***Business Analytics, 2e, GE* (Evans)**

**Chapter 15 Integer Optimization**

1) \_\_\_\_\_\_\_\_ is the parameter that specifies when the *Solver* algorithm will terminate an optimization process with integer constraints.

A) Mutation Rate

B) Population Size

C) Integer Tolerance

D) Convergence

Answer: C

Diff: 1

Blooms: Remember

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

2) What should be the value of Integer Tolerance in order to find the guaranteed optimal integer solution?

A) -1

B) 0

C) 0.5

D) 1

Answer: B

Diff: 1

Blooms: Remember

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

Stone Age Surfboards is a small manufacturer of two types of popular low-tide surfboards, the Graystone and the Lava models. The manufacturing process consists of two departments: fabrication and finishing. The fabrication department has 8 skilled workers, each of whom works 9.25 hours per day. The finishing department has 5 workers, each of whom works a 6-hour shift per day. Each pair of Graystone surfboards requires 2.5 labor hours in the fabrication department and 2 labor hours in finishing. The Lava model requires 4.2 labor-hours in fabrication and 3.6 labor-hours in finishing. The company operates 6 days a week. It makes a per unit profit of $40 on the Graystone model and $60 on the Lava model. The company anticipates selling at least twice as many Lava models as Graystone models.

Use the spreadsheet below for Stone Age Surfboards to answer the following question(s) using integer constraints on variables in the optimization models using the standard Solver.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | A | B | C | D |
| 1 | **Stone Age Surfboards** |  |  |  |
| 2 |  |  |  |  |
| 3 | **Data** |  |  |  |
| 4 |  | **Product** | |  |
| 5 | **Department** | Graystone | Lava | Limitations (hours) |
| 6 | Fabrication | 2.5 | 4.2 | 74 |
| 7 | Finishing | 2 | 3.6 | 30 |
| 8 |  |  |  |  |
| 9 | Profit/Unit | $40.00 | $60.00 |  |
| 10 |  |  |  |  |
| 11 |  |  |  |  |
| 12 | **Model** |  |  |  |
| 13 |  | Graystone | Lava |  |
| 14 | Quantity Produced |  |  | Hours Used |
| 15 | Fabrication |  |  |  |
| 16 | Finishing |  |  |  |
| 17 |  |  |  |  |
| 18 |  |  |  | Excess Lava |
| 19 | Market Mixture |  |  |  |
| 20 |  |  |  |  |
| 21 |  |  |  | Total Profit |
| 22 | Profit Contribution |  |  |  |

3) Which of the following constraints *Solver* uses?

A) $B$14:$C$14 = integer

B) $D$15 > = $D$6

C) $D$16 > = $D$7

D) $D$19 < = 0

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

4) What is the quantity of Graystone surfboards produced?

A) 2

B) 5

C) 7

D) 10

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

5) What is the quantity of Lava surfboards produced?

A) 2

B) 5

C) 7

D) 10

Answer: C

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

6) What is the total number of hours used for fabrication?

A) 39.6

B) 34.4

C) 29.2

D) 24.8

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

7) What is the total number of hours used for the finishing operation?

A) 39.6

B) 34.4

C) 29.2

D) 24.8

Answer: C

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

8) What is the total profit generated?

A) $ 748.28

B) $ 687.46

C) $ 385.65

D) $ 500.00

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

Use the table below to answer the following question(s) using the standard Solver.

A company makes standard 130-inch-wide rolls of thin sheet metal and slits them into smaller rolls to meet customer orders for widths of 10, 14, and 25 inches. Suppose that the company has proposed the following cutting patterns:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | E |
| 1 | **Cutting-Stock Problem** |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 | **Data** |  |  |  |  |
| 4 | **Pattern** | **10-in rolls** | **14 in. rolls** | **25-in. rolls** | **Scrap** |
| 5 | 1 | 0 | 8 | 0 | 10 |
| 6 | 2 | 0 | 2 | 3 | 10 |
| 7 | 3 | 3 | 0 | 3 | 4 |
| 8 | 4 | 10 | 0 | 0 | 10 |
| 9 | 5 | 3 | 2 | 2 | 4 |
| 10 | 6 | 8 | 2 | 0 | 4 |

Demands for the coming week are 950 10-inch rolls, 725 14-inch roles, and 640 25-inch rolls. Develop a model using the AnalyticSolver Platform that will determine how many 130-inch rolls to cut into each of the six patterns in order to meet demand and minimize scrap.

