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Introduction to Management Science, 13e **(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: 34
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: 34
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: 34
Section Heading: Model Formulation
Keywords: model formulation
AACSB: Analytical thinking

4) Both objective functions and constraints contain parameters.
Answer: TRUE
Diff: 2 Page Ref: 34
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: 59
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: 59
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: 59
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: 34
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: 39
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: 59
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: 59
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: 45
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, extreme points, feasible region
AACSB: Analytical thinking

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13) Objective functions in linear programs always minimize costs.
Answer: FALSE
Diff: 2 Page Ref: 34
Section Heading: Model Formulation
Keywords: properties of linear programming models, objective function
AACSB: Analytical thinking

14) The feasible solution area contains infinite solutions to the linear program.
Answer: TRUE
Diff: 1 Page Ref: 41
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: 57
Section Heading: Irregular Types of Linear Programming Problems
Keywords: properties of linear programming models, optimal solution point
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: 36
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: 42
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: 55
Section Heading: A Minimization Model Example
Keywords: properties of linear programming models, surplus variables
AACSB: Analytical thinking

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19) In the graphical approach, simultaneous equations may be used to solve for the optimal solution point.
Answer: TRUE
Diff: 2 Page Ref: 45
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: 47
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, slack variables
AACSB: Analytical thinking

21) Surplus variables are only associated with minimization problems.
Answer: FALSE
Diff: 2 Page Ref: 55
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: 57
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: 57
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: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, objective function line
AACSB: Analytical thinking

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25) The first step in formulating a linear programming model is to define the objective function.
Answer: FALSE
Diff: 2 Page Ref: 34
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: 59
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: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming problems, formulation
AACSB: Application of knowledge

28) Linear programming problems can model decreasing marginal returns.
Answer: FALSE
Diff: 2 Page Ref: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming problems, formulation
AACSB: Application of knowledge

29) One of the most frequent objectives of business forms is to gain the most profit possible.
Answer: TRUE
Diff: 1 Page Ref: 36
Section Heading: Introduction
Keywords: linear programming problems, maximization
AACSB: Analytical thinking

30) We have George Dantzig to thank for developing linear programming.
Answer: TRUE
Diff: 2 Page Ref: 37
Section Heading: A Maximization Model Example
Keywords: linear programming, Dantzig
AACSB: Analytical thinking

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31) In the absence of nonnegativity constraints, our solution cannot have zero values for decision variables.
Answer: FALSE
Diff: 2 Page Ref: 37
Section Heading: A Maximization Model Example
Keywords: nonnegativity, linear programming
AACSB: Analytical thinking

32) If there are no feasible solutions to a linear programming model, then the best course of action for a manager is to choose a solution that violates at least one constraint.
Answer: FALSE
Diff: 1 Page Ref: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: properties of linear programming models, feasible solution area
AACSB: Analytical thinking

33) _____ are mathematical symbols representing levels of activity.
Answer: Decision variables
Diff: 1 Page Ref: 34
Section Heading: Model Formulation
Keywords: decision variables, model formulation
AACSB: Analytical thinking

34) A(n) _____ is a linear relationship representing a restriction on decision making.
Answer: constraint
Diff: 1 Page Ref: 34
Section Heading: Model Formulation
Keywords: constraint, model formulation
AACSB: Analytical thinking

35) If at least one constraint in a linear programming model is violated, the solution is said to be _____.
Answer: infeasible
Diff: 1 Page Ref: 57
Section Heading: Irregular Types of Linear Programming Problems
Keywords: constraint, infeasible solution
AACSB: Analytical thinking

36) A graphical solution is limited to solving linear programming problems with _____ decision variables.
Answer: two
Diff: 1 Page Ref: 38
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

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37) The _____ solution area is an area bounded by the constraint equations.
Answer: feasible
Diff: 1 Page Ref: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

38) Multiple optimal solutions can occur when the objective function line is _____ to a constraint line.
Answer: parallel
Diff: 2 Page Ref: 47
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, multiple optimal solutions
AACSB: Analytical thinking

39) XY Corporation makes two products, X and Y, and uses graphical linear programming to determine their monthly product mix. This November, their only production constraint is $X \leq 75$. November's production problem is _____.
Answer: unbounded
Diff: 2 Page Ref: 58
Section Heading: Irregular Types of Linear Programming Problems
Keywords: graphical solution, unbounded problem
AACSB: Analytical thinking

40) The best feasible solution is _____.
Answer: optimal
Diff: 1 Page Ref: 43
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: optimal solutions
AACSB: Analytical thinking

41) In a constraint, the _____ variable represents unused resources.
Answer: slack
Diff: 1 Page Ref: 47
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, surplus variable
AACSB: Analytical thinking

42) _____ is the difference between the left- and right-hand sides of a greater than or equal to constraint.
Answer: Surplus
Diff: 1 Page Ref: 55
Section Heading: A Minimization Model Example
Keywords: surplus
AACSB: Analytical thinking

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43) If the objective function is parallel to a constraint, the linear program could have _____.
Answer: multiple optimal solutions
Diff: 2 Page Ref: 47
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solutions, multiple optimal solutions
AACSB: Analytical thinking

44) Corner points on the boundary of the feasible solution area are called _____ points.
Answer: extreme
Diff: 1 Page Ref: 44
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: feasibility, constraints
AACSB: Analytical thinking

45) _____ are at the endpoints of the constraint line segment that the objective function parallels.
Answer: Alternate optimal solutions
Diff: 3 Page Ref: 57
Section Heading: Irregular Types of Linear Programming Problems
Keywords: alternative optimal solutions, multiple optimal solutions
AACSB: Analytical thinking

46) The _____ step in formulating a linear programming model is to define the decision variables.
Answer: first
Diff: 1 Page Ref: 36
Section Heading: A Maximization Model Example
Keywords: linear programming, formulation
AACSB: Analytical thinking

47) 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: 58
Section Heading: Irregular Types of Linear Programming Problems
Keywords: unbounded
AACSB: Analytical thinking

48) 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: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: properties of linear programming models, certainty
AACSB: Analytical thinking

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49) The objective function 3x + 2y + 4xy violates the assumption of _____.
Answer: additivity
Diff: 2 Page Ref: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming properties
AACSB: Application of knowledge

50) 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: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming properties
AACSB: Application of knowledge

51) *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: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming properties
AACSB: Application of knowledge

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

$5x1 + 3x2 \leq 30$
$2x1 + 5x2 \leq 20$

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: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: optimal solution, solution interpretation, slope
AACSB: Analytical thinking

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53) In a graphical approach to a linear programming problem, the objective function is represented by a(n) _____.
Answer: (straight) line
Diff: 2 Page Ref: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: optimal solution, solution interpretation, slope
AACSB: Analytical thinking

54) In a graphical approach to a linear programming problem, the objective function has a maximum value when it is _____ the origin.
Answer: farthest away from
Diff: 2 Page Ref: 45
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: optimal solution, solution interpretation, slope
AACSB: Analytical thinking

