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Group 1: Chapter 14 Problem 3

3. Characteristic	Product 1	Product 2
Profit/unit	\$4	\$2
Dept. A hours/unit	1	1
Dept. B hours/unit	2	5

a) Let  $x_1$  = number of units of product 1 produced  
 $x_2$  = number of units of product 2 produced

$$\text{Min } P_1(d_1^+) + P_1(d_1^-) + P_1(d_2^+) + P_1(d_2^-) + P_2(d_3^-)$$

s.t.

$$1x_1 + 1x_2 - d_1^+ + d_1^- = 350 \text{ Goal 1}$$

$$2x_1 + 5x_2 - d_2^+ + d_2^- = 1000 \text{ Goal 2}$$

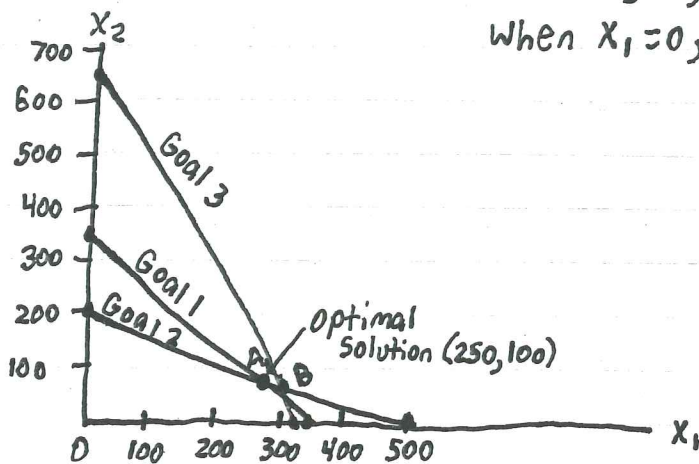
$$4x_1 + 2x_2 - d_3^+ + d_3^- = 1300 \text{ Goal 3}$$

$$x_1, x_2, d_1^+, d_1^-, d_2^+, d_2^-, d_3^+, d_3^- \geq 0$$

b) Line for Goal 1 - When  $x_2 = 0, x_1 = 350$   
 When  $x_1 = 0, x_2 = 350$

Line for Goal 2 - When  $x_2 = 0, x_1 = 500$   
 When  $x_1 = 0, x_2 = 200$

Line for Goal 3 - When  $x_2 = 0, x_1 = 325$   
 When  $x_1 = 0, x_2 = 650$



The optimal solution occurs at the point (250, 100). This achieves goals 1 and 2, but is less than the desired profits of the company.

c) Max  $4x_1 + 2x_2$

s.t.

$1x_1 + 1x_2 \leq 350$  Dept. A

$2x_1 + 5x_2 \leq 1000$  Dept. B

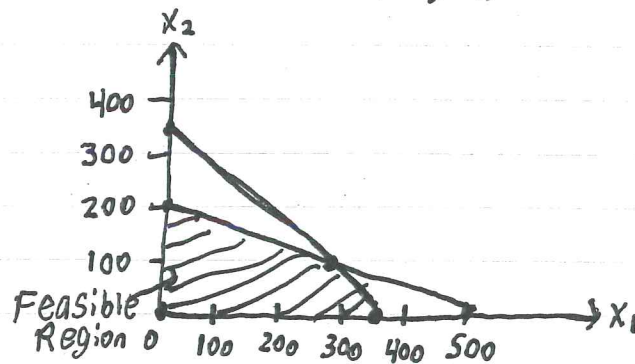
$x_1, x_2 \geq 0$

Line for Dept. A - When  $x_2 = 0, x_1 = 350$

When  $x_1 = 0, x_2 = 350$

Line for Dept. B - When  $x_2 = 0, x_1 = 500$

When  $x_1 = 0, x_2 = 200$



Extreme Points

$(0, 0)$

$(350, 0)$

$(250, 100)$

$(0, 200)$

Profit

$4(0) + 2(0) = 0$

$4(350) + 2(0) = 1400$  ← optimal

$4(250) + 2(100) = 1200$

$4(0) + 2(200) = 400$

The optimal solution occurs at  $(350, 0)$  and produces a profit of \$1,400.

d) I favor the approach taken in Part b because it achieves both labor goals. Although c produces a higher profit, labor usage is cut short and this could prove to be detrimental over the long-term.

e) With reference to the graph drawn in Part B, the new solution would be located at Point B, with  $x_1 = 281.25$  and  $x_2 = 87.5$ . This solution achieves the Department B labor goal and the profit goal, but uses 18.75 more Department A labor hours than there were in the original goal.