9) What is the total number of 10-inch rolls produced?

A) 940

B) 946

C) 950

D) 960

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

10) What is the total number of 14-inch rolls produced?

A) 721

B) 725

C) 728

D) 740

Answer: C

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

11) What is the total number of 25-inch rolls produced?

A) 630

B) 635

C) 640

D) 645

Answer: C

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

12) What is the total scrap produced?

A) 1,389

B) 1,390

C) 1,427

D) 1,445

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

Use the table below to answer the following question(s) using the standard Solver.

Coppell Services contracts with outsourcing partners to handle various customer service functions. Based on a study of call volumes provided by one of the firm's partners, the minimum number of staff needed for each hour of the day is as follows:

|  |  |
| --- | --- |
| **Hour** | **Minimum Staff Required** |
| 8-9 | 6 |
| 9-10 | 10 |
| 10-11 | 12 |
| 11-noon | 10 |
| noon-1 | 8 |
| 1-2 | 16 |
| 2-3 | 15 |
| 3-4 | 20 |
| 4-5 | 15 |

Mr. Coppell hires 6 permanent employees and wants to staff the remaining requirements using part-time employees who work 4-hour shifts (four consecutive hours starting as early as 8 A.M. or as late as 1 P.M.).

13) How many part-time employees are present in the 8-9 time slot?

A) 4

B) 6

C) 9

D) 14

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Develop integer optimization models for practical applications such as workforce scheduling and location.

LO2: Use a modern software tool to perform statistical calculations.

14) How many excess employees are present in the noon-1 time slot?

A) 2

B) 4

C) 5

D) 6

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Develop integer optimization models for practical applications such as workforce scheduling and location.

LO2: Use a modern software tool to perform statistical calculations.

15) How many part-time employees are present in the 3-4 time slot?

A) 16

B) 14

C) 9

D) 7

Answer: B

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Develop integer optimization models for practical applications such as workforce scheduling and location.

LO2: Use a modern software tool to perform statistical calculations.

16) How many excess employees are present in the 4-5 time slot?

A) 0

B) 2

C) 4

D) 6

Answer: A

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Develop integer optimization models for practical applications such as workforce scheduling and location.

LO2: Use a modern software tool to perform statistical calculations.

17) What is the minimum number of total part-time employees needed across all the 4-hour shifts to ensure meeting the staffing requirements?

A) 16

B) 28

C) 24

D) 20

Answer: D

Diff: 3

Blooms: Apply

AACSB: Analytic Skills

Topic: Solving Models with General Integer Variables

LO1: Develop integer optimization models for practical applications such as workforce scheduling and location.

LO2: Use a modern software tool to perform statistical calculations.

18) Which of the following best defines a binary variable?

A) It is a general integer variable that is restricted to being between -1 and 1.

B) It is a general integer variable that is restricted to being a multiple of 2.

C) It is a general integer variable that is restricted to being between 0 and 1.

D) It is a general integer variable that is restricted to being greater than 2.

Answer: C

Diff: 1

Blooms: Remember

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

Use the table below to answer the following question(s) by invoking the binary constraints on the variables using the standard Solver.

Below is the spreadsheet for a project selection model:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | E | F | G |
| 1 | **Project Selection Model** |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |
| 3 | **Data** |  |  |  |  |  |  |
| 4 |  | Project 1 | Project 2 | Project 3 | Project 4 | Project 5 | AvailableResources |
| 5 | **Expected Return (NPV)** | $160,000 | $200,000 | $125,000 | $150,000 | $225,000 |  |
| 6 | **Cash requirements** | $45,000 | $70,000 | $28,000 | $52,000 | $65,000 | $175,000 |
| 7 | **Personnel requirements** | 7 | 4 | 2 | 6 | 4 | 10 |
| 8 |  |  |  |  |  |  |  |
| 9 | **Model** |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |
| 11 | **Project selection decisions** |  |  |  |  |  |  |
| 12 | **Cash Used** |  |  |  |  |  |  |
| 13 | **Personnel Used** |  |  |  |  |  |  |
| 14 | **Return** |  |  |  |  |  |  |

19) Which of the following cells is set as the objective cell in *Solver*?

