**MULTIPLE CHOICE**

1. What most motivates a business to be concerned with efficient use of their resources?
   a. Resources are limited and valuable.
   b. Efficient resource use increases business costs.
   c. Efficient resources use means more free time.
   d. Inefficient resource use means hiring more workers.

   ANS: A PTS: 1

2. Which of the following fields of management science finds the optimal method of using resources to achieve the objectives of a business?
   a. Simulation
   b. Regression
   c. Mathematical programming
   d. Discriminant analysis

   ANS: C PTS: 1

3. Mathematical programming is referred to as
   a. optimization.
   b. satisficing.
   c. approximation.
   d. simulation.

   ANS: A PTS: 1

4. What are the three common elements of an optimization problem?
   a. objectives, resources, goals.
   b. decisions, constraints, an objective.
   c. decision variables, profit levels, costs.
   d. decisions, resource requirements, a profit function.

   ANS: B PTS: 1

5. A mathematical programming application employed by a shipping company is most likely
   a. a product mix problem.
   b. a manufacturing problem.
   c. a routing and logistics problem.
   d. a financial planning problem.

   ANS: C PTS: 1

6. What is the goal in optimization?
   a. Find the decision variable values that result in the best objective function and satisfy all constraints.
   b. Find the values of the decision variables that use all available resources.
   c. Find the values of the decision variables that satisfy all constraints.
   d. None of these.

   ANS: A PTS: 1

7. A set of values for the decision variables that satisfy all the constraints and yields the best objective function value is
   a. a feasible solution.
   b. an optimal solution.
   c. a corner point solution.
   d. both (a) and (c).

   ANS: B PTS: 1

8. A common objective in the product mix problem is
   a. maximizing cost.
   b. maximizing profit.
   c. minimizing production time.
   d. maximizing production volume.

   ANS: B PTS: 1

9. A common objective when manufacturing printed circuit boards is
   a. maximizing the number of holes drilled.
   b. maximizing the number of drill bit changes.
   c. minimizing the number of holes drilled.
   d. minimizing the total distance the drill bit must be moved.

   ANS: D PTS: 1

10. Limited resources are modeled in optimization problems as
    a. an objective function.
    b. constraints.
    c. decision variables.
    d. alternatives.

    ANS: B PTS: 1

11. Retail companies try to find
    a. the least costly method of transferring goods from warehouses to stores.
    b. the most costly method of transferring goods from warehouses to stores.
    c. the largest number of goods to transfer from warehouses to stores.
    d. the least profitable method of transferring goods from warehouses to stores.

    ANS: A PTS: 1

12. Most individuals manage their individual retirement accounts (IRAs) so they
    a. maximize the amount of money they withdraw.
    b. minimize the amount of taxes they must pay.
    c. retire with a minimum amount of money.
    d. leave all their money to the government.

    ANS: B PTS: 1

13. The number of units to ship from Chicago to Memphis is an example of a(n)
    a. decision.
    b. constraint.
    c. objective.
    d. parameter.

    ANS: A PTS: 1

14. A manager has only 200 tons of plastic for his company. This is an example of a(n)
    a. decision.
    b. constraint.
    c. objective.
    d. parameter.

    ANS: B PTS: 1

15. The desire to maximize profits is an example of a(n)
    a. decision.
    b. constraint.
    c. objective.
    d. parameter.

    ANS: C PTS: 1

16. The symbols $X_1$, $Z_1$, Dog are all examples of
    a. decision variables.
    b. constraints.
    c. objectives.
    d. parameters.

    ANS: A PTS: 1

17. A greater than or equal to constraint can be expressed mathematically as
    a. $f(X_1, X_2, ..., X_n) \leq b$.
    b. $f(X_1, X_2, ..., X_n) \geq b$.
    c. $f(X_1, X_2, ..., X_n) = b$.
    d. $f(X_1, X_2, ..., X_n) \neq b$.