55) The three types of linear programming constraints are _____, _____, and _____.
Answer: $\geq$, $\leq$, = (greater than or equal to, less than or equal to, equal to)
Diff: 1 Page Ref: 52
Section Heading: A Minimization Model Example
Keywords: linear programming, constraint
AACSB: Analytical thinking

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

$5x1 + 3x2 \leq 30$
$2x1 + 5x2 \leq 20$

Which of these objective functions will lead to the same optimal solution?
A) 2x1 + 1x2
B) 7x1 + 8x2
C) 80x1 + 60x2
D) 25x1 + 15x2
Answer: D
Diff: 3 Page Ref: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: optimal solution, solution interpretation, slope
AACSB: Analytical thinking

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57) 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: 34
Section Heading: Model Formulation
Keywords: decision variables
AACSB: Analytical thinking

58) 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: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: objective function
AACSB: Analytical thinking

59) 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: 36
Section Heading: A Maximization Model Example
Keywords: formulation, constraints
AACSB: Analytical thinking

60) 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: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: objective function
AACSB: Analytical thinking

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The campaign manager for a doomed candidate is considering the which states to visit during the last frenzied campaign week leading up to the nationwide election. Pennsylvania (P), Wisconsin (W), Florida (F), New York (Y), and North Carolina (C) are all aching for one last visit, but the candidate has only 80 hours and $250 million left in her campaign fund. A visit to Pennsylvania takes 10 hours and costs $15 million but earns 1% of the electorate. A visit to Wisconsin takes 15 hours and costs $20 million and earns 1.5%; a visit to Florida is only $8 million but takes 16 hours and earns 2%, and a visit to New York costs $25 million, requires 2 hours and earns 2% of the electorate. North Carolina requires 18 hours and $22 million per trip but earns 3% of the electorate.

61) What is the objective function?
A) MIN 10P+15W+16F+2Y+18C
B) MAX 10P+15W+16F+2Y+18C
C) MIN 15P+20W+8F+25Y+22C
D) MAX P+1.5W+2F+2Y+3C
Answer: D
Diff: 2 Page Ref: 36
Section Heading: A Maximization Model Example
Keywords: formulation, objective function
AACSB: Analytical thinking

62) What is the time constraint?
A) P+1.5W+2F+2Y+3C ≤ 250
B) P+1.5W+2F+2Y+3C ≤ 80
C) 10P+15W+16F+2Y+18C ≤ 80
D) 15P+20W+8F+25Y+22C ≤ 80
Answer: C
Diff: 2 Page Ref: 36
Section Heading: A Maximization Model Example
Keywords: formulation, constraints
AACSB: Analytical thinking

63) What is the financial constraint?
A) P+1.5W+2F+2Y+3C ≤ 250
B) 15P+20W+8F+25Y+22C ≤ 250
C) 15P+20W+8F+25Y+22C ≤ 80
D) 10P+15W+16F+2Y+18C ≤ 250
Answer: B
Diff: 2 Page Ref: 36
Section Heading: A Maximization Model Example
Keywords: formulation, constraints
AACSB: Analytical thinking

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64) 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: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: properties of linear programming models
AACSB: Analytical thinking

65) 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: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: properties of linear programming models
AACSB: Analytical thinking

66) 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: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, feasibility
AACSB: Analytical thinking

67) In the formulation of a $\geq$ 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: 55
Section Heading: A Minimization Model Example
Keywords: surplus
AACSB: Analytical thinking

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68) 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: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, feasibility
AACSB: Analytical thinking

69) 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: 55
Section Heading: A Minimization Model Example
Keywords: surplus
AACSB: Analytical thinking

70) 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: 58
Section Heading: Irregular Types of Linear Programming Problems
Keywords: infeasible problem, infeasible solution
AACSB: Analytical thinking

71) 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: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: solution
AACSB: Analytical thinking

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72) 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: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, feasibility
AACSB: Analytical thinking

73) 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: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: additivity
AACSB: Analytical thinking

74) 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: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: graphical solution
AACSB: Analytical thinking

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The campaign manager for a doomed candidate is considering the which states to visit during the last frenzied campaign week leading up to the nationwide election. Pennsylvania (P), Wisconsin (W), Florida (F), New York (Y), and North Carolina (C) are all aching for one last visit, but the candidate has only 80 hours and $250 million left in her campaign fund. A visit to Pennsylvania takes 10 hours and costs $15 million but earns 1% of the electorate. A visit to Wisconsin takes 15 hours and costs $20 million and earns 1.5%; a visit to Florida is only $8 million but takes 16 hours and earns 2%, and a visit to New York costs $25 million, requires 2 hours and earns 2% of the electorate. North Carolina requires 18 hours and $22 million per trip but earns 3% of the electorate.

75) Which of the following is *not* a feasible schedule?
A) two trips each to Pennsylvania and Wisconsin and one trip each to Florida, New York, and North Carolina
B) four trips each to New York and North Carolina
C) two trips each to Pennsylvania and North Carolina and one trip to Florida
D) four trips to Wisconsin and five trips to New York
Answer: A
Diff: 3 Page Ref: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, feasibility
AACSB: Analytical thinking

76) What is the total percentage increase if the candidate makes the following schedule?
A) 10%
B) 11%
C) 12%
D) 13%
Answer: D
Diff: 2 Page Ref: 44
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

77) _____ 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: 47
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: sensitivity analysis
AACSB: Analytical thinking

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Lame Example Furniture Company makes two products for its adoring public: chairs (C)and tables (T). Each chair requires 5 hours of labor (L) and 4 linear feet of rich mahogany (M), and each table requires 3 hours of labor and 20 linear feet of rich mahogany. The company has 240 labor hours available this week, and the warehouse has 700 linear feet of rich mahogany available. Profit for each chair is $300 and for each table is $1500.

78) Which of the following is *not* a feasible production plan?
A) 35 chairs and 20 tables
B) 20 chairs and 35 tables
C) 25 chairs and 30 tables
D) 30 chairs and 25 tables
Answer: B
Diff: 3 Page Ref: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: formulation, feasibility
AACSB: Analytical thinking

79) What is the maximum profit?
A) $52,500
B) $48,000
C) $55,000
D) $56,250
Answer: A
Diff: 3 Page Ref: 43
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

80) In order to maximize profit, how many tables and how many chairs should be produced?
A) T = 35, C = 0
B) T = 0, C = 48
C) T = 26.3, C = 32.8
D) T = 28.9, C = 30.7
Answer: A
Diff: 3 Page Ref: 43
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

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81) 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: 34
Section Heading: Model Formulation
Keywords: constraints
AACSB: Analytical thinking

82) 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: 44
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, extreme points, feasible region
AACSB: Analytical thinking

