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

**Chapter 14 Applications of Linear Optimization**

1) Which of the following is an example of a simple bounds constraint?

A) confirming that production does not go beyond a certain unit value

B) reducing production due to scarcity of resources

C) meeting targets for a specific sales job

D) equaling production in September with the resources available at the end of August

Answer: A

Diff: 1

Blooms: Understand

Topic: Types of Constraints in Optimization Models

LO1: Describe the different categories of constraints that are typically used in optimization models.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

2) Problem statements such as production must be sufficient to meet promised customer orders would be categorized as a \_\_\_\_\_\_\_\_ constraint.

A) limitations

B) requirements

C) proportional relationships

D) balance

Answer: B

Diff: 1

Blooms: Remember

Topic: Types of Constraints in Optimization Models

LO1: Describe the different categories of constraints that are typically used in optimization models.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

3) \_\_\_\_\_\_\_\_ constraints essentially state that input = output and ensure that the flow of material or money is accounted for at locations or between time periods.

A) Requirements

B) Proportional relationships

C) Balance

D) Limitations

Answer: C

Diff: 1

Blooms: Remember

Topic: Types of Constraints in Optimization Models

LO1: Describe the different categories of constraints that are typically used in optimization models.

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4) Which of the following would be considered as an example of a proportional relationships constraint?

A) making certain that only a certain amount of units are produced

B) guaranteeing that a certain amount of workforce will be available for a certain month

C) balancing the input to the output during production

D) ensuring that the budget allocated to marketing is thrice that of research and development

Answer: D

Diff: 1

Blooms: Understand

Topic: Types of Constraints in Optimization Models

LO1: Describe the different categories of constraints that are typically used in optimization models.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

5) Problem statements such as the amount of material used in production cannot exceed the amount available in inventory would be categorized as a \_\_\_\_\_\_\_\_ constraint.

A) proportional relationships

B) limitations

C) requirements

D) simple bounds

Answer: B

Diff: 1

Blooms: Understand

Topic: Types of Constraints in Optimization Models

LO1: Describe the different categories of constraints that are typically used in optimization models.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

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

Remington Textiles has a mill that produces three types of fabrics on a make-to-order basis. The mill operates on a 24/7 basis. The key decision facing the plant manager is about the type of loom needed to process each fabric during the coming 12 weeks to meet demands for the three fabrics and not exceed the capacity of the looms in the mill. Two types of looms are used: Jaquard and Northrop. Jaquard looms can be used to make all fabrics and are the only looms that can weave certain fabrics, such as plaids. Demands, variable costs for each fabric, and production rates on the looms are given in the table below. The mill has 10 Northrop looms and 2 Jaquard looms. Any fabrics that cannot be woven in the mill because of limited capacity will be purchased from an external supplier, finished at the mill, and sold at the selling price. In addition to determining which looms to use to process the fabrics, the manager also needs to determine which fabrics to buy externally.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Remington Textiles** |  |  |  |  |  |
|  |  |  |  |  |  |
| **Data** |  |  |  |  |  |
| **Fabric** | **Demand (yards)** | **Jaquard Capacity (yards/hour)** | **Northrop Capacity (yards/hour)** | **Mill Cost ($/yard)** | **Outsourcing Cost ($/yard)** |
| 1 | 50,000 | 5.6 | 0 | 0.53 | 0.81 |
| 2 | 62,000 | 5.2 | 4.8 | 0.6 | 0.85 |
| 3 | 35,000 | 4.8 | 4.5 | 0.71 | 0.84 |

Answer the following questions using a linear optimization model.

6) According to the model, what is the total amount of Fabric 1 to be produced on Jaquard?

A) 50,000

B) 0

C) 27,420.8

D) 22,579.2

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Process Selection Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

7) According to the model, what is the total amount of Fabric 1 to be purchased?

A) 27,420.8

B) 50,000

C) 22,579.2

D) 32,595

Answer: A

Diff: 3

Blooms: Apply

AACSB: Analytic Skills

Topic: Process Selection Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

8) According to the model, what is the total amount of Fabric 2 to be produced with Northrop?

A) 0

B) 62,000

C) 20,160

D) 32,595

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Process Selection Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

9) According to the model, what is the total amount of Fabric 2 to be purchased?

A) 50,000

B) 62,000

C) 0

D) 2,405

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Process Selection Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

10) According to the model, what is the total amount of Fabric 3 to be produced with Northrop?

A) 0

B) 35,000

C) 2,405

D) 32,595

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Process Selection Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

11) According to the model, what is the total amount of Fabric 3 to be purchased?

