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# Test bank:

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## Managerial Decision Modeling w/ Spreadsheets, 3e (Balakrishnan/Render/Stair) Chapter 2 Linear Programming Models: Graphical and Computer Methods

2.1 Chapter Questions

1) Consider the following linear programming model:  $x^{2} + X_{2} + 3X_{2}$ Max Subject to:  $X_1 + X_2 \leq 3$  $X_1 + X_2 \le 1$  $X_1, X_2 > 0$ This problem violates which of the following assumptions? A) certainty B) proportionality C) divisibility D) linearity E) integrality Answer: D Page Ref: 22 Topic: Developing a Linear Programming Model **Difficulty:** Easy 2) Consider the following linear programming model: Min 2X1 + 3X2Subject to:  $X1 + 2X2 \le 1$  $X_2 \le 1$  $X_1 \ge 0, X_2 \le 0$ This problem violates which of the following assumptions? A) additivity B) divisibility C) non-negativity

D) proportionality E) linearity Answer: C Page Ref: 21 Topic: Developing a Linear Programming Model Difficulty: Easy

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3) A redundant constraint is eliminated from a linear programming model. What effect will this have on the optimal solution?

A) feasible region will decrease in size
B) feasible region will increase in size C)
a decrease in objective function value D)
an increase in objective function value E)
no change
Answer: E
Page Ref: 36
Topic: Special Situations in Solving Linear Programming Problems
Difficulty: Moderate

4) Consider the following linear programming model:

2X1 + 3X2Max Subject to:  $X_1 \leq 2$  $X_2 \le 3$  $X_1 \leq 1$  $X_1, X_2 \ge 0$ This linear programming model has: A) alternate optimal solutions B) unbounded solution C) redundant constraint D) infeasible solution E) non-negative solution Answer: C Page Ref: 36 Topic: Special Situations in Solving Linear Programming Problems **Difficulty: Moderate** 

5) A linear programming model generates an optimal solution with fractional values. This solution satisfies which basic linear programming assumption?

A) certainty
B) divisibility
C) proportionality
D) linearity
E) non-negativity
Answer: B Page
Ref: 22
Topic: Developing a Linear Programming Model
Difficulty: Moderate

6) Consider the following linear programming model:

Max X1 + X2Subject to:  $X1 + X2 \leq 2$  $X_1 \ge 1$  $X_2 \ge 3$  $X_1, X_2 \ge 0$ This linear programming model has: A) alternate optimal solution B) unbounded solution C) redundant constraint D) infeasible solution E) unique solution Answer: D Page Ref: 37 Topic: Special Situations in Solving Linear Programming Problems Difficulty: Easy

7) Consider the following linear programming model

Max 2X1 + 3X2Subject to:

 $X1 + X2 \stackrel{\geq 4}{\underset{X1 \geq 2}{x_{1} \geq 2}} X1, X2 \stackrel{\geq}{=} 0$ This linear programming model has: A) redundant constraints B) infeasible solution C) alternate optimal solution D) unique solution E) unbounded solution Answer: E Page Ref: 39 Topic: Special Situations in Solving Linear Programming Problems Difficulty: Easy

8) Consider the following linear programming model 2X1 + 3X2Min Subject to:  $X1+X2 \geq 4$  $X_1 \ge 2$  $x_1, x_2 \ge 0$ This linear programming model has: A) unique optimal solution B) unbounded solution C) infeasible solution D) alternate optimal solution E) redundant constraints Answer: A Page Ref: 38 Topic: Special Situations in Solving Linear Programming Problems Difficulty: Easy

Figure 1:

	A	В	С	D	E
1					
2		$X_1$	$X_2$		
3	Number to Make:				OBJ. FN. VALUE:
4					
5	Unit profit:	\$4	\$3		
6			a		
7	Constraints:			Used	Available
8	1	3	5		40
9	2	12	10		120
10	3	1	0		15

Figure 1 demonstrates an Excel spreadsheet that is used to model the following linear programming problem:

Max: 4 X1 + 3 X2Subject to:  $3 X1 + 5 X2 \le 40$  $12 X1 + 10 X2 \le 120$  $X1 \ge 15$  $X1, X2 \ge 0$ 

Note: Cells B3 and C3 are the designated cells for the optimal values of X1 and X2, respectively, while cell E4 is the designated cell for the objective function value. Cells D8:D10 designate the left-hand side of the constraints.