A) $G$12

B) $F$14

C) $G$14

D) $B$12

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

LO2: Use a modern software tool to perform statistical calculations.

20) What is the amount of cash used for Project 2?

A) $ 105,000

B) $ 25,000

C) $ 115,000

D) $ 70,000

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

LO2: Use a modern software tool to perform statistical calculations.

21) What is the amount of cash used for Project 5?

A) $ 65,000

B) $ 117,000

C) $ 13,000

D) $ 110,000

Answer: A

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

LO2: Use a modern software tool to perform statistical calculations.

22) What is the total amount of cash used for all five projects?

A) $ 175,000

B) $ 163,000

C) $ 215,000

D) $ 260,000

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

LO2: Use a modern software tool to perform statistical calculations.

23) What is the amount of personnel used for Project 2?

A) 3

B) 4

C) 6

D) 11

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

LO2: Use a modern software tool to perform statistical calculations.

24) What is the total amount of personnel used for all five projects?

A) 23

B) 17

C) 10

D) 4

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

LO2: Use a modern software tool to perform statistical calculations.

25) What is the return obtained from Project 3?

A) $ 200,000

B) $ 125,000

C) $ 275,000

D) $ 225,000

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

LO2: Use a modern software tool to perform statistical calculations.

26) What is the return obtained from Project 5?

A) $ 200,000

B) $ 125,000

C) $ 275,000

D) $ 225,000

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

LO2: Use a modern software tool to perform statistical calculations.

27) What is the total return obtained from all five projects?

A) $ 860,000

B) $ 550,000

C) $ 700,000

D) $ 395,000

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

LO2: Use a modern software tool to perform statistical calculations.

Use the table below to answer the following question(s) using the standard Solver.

Below is the spreadsheet for a plant location model:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | E | F |
| 1 | **Plant Location Model** |  |  |  |  |  |
| 2 |  |  |  |  |  |  |
| 3 | **Data** |  |  |  |  |  |
| 4 |  | **Distribution Center** | | | |  |
| 5 | **Plant** | **Houston** | **San Jose** | **Jacksonville** | **Memphis** | **Capacity** |
| 6 | **Dallas** | $11.80 | $16.48 | $12.35 | $18.56 | 1,300 |
| 7 | **Atlanta** | $8.54 | $14.65 | $9.58 | $18.25 | 750 |
| 8 | **Detroit** | $12.89 | $10.78 | $7.85 | $10.28 | 1,400 |
| 9 | **Baltimore** | $14.36 | $18.95 | $14.61 | $6.64 | 1,300 |
| 10 | **Demand** | 350 | 450 | 800 | 1,700 |  |
| 11 |  |  |  |  |  |  |
| 12 | **Model** |  |  |  |  |  |
| 13 |  |  |  |  |  |  |
| 14 | **Amount Shipped** | **Distribution Center** | | | |  |
| 15 | **Plant** | **Houston** | **San Jose** | **Jacksonville** | **Memphis** | **Total Shipped** |
| 16 | **Dallas** |  |  |  |  |  |
| 17 | **Atlanta** |  |  |  |  |  |
| 18 | **Detroit** |  |  |  |  |  |
| 19 | **Baltimore** |  |  |  |  |  |
| 20 | **Supply** |  |  |  |  |  |
| 21 |  |  |  |  |  |  |
| 22 | **Total Cost** |  |  |  |  |  |
| 23 | $0.00 |  |  |  |  |  |

28) Which of the following constraints is used in *Solver*?

A) $F$16:$F$19>= $F$6:$F$9

B) $B$20:$E$20 < $B$10:$E$10

C) $B$20:$E$20= binary

D) $F$16:$F$19 <= $F$6:$F$9

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

29) In which of the following plants is the total amount shipped to the distribution centers equal to zero?