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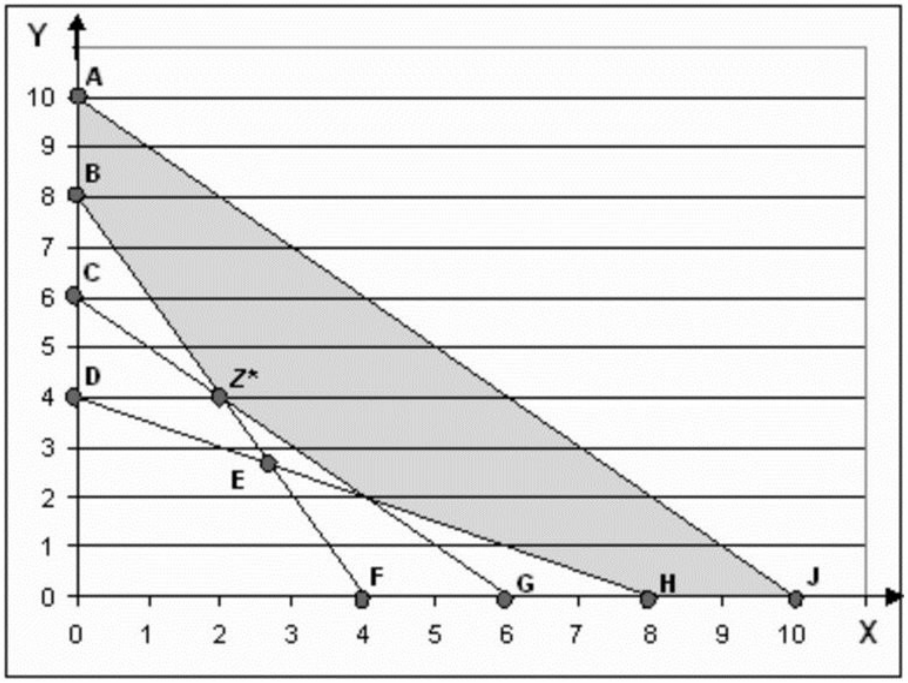
Figure 1: The following is a graph of a linear programming problem. The feasible solution space is shaded, and the optimal solution is at the point labeled *Z**.



83) This linear programming problem shown in Figure 1 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: 52
Section Heading: A Minimization Model Example
Keywords: graphical solution
AACSB: Analytical thinking

84) The equation for constraint DH as shown in Figure 1 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: 52
Section Heading: A Minimization Model Example
Keywords: graphical solution, constraints
AACSB: Analytical thinking

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85) Which of the following points is *not* feasible for the graph shown in Figure 1?
A) A
B) B
C) H
D) G
Answer: D
Diff: 1 Page Ref: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, feasible point
AACSB: Analytical thinking

86) Which line in Figure 1 is represented by the equation $2X + Y \geq 8$?
A) BF
B) CG
C) DH
D) AJ
Answer: A
Diff: 2 Page Ref: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, constraints
AACSB: Analytical thinking

87) Which of the following constraints shown in Figure 1 has a surplus greater than 0?
A) BF
B) CG
C) DH
D) AJ
Answer: C
Diff: 2 Page Ref: 55
Section Heading: A Minimization Model Example
Keywords: graphical solution, constraints
AACSB: Analytical thinking

88) In Figure 1, 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: 55
Section Heading: A Minimization Model Example
Keywords: graphical solution, constraints
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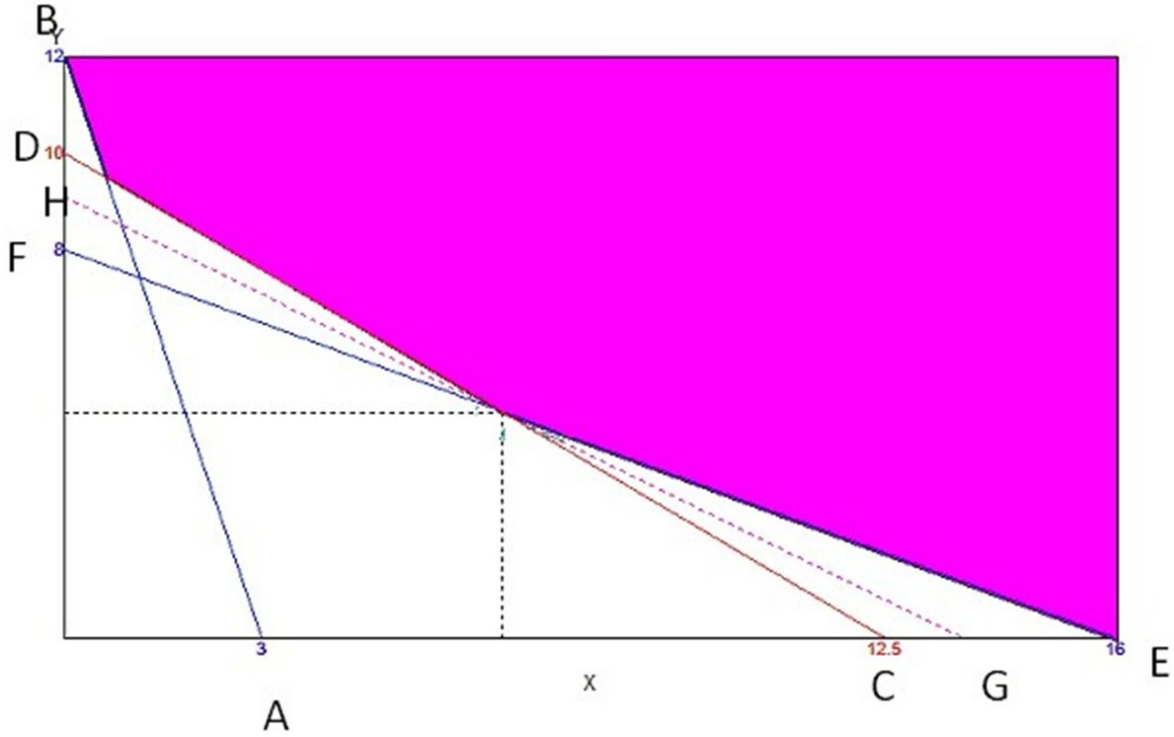
Figure 2



89) Consider the optimization problem represented by the graph in Figure 2. 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: 56
Section Heading: A Minimization Model Example
Keywords: graphical solution, feasibility
AACSB: Analytical thinking

90) Line segment GH in Figure 2 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: 55
Section Heading: A Minimization Model Example
Keywords: graphical solution, surplus variable
AACSB: Analytical thinking

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91) What is the equation for the constraint AB shown in Figure 2?
A) $3X + 12Y \geq 15$
B) $X + 4Y \geq 12$
C) $X + Y \geq 15$
D) $12X + 3Y \geq 36$
Answer: D
Diff: 3 Page Ref: 53
Section Heading: A Minimization Model Example
Keywords: graphical solution, constraints
AACSB: Analytical thinking

92) What is the equation for constraint EF shown in Figure 2?
A) $4X + 8Y \geq 64$
B) $4X + 8Y \geq 12$
C) $16X + 8Y \geq 24$
D) $16X + 8Y \geq 32$
Answer: A
Diff: 3 Page Ref: 53
Section Heading: A Minimization Model Example
Keywords: graphical solution, constraints
AACSB: Analytical thinking