A) 2,405

B) 0

C) 32,595

D) 35,000

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Process Selection Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

12) According to the model, what is the total cost incurred by Remington for producing the three fabrics?

A) $96,540.47

B) $149,240.47

C) $96,227.82

D) $88,862.65

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Process Selection Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

13) From the Sensitivity Report, what cost reduction($/hour) would make it feasible to purchase some amount of Fabric 2 from the external supplier rather than just produce it?

A) $0.6

B) $0.25

C) $0.128

D) $1.1

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Process Selection Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

14) From the Sensitivity Report, which of the following would reduce the total cost by $1.568 for each additional hour of capacity for the Jaquard looms?

A) decreasing the Northrop loom cost per hour by $0.58

B) decreasing the Northrop loom capacity down by 534.4

C) increasing the Jaquard loom capacity up by 4896.5 hours

D) increasing the Jaquard loom capacity up by 4032 hours

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Process Selection Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

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

Qualis Investments is a private limited business that manages personal financial portfolios. The company manages six mutual funds and has a client that has acquired $750,000 from an inheritance. Characteristics of the funds are given in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Qualis Mutual Fund Data** |  |  |
|  |  | **Expected Annual Return** | **Risk Measure** |
| 1 | Qualis Low-priced Stock Fund | 7.23% | 11.87 |
| 2 | Qualis Multinational Fund | 8.42% | 12.62 |
| 3 | Qualis Mid-cap Stock Fund | 6.66% | 13.72 |
| 4 | Qualis Mortgage Fund | 2.72% | 3.37 |
| 5 | Qualis Income Equity Fund | 8.89% | 8.4 |
| 6 | Qualis Balanced Fund | 3.50% | 6.91 |

The company recommends that no more than $300,000 be invested in any individual fund, and that at least $80,000 be invested in each of the mid-cap stock and mortgage fund. The total amount invested in the low-priced and multinational funds are at least 35% of the total investment. The client would like an average return of at least 6%. Assume that *X*1-*X*6represent the dollar amounts invested in funds 1 through 6, respectively.

15) Which of the following is the objective function minimize total risk?

A) 11.87 *X*1 + 12.62 *X*2 + 13.72 .*X*3 + 3.37 X4 + 8.4 *X*5 + 6.91 *X*6

B) 7.23 *X*1 + 8.42 *X*2 + 6.66 .*X*3 + 2.72 X4 + 8.89 *X*5 + 3.5 *X*6

C) 11.87 *X*1 + 12.62 *X*2 + 13.72 .*X*3 + 3.37 X4 + 8.4 *X*5 + 6.91 *X*6 / 750,000

D) 7.23 *X*1 + 8.42 *X*2 + 6.66 .*X*3 + 2.72 X4 + 8.89 *X*5 + 3.5 *X*6 ≥ 6%

Answer: C

Diff: 2

Blooms: Apply

Topic: Portfolio Investment Models

LO1: Build linear optimization models for a variety of applications.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

16) Which of the following is the constraint for the weighted return?

A) *X*1 + *X*2 + *X*3 + X4 + *X*5 + *X*6 = 750,000

B) 7.23 *X*1 + 8.42 *X*2 + 6.66 .*X*3 + 2.72 X4 + 8.89 *X*5 + 3.5 *X*6 ≥ 6.00

C) ( 7.23*X*1 + 8.42 *X*2 + 6.66 .*X*3 + 2.72 X4 + 8.89 *X*5 + 3.5 *X*6 )/ 750,000 ≥ 6.00

D) ( 7.23*X*1 + 8.42 *X*2 + 6.66 .*X*3 + 2.72 X4 + 8.89 *X*5 + 3.5 *X*6 ) / 750,000

Answer: C

Diff: 2

Blooms: Apply

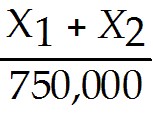
Topic: Portfolio Investment Models

LO1: Build linear optimization models for a variety of applications.

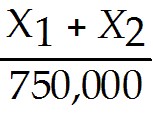
LO2: Identify different business uses for statistics and the major statistical tools businesses use

17) Which of the following is the constraint for investment in low-priced and multinational funds?

A) X1 + *X*2 ≥ 0.35(750,000)

B)  ≥ 0.35(750,000)

C) X1 + *X*2 + X3 + *X*4 + X5 + *X*6 ≥ 0.35(750,000)

D)  ≥ 0.35

Answer: A

Diff: 2

Blooms: Apply

Topic: Portfolio Investment Models

LO1: Build linear optimization models for a variety of applications.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

18) Which of the following describes the constraint on the mid-cap fund?

