Test Bank for Introduction to Management Science 12th Taylor

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Introduction to Management Science, 12e **(Taylor)**
Chapter 2 Linear Programming: Model Formulation and Graphical Solution

1) Linear programming is a model consisting of linear relationships representing a firm's decisions given an objective and resource constraints.
Answer: TRUE
Diff: 2 Page Ref: 32
Section Heading: Model Formulation
Keywords: model formulation
AACSB: Analytical thinking

2) The objective function always consists of either maximizing or minimizing some value.
Answer: TRUE
Diff: 2 Page Ref: 32
Section Heading: Model Formulation
Keywords: objective function
AACSB: Analytical thinking

3) The objective function is a linear relationship reflecting the objective of an operation.
Answer: TRUE
Diff: 1 Page Ref: 32
Section Heading: Model Formulation
Keywords: model formulation
AACSB: Analytical thinking

4) A constraint is a linear relationship representing a restriction on decision making.
Answer: TRUE
Diff: 1 Page Ref: 32
Section Heading: Model Formulation
Keywords: model formulation
AACSB: Analytical thinking

5) Proportionality means the slope of a constraint is proportional to the slope of the objective function.
Answer: FALSE
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: properties of linear programming models, proportionality
AACSB: Analytical thinking

6) The terms in the objective function or constraints are additive.
Answer: TRUE
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: properties of linear programming models, additive
AACSB: Analytical thinking

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7) The terms in the objective function or constraints are multiplicative.
Answer: FALSE
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: properties of linear programming models, additive
AACSB: Analytical thinking

8) All linear programming models exhibit a set of constraints.
Answer: TRUE
Diff: 1 Page Ref: 32
Section Heading: Model Formulation
Keywords: properties of linear programming models, constraints
AACSB: Analytical thinking

9) When using the graphical method, only one of the four quadrants of an xy-axis needs to be drawn.
Answer: TRUE
Diff: 1 Page Ref: 37
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical linear programming
AACSB: Analytical thinking

10) Linear programming models exhibit linearity among all constraint relationships and the objective function.
Answer: TRUE
Diff: 1 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: properties of linear prog models, linearity, proportionality
AACSB: Analytical thinking

11) The equation $8xy = 32$ satisfies the proportionality property of linear programming.
Answer: FALSE
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: graphical solution, proportionality
AACSB: Analytical thinking

12) Typically, finding a corner point for the feasible region involves solving a set of three simultaneous equations.
Answer: FALSE
Diff: 2 Page Ref: 43
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, extreme points, feasible region
AACSB: Analytical thinking

13) Objective functions in linear programs always minimize costs.
Answer: FALSE
Diff: 2 Page Ref: 32
Section Heading: Model Formulation
Keywords: properties of linear programming models, objective function
AACSB: Analytical thinking

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14) The feasible solution area contains infinite solutions to the linear program.
Answer: TRUE
Diff: 1 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: properties of linear programming models, feasible solution area
AACSB: Analytical thinking

15) There is exactly one optimal solution point to a linear program.
Answer: FALSE
Diff: 2 Page Ref: 55
Section Heading: Irregular Types of Linear Programming Problems
Keywords: properties of linear programming models, optimal solution pt
AACSB: Analytical thinking

16) The following equation represents a resource constraint for a maximization problem: $X + Y \geq 20$.
Answer: FALSE
Diff: 2 Page Ref: 34
Section Heading: A Maximization Model Example
Keywords: properties of linear programming models, constraints
AACSB: Analytical thinking

17) The optimal solution for a graphical linear programming problem is the corner point that is the farthest from the origin.
Answer: FALSE
Diff: 2 Page Ref: 40
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: feasibility, constraints
AACSB: Analytical thinking

18) A minimization model of a linear program contains only surplus variables.
Answer: FALSE
Diff: 1 Page Ref: 53
Section Heading: A Minimization Model Example
Keywords: properties of linear programming models, surplus variables
AACSB: Analytical thinking

19) In the graphical approach, simultaneous equations may be used to solve for the optimal solution point.
Answer: TRUE
Diff: 2 Page Ref: 43
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

20) Slack variables are only associated with maximization problems.
Answer: FALSE
Diff: 2 Page Ref: 45
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, slack variables
AACSB: Analytical thinking

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21) Surplus variables are only associated with minimization problems.
Answer: FALSE
Diff: 2 Page Ref: 53
Section Heading: A Minimization Model Example
Keywords: graphical solution, surplus variable
AACSB: Analytical thinking

22) If the objective function is parallel to a constraint, the constraint is infeasible.
Answer: FALSE
Diff: 2 Page Ref: 55
Section Heading: Irregular Types of Linear Programming Problems
Keywords: graphical solution
AACSB: Analytical thinking

23) Multiple optimal solutions occur when constraints are parallel to each other.
Answer: FALSE
Diff: 2 Page Ref: 55
Section Heading: Irregular Types of Linear Programming Problems
Keywords: graphical solution
AACSB: Analytical thinking

24) Graphical solutions to linear programming problems have an infinite number of possible objective function lines.
Answer: TRUE
Diff: 2 Page Ref: 40
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, objective function line
AACSB: Analytical thinking

25) The first step in formulating a linear programming model is to define the objective function.
Answer: FALSE
Diff: 2 Page Ref: 32
Section Heading: Introduction
Keywords: linear programming problems, formulation
AACSB: Analytical thinking

26) A linear programming problem requires a choice between alternative courses of action.
Answer: TRUE
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming problems, formulation
AACSB: Application of knowledge

27) The term *continuous* is synonymous with *divisible* in the context of linear programming.
Answer: TRUE
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming problems, formulation
AACSB: Application of knowledge

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28) Linear programming problems can model decreasing marginal returns.
Answer: FALSE
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming problems, formulation
AACSB: Application of knowledge

29) _____ are mathematical symbols representing levels of activity.
Answer: Decision variables
Diff: 1 Page Ref: 32
Section Heading: Model Formulation
Keywords: decision variables, model formulation
AACSB: Analytical thinking

30) A _____ is a linear relationship representing a restriction on decision making.
Answer: constraint
Diff: 1 Page Ref: 32
Section Heading: Model Formulation
Keywords: constraint, model formulation
AACSB: Analytical thinking

31) If at least one constraint in a linear programming model is violated, the solution is said to be _____.
Answer: infeasible
Diff: 1 Page Ref: 55
Section Heading: Irregular Types of Linear Programming Problems
Keywords: constraint, infeasible solution
AACSB: Analytical thinking

32) A graphical solution is limited to solving linear programming problems with _____ decision variables.
Answer: two
Diff: 1 Page Ref: 36
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

33) The _____ solution area is an area bounded by the constraint equations.
Answer: feasible
Diff: 1 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

34) Multiple optimal solutions can occur when the objective function line is _____ to a constraint line.
Answer: parallel
Diff: 2 Page Ref: 45
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, multiple optimal solutions
AACSB: Analytical thinking

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35) When a maximization problem is _____, the objective function can increase indefinitely without reaching a maximum value.
Answer: unbounded
Diff: 2 Page Ref: 56
Section Heading: Irregular Types of Linear Programming Problems
Keywords: graphical solution, unbounded problem
AACSB: Analytical thinking

36) The best feasible solution is _____.
Answer: optimal
Diff: 1 Page Ref: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: optimal solutions
AACSB: Analytical thinking

37) In a constraint, the _____ variable represents unused resources.
Answer: slack
Diff: 1 Page Ref: 45
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, surplus variable
AACSB: Analytical thinking

38) _____ is the difference between the left- and right-hand sides of a greater than or equal to constraint.
Answer: Surplus
Diff: 1 Page Ref: 53
Section Heading: A Minimization Model Example
Keywords: surplus
AACSB: Analytical thinking

39) If the objective function is parallel to a constraint, the linear program could have _____.
Answer: multiple optimal solutions
Diff: 2 Page Ref: 45
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solutions, multiple optimal solutions
AACSB: Analytical thinking