    ANS: B PTS: 1

18. A production optimization problem has 4 decision variables and resource 1 limits how many of the 4 products can be produced. Which of the following constraints reflects this fact?
    a. $f(X_1, X_2, X_3, X_4) \leq b_1$
    b. $f(X_1, X_2, X_3, X_4) \geq b_1$
    c. $f(X_1, X_2, X_3, X_4) = b_1$
    d. $f(X_1, X_2, X_3, X_4) \neq b_1$

    ANS: A PTS: 1

19. A production optimization problem has 4 decision variables and a requirement that at least $b_1$ units of material 1 are consumed. Which of the following constraints reflects this fact?
    a. $f(X_1, X_2, X_3, X_4) \leq b_1$
    b. $f(X_1, X_2, X_3, X_4) \geq b_1$
    c. $f(X_1, X_2, X_3, X_4) = b_1$
    d. $f(X_1, X_2, X_3, X_4) \neq b_1$

    ANS: B PTS: 1

20. Which of the following is the general format of an objective function?
    a. $f(X_1, X_2, ..., X_n) \leq b$
    b. $f(X_1, X_2, ..., X_n) \geq b$
    c. $f(X_1, X_2, ..., X_n) = b$

d. $f(X_1, X_2, ..., X_n)$

ANS: D PTS: 1

21. Linear programming problems have
    a. linear objective functions, non-linear constraints.
    b. non-linear objective functions, non-linear constraints.
    c. non-linear objective functions, linear constraints.
    d. linear objective functions, linear constraints.

    ANS: D PTS: 1

22. The first step in formulating a linear programming problem is
    a. Identify any upper or lower bounds on the decision variables.
    b. State the constraints as linear combinations of the decision variables.
    c. Understand the problem.
    d. Identify the decision variables.
    e. State the objective function as a linear combination of the decision variables.

    ANS: C PTS: 1

23. The second step in formulating a linear programming problem is
    a. Identify any upper or lower bounds on the decision variables.
    b. State the constraints as linear combinations of the decision variables.
    c. Understand the problem.
    d. Identify the decision variables.
    e. State the objective function as a linear combination of the decision variables.

    ANS: D PTS: 1

24. The third step in formulating a linear programming problem is
    a. Identify any upper or lower bounds on the decision variables.
    b. State the constraints as linear combinations of the decision variables.
    c. Understand the problem.
    d. Identify the decision variables.
    e. State the objective function as a linear combination of the decision variables.

    ANS: E PTS: 1

25. The following linear programming problem has been written to plan the production of two products. The company wants to maximize its profits.

    $X_1$ = number of product 1 produced in each batch
    $X_2$ = number of product 2 produced in each batch

    MAX: $150 X_1 + 250 X_2$
    Subject to: $2 X_1 + 5 X_2 \leq 200$
    $3 X_1 + 7 X_2 \leq 175$
    $X_1, X_2 \geq 0$

    How much profit is earned per each unit of product 2 produced?
    a. 150
    b. 175
    c. 200
    d. 250

ANS: D PTS: 1

26. The following linear programming problem has been written to plan the production of two products. The company wants to maximize its profits.

$X_1$ = number of product 1 produced in each batch
$X_2$ = number of product 2 produced in each batch

MAX: $150 X_1 + 250 X_2$
Subject to: $2 X_1 + 5 X_2 \leq 200$ – resource 1
$3 X_1 + 7 X_2 \leq 175$ – resource 2
$X_1, X_2 \geq 0$

How many units of resource 1 are consumed by each unit of product 1 produced?
a. 1
b. 2
c. 3
d. 5

ANS: B PTS: 1

27. The following linear programming problem has been written to plan the production of two products. The company wants to maximize its profits.