9) Refer to Figure 1. What formula should be entered in cell E4 to compute total profitability?
A) =SUMPRODUCT(B5:C5,B2:C2)
B) =SUM(B3:C3) C)
=B2\*B5 + C2\*C5
D) =SUMPRODUCT(B5:C5,E8:E10)
E) =B3\*B5 + C3\*C5
Answer: E
Page Ref: 42
Topic: Setting Up and Solving Linear Programming Problems Using Excel's Solver
Difficulty: Easy

10) Refer to Figure 1. What formula should be entered in cell D9 to compute the amount of resource 2 that is consumed?
A) =B9\*D9 + C9\*D9
B) =SUMPRODUCT(B2:C2,B9:C9)
C) =SUM(B9:C9)
D) =SUMPRODUCT(B3:C3,B9:C9)
E) =SUMPRODUCT(B9:C9,B5:C5)
Answer: D
Page Ref: 42
Topic: Setting Up and Solving Linear Programming Problems Using Excel's Solver
Difficulty: Easy

11) Refer to Figure 1. Which cell(s) are the *Changing Cells* as designated by "Solver"? A) E4 B) B2:C2 C) B3:C3 D) D8:D10 E) B5:C5 Answer: C Page Ref: 42 Topic: Setting Up and Solving Linear Programming Problems Using Excel's Solver Difficulty: Easy 12) Refer to Figure 1. What cell reference designates the *Target Cell* in "Solver"?

A) E4

B) B3

C) C3

D) D8:D10

E) E8:E10

Answer: A

Page Ref: 42

Topic: Setting Up and Solving Linear Programming Problems Using Excel's Solver Difficulty: Easy

13) The constraint for a given resource is given by the following equation:

 $2X1 + 3X2 \le 20$ If  $X_1 = 5$  and  $X_2 = 3$ , how many units of this resource are unused? A) 20 B) 19 C) 1 D) 0 E) 17 Answer: C Page Ref: 49 Topic: Setting Up and Solving Linear Programming Problems Using Excel's Solver **Difficulty:** Easy

14) The constraint for a given resource is given by the following equation:

 $2X1 + 3X2 \ge 20$ 

If  $X_1 = 5$  and  $X_2 = 4$  how many units of this resource are unused?

- A) 20
- B) 2

C) 22

D) 0

E) 9 Answer:

B Page Ref:

49

Topic: Setting Up and Solving Linear Programming Problems Using Excel's Solver **Difficulty: Easy** 

15) "Solver" typically generates which of the following report(s)? A) answer report
B) sensitivity analysis report
C) limits report
D) A and B only
E) A, B, and C
Answer: E Page
Ref: 48
Topic: Setting Up and Solving Linear Programming Problems Using Excel's Solver Difficulty: Easy

16) \_\_\_\_\_\_\_ systematically examines corner points, using algebraic steps, until an optimal solution is found.
A) The graphical approach
B) The simplex method C)
Karmarkar's method D)
Trial-and-error
E) none of the above
Answer: B
Page Ref: 52
Topic: Algebraic Solution Procedures for Linear Programming Problems
Difficulty: Moderate

17) \_\_\_\_\_\_ follows a path of points inside the feasible region to find an optimal solution.A) The graphical approachB) The simplex methodC) Karmarkar's method

D) Trial-and-error E) none of the above Answer: C Page Ref: 52 Topic: Algebraic Solution Procedures for Linear Programming Problems Difficulty: Moderate

18) If a linear programming problem has alternate optimal solutions, then the objective function value will vary according to each alternate optimal point.
Answer: FALSE
Page Ref: 38
Topic: Special Situations in Solving Linear Programming Problems
Difficulty: Moderate

19) Unbounded linear programming problems typically arise as a result of misformulation.Answer: TRUEPage Ref: 39Topic: Special Situations in Solving Linear Programming ProblemsDifficulty: Moderate

20) If an isoprofit line can be moved outward such that the objective function value can be made to reach infinity, then this problem has an unbounded solution.
Answer: TRUE
Page Ref: 39
Topic: Special Situations in Solving Linear Programming Problems
Difficulty: Easy

