  20 x3 + d2m - d2p = 3000
      med)  20 x1 +  15 x2 +  40 x3 + d3m - d3p = 1000
   budget) 400 x1 + 300 x2 + 250 x3 + d4m - d4p = 28000

end

LP OPTIMUM FOUND AT STEP      6

        OBJECTIVE FUNCTION VALUE

        1)      0.0000000E+00

  VARIABLE        VALUE          REDUCED COST
       D4P         0.000000          1.000000
        X1        10.000000          0.000000
        X2        80.000000          0.000000
        X3         0.000000          0.000000
       D1M       400.000000          0.000000
       D1P         0.000000          0.000000
       D2M         0.000000          0.000000
       D2P         0.000000          0.000000
       D3M         0.000000          0.000000
       D3P       400.000000          0.000000
       D4M         0.000000          0.000000


       ROW   SLACK OR SURPLUS     DUAL PRICES
   EXCELL)         0.000000          0.000000
     GOOD)         0.000000          0.000000
      MED)         0.000000          0.000000
   BUDGET)         0.000000          0.000000

 NO. ITERATIONS=       6

! Budget goal now a constraint, solve for goal 2 (excellent chip demand)

Min d1m

ST

   excell)  60 x1 +  50 x2 +  40 x3 + d1m - d1p = 5000
     good)  20 x1 +  35 x2 +  20 x3 + d2m - d2p = 3000
      med)  20 x1 +  15 x2 +  40 x3 + d3m - d3p = 1000
   budget) 400 x1 + 300 x2 + 250 x3 + d4m - d4p = 28000
                                          d4p = 0

end

 LP OPTIMUM FOUND AT STEP      7

        OBJECTIVE FUNCTION VALUE

        1)      333.3333

  VARIABLE        VALUE          REDUCED COST
       D1M       333.333344          0.000000
        X1         0.000000          6.666667
        X2        93.333336          0.000000
        X3         0.000000          1.666667
       D1P         0.000000          1.000000
       D2M         0.000000          0.000000
       D2P       266.666656          0.000000
       D3M         0.000000          0.000000
       D3P       400.000000          0.000000
       D4M         0.000000          0.166667
       D4P         0.000000          0.000000
```

ROW	SLACK OR SURPLUS	DUAL PRICES
EXCELL)	0.000000	-1.000000
GOOD)	0.000000	0.000000
MED)	0.000000	0.000000
BUDGET)	0.000000	0.166667
6)	0.000000	0.166667

NO. ITERATIONS= 7

Stop, goal 2 not completely met.