93) Consider the optimization problem represented by the graph in Figure 2. 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: 53
Section Heading: A Minimization Model Example
Keywords: graphical solution, objective function line
AACSB: Analytical thinking

94) Consider the optimization problem represented by the graph in Figure 2. 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: 53
Section Heading: A Minimization Model Example
Keywords: graphical solution, multiple optimal solutions
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95) 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: 57
Section Heading: Irregular Types of Linear Programming Problems
Keywords: graphical solutions, multiple optimal solutions
AACSB: Analytical thinking

96) 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: 57
Section Heading: Irregular Types of Linear Programming Problems
Keywords: graphical solutions, multiple optimal solutions
AACSB: Analytical thinking

97) 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: 57
Section Heading: Irregular Types of Linear Programming Problems
Keywords: graphical solutions, multiple optimal solutions
AACSB: Analytical thinking

98) 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: 58
Section Heading: Irregular Types of Linear Programming Problems
Keywords: infeasible problem, infeasible solution
AACSB: Analytical thinking

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99) 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: 58
Section Heading: Irregular Types of Linear Programming Problems
Keywords: unbounded
AACSB: Analytical thinking

100) 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: 57
Section Heading: Irregular Types of Linear Programming Problems
Keywords: irregular types of linear programming problems
AACSB: Analytical thinking

101) 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: 46
Section Heading: Slack Variables
Keywords: slack variables
AACSB: Analytical thinking

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The campaign manager for a doomed candidate is considering the which states to visit during the last frenzied campaign week leading up to the nationwide election. Pennsylvania (P), Wisconsin (W), Florida (F), New York (Y), and North Carolina (C) are all aching for one last visit, but the candidate has only 80 hours and $250 million left in her campaign fund. A visit to Pennsylvania takes 10 hours and costs $15 million but earns 1% of the electorate. A visit to Wisconsin takes 15 hours and costs $20 million and earns 1.5%; a visit to Florida is only $8 million but takes 16 hours and earns 2%, and a visit to New York costs $25 million, requires 2 hours and earns 2% of the electorate. North Carolina requires 18 hours and $22 million per trip but earns 3% of the electorate.

102) The campaign manager elects to take one trip each of Pennsylvania, Florida and North Carolina, two trips to Wisconsin, and three trips to New York. Which resources will be completely used?
A) only money
B) only time
C) time and money
D) neither time nor money
Answer: B
Diff: 2 Page Ref: 48
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: slack variables
AACSB: Analytical thinking

Lame Example Furniture Company makes two products for its adoring public: chairs (C)and tables (T). Each chair requires 5 hours of labor (L) and 4 linear feet of rich mahogany (M), and each table requires 3 hours of labor and 20 linear feet of rich mahogany. The company has 240 labor hours available this week, and the warehouse has 700 linear feet of rich mahogany available. Profit for each chair is $300 and for each table is $1500.

103) If the furniture company produces twenty tables and thirty-six chairs, which of the two resources will be completely used?
A) labor only
B) rich mahogany only
C) both labor and rich mahogany
D) neither labor and rich mahogany
Answer: A
Diff: 2 Page Ref: 41
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: slack variables
AACSB: Analytical thinking

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104) 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: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: slack variables
AACSB: Analytical thinking

105) 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: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphic solution, steps for solving a graphical linear prog model
AACSB: Analytical thinking

106) 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: 53
Section Heading: A Minimization Model Example
Keywords: minimization problem
AACSB: Analytical thinking

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107) 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: 57
Section Heading: Irregular Types of Linear Programming Problems
Keywords: irregular types of linear programming problems
AACSB: Analytical thinking

108) 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: 57
Section Heading: Irregular Types of Linear Programming Problems
Keywords: irregular types of linear programming problems
AACSB: Analytical thinking

109) 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: 58
Section Heading: Irregular Types of Linear Programming Problems
Keywords: irregular types of linear programming problems, unboundedness
AACSB: Analytical thinking

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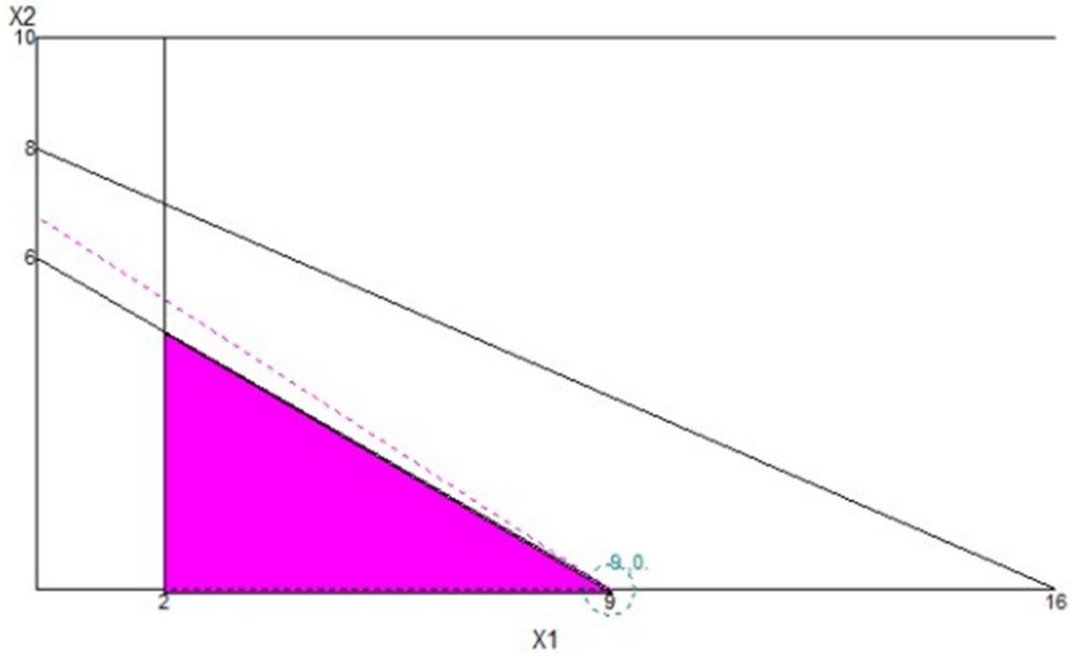
110) Solve the following graphically:
Max z = 3x1 + 4x2
s.t. x1 + 2x2 ≤ 16
2x1 + 3x2 ≤ 18
x1 ≥ 2
x2 ≤ 10
x1, x2 ≥ 0
What are the optimal values of x1, x2, and z?
Answer: x1 = 9, x2 = 0, z = 27



Diff: 3 Page Ref: 39
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, simultaneous solution
AACSB: Analytical thinking