21) If a redundant constraint is eliminated from a linear programming model, this will have an impact on the optimal solution.
Answer: FALSE
Page Ref: 36
Topic: Special Situations in Solving Linear Programming Problems
Difficulty: Moderate

22) A linear programming model has the following two constraints:  $X_1 \ge 3$  and  $X_1 \ge 4$ . This model has a redundant constraint. Answer: TRUE Page Ref: 36 Topic: Special Situations in Solving Linear Programming Problems Difficulty: Easy

23) A linear programming problem has the following two constraints:  $X_1 \le 20$  and  $X_1 \ge 25$ . This problem is infeasible. Answer: TRUE Page Ref: 37 Topic: Special Situations in Solving Linear Programming Problems Difficulty: Easy

24) It is possible to solve graphically a linear programming model with 4 decision variables.Answer: FALSEPage Ref: 26Topic: Graphical Solution to a Linear Programming ModelDifficulty: Moderate

25) An isoprofit line represents a line whereby all profits are the same along the line. Answer: TRUEPage Ref: 29Topic: Graphical Solution to a Linear Programming ModelDifficulty: Easy

26) Linear programming models typically do not have coefficients (i.e., objective function or constraint coefficients) that assume random values.
Answer: TRUE
Page Ref: 22
Topic: Developing a Linear Programming Model
Difficulty: Moderate

27) It is possible for a linear programming model to yield an optimal solution that has fractional values. Answer: TRUEPage Ref: 22Topic: Developing a Linear Programming ModelDifficulty: Easy

28) A linear programming model has the following objective function: Max:  $X1^2 + 3X2 + 4X3$ . This model violates a key linear programming model assumption.

Answer: TRUE Page Ref: 22 Topic: Developing a Linear Programming Model Difficulty: Easy

29) In a product mix problem, a decision maker has limited availability of weekly labor hours. Labor hours would most likely constitute a decision variable rather than a constraint.
Answer: FALSE
Page Ref: 24
Topic: Formulating a Linear Programming Model
Difficulty: Easy

30) When using Solver, the parameter *Changing Cells* is typically associated with the objective function.
Answer: FALSE
Page Ref: 45
Topic: Setting Up and Solving Linear Programming Problems Using Excel's Solver
Difficulty: Easy

31) The simplex method is an algebraic solution procedure for a linear programming problem.
Answer: TRUE
Page Ref: 52
Topic: Algebraic Solution Procedures for Linear Programming Problems
Difficulty: Easy

32) Karmarkar's method is synonymous with the corner point method.Answer: FALSEPage Ref: 52Topic: Algebraic Solution Procedures for Linear Programming ProblemsDifficulty: Moderate

## 2.2 Excel Problems

1) Consider the following linear programming problem.

Maximize 6X1 + 4X2Subject to:  $X1 + 2X2 \le 16$  $3X1 + 2X2 \le 24$ X1 > 2

$$\begin{array}{l} x_1 \ge 2 \\ x_1, x_2 \ge 0 \end{array}$$

Use Solver to find the optimal values of X1 and X2.

	A	В	С	D	E	F
1						
2		<u>X1</u>	<u>X2</u>			
3	Profit Coefficients:	6	4		Decis	ion
4	Optimal Values:	10	0	+	varial	oles
5						
6	Constraint Coefficients:			L.H.S.		R.H.S.
7	Constraint 1	1	2	10	5	16
8	Constraint 2	3	2	30	5	30
9	Constraint 3	1	0	10	2	2
10						
11	Objective function value:	60				
12		-		optimal of		
13				function	value	
14						

2) Consider the following linear programming problem.

Maximize Subject to:	$\begin{array}{c} 5X1+3X2\\ X_{1}\\ +X2\leq 20 \end{array}$
	$\begin{array}{l} x_1 \geq 5 \\ x_2 \leq 10 \end{array}$
	$X_1, X_2 \ge 0$

Use Solver to find the optimal values of X1 and X2.

	A	В	С	D	E	F
1						
2		<u>X1</u>	<u>X2</u>		_	
3	Profit Coefficients:	5	3		Decis	ion
4	Optimal Values:	20	0	+	varial	oles
5						
6	Constraint Coefficients:			L.H.S.		R.H.S.
7	Constraint 1	1	1	20	5	20
8	Constraint 2	1	0	20	2	5
9	Constraint 3	0	1	0	5	10
10				7		
11	Objective function value:	100				
12		_		optimal of		
13				function	value	
14						

3) Consider the following linear programming problem.