$X_1$ = number of product 1 produced in each batch
$X_2$ = number of product 2 produced in each batch

MAX: $150 X_1 + 250 X_2$
Subject to: $2 X_1 + 5 X_2 \leq 200$
$3 X_1 + 7 X_2 \leq 175$
$X_1, X_2 \geq 0$

How much profit is earned if the company produces 10 units of product 1 and 5 units of product 2?
a. 750
b. 2500
c. 2750
d. 3250

ANS: C PTS: 1

28. A company uses 4 pounds of resource 1 to make each unit of $X_1$ and 3 pounds of resource 1 to make each unit of $X_2$. There are only 150 pounds of resource 1 available. Which of the following constraints reflects the relationship between $X_1$, $X_2$ and resource 1?
a. $4 X_1 + 3 X_2 \geq 150$
b. $4 X_1 + 3 X_2 \leq 150$
c. $4 X_1 + 3 X_2 = 150$
d. $4 X_1 \leq 150$

ANS: B PTS: 1

29. A diet is being developed which must contain at least 100 mg of vitamin C. Two fruits are used in this diet. Bananas contain 30 mg of vitamin C and Apples contain 20 mg of vitamin C. The diet must contain at least 100 mg of vitamin C. Which of the following constraints reflects the relationship between Bananas, Apples and vitamin C?

a. $20 A + 30 B \geq 100$
b. $20 A + 30 B \leq 100$
c. $20 A + 30 B = 100$
d. $20 A = 100$

ANS: A PTS: 1

30. The constraint for resource 1 is $5 X_1 + 4 X_2 \leq 200$. If $X_1 = 20$, what it the maximum value for $X_2$?
a. 20
b. 25
c. 40
d. 50

ANS: B PTS: 1

31. The constraint for resource 1 is $5 X_1 + 4 X_2 \geq 200$. If $X_2 = 20$, what it the minimum value for $X_1$?
a. 20
b. 24
c. 40
d. 50

ANS: B PTS: 1

32. The constraint for resource 1 is $5 X_1 + 4 X_2 \leq 200$. If $X_1 = 20$ and $X_2 = 5$, how much of resource 1 is unused?
a. 0
b. 80
c. 100
d. 200

ANS: B PTS: 1

33. The constraint for resource 1 is $5 X_1 + 4 X_2 \geq 200$. If $X_1 = 40$ and $X_2 = 20$, how many additional units, if any, of resource 1 are employed above the minimum of 200?
a. 0
b. 20
c. 40
d. 80

ANS: D PTS: 1

34. The objective function for a LP model is $3 X_1 + 2 X_2$. If $X_1 = 20$ and $X_2 = 30$, what is the value of the objective function?
a. 0
b. 50
c. 60
d. 120

ANS: D PTS: 1

35. A company makes two products, $X_1$ and $X_2$. They require at least 20 of each be produced. Which set of lower bound constraints reflect this requirement?
a. $X_1 \geq 20, X_2 \geq 20$
b. $X_1 + X_2 \geq 20$
c. $X_1 + X_2 \geq 40$

d. $X_1 \geq 20, X_2 \geq 20, X_1 + X_2 \leq 40$

ANS: A PTS: 1

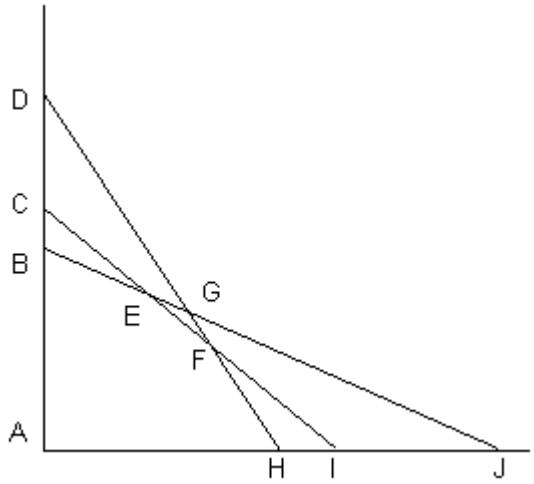
36. Why do we study the graphical method of solving LP problems?
    a. Lines are easy to draw on paper.
    b. To develop an understanding of the linear programming strategy.
    c. It is faster than computerized methods.
    d. It provides better solutions than computerized methods.