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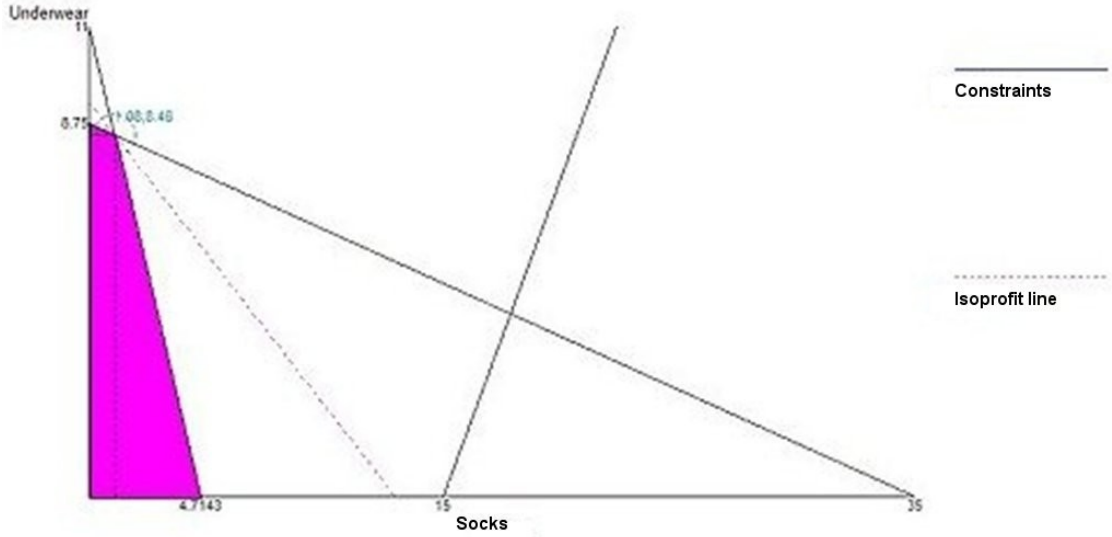
111) A novice business analyst develops the following model to determine the optimal combination of socks and underwear to take on his next business trip. The model is as follows:
Maximize 5S + 7U
subject to:
$3S - 2U \leq 45$
$7S + 3U \leq 33$
$2S + 8U \leq 70$
Solve this problem graphically and determine 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
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Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution
AACSB: Analytical thinking

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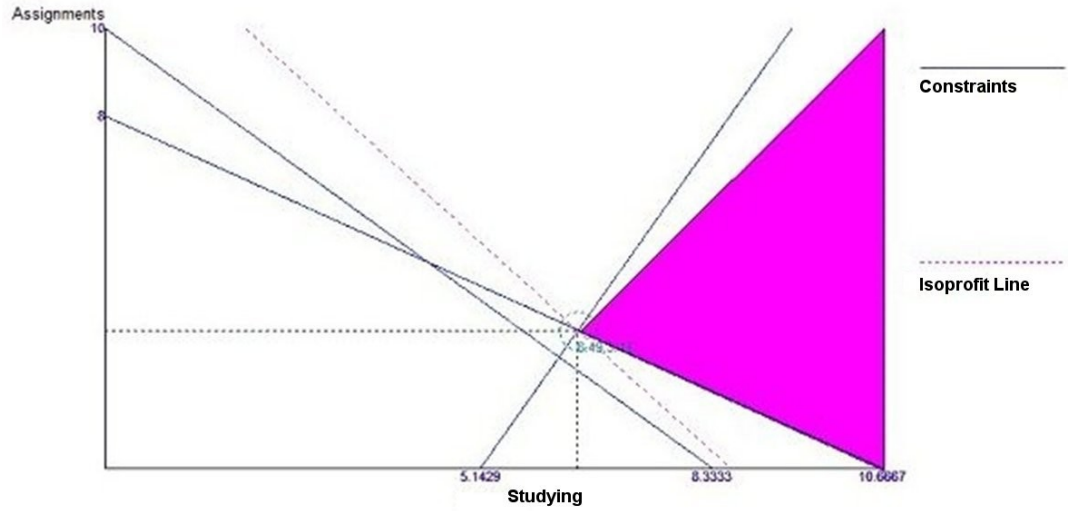
112) Nathan enters the final exam period needing to pull off a miracle to pass his three toughest classes, Healthy Life Choices, Success Central, and Walking Fitness. Naturally he would also prefer to expend as little effort as possible doing so and as luck would have it, he knows a guy that can help 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.
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Section Heading: A Minimization Model Example
Keywords: graphical solution
AACSB: Analytical thinking

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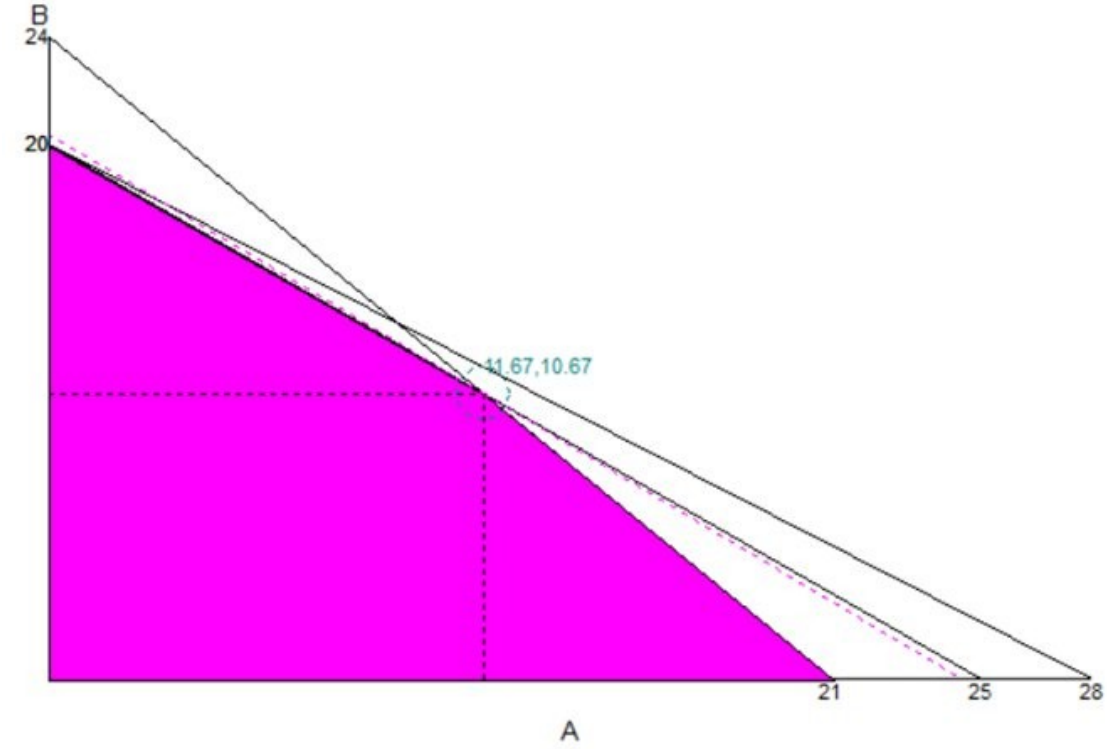
113) Consider the following linear program:

MAX Z = 25A + 30B
s.t. 12A + 15B ≤ 300
8A + 7B ≤ 168
10A + 14B ≤ 280

Solve this linear program graphically and determine the optimal quantities of A, B, and the value of Z.
Answer: Solution shown below. A = 11.67, B = 10.67



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Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical linear programming
AACSB: Analytical thinking

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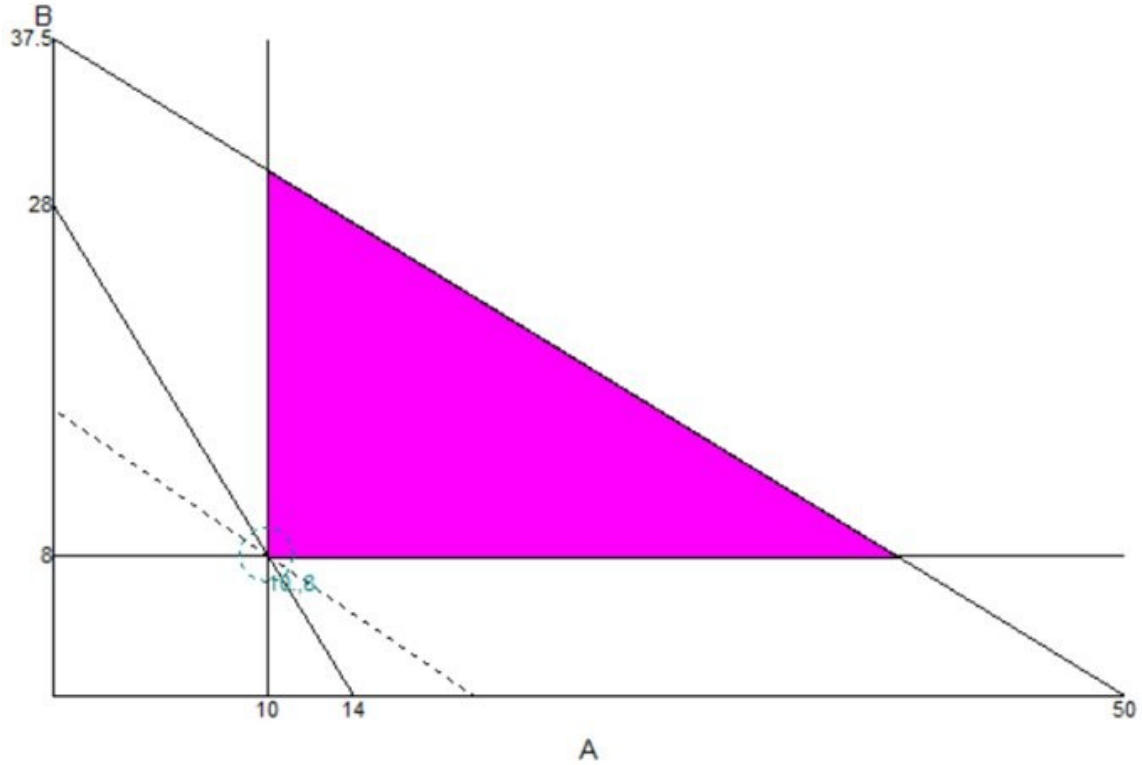
114) Consider the following linear program:

MIN Z = 50A + 60B
s.t. 6A + 8B ≤ 300
14A + 7B ≥ 196
A ≥ 10
B ≥ 8

Solve this linear program graphically and determine the optimal quantities of A, B, and the value of Z.

Answer: A = 10, B = 8, Z = 980



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Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical linear programming
AACSB: Analytical thinking

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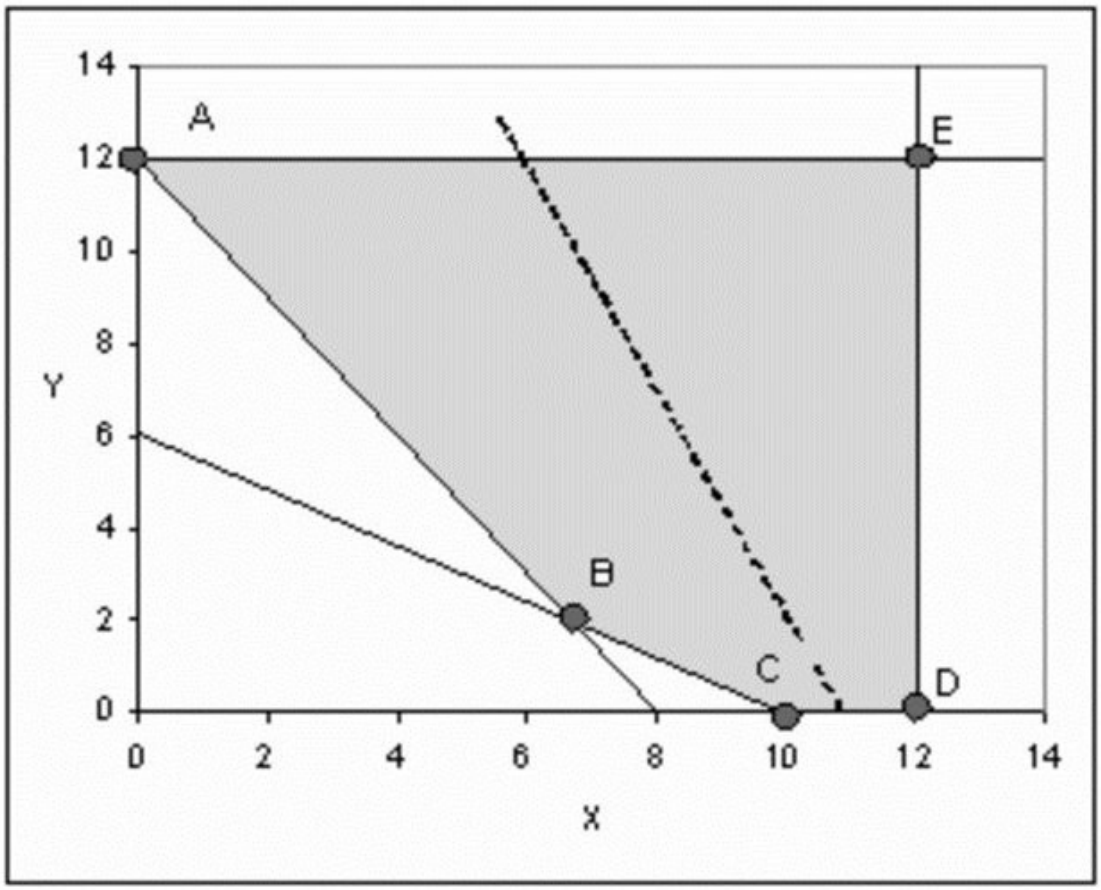
115) A graphical representation of a linear program is shown below. The shaded area represents the feasible region, and the dashed line in the middle is the slope of the objective function.