Minimize Subject to:	$\begin{array}{c} 3X1+2X2\\ X_{1}\\ +X2\geq 10 \end{array}$
	$X_1 + X_2 \le 20$ $X_2 \le 10$ $X_1 \le 18$
	$X1, X2 \ge 0$

Use Solver to find the optimal values of X1 and X2.

	A	В	С	D	E	F
1						
2		<u>X1</u>	<u>X2</u>			
3	Cost Coefficients:	3	2		Decis	ion
4	Optimal Values:	0	10	+	varial	bles
5						
6	Constraint Coefficients:			L.H.S.		R.H.S.
7	Constraint 1	1	1	10	2	10
8	Constraint 2	1	1	10	5	20
9	Constraint 3	0	1	10	5	10
10	Constraint 4	1	0	0	5	18
11						
12						
13	Objective function value:	20				
14		_		optimal of		
15				function value		
16						

4) Consider the following linear programming problem.

Minimize Subject to:

Use Solver to find the optimal values of X1 and X2.

	A	В	С	D	E	F
1						
2		<u>X1</u>	<u>X2</u>		-	
3	Cost Coefficients:	6	3		Decis	C-REPORT OF THE REPORT OF THE
4	Optimal Values:	0	8		varial	oles
5						
6	Constraint Coefficients:			L.H.S.		R.H.S.
7	Constraint 1	2	4	32	2	16
8	Constraint 2	4	3	24	2	24
9						
10	Objective function value:	24				
11						
12				function value		
13		1, 1		1	1	

5) A computer retail store sells two types of flat screen monitors: 17 inches and 19 inches, with a profit contribution of \$300 and \$250, respectively. The monitors are ordered each week from an outside supplier. As an added feature, the retail store installs on each monitor a privacy filter that narrows the viewing angle so that only persons sitting directly in front of the monitor are able to see on-screen data. Each 19" monitor consumes about 30 minutes of installation time, while each 17" monitor requires about 10 minutes of installation time. The retail store has approximately 40 hours of labor time available each week. The total combined demand for both monitors is at least 40 monitors each week. How many units of each monitor should the retail store order each week to maximize its weekly profits and meet its weekly demand?

	A	В	С	D	E	F	G	Н
1					×			
2		<u>X1</u>	<u>X2</u>	ji				
3	Profit Coefficients:	300	250		Decis	ion		
4	Optimal Values:	0	240		varial	oles	3	
5								
6	Constraint Coefficients:			L.H.S.	8	R.H.S.	Units are	in
7	Constraint 1	30	10	2400	≤	2400	minutes	
8	Constraint 2	1	1	240	2	40	L	
9								
10	Objective function value:	60000						
11		1			objective			
12				function	value			
13	Formulation			-				
14	Max: 300 X1 + 250X2			11.4				
15	Subject to:							
16	30X1 + 10X2 ≤ 2400							
16 17 18	X1 + X2 ≥ 40							
	X1, X2 ≥ 0							
19								
20				10				

6) Creatine and protein are common supplements in most bodybuilding products. Bodyworks, a nutrition

health store, makes a powder supplement that combines creatine and protein from two ingredients (X1 and

X2). Ingredient X1 provides 20 grams of protein and 5 grams of creatine per pound. Ingredient X2

provides 15 grams of protein and 3 grams of creatine per pound. Ingredients X1 and X2 cost Bodyworks \$5 and \$7 per pound, respectively. Bodyworks wants its supplement to contain at least 30 grams of protein and 10 grams of creatine per pound and be produced at the least cost.

Determine what combination will maximize profits.

5	A	В	С	D	E	F
1						
2		<u>X1</u>	<u>X2</u>		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
3	Cost Coefficients:	5	7		Decis	Contraction of the second s
4	Optimal Values:	2	0	+	varial	oles
5						
6	Constraint Coefficients:			L.H.S.		R.H.S.
7	Constraint 1	20	15	40	2	30
8	Constraint 2	5	3	10	2	10
9						
10	Objective function value:	10				
11					objective	
12				function	value	
13	Formulation					
14	Min 5X1 + 7X2					
15	Subject to:					
16	20X1 + 15X2 ≥ 30					
17	5X1 + 3X2 ≥ 10					
18	X1, X2 ≥ 0					
19						
20						

7) A furniture store produces beds and desks for college students. The production process requires assembly and painting. Each bed requires 6 hours of assembly and 4 hours of painting. Each desk requires 4 hours of assembly and 8 hours of painting. There are 40 hours of assembly time and 45 hours of painting time available each week. Each bed generates \$35 of profit and each desk generates \$45 of profit. As a result of a labor strike, the furniture store is limited to producing at most 8 beds each week. Determine how many beds and desks should be produced each week to maximize weekly profits.