A) Dallas

B) Atlanta

C) Detroit

D) Baltimore

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

30) What is the total amount shipped by the Detroitplant to the distribution centers?

A) 750

B) 1,000

C) 1,400

D) 1,300

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

31) What is the total amount shipped by the Atlanta plant to the distribution centers?

A) 600

B) 1,000

C) 1,250

D) 1,300

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

32) What is the total amount shipped by the Baltimore plant to the distribution centers?

A) 750

B) 1,000

C) 1,250

D) 1,300

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

33) What is the total cost incurred?

A) $ 27,297

B) $ 35,233

C) $ 42,675

D) $ 47,864

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

Use the table below to answer the following question(s) using the standard Solver.

Below is the spreadsheet for Memphis Designs fixed cost model:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | A | B | C | D |
| 1 | **Memphis Design Fixed Cost Model** | |  |  |
| 2 |  |  |  |  |
| 3 | **Data** |  |  |  |
| 4 |  |  |  |  |
| 5 | **Cost** | **Quarter 1** | **Quarter 2** | **Quarter 3** |
| 6 | **Production** | $10.00 | $15.00 | $13.50 |
| 7 | **Inventory** | $1.70 | $1.70 | $1.70 |
| 8 | **Demand** | 200 | 450 | 75 |
| 9 | **Fixed Cost** | $75.00 | $75.00 | $75.00 |
| 10 |  |  |  |  |
| 11 | **Model** |  |  |  |
| 12 |  |  |  |  |
| 13 |  | **Quarter 1** | **Quarter 2** | **Quarter 3** |
| 14 | **Production** |  |  |  |
| 15 | **Inventory** |  |  |  |
| 16 | **Binary** |  |  |  |
| 17 |  |  |  |  |
| 18 | **Binary constraints** |  |  |  |
| 19 | **Net Production** |  |  |  |
| 20 |  |  |  |  |
| 21 |  | **Cost** |  |  |
| 22 | **Total** |  |  |  |

34) Which of the following constraints is used in *Solver*?

A) $B$14:$D$14 > = $B$18:$D$18

B) $B$16:$D$16 = binary

C) $B$19:$D$19 < = $B$8:$D$8

D) $B$15:$D$15 = binary

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

35) What is the inventory at the end of the first quarter?

A) 725

B) 525

C) 50

D) 75

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

36) What is the binary constraint at the end of the third quarter?

A) 75

B) 200

C) 450

D) 0

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

37) What is the net production at the end of the first quarter?

A) 75

B) 200

C) 450

D) 600

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

38) What is the net production at the end of the second quarter?

A) 75

B) 200

C) 450

D) 600

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

39) What is the net production at the end of the third quarter?

A) 75

B) 200

C) 450

D) 600

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

40) What is the total cost incurred by the company?

A) $ 8,345.00

B) $ 10,756.80

C) $ 7,289.62

D) $ 9,582.75

Answer: A

Diff: 3

Blooms: Apply

AACSB: Analytic Skills

Topic: Mixed-Integer Optimization Models

LO1: Develop and solve mixed-integer optimization models such as facility location and fixed-cost models.

LO2: Use a modern software tool to perform statistical calculations.

41) Decision variables that are forced to be integers are called general integer variables.

Answer: TRUE

Diff: 1

Blooms: Remember

Topic: Solving Models with General Integer Variables

LO1: Recognize when to use integer variables in optimization models.

42) If the Integer Tolerance is set to 0.01, the *Solver* will stop if it finds an integer solution that is within 10% of the optimal solution.

Answer: FALSE

Diff: 1

Blooms: Understand

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

43) *Solver* can generate a Sensitivity report for integer models.

Answer: FALSE

Diff: 1

Blooms: Remember

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

44) Mathematically, a binary variable *x* can be represented as *x*> 2 and integer.

Answer: FALSE

Diff: 1

Blooms: Remember

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

45) To invoke the binary constraints on the variables, the option *bin* is chosen from the dropdown box in the *Add Constraint* dialog.

Answer: TRUE

Diff: 1

Blooms: Remember

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

LO2: Use a modern software tool to perform statistical calculations.