If this is a maximization, which extreme point is the optimal solution?
Answer: E
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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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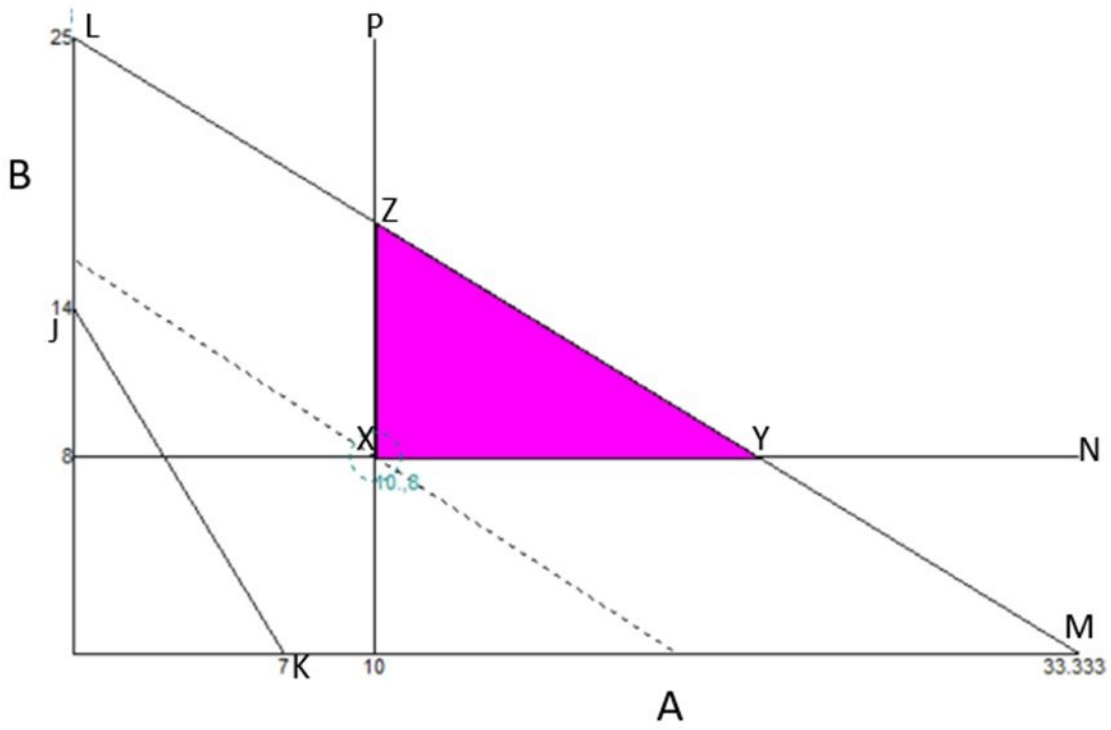
116) A graphical representation of a linear program is shown below. The shaded area represents the feasible region, and the dashed line in the middle is the slope of the objective function.



What are the equations for any two greater than or equal constraints for this problem?
Answer: The three greater than or equal constraints are A≥10, B≥8, 14A+7B≥98
Diff: 3 Page Ref: 44
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, extreme points, feasible region
AACSB: Analytical thinking

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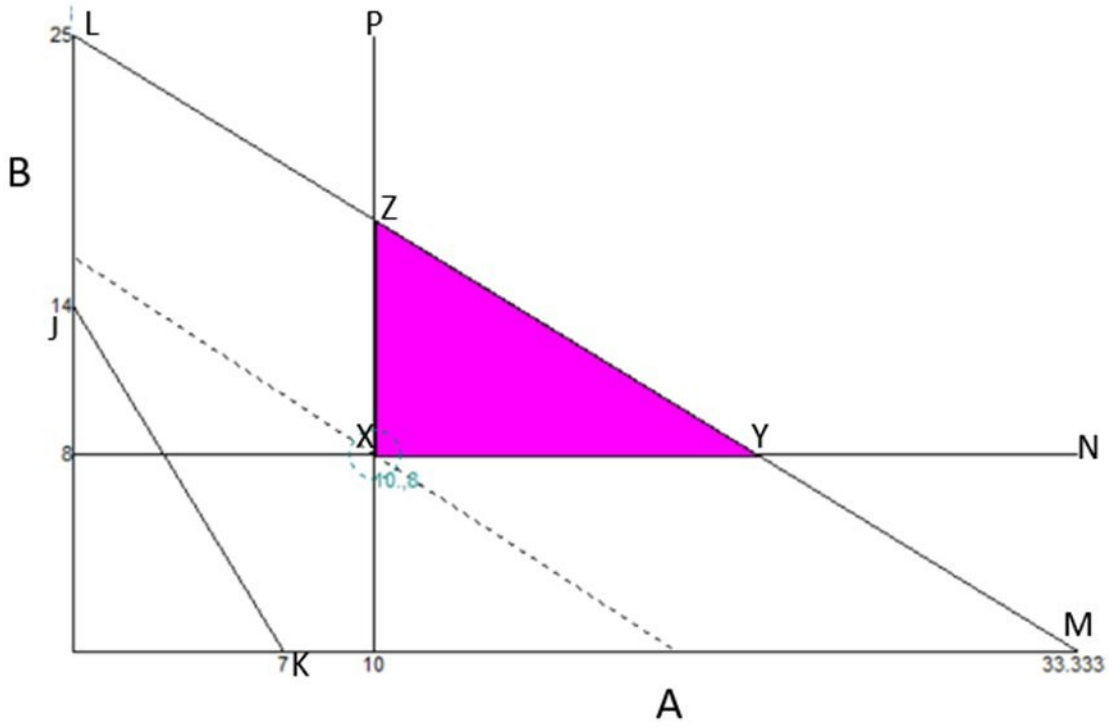
117) A graphical representation of a linear program is shown below. The shaded area represents the feasible region, and the dashed line in the middle is the slope of the objective function.