	A	В	C	D	E	F
1						
2		Beds	Desks			
3	Profit Coefficients:	\$ 35.00	\$ 45.00		Decis	1997
	Optimal Values:	4.375	3.4375	4	varial	oles
5						
6	Constraint Coefficients:			L.H.S.		R.H.S.
7	Constraint 1	6	4	40	5	40
8	Constraint 2	4	8	45	2	45
7.000	Constraint 3	1	0	4.375	5	8
0						
1						
	Objective function value:	\$ 307.81				
13			1000	optimal of		
4				function	value	
-	Formulation					0
6	Min 35 Beds + 45 Chairs					
17	Subject to:					
8	6 Beds + 4 Chairs ≤ 40 (1)	1				
19	4 Beds + 8 Chairs ≤ 45 (2)					
20	Beds ≤ 8 (3)					
21	Beds, Chairs ≥ 0					
22	Beds, Chairs ≥ 0					

8) An ice cream shop sells single scoop ice cream cones that come in three flavors: chocolate only, vanilla only, and chocolate-vanilla twist. The cones are prepackaged and sold to a supermarket daily. The ingredients used along with the minimum demand of each flavor are shown as follows:

		Ice Cream Flay	/or
	Chocolate	<u>Vanilla</u>	Chocolate-Vanilla
Ingredient:			
Chocolate	4 oz.	0 oz.	3 oz.
Vanilla	0 oz.	4 oz.	2 oz.
Min daily demand:	20 scoops	15 scoops	10 scoops

Each day, 40 pounds of chocolate and 38 pounds of vanilla are supplied to the ice cream shop from an outside vendor. The chocolate, vanilla, and chocolate-vanilla twist each yield a profit of \$2.00, \$2.50, and \$3.00 per cone, respectively. How many chocolate, vanilla, and chocolate-vanilla twist cones must prepackage daily to maximize daily profits?

	A	В	С	D	E	F	G
1							
2		Chocolate	Vanilla	Chocolate_Vanilla			
3		<u>X1</u>	<u>X2</u>	<u>X3</u>			Decision
4	Profit Coefficients:	2	2.5	3	a		variables
5	Optimal Values:	20	58.66667	186.6666667			
6							
7	Constraint Coefficients:				L.H.S.		R.H.S.
8	Constraint 1	4	0	3	640	5	640
9	Constraint 2	0	4	2	608	5	608
10	Constraint 3	1	0	0	20	2	20
11	Constraint 4	0	1	0	58.66667	2	15
12	Constraint 5	0	0	1	186.6667	2	10
13							
14	Objective function value:	746.6667		4			
15				optimal objective	/e		
16				function value			
17	Formulation						
18	Max 2X1 + 2.50X2 + 3X	3					
19	Subject to:						
20	4X1 + 3X3 ≤ 640						
21	4X2 + 2X3 ≤ 608						
22	X1 ≥ 20						
23	X2 ≥ 15						
24	X3 ≥ 10						
25	X1, X2, X3 ≥ 0						
25 26							

9) A company manufactures four products A, B, C, and D that must go through assembly, polishing, and packing before being shipped to a wholesaler. For each product, the time required for these operations is shown below (in minutes) as is the profit per unit sold.

Product	Assembly	Polish	Pack	Profit <u>(\$</u> )
А	2	3	2	1.50
В	4	2	3	2.50
С	3	3	2	3.00
D	7	4	5	4.50

The company estimates that each year they have 1667 hours of assembly time, 833 hours of polishing time and 1000 hours of packing time available. How many of each product should the company make per year to maximize its yearly profit?