    ANS: B PTS: 1

37. The constraints of an LP model define the
    a. feasible region
    b. practical region
    c. maximal region
    d. opportunity region

    ANS: A PTS: 1

38. The following diagram shows the constraints for a LP model. Assume the point (0,0) satisfies constraint (B,J) but does not satisfy constraints (D,H) or (C,I). Which set of points on this diagram defines the feasible solution space?




    a. A, B, E, F, H
    b. A, D, G, J
    c. F, G, H, J
    d. F, G, I, J

    ANS: D PTS: 1

39. If constraints are added to an LP model the feasible solution space will generally
    a. decrease.
    b. increase.
    c. remain the same.
    d. become more feasible.

    ANS: A PTS: 1

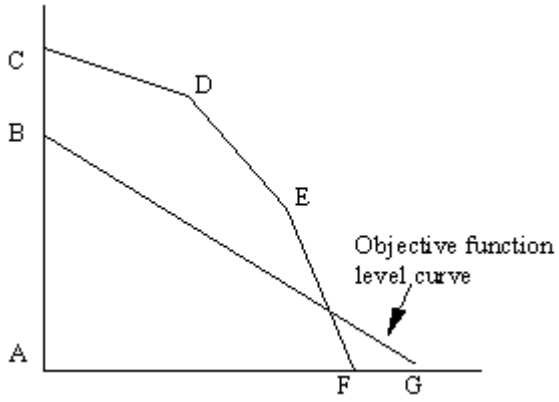
40. Which of the following actions would expand the feasible region of an LP model?
    a. Loosening the constraints.
    b. Tightening the constraints.
    c. Multiplying each constraint by 2.
    d. Adding an additional constraint.

    ANS: A PTS: 1

41. Level curves are used when solving LP models using the graphical method. To what part of the model do level curves relate?
    a. constraints
    b. boundaries
    c. right hand sides
    d. objective function

    ANS: D PTS: 1

42. This graph shows the feasible region (defined by points ACDEF) and objective function level curve (BG) for a maximization problem. Which point corresponds to the optimal solution to the problem?




    a. A
    b. B
    c. C
    d. D
    e. E

    ANS: D PTS: 1

43. When do alternate optimal solutions occur in LP models?
    a. When a binding constraint is parallel to a level curve.
    b. When a non-binding constraint is perpendicular to a level curve.
    c. When a constraint is parallel to another constraint.
    d. Alternate optimal solutions indicate an infeasible condition.

    ANS: A
    Chapter says level curve sits on feasible region edge, which implies parallel

    PTS: 1

44. A redundant constraint is one which
    a. plays no role in determining the feasible region of the problem.
    b. is parallel to the level curve.

c. is added after the problem is already formulated.
d. can only increase the objective function value.

ANS: A PTS: 1

45. When the objective function can increase without ever contacting a constraint the LP model is said to be
a. infeasible.
b. open ended.
c. multi-optimal.
d. unbounded.

ANS: D PTS: 1

46. If there is no way to simultaneously satisfy all the constraints in an LP model the problem is said to be
a. infeasible.
b. open ended.
c. multi-optimal.
d. unbounded.

ANS: A PTS: 1

47. Which of the following special conditions in an LP model represent potential errors in the mathematical formulation?
a. Alternate optimum solutions and infeasibility.
b. Redundant constraints and unbounded solutions.
c. Infeasibility and unbounded solutions.
d. Alternate optimum solutions and redundant constraints.