46) Explain the method of solving models with general integer variables.

Answer: Decision variables that are forced to be integers are called general integer variables. If the linear optimization model is solved without the integer restrictions and the optimal solution happens to have all integer values, then it clearly would have solved the integer model. However, this is generally not the case. The algorithm used to solve integer optimization models begins by solving the LP relaxation and proceeds to enforce the integer restrictions using a systematic research process that involves solving a series of modified linear optimization problems.

Diff: 1

Blooms: Remember

Topic: Solving Models with General Integer Variables

LO1: Recognize when to use integer variables in optimization models.

47) What is the importance of *Integer Tolerance* in *Solver*?

Answer: When using *Solver*, it is important to set a parameter called the Integer Tolerance. This value specifies when the *Solver* algorithm will terminate. By default, the Integer Tolerance is set to 0.05 within *Solver*. This means that *Solver* will stop if it finds an integer solution that is within 5% of the optimal solution. To find the guaranteed optimal integer solution, *Integer Tolerance* must be set to 0. To do this, click the Options button in the *Solver Parameters* dialog and change the value of *Integer Optimality* (%) to 0.

Diff: 1

Blooms: Remember

Topic: Solving Models with General Integer Variables

LO1: Incorporate integer variables into Solver models.

LO2: Use a modern software tool to perform statistical calculations.

48) What is the importance of binary variables in integer optimization models?

Answer: Many optimization models require binary variables, which are variables that are restricted to being either 0 or 1. Binary variables are used to model logical decisions in optimization models. They can be used to model whether to place (*x*=1) or not to place (*x*=0) a facility at a certain location, whether or not to run a production line, or whether or not to invest in a certain stock.

Diff: 1

Blooms: Remember

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

49) What is the purpose of a heat map?

Answer: As the amount of cash and personnel vary from the base case to the extreme, the optimal results can be found in the project selection models. The color-coded regions in the matrix show combinations of personnel and cash with the same minimal values of the return. Such a visual display is often called a heat map. This information can help the manager evaluate the trade-offs between increasing the expected return and acquiring additional resources.

Diff: 1

Blooms: Understand

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.

LO2: Use a modern software tool to perform statistical calculations.

50) Explain the implementation of a project-selection model.

Answer:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | E | F | G |
| 1 | **Project Selection Model** | | |  |  |  |  |
| 2 |  |  |  |  |  |  |  |
| 3 | **Data** |  |  |  |  |  |  |
| 4 |  | Project1 | Project 2 | Project 3 | Project 4 | Project 5 | Available |
| 5 | **Expected Return (NPV)** | $160,000 | $200,000 | $125,000 | $150,000 | $225,000 | Resources |
| 6 | **Cash requirements** | $45,000 | $70,000 | $28,000 | $52,000 | $65,000 | $175,000 |
| 7 | **Personnel requirements** | 7 | 4 | 2 | 6 | 4 | 10 |
| 8 |  |  |  |  |  |  |  |
| 9 | **Model** |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |
| 11 | **Project selection decisions** |  |  |  |  |  |  |
| 12 | **Cash Used** | B6\*B11 | C6\*C11 | D6\*D11 | E6\*E11 | F6\*F11 | SUM(B12:F12) |
| 13 | **Personnel Used** | B7\*B11 | C7\*C11 | D7\*D11 | E7\*E11 | F7\*F11 | SUM(B13:F13) |
| 14 | **Return** | B5\*B11 | C5\*C11 | D5\*D11 | E5\*E11 | F5\*F11 | SUM(B14:F14) |

The decision variables are defined in cells B11:F11. By multiplying these values by the data for each project in rows 5-7, the total return, cash used, and personnel used for the projects that are selected, can be computed in rows 12-14. The objective function is computed in cell G14 as the sum of the returns for the selected projects. Similarly, the amounts of cash and personnel used are also summed for the projects selected, representing the constraint functions in cells G12 and G13. The binary constraints are invoked in the *Solver*.

Diff: 3

Blooms: Apply

AACSB: Analytic Skills

Topic: Integer Optimization Models with Binary Variables

LO1: Formulate and solve optimization models with binary variables and logical constraints.