40) Corner points on the boundary of the feasible solution area are called _____ points.
Answer: extreme
Diff: 1 Page Ref: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: feasibility, constraints
AACSB: Analytical thinking

41) _____ are at the endpoints of the constraint line segment that the objective function parallels.
Answer: Alternate optimal solutions
Diff: 3 Page Ref: 55
Section Heading: Irregular Types of Linear Programming Problems
Keywords: alternative optimal solutions, multiple optimal solutions
AACSB: Analytical thinking

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42) The _____ step in formulating a linear programming model is to define the decision variables.
Answer: first
Diff: 1 Page Ref: 34
Section Heading: A Maximization Model Example
Keywords: linear programming, formulation
AACSB: Analytical thinking

43) The management scientist constructed a linear program to help the alchemist maximize his gold production process. The computer model chugged away for a few minutes and returned an answer of infinite profit., which is what might be expected from a(n) _____ problem.
Answer: unbounded
Diff: 1 Page Ref: 56
Section Heading: Irregular Types of Linear Programming Problems
Keywords: unbounded
AACSB: Analytical thinking

44) The _____ property of linear programming models indicates that the rate of change, or slope, of the objective function or a constraint is constant.
Answer: proportionality or linearity
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: properties of linear programming models, certainty
AACSB: Analytical thinking

45) The objective function 3x + 2y + 4xy violates the assumption of _____.
Answer: proportionality
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming properties
AACSB: Application of knowledge

46) Mildred is attempting to prepare an optimal quantity of macaroni and cheese for the potluck supper this Sunday. The instructions indicate that one cup of water is needed for each box she needs to prepare. She sleeps well on Saturday night, secure in her knowledge that she knows the precise amount of water she will need the next day. This knowledge illustrates the assumption of _____.
Answer: certainty
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming properties
AACSB: Application of knowledge

47) *Tim!* airlines procurement division works with their linear programming algorithm to secure contracts for gasoline for the coming year. After twenty minutes of thinking, the computer suggests that they secure 425.8125 contracts with their suppliers. This value illustrates the assumption of _____ in linear programming models.
Answer: divisibility or continuous
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming properties
AACSB: Application of knowledge

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48) Solve the following graphically:

Max z = $3x_1 + 4x_2$

s.t. $x_1 + 2x_2 \le 16$

$2x_1 + 3x_2 \le 18$

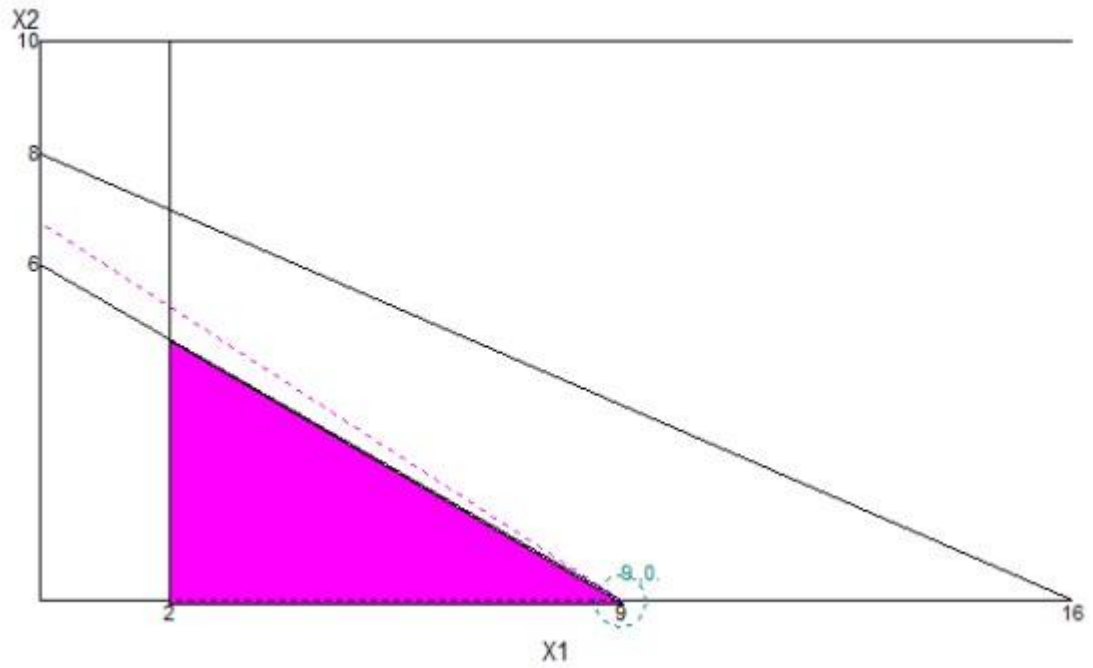
$x_1 \ge 2$

$x_2 \le 10$

$x_1, x_2 \ge 0$

What are the optimal values of x_1, x_2, and z?

Answer: $x_1 = 9$, $x_2 = 0$, $z = 27$



Diff: 3 Page Ref: 37-41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, simultaneous solution
AACSB: Analytical thinking

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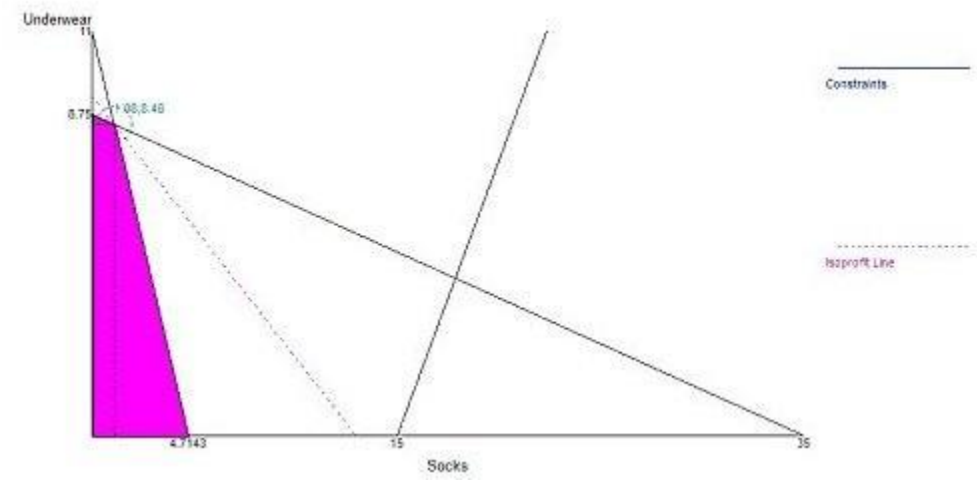
49) A novice business analyst develops the following model to determine the optimal combination of socks and underwear to take on his next business trip. The model is as follows:
Maximize 5S+7U
subject to:

$3S - 2U \leq 45$
$7S + 3U \leq 33$
$2S + 8U \leq 70$

Solve this problem graphically and determine how many of each item the analyst should pack.
Answer: The optimal solution lies at the point representing 1.08 socks and 8.48 underwear. I suppose this is why I referred to the analyst as a novice.



Corner points and the objective function value in (Socks,Underwear) order are:
Z(0,0)=0
Z(4.714,0)=23.57
Z(0,8.75)=61.25
Z(1.08. 8.48)=64.76 optimal
Diff: 3 Page Ref: 37-41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

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50) Nathan enters the final exam period needing to pull off a miracle to pass his three toughest classes, Healthy Life Choices, Success Central, and Walking Fitness. Naturally he would also prefer to expend as little effort as possible doing so and as luck would have it, he knows a guy that can help optimize his time and GPA using the magic of management science. The model they develop is built around the notion of time spent studying and doing all the assignments he has neglected throughout the semester. The model is as follows, where S represents time spent studying (in minutes) and A represents time spent making up assignments (also in minutes).