ANS: C PTS: 1

**PROBLEM**

48. Solve the following LP problem graphically by enumerating the corner points.

MAX: $2 X_1 + 7 X_2$
Subject to: $5 X_1 + 9 X_2 \leq 90$
$9 X_1 + 8 X_2 \leq 144$
$X_2 \leq 8$
$X_1, X_2 \geq 0$

ANS:
Obj = 63.20
$X_1 = 3.6$
$X_2 = 8$

PTS: 1

49. Solve the following LP problem graphically by enumerating the corner points.

MAX: $4 X_1 + 3 X_2$
Subject to: $6 X_1 + 7 X_2 \leq 84$
$X_1 \leq 10$
$X_2 \leq 8$

$X_1, X_2 \geq 0$

ANS:
Obj = 50.28
$X_1 = 10$
$X_2 = 3.43$

PTS: 1

50. Solve the following LP problem graphically using level curves.

MAX: $7 X_1 + 4 X_2$
Subject to: $2 X_1 + X_2 \leq 16$
$X_1 + X_2 \leq 10$
$2 X_1 + 5 X_2 \leq 40$
$X_1, X_2 \geq 0$

ANS:
Obj = 58
$X_1 = 6$
$X_2 = 4$

PTS: 1

51. Solve the following LP problem graphically using level curves.

MAX: $5 X_1 + 6 X_2$
Subject to: $3 X_1 + 8 X_2 \leq 48$
$12 X_1 + 11 X_2 \leq 132$
$2 X_1 + 3 X_2 \leq 24$
$X_1, X_2 \geq 0$

ANS:
Obj = 57.43
$X_1 = 9.43$
$X_2 = 1.71$

PTS: 1

52. Solve the following LP problem graphically by enumerating the corner points.

MIN: $8 X_1 + 3 X_2$
Subject to: $X_2 \geq 8$
$8 X_1 + 5 X_2 \geq 80$
$3 X_1 + 5 X_2 \geq 60$
$X_1, X_2 \geq 0$

ANS:
Obj = 48
$X_1 = 0$
$X_2 = 16$

PTS: 1

53. Solve the following LP problem graphically by enumerating the corner points.

MIN: $8 X_1 + 5 X_2$
Subject to: $6 X_1 + 7 X_2 \geq 84$
$X_1 \geq 4$
$X_2 \geq 6$
$X_1, X_2 \geq 0$

ANS:
Obj = 74.86
$X_1 = 4$
$X_2 = 8.57$

PTS: 1

54. Solve the following LP problem graphically using level curves.

MAX: $5 X_1 + 3 X_2$
Subject to: $2 X_1 - 1 X_2 \leq 2$
$6 X_1 + 6 X_2 \geq 12$
$1 X_1 + 3 X_2 \leq 5$
$X_1, X_2 \geq 0$

ANS:
Obj = 11.29
$X_1 = 1.57$
$X_2 = 1.14$

PTS: 1

55. Solve the following LP problem graphically using level curves.

MIN: $8 X_1 + 12 X_2$
Subject to: $2 X_1 + 1 X_2 \geq 16$
$2 X_1 + 3 X_2 \geq 36$
$7 X_1 + 8 X_2 \geq 112$
$X_1, X_2 \geq 0$

ANS:
Alternate optima solutions exist between the corner points

$X_1 = 9.6$ $X_1 = 18$
$X_2 = 5.6$ $X_2 = 0$

PTS: 1

56. Solve the following LP problem graphically using level curves.

MIN: $5 X_1 + 7 X_2$
Subject to: $4 X_1 + 1 X_2 \geq 16$

$6 X_1 + 5 X_2 \geq 60$
$5 X_1 + 8 X_2 \geq 80$
$X_1, X_2 \geq 0$

ANS:
Obj = 72.17
$X_1 = 3.48$
$X_2 = 7.83$

PTS: 1

57. The Happy Pet pet food company produces dog and cat food. Each food is comprised of meat, soybeans and fillers. The company earns a profit on each product but there is a limited demand for them. The pounds of ingredients required and available, profits and demand are summarized in the following table. The company wants to plan their product mix, in terms of the number of bags produced, in order to maximize profit.