	A	В	С	D	E	F	G	Н		J
1										
2		A	B	<u>C</u> 3	D		De		-	
3	Profit Coefficients	1.5	2.5	3	4.5			cision		
4	Optima Values:	0	16008	5988	0	4	var	iables		
5										
6	Constraint Coefficients:					L.H.S.		R.H.S.		
7	Constraint 1	2	4	3	7	81996	5	100020 ~		
8	Constraint 2	3	2	3	4	49980	5	49980	Units	
9	Constraint 3	2	3	2	5	60000	5	60000 -	minut	es
10										
11	Objective function value:	57984	-							
12						objective				
13					function	value				
14	Formulation			L						
15		0 1 50								
16	Max 1.50A + 2.50B + 3	C + 4.50	U					1		
17	Subject to:									
18	2A + 4B + 3C + 7D ≤ 1									
19	$3A + 2B + 3C + 4D \le 41$									
20	$2A + 3B + 2C + 5D \le 6$	0000								
21	A, B, C, D ≥ 0									
22										

10) Suppose that a farmer has 5 acres of land that can be planted with either wheat, corn, or a combination of the two. To ensure a healthy crop, a fertilizer and an insecticide must be applied at the beginning of the season before harvesting. The farmer currently has 100 pounds of the fertilizer and 150 pounds of the insecticide at the beginning of the season. Each acre of wheat planted requires 10 pounds of the fertilizer and 12 pounds of the insecticide. Each acre of corn planted requires 13 pounds of the fertilizer and 11 pounds of the insecticide. Each acre of wheat harvested yields a profit of \$600, while each acre of corn harvested yields \$750 in profit. What is the optimal allocation for the crops that maximizes the farmer's profit?

	A	B	C	D	E	F
1						
2		Wheat (W)	Com(C)		1220-12	10.000
3	Profit Coefficients:	600	750		Decis	ion
4	Optimal Values	0	5	+	varial	bles
5	Contraction of the second s					
6	Constraint Coefficients	1		LHS		RHS
7	Constraint 1	1	1	5	5	5
8	Constraint 2	10	13	65	5	100
9	Constraint 3	12	11	55	5	150
10						- 11 Act 1
11	Objective function value	3750			and the second s	10
12				optimal of	objective	1
13	10× 10×01			function	value	
14	Formulation					1
15	Max 600W + 750C	-				
16	Max 600vy + 750G					
17	Subject to: W + C ≤ 5					
18	W+USD					
15 16 17 18 19	10W + 13C ≤ 100					
20	1611 7 110 2 100					
21	W, C ≥ 0					

11) A carpenter makes tables and chairs. Each table can be sold for a profit of \$50 and each chair for a profit of \$30. The carpenter works a maximum of 40 hours per week and spends 5 hours to make a table and 2 hours to make a chair. Customer demand requires that he makes at least twice as many chairs as tables. The carpenter stores the finished products in his garage, and there is room for a maximum of 6 furniture pieces each week. Determine the carpenter's optimal production mix.

Answer:	
miswer.	

	A		В	С	D	E	F
1							
2		Tab	les (T)	Chairs (C)		1	
3	Profit Coefficients:	S	50.00	\$ 30.00		Decis	a second s
4	Optimal Values:		6	0	+	varial	oles
5							
6	Constraint Coefficients:				L.H.S.		R.H.S.
7	Constraint 1		5	2	30	5	40
8	Constraint 2		2	-1	12	2	0
9	Constraint 3		1	1	6	5	6
10							
11	Objective function value:	S	300.00				
12						objective	
13					function	value	
14	Formulation		1000				
15	Max 50T + 30C						
16	Subject to:						
17	5T + 2C ≤ 40 (1)						
18	2T - C ≥ 0 (2)						
19	$T + C \le 6 (3)$						
20	T, C ≥ 0						
			121				

12) A bank is attempting to determine where its assets should be allocated in order to maximize its annual return. At present, \$750,000 is available for investment in three types of mutual funds: A, B, and C. The annual rate of return on each type of fund is as follows: fund A, 15%; fund B, 12%; fund C; 13%. The bank's manager has placed the following restrictions on the bank's portfolio:

- No more than 20% of the total amount invested may be in fund A.
- The amount invested in fund B cannot exceed the amount invested in fund C.

Determine the optimal allocation that maximizes the bank's annual return.