Maximize Z = 6S + 4A

subject to:

HLC $12S+10A \geq 100$

SC $6S + 8A \geq 64$

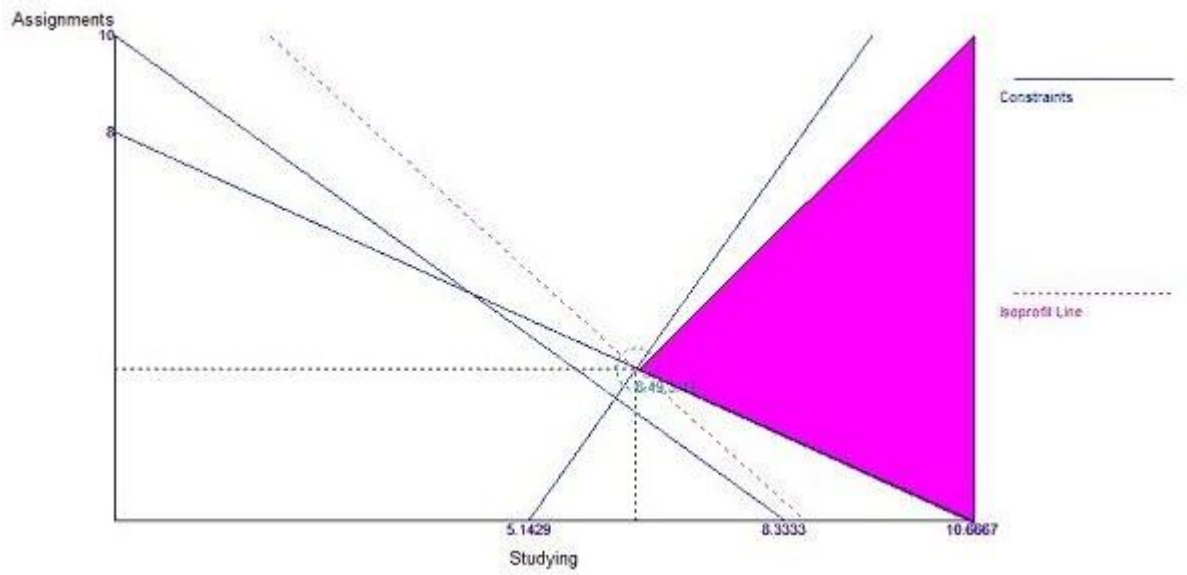
W $7S - 3A \geq 36$

Graphing was never one of Nathan's strengths, so it is up to you to develop a graphical solution to his problem and advise him on how much time should be invested in studying and how much time should be spent catching up on assignments.

Answer: The two corner points meriting investigation are (in (Studying, Assignments) order)

Z(10.67,0)=64

Z(6.48,3.13)=51.46 the optimal solution



So, 6 minutes of studying and 3 minutes of working on assignments was all that was required for my first born to successfully complete his first semester with something other than a 0.0 GPA. Sad, but true.

Diff: 2 Page Ref: 51-52

Section Heading: A Minimization Model Example

Keywords: graphical solution

AACSB: Analytical thinking

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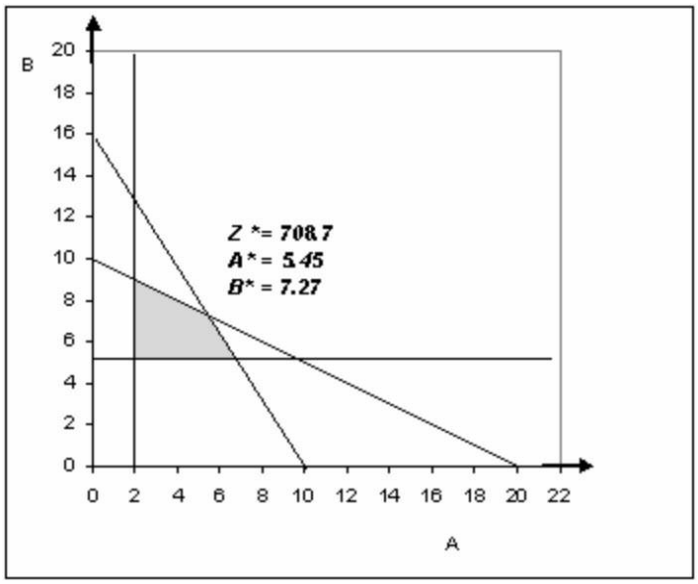
51) Consider the following linear program:

MAX $Z = 60A + 50B$
s.t. $10A + 20B \leq 200$
$8A + 5B \leq 80$
$A \geq 2$
$B \geq 5$

Solve this linear program graphically and determine the optimal quantities of A, B, and the value of Z.
Answer: Solution shown below.



Diff: 2 Page Ref: 37-41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical linear programming
AACSB: Analytical thinking

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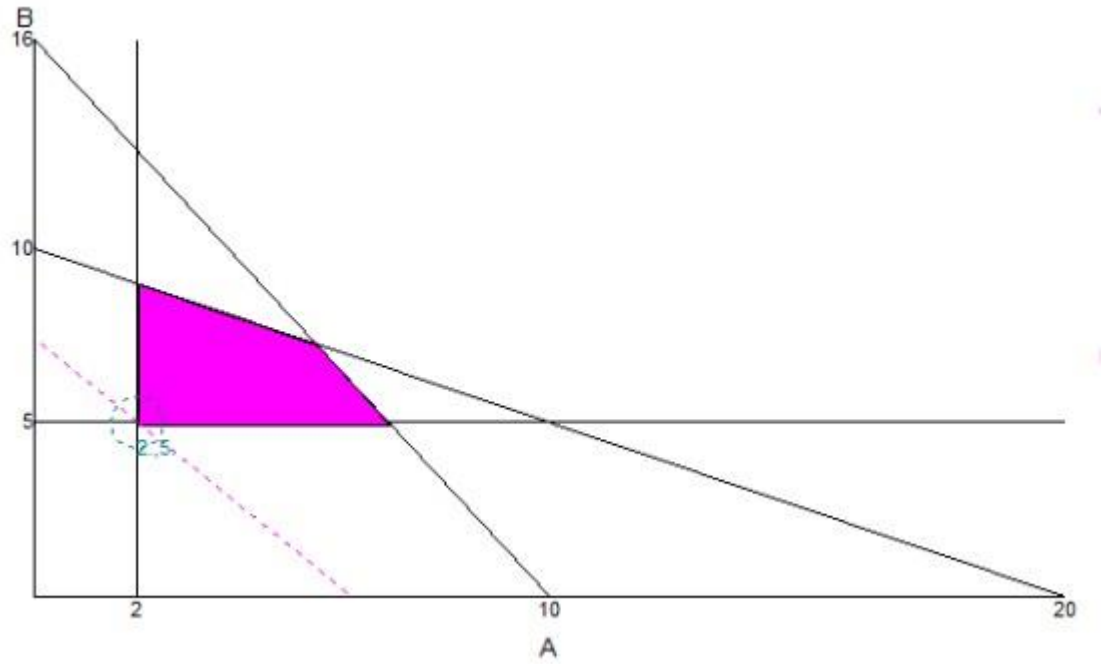
52) Consider the following linear program:

MIN	Z = 60A + 50B
s.t.	10A + 20B ≤ 200
	8A + 5B ≤ 80
	A ≥ 2
	B ≥ 5

Solve this linear program graphically and determine the optimal quantities of A, B, and the value of Z.
Answer: A = 2, B = 5, Z = 370



Diff: 2 Page Ref: 37-41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical linear programming
AACSB: Analytical thinking