| Product | Profit per Bag ($) | Demand for product | Pounds of Meat per bag | Pounds of Soybeans per bag | Pounds of Filler per bag |
|---|---|---|---|---|---|
| Dog food | 4 | 40 | 4 | 6 | 4 |
| Cat food | 5 | 30 | 5 | 3 | 10 |
| | Material available (pounds) | | 100 | 120 | 160 |

a. Formulate the LP model for this problem.

b. Solve the problem using the graphical method.

ANS:
a. Let $X_1$ = bags of Dog food to produce
$X_2$ = bags of Cat food to produce

MAX: $4 X_1 + 5 X_2$
Subject to: $4 X_1 + 5 X_2 \leq 100$ (meat)
$6 X_1 + 3 X_2 \leq 120$ (soybeans)
$4 X_1 + 10 X_2 \leq 160$ (filler)
$X_1 \leq 40$ (Dog food demand)
$X_2 \leq 30$ (Cat food demand)

b. Obj = 100
$X_1 = 10$
$X_2 = 12$

PTS: 1

58. Jones Furniture Company produces beds and desks for college students. The production process requires carpentry and varnishing. Each bed requires 6 hours of carpentry and 4 hour of varnishing. Each desk requires 4 hours of carpentry and 8 hours of varnishing. There are 36 hours of carpentry time and 40 hours of varnishing time available. Beds generate $30 of profit and desks generate $40 of profit. Demand for desks is limited so at most 8 will be produced.

a. Formulate the LP model for this problem.

b. Solve the problem using the graphical method.

ANS:

a. Let $X_1$ = Number of Beds to produce
$X_2$ = Number of Desks to produce

MAX: $30 X_1 + 40 X_2$
Subject to: $6 X_1 + 4 X_2 \leq 36$ (carpentry)
$4 X_1 + 8 X_2 \leq 40$ (varnishing)
$X_2 \leq 8$ (demand for $X_2$)
$X_1, X_2 \geq 0$

b. Obj = 240
$X_1 = 4$
$X_2 = 3$

PTS: 1

59. The Byte computer company produces two models of computers, Plain and Fancy. It wants to plan how many computers to produce next month to maximize profits. Producing these computers requires wiring, assembly and inspection time. Each computer produces a certain level of profits but faces a limited demand. There are a limited number of wiring, assembly and inspection hours available next month. The data for this problem is summarized in the following table.

| Computer Model | Profit per Model ($) | Maximum demand for product | Wiring Hours Required | Assembly Hours Required | Inspection Hours Required |
|---|---|---|---|---|---|
| Plain | 30 | 80 | .4 | .5 | .2 |
| Fancy | 40 | 90 | .5 | .4 | .3 |
| | | Hours Available | 50 | 50 | 22 |

a. Formulate the LP model for this problem.

b. Solve the problem using the graphical method.

ANS:

a. Let $X_1$ = Number of Plain computers produce
$X_2$ = Number of Fancy computers to produce

MAX: $30 X_1 + 40 X_2$
Subject to: $.4 X_1 + .5 X_2 \leq 50$ (wiring hours)
$.5 X_1 + .4 X_2 \leq 50$ (assembly hours)
$.2 X_1 + .2 X_2 \leq 22$ (inspection hours)
$X_1 \leq 80$ (Plain computers demand)
$X_2 \leq 90$ (Fancy computers demand)
$X_1, X_2 \geq 0$

b. Obj = 3975
$X_1 = 12.5$
$X_2 = 90$

PTS: 1

60. The Big Bang explosives company produces customized blasting compounds for use in the mining industry. The two ingredients for these explosives are agent A and agent B. Big Bang just received an order for 1400 pounds of explosive. Agent A costs $5 per pound and agent B costs $6 per pound. The customer's mixture must contain at least 20% agent A and at least 50% agent B. The company wants to provide the least expensive mixture which will satisfy the customers requirements.

    a. Formulate the LP model for this problem.

    b. Solve the problem using the graphical method.