	А	В	С	D	E	F	G	Н
1								
2	65	Fund A	Fund B	Fund C				
3	Profit Coefficients	1.15	1.12	1.13			Decision	
4	Optimal Values:	150000	300000	300000	<		Variables	
5							1	
6	Constraint Coefficients				L.H.S.		R.H.S	
7	Constraint 1	1	0	0	150000	≤	150000	
8	Constraint 2	0	1	-1	0	≥	0	
9	Constraint 3	1	1	1	750000	≤	750000	
10								
11	Objective function value	847500						
12	Rate of return	0.13						
13			~					
14				(	Dbjective			
15				1	unction va	lue		
16	Max 1.15A + 1.12	2B + 1.13C						
17	Subjectto: A≤150,000						1	
18	A ≤ 150,000 B-C≥0							
19	A+B+C≤750,0	00						
20	A, B, C≥0							
21								
22								
23								
24								

13) A warehouse stocks five different products, A, B, C, and D. The warehouse has a total of 100,000 square feet of floor space available to accommodate all the products that it inventories. The monthly profit per square foot for each product is as follows:

Product	Profit per square foot
А	\$4.50
В	\$3.00
С	\$2.75
D	\$3.75

allocated to each product to maximize profit.

Each product must have at least 10,000 ft $^2$ , and no single product can have more than 25% of the total warehouse space. The warehouse manager wants to know the floor space that should be

	A	В	С	D	E	F	G	Н
1								
2		A	B	<u>c</u>	D			
3	Profit Coefficients:	\$ 4.50	\$ 3.00	\$ 2.75	\$ 3.75			Decision
4	Optimal Values:	10000	10000	10000	10000	4		variables
5								100
6	Constraint Coefficients:					L.H.S.		R.H.S.
7	Constraint 1	1	1	1	1	40000	5	100000
8	Constraint 2	1	0	0	0	10000	\$	25000
9	Constraint 3	0	1	0	0	10000	5	25000
10	Constraint 4	0	0	1	0	10000	\$	25000
11	Constraint 5	0	0	0	1	10000	5	25000
12	Constraint 6	1	0	0	0	10000	≥	10000
13	Constraint 7	0	1	0	0	10000	≥	10000
14	Constraint 8	0	0	1	0	10000	2	10000
15	Constraint 9	0	0	0	1	10000	≥	10000
16								
17	Objective function value	\$140,000.00		30	<u></u>			
18				optimal	objective			
19				function	value			
20	Formulation					1.		
21	Max 4.50A + 3B + 2.750	1 2 75D						
22	Subject to:	110.700						
23	A + B + C + D ≤ 100,00	0.(1)						
24		0(1)			-			
25	A ≤ 25000 (2)							
26	B ≤ 25000 (3)							
20	C ≤ 25000 (4)		-		-			
27	D ≤ 25000 (5)							
28	A ≥ 10000 (6)							
29	B ≥ 10000 (7)					3		
30	C ≥ 10000 (8)							
31				-				
32	D ≥ 10000 (9)					-		
	A, B, C, D ≥ 0		2					
33								

14) A company that is introducing a new product would like to generate maximum market exposure. The marketing department currently has \$100,000 of advertising budget for the year and is considering placing ads in three media: radio, television, and newspapers. The cost per ad and the exposure rating are as follows:

	Cost/ad	Exposure/ad
Radio	\$10,000	30,000 individuals
Television	\$25,000	50,000 individuals
Newspaper	\$5000	20,000 individuals

The marketing department would like to place twice as many radio ads as television ads. They also would like to place at least 4 ads in each advertising media. What is the optimal allocation to each advertising medium to maximize audience exposure?

	A	В	Formula Bar	D	E	F	G
1							
2			Statistics of the				
3		Radio (R)	Television (T)	Newspaper (N)			Decision
4	Exposure/ad	30,000.00	50,000.00	20,000.00	a		variables
5	Optimal Values:	4	2	2	100		
6		_					
7	Constraint Coefficients:				L.H.S.		R.H.S.
8	Constraint 1	10000	25000	5000	100000	5	100,000
9	Constraint 2	1	0	0	4	2	2
10	Constraint 3	0	1	0	2	2	2
11	Constraint 4	0	0	1	2	2	2
12	Constraint 5	1	-2	0	0	2	0
13							
14	Objective function value:	260000	no.		_		
15				optimal objec			
16				function value	9		
17	Formulation						
18	Max 30,000R + 50,000T	+ 20 000N					
19	Subject to:	. 20,00011					
20	10,000R + 25,000T + 50	$100N \le 750.0$	00				
21	R≥2						
22	T≥2						
23	N ≥ 2						
24	R - 2T ≥ 0						
25	A, B, C ≥ 0						
26	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						
27			-				