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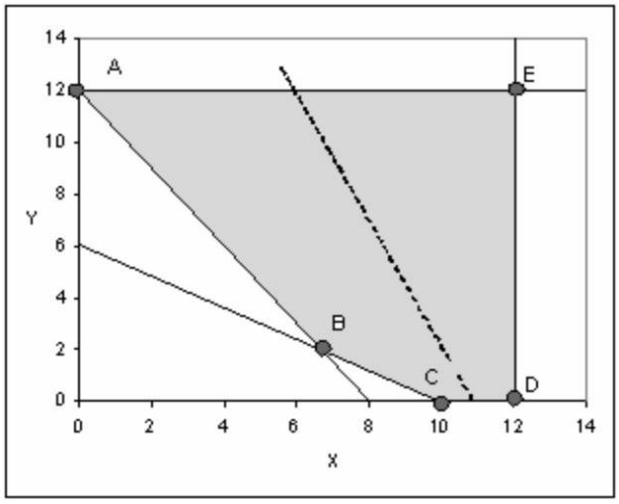
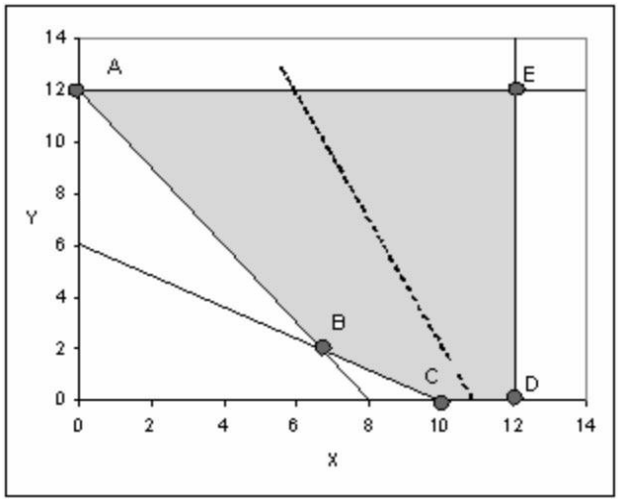
53) A graphical representation of a linear program is shown below. The shaded area represents the feasible region, and the dashed line in the middle is the slope of the objective function.



If this is a maximization, which extreme point is the optimal solution?
Answer: E
Diff: 1 Page Ref: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, extreme points, feasible region
AACSB: Analytical thinking

54) A graphical representation of a linear program is shown below. The shaded area represents the feasible region, and the dashed line in the middle is the slope of the objective function.



If this is a minimization, which extreme point is the optimal solution?
Answer: A
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Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, extreme points, feasible region
AACSB: Analytical thinking

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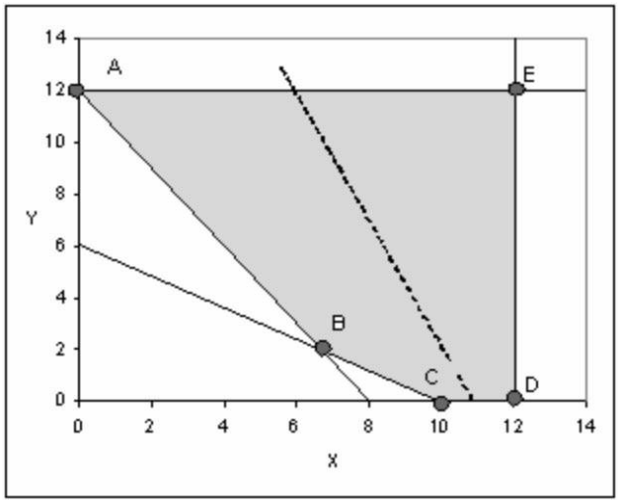
55) A graphical representation of a linear program is shown below. The shaded area represents the feasible region, and the dashed line in the middle is the slope of the objective function.



What would the be the new slope of the objective function if multiple optimal solutions occurred along line segment AB?

Answer: -3/2

Diff: 2 Page Ref: 55

Section Heading: Irregular Types of Linear Programming Problems

Keywords: graphical solution, multiple optimal solutions

AACSB: Analytical thinking

56) Consider the following linear programming problem:

Max Z = $\$15x + \$20y$

Subject to: $8x + 5y \leq 40$

$0.4x + y \geq 4$

$x, y \geq 0$

Determine the values for x and y that will maximize revenue. Given this optimal revenue, what is the amount of slack associated with the first constraint?

Answer: x = 0, y = 8, revenue = \$160, $s_1 = 0$

Diff: 2 Page Ref: 46

Section Heading: Graphical Solutions of Linear Programming Models

Keywords: graphical solution, slack variables

AACSB: Analytical thinking

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57) Given this model
Maximize Z = 6S + 4A
subject to:
12S + 10A ≥ 100
6S + 8A ≥ 64
7S - 3A ≥ 36
What is the optimal solution and the surplus associated with the first constraint?
Answer: The optimal solution lies at S = 6.48 and A = 3.13.
The s1 variable is 9.1892
Diff: 2 Page Ref: 52
Section Heading: A Minimization Model Example
Keywords: surplus
AACSB: Analytical thinking

58) The poultry farmer decided to make his own chicken scratch by combining alfalfa and corn in rail car quantities. A rail car of corn costs $400 and a rail car of alfalfa costs $200. The farmer's chickens have a minimum daily requirement of vitamin K (500 milligrams) and iron (400 milligrams), but it doesn't matter whether those elements come from corn, alfalfa, or some other grain. A unit of corn contains 150 milligrams of vitamin K and 75 milligrams of iron. A unit of alfalfa contains 250 milligrams of vitamin K and 50 milligrams of iron. Formulate the linear programming model for this situation.
Answer:
Min Z = $4005C + $200A
Subject to: 150C + 250A ≥ 500
75C + 50A ≥ 400
C, A ≥ 0
Diff: 3 Page Ref: 34-35
Section Heading: A Maximization Model Example
Keywords: constraint, model formulation
AACSB: Analytical thinking

59) Consider the following linear programming problem:
MIN Z = $3x_1 + 2x_2$
Subject to: $2x_1 + 3x_2 \geq 12$
$5x_1 + 8x_2 \geq 37$
$x_1, x_2 \geq 0$
What is minimum cost and the value of x_1 and x_2 at the optimal solution?
Answer: 9.25 at $x_1 = 0$ and $x_2 = 4.625$
Diff: 3 Page Ref: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: minimization problem
AACSB: Analytical thinking

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60) Consider the following linear programming problem:

MIN Z = $3x_1 + 2x_2$

Subject to: $2x_1 + 3x_2 \geq 12$

$5x_1 + 8x_2 \geq 37$

$x_1, x_2 \geq 0$

What is minimum cost and the value of x_1 and x_2 at the optimal solution?

Answer: 9.25 at $x_1 = 0$ and $x_2 = 4.625$

Diff: 3 Page Ref: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: minimization problem
AACSB: Analytical thinking

61) Ponder the following linear programming problem:

MIN Z = $3x_1 + 8x_2$

Subject to: $3x_1 + 4x_2 \geq 52$

$3x_1 + 4x_2 \geq 38$

$x_1, x_2 \geq 0$

What is minimum cost and the value of x_1 and x_2 at the optimal solution?

Answer: 52 at $x_1 = 17.33$ and $x_2 = 0.0$

Diff: 3 Page Ref: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: minimization problem
AACSB: Analytical thinking

62) The international man of mystery knew the finest haberdashers the world over and constantly sought to expand his dazzling array of fine suits, ties, and cufflinks. Closet space was at a premium however, so purchases were carefully weighed. Each suit provides 23 units of dazzlement, each tie 14, and a set of cufflinks is worth an easy 8. A suit takes up 0.5 cubic feet of closet space and $900 of budget. A tie costs $135 and cufflinks cost $100 per set. Cufflinks are tiny — even in the original box, they take up only .01 cubic feet while ties occupy a lusty .25 cubic feet. He has budgeted $12,000 for clothes on this trip and has 20 cubic feet of closet space left to fill.
Formulate an objective function and constraints to model this situation.