**Group 1 Chapter 14 Problem 3**

<u>Characteristic</u>	<u>Product 1</u>	<u>Product 2</u>
Profit/Unit	4	2
Dept. A Hours/Unit	1	1
Dept. B Hours/Unit	2	5

Let X1= number of units of Product 1 produced

Let X2= number of units of Product 2 produced

**Optimal**            18.75

<u>X1</u>	<u>X2</u>	<u>d1+</u>	<u>d1-</u>	<u>d2+</u>	<u>d2-</u>	<u>d3+</u>	<u>d3-</u>
281.25	87.5	18.75	0	0	0	0	0

**Constraints:**

350	=	350
1000	=	1000
1300	=	1300

Microsoft Excel 14.0 Answer Report

Worksheet: [Book1]Sheet1

Report Created: 11/27/2012 12:39:52 PM

Result: Solver found a solution. All Constraints and optimality conditions are satisfied.

Solver Engine

Engine: Simplex LP

Solution Time: 0.125 Seconds.

Iterations: 3 Subproblems: 0

Solver Options

Max Time Unlimited, Iterations Unlimited, Precision 0.000001, Use Automatic Scaling

Max Subproblems Unlimited, Max Integer Sols Unlimited, Integer Tolerance 1%, Assume NonNegative

Objective Cell (Min)

Cell	Name	Original Value	Final Value
\$B\$11	Optimal	0	18.75

Variable Cells

Cell	Name	Original Value	Final Value	Integer
\$A\$15	X1	0	281.25	Contin
\$B\$15	X2	0	87.5	Contin
\$C\$15	d1+	0	18.75	Contin
\$D\$15	d1-	0	0	Contin
\$E\$15	d2+	0	0	Contin
\$F\$15	d2-	0	0	Contin
\$G\$15	d3+	0	0	Contin
\$H\$15	d3-	0	0	Contin

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
\$A\$19	Constraints:	350	\$A\$19=\$C\$19	Binding	0
\$A\$20	Constraints:	1000	\$A\$20=\$C\$20	Binding	0
\$A\$21	Constraints:	1300	\$A\$21=\$C\$21	Binding	0

Microsoft Excel 14.0 Sensitivity Report

Worksheet: [Book1]Sheet1

Report Created: 11/27/2012 12:39:52 PM

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$A\$15	X1	281.25	0	0	2.6	0.6
\$B\$15	X2	87.5	0	0	1.5	4.5
\$C\$15	d1+	18.75	0	1	4.333333333	1
\$D\$15	d1-	0	2	1	1E+30	2
\$E\$15	d2+	0	1.125	1	1E+30	1.125
\$F\$15	d2-	0	0.875	1	1E+30	0.875
\$G\$15	d3+	0	0.1875	0	1E+30	0.1875
\$H\$15	d3-	0	0.8125	1	1E+30	0.8125

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$A\$19	Constraints:	350	-1	350	18.75	1E+30
\$A\$20	Constraints:	1000	0.125	1000	2250	150
\$A\$21	Constraints:	1300	0.1875	1300	700	100

Category		Audience			# of adv.
		reach/ adv.	Cost per adv.	Max. # of adv.	
TV	X1	200,000	\$ 2,500.00	10	
Radio	X2	50,000	\$ 400.00	15	
Newspaper	X3	100,000	\$ 5,000.00	20	

Objective Minimize  $P1(d1-) + P2(d2-) + P3(d3+) + P4(d4+)$   
 Function: 110.060001

X1	X2	X3	d1+	d1-	d2+	d2-	d3+
1.6	15.0	20.0	0.0	93.0	0.0	9.4	7.7

S.T.	X1	X2	X3	d1+	d1-	d2+	d2-	d3+
Constraints					<=	10		
					<=	15		
					<=	20		
				$20X1 + 5X2 + 10X3 - (d1+) + (d1-)$	=	400	Goal 1	
				$0.7X1 - 0.3X2 - 0.3X3 - (d2+) + (d2-)$	=	0	Goal 2	
				$-0.2X1 + 0.8X2 - 0.2X3 - (d3+) + (d3-)$	=	0	Goal 3	
				$25X1 + 4X2 + 5X3 - (d4+) + (d4-)$	=	200	Goal 4	
				X1, X2, X3	>=	0		
				d1+, d1-, d2+, d2-, d3+, d3-, d4+, d4-	>=	0		
	1.60	<=		10				
	15.00	<=		15				
	20.00	<=		20				
	400.00	=		400	Goal 1			
	0.00	=		0	Goal 2			
	0.00	=		0	Goal 3			
	200.00	=		200	Goal 4			
	1.60	>=		0				
	15.00	>=		0				
	20.00	>=		0				
	0.00	>=		0				
	93.00	>=		0				
	0.00	>=		0				
	9.38	>=		0				
	7.68	>=		0				
	0.00	>=		0				
	0.00	>=		0				
	0.00	>=		0				