    ANS:

    a. Let $X_1$ = Pounds of agent A used
    $X_2$ = Pounds of agent B used

    MIN: $5 X_1 + 6 X_2$
    Subject to: $X_1 \geq 280$ (Agent A requirement)
    $X_2 \geq 700$ (Agent B requirement)
    $X_1 + X_2 = 1400$ (Total pounds)
    $X_1, X_2 \geq 0$

    b. Obj = 7700
    $X_1 = 700$
    $X_2 = 700$

    PTS: 1

61. Jim's winery blends fine wines for local restaurants. One of his customers has requested a special blend of two burgundy wines, call them A and B. The customer wants 500 gallons of wine and it must contain at least 100 gallons of A and be at least 45% B. The customer also specified that the wine have an alcohol content of at least 12%. Wine A contains 14% alcohol while wine B contains 10%. The blend is sold for $10 per gallon. Wine A costs $4 per gallon and B costs $3 per gallon. The company wants to determine the blend that will meet the customer's requirements and maximize profit.

    a. Formulate the LP model for this problem.

    b. Solve the problem using the graphical method.

    c. How much profit will Jim make on the order?

    ANS:

    a. Let $X_1$ = Gallons of wine A in mix
    $X_2$ = Gallons of wine B in mix

    MIN: $4 X_1 + 3 X_2$
    Subject to: $X_1 + X_2 \geq 500$ (Total gallons of mix)
    $X_1 \geq 100$ ($X_1$ minimum)
    $X_2 \geq 225$ ($X_2$ minimum)
    $.14 X_1 + .10 X_2 \geq 60$ (12% alcohol minimum)
    $X_1, X_2 \geq 0$

    b. Obj = 1750
    $X_1 = 250$
    $X_2 = 250$

c. $3250 total profit.

PTS: 1

62. Bob and Dora Sweet wish to start investing $1,000 each month. The Sweets are looking at five investment plans and wish to maximize their expected return each month. Assume interest rates remain fixed and once their investment plan is selected they do not change their mind. The investment plans offered are:

| | |
|---|---|
| Fidelity | 9.1% return per year |
| Optima | 16.1% return per year |
| CaseWay | 7.3% return per year |
| Safeway | 5.6% return per year |
| National | 12.3% return per year |

Since Optima and National are riskier, the Sweets want a limit of 30% per month of their total investments placed in these two investments. Since Safeway and Fidelity are low risk, they want at least 40% of their investment total placed in these investments.

Formulate the LP model for this problem.

ANS:

MAX: $0.091X_1 + 0.161X_2 + 0.073X_3 + 0.056X_4 + 0.123X_5$

Subject to: $X_1 + X_2 + X_3 + X_4 + X_5 = 1000$

$X_2 + X_5 \leq 300$

$X_1 + X_4 \geq 400$

$X_1, X_2, X_3, X_4, X_5 \geq 0$

PTS: 1

**PROJECT**

63. **Project 2.1**

Joey Koons runs a small custom computer parts company. As a sideline he offers customized and pre-built computer system packages. In preparation for the upcoming school year, he has decided to offer two custom computer packages tailored for what he believes are current student needs. System A provides a strong computing capability at a reasonable cost while System B provides a much more powerful computing capability, but at a higher cost. Joey has a fairly robust parts inventory but is concerned about his stock of those components that are common to each proposed system. A portion of his inventory, the item cost, and inventory level is provided in the table below.