Answer: Max Dazzlement = 23S + 14T + 8C
subject to:
900S + 135T + 100C ≤ 12,000
0.5S + 0.25T + 0.01C ≤ 20

Diff: 3 Page Ref: 34
Section Heading: A Maximization Model Example
Keywords: linear programming formulation
AACSB: Analytical thinking

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63) Ponder the following linear programming problem:

Max Z = $5x_1 + 6x_2$

Subject to: $3x_1 + 4x_2 \leq 76$

$8x_1 + 9x_2 \leq 123$

$3x_1 + 3x_2 \leq 56$

$x_1, x_2 \geq 0$

What is the optimal solution point?

Answer: 12.31 at x_1 and 2.72 at x_2 for an objective function value of 77.897

Diff: 3 Page Ref: 40
Section Heading: A Maximization Model Example
Keywords: optimal solutions
AACSB: Analytical thinking

64) List the four properties of linear programming models and provide an example of a violation of each.
Answer: Properties and brief discussions are contained in the table. Counter examples will vary.

Proportionality	The slope of a constraint or objective function is constant. There are no increasing or decreasing marginal returns on either.
Additivity	Strictly linear functions - there are no interaction effects among decision variables.
Divisibility	Non-integer values of decision variables are OK.
Certainty	All model parameters are known exactly.

Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming properties
AACSB: Application of knowledge

65) Formulate all elements of linear program to model your university effort. Include a narrative that explains each of the components.
Answer: Answers will vary, perhaps dramatically. A noble objective function would seek to maximize a GPA or minimize total cost. Constraints would likely include budget, hours in a day, financial capital, conflicts with social endeavors, and others.
Diff: 2 Page Ref: 32
Section Heading: Model Formulation
Keywords: linear programming properties
AACSB: Application of knowledge

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66) Consider the following linear programming problem:

MIN Z = $10x_1 + 20x_2$

Subject to: $x_1 + x_2 \geq 12$

$2x_1 + 5x_2 \geq 40$

$x_2 \leq 13$

$x_1, x_2 \geq 0$

At the optimal solution, what is the value of surplus associated with constraint 1 and constraint 3, respectively?

Answer: constraint 1: (0 surplus), constraint 2: (7.667 surplus)

Diff: 2 Page Ref: 50-54

Section Heading: A Minimization Model Example

Keywords: graphical solution

AACSB: Analytical thinking

67) Given this set of constraints, for what objective function is the point x=5, y=3 in the feasible region?

s.t $3x + 6y \leq 30$

$10x + 10y \leq 60$

$10x + 15y \leq 90$

Answer: No objective function can move that point into the feasible region.

Diff: 2 Page Ref: 40

Section Heading: Graphical Solutions of Linear Programming Models

Keywords: feasibility, constraints

AACSB: Analytical thinking

68) Consider the following linear programming problem:

MIN Z = $2x_1 + 3x_2$

Subject to: $x_1 + 2x_2 \leq 20$

$5x_1 + x_2 \leq 40$

$4x_1 + 6x_2 \leq 60$

$x_1 , x_2 \geq 0$

What is the optimal solution?

Answer: Multiple optimal solutions exist between the extreme point (0,10) and (6.92,5.38) along the line with a slope of -2/3.

Diff: 2 Page Ref: 50-51

Section Heading: A Minimization Model Example

Keywords: graphical solution, multiple optimal solutions

AACSB: Analytical thinking

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69) A company producing a standard line and a deluxe line of dishwashers has the following time requirements (in minutes) in departments where either model can be processed.

	Standard	Deluxe
Stamping	3	6
Motor installation	10	10
Wiring	10	15

The standard models contribute $20 each and the deluxe $30 each to profits. Because the company produces other items that share resources used to make the dishwashers, the stamping machine is available only 30 minutes per hour, on average. The motor installation production line has 60 minutes available each hour. There are two lines for wiring, so the time availability is 90 minutes per hour.

Let x = number of standard dishwashers produced per hour
y = number of deluxe dishwashers produced per hour

Write the formulation for this linear program.
Answer: Max $20x + 30y$
s.t $3x + 6y \leq 30$
$10x + 10y \leq 60$
$10x + 15y \leq 90$
Diff: 2 Page Ref: 34-35
Section Heading: A Maximization Model Example
Keywords: formulation, objective function, constraints
AACSB: Analytical thinking

70) In a linear programming problem, the binding constraints for the optimal solution are:

$5x_1 + 3x_2 \leq 30$
$2x_1 + 5x_2 \leq 20$

As long as the slope of the objective function stays between _____ and _____, the current optimal solution point will remain optimal.
Answer: -5/3, -2/5
Diff: 3 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: optimal solution, solution interpretation, slope
AACSB: Analytical thinking

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71) In a linear programming problem, the binding constraints for the optimal solution are:

$5x_1 + 3x_2 \leq 30$
$2x_1 + 5x_2 \leq 20$

Which of these objective functions will lead to the same optimal solution?
A) $2x_1 + 1x_2$
B) $7x_1 + 8x_2$
C) $80x_1 + 60x_2$
D) $25x_1 + 15x_2$
Answer: D
Diff: 3 Page Ref: 40
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: optimal solution, solution interpretation, slope
AACSB: Analytical thinking

72) Decision variables:
A) measure the objective function.
B) measure how much or how many items to produce, purchase, hire, etc.
C) always exist for each constraint.
D) measure the values of each constraint.
Answer: B
Diff: 2 Page Ref: 32
Section Heading: Model Formulation
Keywords: decision variables
AACSB: Analytical thinking

73) In a linear programming problem, a valid objective function can be represented as:
A) Max Z = 5xy
B) Max Z $5x^2 + 2y^2$
C) Max $3x + 3y + 1/3\ z$
D) Min $(x_1 + x_2) / x_3$
Answer: C
Diff: 3 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: objective function
AACSB: Analytical thinking

74) Which of the following could not be a linear programming problem constraint?
A) $1A + 2B \neq 3$
B) $1A + 2B = 3$
C) $1A + 2B \leq 3$
D) $1A + 2B \geq 3$
Answer: A
Diff: 2 Page Ref: 34-35
Section Heading: A Maximization Model Example
Keywords: formulation, constraints
AACSB: Analytical thinking

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75) Which of the following could be a linear programming objective function?
A) Z = 1A + 2BC + 3D
B) Z = 1A + 2B + 3C + 4D
C) Z = 1A + 2B / C + 3D
D) Z = 1A + $2B^2$ + 3D
Answer: B
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: objective function
AACSB: Analytical thinking

76) The production manager for the Coory soft drink company is considering the production of two kinds of soft drinks: regular (R) and diet (D). Two of her limited resources are production time (8 hours = 480 minutes per day) and syrup (1 of the ingredients), limited to 675 gallons per day. To produce a regular case requires 2 minutes and 5 gallons of syrup, while a diet case needs 4 minutes and 3 gallons of syrup. Profits for regular soft drink are $3.00 per case and profits for diet soft drink are $2.00 per case. What is the objective function?
A) MAX $2R + $4D
B) MAX $3R + $2D
C) MAX $3D + $2R
D) MAX $4D + $2R
Answer: B
Diff: 2 Page Ref: 34
Section Heading: A Maximization Model Example
Keywords: formulation, objective function
AACSB: Analytical thinking

77) The production manager for the Coory soft drink company is considering the production of two kinds of soft drinks: regular (R) and diet(D). Two of the limited resources are production time (8 hours = 480 minutes per day) and syrup (1 of the ingredients), limited to 675 gallons per day. To produce a regular case requires 2 minutes and 5 gallons of syrup, while a diet case needs 4 minutes and 3 gallons of syrup. Profits for regular soft drink are $3.00 per case and profits for diet soft drink are $2.00 per case. What is the time constraint?
A) 2D + 4R ≤ 480
B) 2R + 3D ≤ 480
C) 3R + 2D ≤ 480
D) 2R + 4D ≤ 480
Answer: D
Diff: 2 Page Ref: 34-35
Section Heading: A Maximization Model Example
Keywords: formulation, constraints
AACSB: Analytical thinking