Provide a full description of the type of constraint is represented by line JK.
Answer: Line JK is a nonbinding, greater than or equal constraint. It cannot be a less than or equal constraint because then the problem would be infeasible.
Diff: 2 Page Ref: 57
Section Heading: Irregular Types of Linear Programming Problems
Keywords: graphical solution, multiple optimal solutions
AACSB: Analytical thinking

118) 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, s1= 0
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Section Heading: Graphical Solutions of Linear Programming Models
Keywords: graphical solution, slack variables
AACSB: Analytical thinking

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119) 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: 54
Section Heading: A Minimization Model Example
Keywords: surplus
AACSB: Analytical thinking

120) 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: 36
Section Heading: A Maximization Model Example
Keywords: constraint, model formulation
AACSB: Analytical thinking

121) Consider the following linear programming problem:
MIN Z = 3x1 + 2x2
Subject to: 2x1 + 3x2 ≥ 12
5x1 + 8x2 ≥ 37
x1, x2 ≥ 0
What is minimum cost and the value of x1 and x2 at the optimal solution?
Answer: 9.25 at x1 = 0 and x2 = 4.625
Diff: 3 Page Ref: 44
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: minimization problem
AACSB: Analytical thinking

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122) Consider the following linear programming problem:
MIN Z = 3x1 + 2x2
Subject to: 2x1 + 3x2 ≥ 12
5x1 + 8x2 ≥ 37
x1, x2 ≥ 0
What is minimum cost and the value of x1 and x2 at the optimal solution?
Answer: 9.25 at x1 = 0 and x2 = 4.625
Diff: 3 Page Ref: 44
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: minimization problem
AACSB: Analytical thinking

123) Ponder the following linear programming problem:
MIN Z = 3x1 + 8x2
Subject to: 3x1 + 4x2 ≥ 52
3x1 + 4x2 ≥ 38
x1, x2 ≥ 0
What is minimum cost and the value of x1 and x2 at the optimal solution?
Answer: 52 at x1 = 17.33 and x2 = 0.0
Diff: 3 Page Ref: 44
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: minimization problem
AACSB: Analytical thinking

124) 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: 36
Section Heading: A Maximization Model Example
Keywords: linear programming formulation
AACSB: Analytical thinking

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125) Ponder the following linear programming problem:
Max Z = 5x1 + 6x2
Subject to: $3x1 + 4x2 \leq 76$
$8x1 + 9x2 \leq 123$
$3x1 + 3x2 \leq 56$
$x1, x2 \geq 0$
What is the optimal solution point?
Answer: 12.31 at x1 and 2.72 at x2 for an objective function value of 77.897
Diff: 3 Page Ref: 42
Section Heading: A Maximization Model Example
Keywords: optimal solutions
AACSB: Analytical thinking

126) 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: 59
Section Heading: Characteristics of Linear Programming Problems
Keywords: linear programming properties
AACSB: Application of knowledge

127) 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: 34
Section Heading: Model Formulation
Keywords: linear programming properties
AACSB: Application of knowledge

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128) Consider the following linear programming problem:
MIN Z = 10x1 + 20x2
Subject to: x1 + x2 ≥ 12
2x1 + 5x2 ≥ 40
x2 ≤ 13
x1, x2 ≥ 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: 52
Section Heading: A Minimization Model Example
Keywords: graphical solution
AACSB: Analytical thinking

129) Given this set of constraints, for what objective function is the point x = 5, y = 3 in the feasible region?
s.t 3x + 6y ≤ 30
10x + 10y ≤ 60
10x + 15y ≤ 90
Answer: No objective function can move that point into the feasible region.
Diff: 2 Page Ref: 42
Section Heading: Graphical Solutions of Linear Programming Models
Keywords: feasibility, constraints
AACSB: Analytical thinking

130) Consider the following linear programming problem:
MIN Z = 2x1 + 3x2
Subject to: x1 + 2x2 ≤ 20
5x1 + x2 ≤ 40
4x1 + 6x2 ≤ 60
x1, x2 ≥ 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: 52
Section Heading: A Minimization Model Example
Keywords: graphical solution, multiple optimal solutions
AACSB: Analytical thinking

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

	Standard	Deluxe
Stamping	0.3	0.4
Extruding	0.25	0.5
Fidget Testing	1	1.5

The standard models contribute $2 each and the deluxe $3 each to profits. Because the company produces other items that share resources used to make the fidget spinners, the stamping machine is available only 15 minutes per hour, on average. The extruding unit has 20 minutes available each hour. There are two ADHD certified inspectors for fidget testing, but their availability is only 45 minutes per hour because they're easily distracted.

Let S = number of standard fidget spinners produced per hour
D = number of deluxe fidget spinners produced per hour

Write the formulation for this linear program and solve it using the graphical method.

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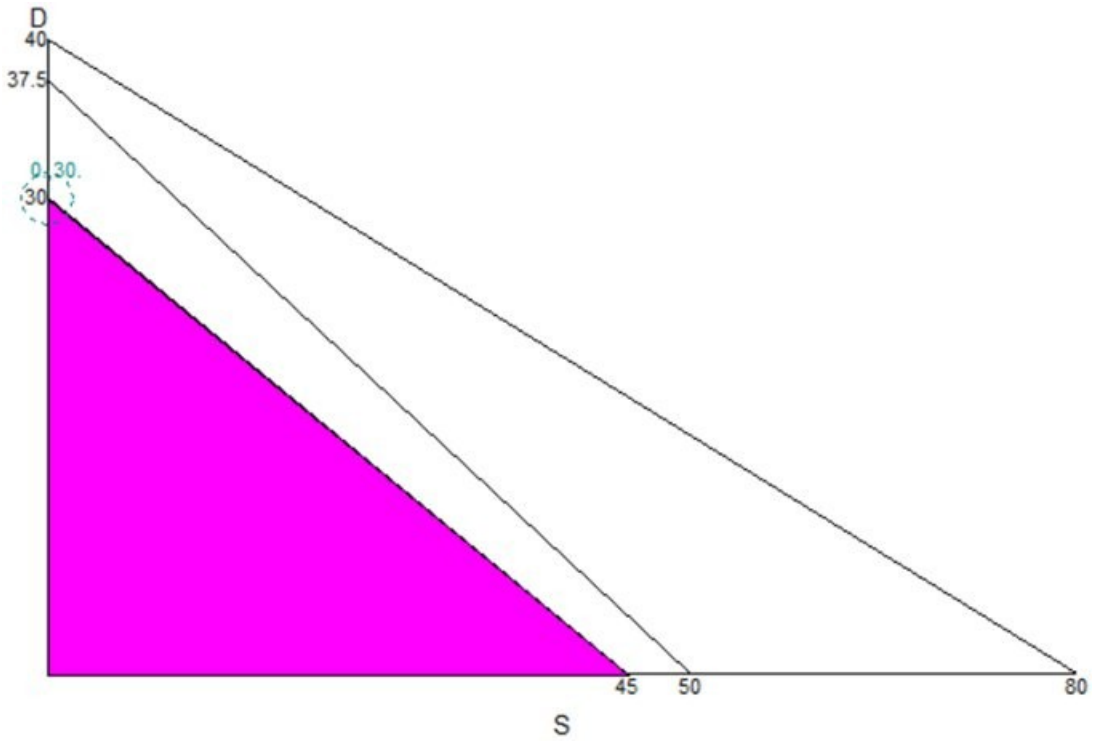
Answer: Max $2S + $3D
s.t 0.3S + 0.4D ≤ 15
0.25S + 0.5D ≤ 20
1S + 1.5D ≤ 45



The optimal product mix is to make 30 Deluxe units and no Standard units.
Diff: 3 Page Ref: 36
Section Heading: A Maximization Model Example
Keywords: formulation, objective function, constraints
AACSB: Analytical thinking

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