| Part | Type / Cost | On Hand | Type / Cost | On Hand | Type / Cost | On Hand | Type / Cost | On Hand |
|---|---|---|---|---|---|---|---|---|
| Processor | 366 MHZ $175 | 40 | 500 MHZ $239 | 40 | 650 MHZ $500 | 40 | 700 MHZ $742 | 40 |
| Memory | 64 MB $95 | 40 | 96 MB $189 | 40 | 128 MB $250 | 15 | 256 MB $496 | 15 |
| Hard Drive | 4 GB $89 | 10 | 6 GB $133 | 25 | 13 GB $196 | 35 | 20 GB $350 | 50 |
| Monitor | 14 " $95 | 3 | 15 " $160 | 65 | 17 " $280 | 25 | 19 " $480 | 10 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Graphics Card | Stock $100 | 100 | 3-D $250 | 15 | | | | |
| CD-ROM | 24X $30 | 5 | 40X $58 | 25 | 72X $125 | 50 | DVD $178 | 45 |
| Sound Card | Stock $99 | 100 | Sound II $150 | 50 | Plat II $195 | 25 | | |
| Speakers | Stock $29 | 75 | 60 W $69 | 75 | 120 W $119 | 25 | | |
| Modem | Stock $99 | 125 | | | | | | |
| Mouse | Stock $39 | 125 | Ergo $69 | 35 | | | | |
| Keyboard | Stock $59 | 100 | Ergo $129 | 35 | | | | |
| Game Devices | Stock $165 | 25 | | | | | | |

The requirements for each system are provided in the following table:

| | System A | System B |
|---|---|---|
| Processor | 366 MHZ | 700 MHZ |
| Memory | 64 MG | 96 MG |
| Hard Drive | 6 GB | 20 GB |
| Monitor | 15 " | 15 " |
| Graphics Card | Stock | Stock |
| CD-ROM | 40X | 72X |
| Sound Card | Stock | Stock |
| Speakers | Stock | 60W |
| Modem | Stock | Stock |
| Mouse | Stock | Stock |
| Keyboard | Stock | Stock |

Each system requires assembly, testing and packaging. The requirements per system built and resources available are summarized in the table below.

| | System A | System B | Total Hours Available |
|---|---|---|---|
| Assembly (hours) | 2.25 | 2.50 | 200 |
| Testing (hours) | 1.25 | 2.00 | 150 |
| Packaging (hours) | 0.50 | 0.50 | 75 |

Joey is uncertain about product demand. In the past he has put together similar types of computer packages but his sales results vary. As a result is unwilling to commit all his in-house labor force to building the computer packages. He is confident he can sell all he can build and is not overly concerned with lost sales due to stock-outs. Based on his market survey, he has completed his advertising flyer and will offer System A for $ 1250 and will offer system B for $ 2325. Joey now needs to let his workers know how many of each system to build and he wants that mix to maximize his profits.

Formulate an LP for Dave's problem. Solve the model using the graphical method. What is Dave's preferred product mix? What profit does Dave expect to make from this product mix?

ANS:

The cost to make System A is $1007 while the cost to make System B is $1992. The inventory levels for hard drives limit System A production to 25 while the 700 MHZ processor inventory limits System B production to 40. The common monitor is the 15 " unit and its inventory limits total production to 60. Coupled with the assembly, testing, and packaging constraints, the LP formulation is:

| | | |
|---|---|---|
| Maximize | $\$243\ X_1 + \$333\ X_2$ | |
| | $2.25\ X_1 + 2.50\ X_2 \le 200$ | {assembly hours} |
| | $1.25\ X_1 + 2.00\ X_2 \le 150$ | {testing hours} |
| | $0.50\ X_1 + 0.50\ X_2 \le 75$ | {packaging hours} |
| | $X_1 \le 25$ | {hard drive limits} |
| | $X_2 \le 40$ | {processor limits} |
| | $X_1 + X_2 \le 60$ | {monitor limits} |
| | $X_1 , X_2 \ge 0$ | |

Build 20 System A and 40 System B, total profit $18,180.

PTS: 1