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78) The _____ property of linear programming models indicates that the rate of change or slope of the objective function or a constraint is constant.
A) additive
B) divisibility
C) certainty
D) proportionality
Answer: D
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: properties of linear programming models
AACSB: Analytical thinking

79) The _____ property of linear programming models indicates that the values of all the model parameters are known and are assumed to be constant.
A) additive
B) divisibility
C) certainty
D) proportionality
Answer: C
Diff: 2 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: properties of linear programming models
AACSB: Analytical thinking

80) The region that satisfies all of the constraints in a graphical linear programming problem is called the:
A) region of optimality.
B) feasible solution space.
C) region of non-negativity.
D) optimal solution space.
Answer: B
Diff: 1 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, feasibility
AACSB: Analytical thinking

81) In the formulation of a ≥ constraint:
A) a surplus variable is subtracted.
B) a surplus variable is added.
C) a slack variable is subtracted.
D) a slack variable is added.
Answer: A
Diff: 1 Page Ref: 53
Section Heading: A Minimization Model Example
Keywords: surplus
AACSB: Analytical thinking

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82) Which of the following statements is *not* true?
A) An infeasible solution violates all constraints.
B) A feasible solution point does not have to lie on the boundary of the feasible solution.
C) A feasible solution satisfies all constraints.
D) An optimal solution satisfies all constraints.
Answer: A
Diff: 2 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, feasibility
AACSB: Analytical thinking

83) A hot dog manufacturer wishes to minimize the cost in dollars of producing a low-cost niched product while meeting the dietary guidelines for protein and sodium. Once the model has been run, the surplus variable in the sodium constraint has a value of 1300 milligrams. The best interpretation of this outcome is:
A) The value of the sodium in a hot dog is 1300.
B) The amount of sodium in a single hot dog should be 1300 milligrams.
C) The minimum cost hot dog has 1300 milligrams more sodium than required.
D) A hot dog should have at least 1300 milligrams of sodium.
Answer: C
Diff: 2 Page Ref: 53
Section Heading: A Minimization Model Example
Keywords: surplus
AACSB: Analytical thinking

84) Which of these statements is best?
A) An unbounded problem is also infeasible.
B) An infeasible problem is also unbounded.
C) An unbounded problem has feasible solutions.
D) An infeasible problem has unbounded solutions.
Answer: C
Diff: 2 Page Ref: 56
Section Heading: Irregular Types of Linear Programming Problems
Keywords: infeasible problem, infeasible solution
AACSB: Analytical thinking

85) The optimal solution to a linear programming model that has been solved using the graphical approach:
A) is typically located at the origin.
B) must be below and on the left side of all constraint lines.
C) must be above and the right of all constraint lines.
D) is typically at some corner of the feasible region.
Answer: D
Diff: 1 Page Ref: 40
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: solution
AACSB: Analytical thinking

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86) Without satisfying the non-negativity constraint, a solution that satisfies all the other constraints of a linear programming problem is called:
A) feasible.
B) infeasible.
C) semi-feasible.
D) optimal.
Answer: B
Diff: 3 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, feasibility
AACSB: Analytical thinking

87) An intern sets up a linear program to optimize the use of paper products in the men's washroom. The system of equations he develops is:

Max $2T + 3S + 4ST$
s.t $3T + 6S \leq 40$
$10T + 10S \leq 66$
$10T + 15S \leq 99$

His mentor studies the model, frowns, and admonishes the intern for violating which of the following properties of linear programming models?
A) divisibility
B) proportionality
C) certainty
D) additivity
Answer: D
Diff: 1 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: additivity
AACSB: Analytical thinking

88) Which of the following is *not* a typical characteristic of a linear programming problem?
A) Restrictions exist.
B) A choice among alternatives is required.
C) The problem can be solved graphically.
D) The problem has an objective.
Answer: C
Diff: 1 Page Ref: 57
Section Heading: Characteristics of Linear Programming Problems
Keywords: graphical solution
AACSB: Analytical thinking

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89) The production manager for the Coory soft drink company is considering the production of two kinds of soft drinks: regular and diet. Two of her limited resources are production time (8 hours = 480 minutes per day) and syrup (1 of the ingredients), limited to 675 gallons per day. To produce a regular case requires 2 minutes and 5 gallons of syrup, while a diet case needs 4 minutes and 3 gallons of syrup. Profits for regular soft drink are $3.00 per case and profits for diet soft drink are $2.00 per case. Which of the following is not a feasible production combination?
A) 90R and 75D
B) 135R and 0D
C) 75R and 90D
D) 40R and 100D
Answer: C
Diff: 3 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, feasibility
AACSB: Analytical thinking

90) The production manager for the Coory soft drink company is considering the production of two kinds of soft drinks: regular and diet. Two of her limited resources are production time (8 hours = 480 minutes per day) and syrup (1 of the ingredients), limited to 675 gallons per day. To produce a regular case requires 2 minutes and 5 gallons of syrup, while a diet case needs 4 minutes and 3 gallons of syrup. Profits for regular soft drink are $3.00 per case and profits for diet soft drink are $2.00 per case. What are the optimal daily production quantities of each product and the optimal daily profit?
A) R = 75, D = 90, Z = $405
B) R = 135, D = 0, Z = $405
C) R = 90, D = 75, Z = $420
D) R = 40, D= 100, Z = $320
Answer: C
Diff: 3 Page Ref: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

91) _____ is used to analyze changes in model parameters.
A) Optimal solution
B) Feasible solution
C) Sensitivity analysis
D) A slack variable
Answer: C
Diff: 2 Page Ref: 45
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: sensitivity analysis
AACSB: Analytical thinking

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92) Cully Furniture buys two products for resale: big shelves (B)and medium shelves (M). Each big shelf costs $500 and requires 100 cubic feet of storage space, and each medium shelf costs $300 and requires 90 cubic feet of storage space. The company has $75,000 to invest in shelves this week, and the warehouse has 18,000 cubic feet available for storage. Profit for each big shelf is $300 and for each medium shelf is $150. Which of the following is not a feasible purchase combination?
A) 100 big shelves and 82 medium shelves
B) 150 big shelves and 0 medium shelves
C) 100 big shelves and 100 medium shelves
D) 100 big shelves and 0 medium shelves
Answer: C
Diff: 3 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: formulation, feasibility
AACSB: Analytical thinking

93) Cully Furniture buys two products for resale: big shelves (B) and medium shelves (M). Each big shelf costs $500 and requires 100 cubic feet of storage space, and each medium shelf costs $300 and requires 90 cubic feet of storage space. The company has $75,000 to invest in shelves this week, and the warehouse has 18,000 cubic feet available for storage. Profit for each big shelf is $300 and for each medium shelf is $150. What is the maximum profit?
A) $35,000
B) $45,000
C) $55,000
D) $65,000
Answer: B
Diff: 3 Page Ref: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

94) Cully Furniture buys two products for resale: big shelves (B) and medium shelves (M). Each big shelf costs $500 and requires 100 cubic feet of storage space, and each medium shelf costs $300 and requires 90 cubic feet of storage space. The company has $75,000 to invest in shelves this week, and the warehouse has 18,000 cubic feet available for storage. Profit for each big shelf is $300 and for each medium shelf is $150. In order to maximize profit, how many big shelves (B) and how many medium shelves (M) should be purchased?
A) B = 90, M = 75
B) B = 150, M = 0
C) B = 0, M = 200
D) B = 100, M = 100
Answer: B
Diff: 3 Page Ref: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

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95) The theoretical limit on the number of constraints that can be handled by a linear programming problem is:
A) 2.
B) 3.
C) 4.
D) unlimited.
Answer: D
Diff: 1 Page Ref: 32
Section Heading: Model Formulation
Keywords: constraints
AACSB: Analytical thinking

96) Consider the following maximization problem.