15) A meat packing store produces a dog food mixture that is sold to pet retail outlets in bags of 10 pounds each. The food mixture contains the ingredients turkey and beef. The cost per pound of each of these ingredients is as follows:

Ingredient	Cost/pound
Turkey	\$2.00
Beef	\$5.50

Each bag must contain at least 5 pounds of turkey. Moreover, the ratio of turkey to beef must be at least 2 to 1. What is the optimal mixture of the ingredients that will minimize total cost?

A	В	С	D	E	F
	Turkey (T)	Beef (B)			
CostCoefficients:	2	5.5		Decis	ion
Optimal Values:	10	0		variables	
Constraint Coefficients:			L.H.S.		R.H.S.
Constraint 1	1	1	10	=	10
Constraint 2	1	-2	10	Z	0
Constraint 3	1	0	10	2	5
			[		
	20		-		6
			function value		
Formulation					S.
Min 2 00T + 5 50B					
A STATE OF A STATE AND A ST					
100,020					
	CostCoefficients: Optimal Values: Constraint Coefficients: Constraint 1 Constraint 2 Constraint 3 Objective function value:	Turkey (T)CostCoefficients:2Optimal Values:10Constraint Coefficients:10Constraint 11Constraint 21Constraint 31Objective function value:20FormulationMin 2.00T + 5.50BSubject to:1T + B = 101T - 2B $\ge 0$ 1T $\ge 5$ 1	Turkey (T)Beef (B)CostCoefficients:25.5Optimal Values:100Constraint Coefficients:0Constraint 111Constraint 21-2Constraint 310Objective function value:20FormulationMin 2.00T + 5.50BSubject to:-T + B = 10-T - 2B $\ge 0$ -T $\ge 5$ -	Turkey (T)Beef (B)CostCoefficients:25.5Optimal Values:100Constraint Coefficients:L.H.S.Constraint 111Constraint 21-2Constraint 310Objective function value:20optimal of functionMin 2.00T + 5.50BSubject to:	Turkey (I)Beef (B)CostCoefficients:25.5Optimal Values:100Constraint Coefficients:L.H.S.Constraint 111Constraint 21Constraint 310Objective function value:20optimal objective function value:Formulation0Min 2.00T + 5.50B0Subject to:7 + B = 10T + B = 107 - 2B ≥ 0T ≥ 50

16) A company can decide how many additional labor hours to acquire for a given week. Subcontractors will only work a maximum of 20 hours a week. The company must produce at least 200 units of product A, 300 units of product B, and 400 units of product C. In 1 hour of work, worker 1 can produce 15 units of product A, 10 units of product B, and 30 units of product C. Worker 2 can produce 5 units of product B, 20 units of product B, and 35 units of product C. Worker 3 can produce 20 units of product A, 15 units of product B, and 25 units of product C. Worker 1 demands a salary of \$50/hr, worker 2 demands a salary of \$40/hr, and worker 3 demands a salary of \$45/hr. The company must choose how many hours they should hire from each worker to meet their production requirements and minimize labor cost.

	Product A (A)	Product B (B)	Product C (C)		1	Decision	
Cost Coefficients	50	40	45			Variables	
Optimal Values	0	9.230769231	7.692307692	-		-	
Constraint Coefficients				L.H.S.		<u>R.H.S</u>	
Constraint 1	15	5	20	200	≥	200	
Constraint 2	10	20	15	300	≥	300	
Constraint 3	30	35	25	515.3846	≥	400	
Constraint 4	1	0	0	0	≤	20	
Constraint 5	0	1	0	9.230769	≤	20	
Constraint 6	0	0	1	7.692308	≤	20	
Objective function value	715.3846154		nal objective				
Formulation			ion value			_	
Min 50A + 40B + 45C Subjectto: $15A + 5B + 20C \ge 200$ $10A + 20B + 15C \ge 300$ $30A + 35B + 25C \ge 400$ A,B,C $\le 20$ A,B,C $\ge 0$							