MAX z = x + 2y
s.t.
$2x + 3y \leq 6$
$5x + 6y \leq 30$
$y \geq 1$

The optimal solution:
A) occurs where x = 4.67 and y = 1.11.
B) occurs where x = 0 and y = 2.
C) occurs where x = 6 and y = 0.
D) results in an objective function value of 12.
Answer: B
Diff: 1 Page Ref: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, extreme points, feasible region
AACSB: Analytical thinking

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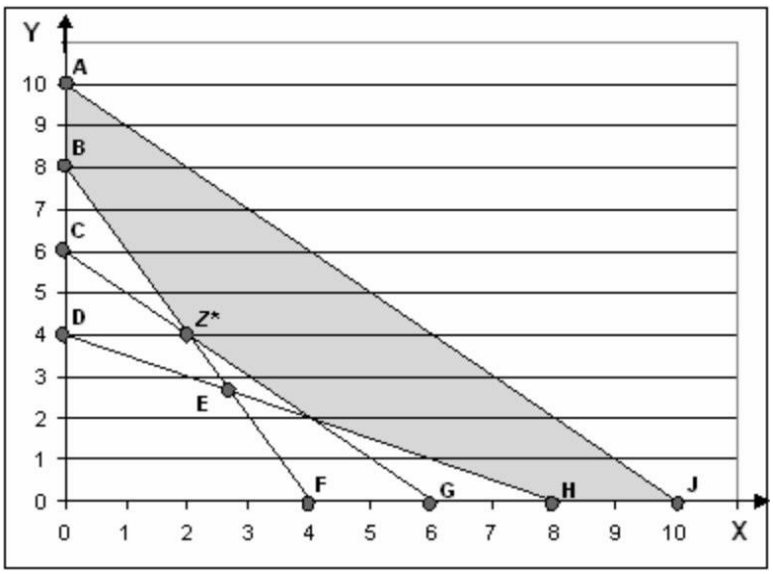
The following is a graph of a linear programming problem. The feasible solution space is shaded, and the optimal solution is at the point labeled *Z**.



97) This linear programming problem is a(n):
A) maximization problem.
B) minimization problem.
C) irregular problem.
D) cannot tell from the information given
Answer: B
Diff: 1 Page Ref: 50
Section Heading: A Minimization Model Example
Keywords: graphical solution
AACSB: Analytical thinking

98) The equation for constraint DH is:
A) $4X + 8Y \geq 32$.
B) $8X + 4Y \geq 32$.
C) $X + 2Y \geq 8$.
D) $2X + Y \geq 8$.
Answer: C
Diff: 3 Page Ref: 50
Section Heading: A Minimization Model Example
Keywords: graphical solution, constraints
AACSB: Analytical thinking

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99) Which of the following points is *not* feasible?
A) A
B) B
C) H
D) G
Answer: D
Diff: 1 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, feasible point
AACSB: Analytical thinking

100) Which line is represented by the equation $2X + Y \geq 8$?
A) BF
B) CG
C) DH
D) AJ
Answer: A
Diff: 2 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, constraints
AACSB: Analytical thinking

101) Which of the following constraints has a surplus greater than 0?
A) BF
B) CG
C) DH
D) AJ
Answer: C
Diff: 2 Page Ref: 53-54
Section Heading: A Minimization Model Example
Keywords: graphical solution, constraints
AACSB: Analytical thinking

102) The constraint AJ:
A) is a binding constraint.
B) has no surplus.
C) does not contain feasible points.
D) contains the optimal solution.
Answer: B
Diff: 3 Page Ref: 53-54
Section Heading: A Minimization Model Example
Keywords: graphical solution, constraints
AACSB: Analytical thinking

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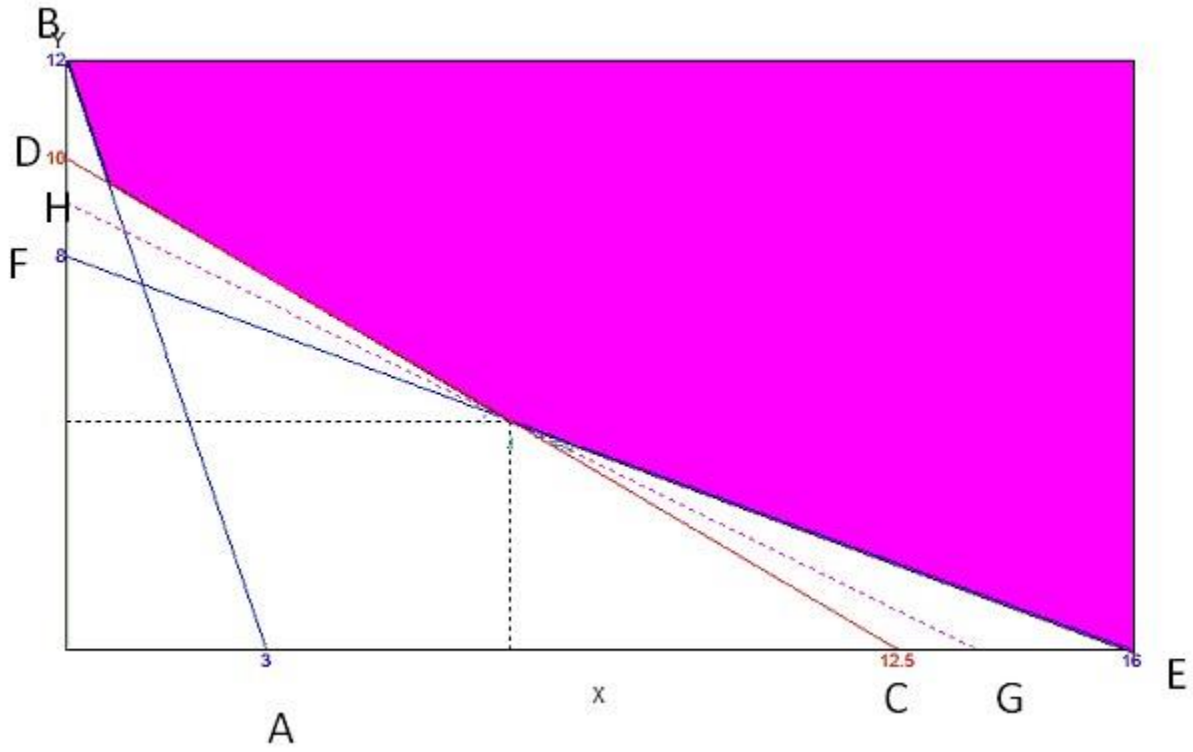
Figure 2



103) Consider the optimization problem represented by this graph. Which of the following statements is best?
A) This is a maximization problem with a feasible solution.
B) This is a maximization problem with no feasible solution.
C) This is a minimization problem with a feasible solution.
D) This is a minimization problem with no feasible solution.
Answer: C
Diff: 1 Page Ref: 54
Section Heading: A Minimization Model Example
Keywords: graphical solution, feasibility
AACSB: Analytical thinking

104) Line segment GH represents the objective function. Which constraint has surplus?
A) AB
B) CD
C) EF
D) none of the constraints has surplus
Answer: A
Diff: 2 Page Ref: 53
Section Heading: A Minimization Model Example
Keywords: graphical solution, surplus variable
AACSB: Analytical thinking

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105) What is the equation for the constraint AB?
A) 3X + 12Y ≥ 15
B) X + 4Y ≥ 12
C) X + Y ≥ 15
D) 12X +3Y ≥ 36
Answer: D
Diff: 3 Page Ref: 51
Section Heading: A Minimization Model Example
Keywords: graphical solution, constraints
AACSB: Analytical thinking

106) What is the equation for constraint EF?
A) 4X + 8Y ≥ 64
B) 4X + 8Y ≥ 12
C) 16X + 8Y ≥ 24
D) 16X + 8Y ≥ 32
Answer: A
Diff: 3 Page Ref: 51
Section Heading: A Minimization Model Example
Keywords: graphical solution, constraints
AACSB: Analytical thinking

107) Consider the optimization problem represented by this graph. The objective function is represented by line GH. Where is the optimal solution?
A) the intersection of lines AB and EF
B) the intersection of lines AB and CD
C) the intersection of lines CD and EF
D) the upper right corner of the shaded region
Answer: C
Diff: 1 Page Ref: 51
Section Heading: A Minimization Model Example
Keywords: graphical solution, objective function line
AACSB: Analytical thinking

108) Consider the optimization problem represented by this graph. Line GH represents the objective function. Which of the following statements is best?
A) This is a single optimal solution.
B) All points along GH are optimal.
C) All points on lines AB, CD and DE that touch the shaded region are optimal.
D) All points in the shaded region are optimal
Answer: A
Diff: 1 Page Ref: 51
Section Heading: A Minimization Model Example
Keywords: graphical solution, multiple optimal solutions
AACSB: Analytical thinking

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109) In order for an optimization problem to have multiple optimal solutions:
A) the objective function and one constraint must have the same y-intercept.
B) the objective function and one constraint must have the same slope.
C) two or more of the constraints must not have intersection points.
D) two or more of the constraints must have the same slope.
Answer: B
Diff: 2 Page Ref: 55
Section Heading: Irregular Types of Linear Programming Problems
Keywords: graphical solutions, multiple optimal solutions
AACSB: Analytical thinking

110) An optimization problem that has multiple optimal solutions:
A) means that there are actually no optimal solutions.
B) is reflected by the entire feasible region being optimal
C) means that the surplus for a third constraint cannot be calculated.
D) provides the decision-maker with increased flexibility.
Answer: D
Diff: 2 Page Ref: 55
Section Heading: Irregular Types of Linear Programming Problems
Keywords: graphical solutions, multiple optimal solutions
AACSB: Analytical thinking

111) How would multiple optimal solutions typically appear on a graphical solution?
A) a point
B) a line
C) a plane
D) a cube
Answer: B
Diff: 2 Page Ref: 55
Section Heading: Irregular Types of Linear Programming Problems
Keywords: graphical solutions, multiple optimal solutions
AACSB: Analytical thinking

112) Which of the following statements about infeasible problems is best?
A) All of the possible solutions violate at least one constraint.
B) All of the possible solutions violate all of the constraints.
C) At least one of the possible solutions violates all of the constraints.
D) At least one of the possible solutions violates at least one of the constraints.
Answer: A
Diff: 1 Page Ref: 56
Section Heading: Irregular Types of Linear Programming Problems
Keywords: infeasible problem, infeasible solution
AACSB: Analytical thinking

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113) Greg, a young entrepreneur, has developed an aggressive business plan and is presenting his profit projections on the popular show *Shark Tank* in hopes of securing some venture capital. He concludes his presentation with an LP model of his planned product mix, and is convinced he will seal the deal by demonstrating that his profits are limitless since his LP model is unbounded. What should the sharks tell him?
A) "Limitless profits sound fantastic, here's a blank check."
B) "Limitless profits are possible only in minimization models, and we want you to maximize profits."
C) "Unlimited profits aren't possible. You must have made a mistake in your LP model."
D) "Limitless profits are possible only in maximization models, and we want you to minimize profits."
Answer: C
Diff: 1 Page Ref: 56
Section Heading: Irregular Types of Linear Programming Problems
Keywords: unbounded
AACSB: Analytical thinking

114) Multiple optimal solutions can occur when the objective function is _____ a constraint line.
A) unequal to
B) equal to
C) perpendicular to
D) parallel to
Answer: D
Diff: 2 Page Ref: 55
Section Heading: Irregular Types of Linear Programming Problems
Keywords: irregular types of linear programming problems
AACSB: Analytical thinking

115) A slack variable:
A) is the amount by which the left side of a ≥ constraint is larger than the right side.
B) is the amount by which the left side of a ≤ constraint is smaller than the right side.
C) is the difference between the left and right side of a constraint.
D) exists for each variable in a linear programming problem.
Answer: B
Diff: 2 Page Ref: 44
Section Heading: Slack Variables
Keywords: slack variables
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116) The production manager for the Coory soft drink company is considering the production of two kinds of soft drinks: regular and diet. Two of her limited resources are production time (8 hours = 480 minutes per day) and syrup (1 of the ingredients), limited to 675 gallons per day. To produce a regular case requires 2 minutes and 5 gallons of syrup, while a diet case needs 4 minutes and 3 gallons of syrup. Profits for regular soft drink are $3.00 per case and profits for diet soft drink are $2.00 per case. For the production combination of 135 cases of regular and 0 cases of diet soft drink, which resources will not be completely used?
A) only time
B) only syrup
C) time and syrup
D) neither time nor syrup
Answer: A
Diff: 2 Page Ref: 46
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: slack variables
AACSB: Analytical thinking

117) Cully Furniture buys two products for resale: big shelves (B) and medium shelves (M). Each big shelf costs $500 and requires 100 cubic feet of storage space, and each medium shelf costs $300 and requires 90 cubic feet of storage space. The company has $75,000 to invest in shelves this week, and the warehouse has 18,000 cubic feet available for storage. Profit for each big shelf is $300 and for each medium shelf is $150. If the furniture company purchases no big shelves and 200 medium shelves, which of the two resources will be completely used (at capacity)?
A) investment money only
B) storage space only
C) investment money and storage space
D) neither investment money nor storage space
Answer: B
Diff: 2 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: slack variables
AACSB: Analytical thinking

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118) Consider the following linear program:

MAX $z = 5x + 3y$
s.t. $x - y \leq 6$
$x \leq 1$

The optimal solution:
A) is infeasible.
B) occurs where x = 1 and y = 0.
C) occurs where x = 0 and y = 1.
D) results in an objective function value of 5.
Answer: D
Diff: 2 Page Ref: 40
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: slack variables
AACSB: Analytical thinking

119) The first step in solving a graphical linear programming model is to:
A) plot the model constraints as equations on the graph and indicate the feasible solution area.
B) plot the objective function and move this line out from the origin to locate the optimal solution point.
C) solve simultaneous equations at each corner point to find the solution values at each point.
D) determine which constraints are binding.
Answer: A
Diff: 1 Page Ref: 37
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphic solution, steps for solving a graphical linear prog model
AACSB: Analytical thinking

120) The optimal solution of a minimization problem is at the extreme point _____ the origin.
A) farthest from
B) closest to
C) exactly at
D) parallel to
Answer: B
Diff: 2 Page Ref: 51
Section Heading: A Minimization Model Example
Keywords: minimization problem
AACSB: Analytical thinking

121) Multiple optimal solutions provide _____ flexibility to the decision maker.
A) greater
B) less
C) greater or equal
D) less or equal
Answer: A
Diff: 2 Page Ref: 55
Section Heading: Irregular Types of Linear Programming Problems
Keywords: irregular types of linear programming problems
AACSB: Analytical thinking

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122) Which of the following special cases *does not* require reformulation of the problem in order to obtain a solution?
A) unboundedness
B) infeasibility
C) alternate optimality
D) Each one of these cases requires reformulation.
Answer: C
Diff: 3 Page Ref: 55
Section Heading: Irregular Types of Linear Programming Problems
Keywords: irregular types of linear programming problems
AACSB: Analytical thinking

123) If the feasible region for a linear programming problem is unbounded, then the solution to the corresponding linear programming problem is _____ unbounded.
A) always
B) sometimes
C) never
D) There is not enough information to complete this statement.
Answer: B
Diff: 3 Page Ref: 56
Section Heading: Irregular Types of Linear Programming Problems
Keywords: irregular types of linear programming problems, unboundedness
AACSB: Analytical thinking

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