A) *X*3 ≥ 0.35(750,000)

B) *X*3 ≥ 80,000

C) *X*3 ≥ 0.35(80,000)

D) *X*3 ≤ 670,000

Answer: B

Diff: 2

Blooms: Apply

Topic: Portfolio Investment Models

LO1: Build linear optimization models for a variety of applications.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

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

The Riviera Transport Company (RTC) produces car accessories at two plants: Dallas and Atlanta. They ship them to major distribution centers in Houston, San Jose, Jacksonville, and Memphis. The accounting, production, and marketing departments have provided the information in the table below, which shows the unit cost of shipping between any plant and distribution center, plant capacities over the next planning period, and distribution center demands. RTC's supply chain manager faces the problem of determining how much to ship between each plant and distribution center to minimize the total transportation cost, not exceed available capacity, and meet customer demand.

Assume *Xij* = amount shipped from plant *i* to distribution center *j,* where *i*= 1 represents Dallas, *i* = 2 represents Atlanta, *j* = 1 represents Houston, and so on.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Transportation Model** |  |  |  |  |  |
|  |  |  |  |  |  |
| **Data** |  |  |  |  |  |
|  | **Distribution Center** |  |  |  |  |
| **Plant** | Houston | San Jose | Jacksonville | Memphis | **Capacity** |
| Dallas | 13.00 | 15.25 | 10.99 | 18.48 | 1250 |
| Atlanta | 10.75 | 15.16 | 9.65 | 18.50 | 750 |
| **Demand** | 175 | 325 | 480 | 950 |  |

Answer the following question(s) using a linear optimization model.

19) Which of the following is the objective function for cost minimization?

A) minimize cost = 13 *X*11 +15.25 *X*12 +10.99 *X*13 +18.48 *X*14 / 10.75 *X*21 +15.16 *X*22 +9.65 *X*23 +18.5 *X*24

B) minimize cost = 13 *X*11 +15.25 *X*12 +10.99 *X*13 +18.48 *X*14 + 10.75 *X*21 +15.16 *X*22 +9.65 *X*23 +18.5 *X*24

C) minimize cost = 13 *X*11 +15.25 *X*12 +10.99 *X*13 +18.48 *X*14 - 10.75 *X*21 +15.16 *X*22 +9.65 *X*23 +18.5 *X*24

D) minimize cost = (13 *X*11 +15.25 *X*12 +10.99 *X*13 +18.48 *X*14 - 10.75 *X*21 +15.16 *X*22 +9.65 *X*23 +18.5 *X*24 )(1,250 / 750)

Answer: B

Diff: 2

Blooms: Apply

Topic: Transportation Models

LO1: Build linear optimization models for a variety of applications.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

20) Which of the following is the constraint for total amount shipped from Dallas?

A) *X*11 + *X*12 + *X*13 + *X*14 ≤1,250

B) *X*21 + *X*22 + *X*23 + *X*24 ≤ 1,250

C) *X*21 + *X*22 + *X*23 + *X*24 ≤750

D) *X*11 + *X*12 + *X*13 + *X*14 - *X*21 + *X*22 + *X*23 + *X*24 ≤850

Answer: A

Diff: 2

Blooms: Apply

Topic: Transportation Models

LO1: Build linear optimization models for a variety of applications.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

21) Which of the following is the constraint for total amount shipped from Atlanta?

A) *X*11 + *X*12 + *X*13 + *X*14 - *X*21 + *X*22 + *X*23 + *X*24 ≤850

B) *X*21 + *X*22 + *X*23 + *X*24 ≤750

C) *X*21 + *X*22 + *X*23 + *X*24 ≤1250

D) *X*11 + *X*12 + *X*13 + *X*14 ≤1250

Answer: B

Diff: 2

Blooms: Apply

Topic: Transportation Models

LO1: Build linear optimization models for a variety of applications.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

22) Which of the following gives the constraint for the demand met at a distribution center?

A) *X*11 + *X*21 = 1,250

B) *X*13 + *X*23 ≥ 210

C) *X*13 + *X*23 = 770

D) *X*13 + *X*23 = 480

Answer: D

Diff: 2

Blooms: Apply

Topic: Transportation Models

LO1: Build linear optimization models for a variety of applications.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

23) Which of the following is the constraint of nonnegativity for all values of *i* and *j*?

A) 13 *X*11 +15.25 *X*12 +10.99 *X*13 +18.48 *X*14 / 10.75 *X*21 +15.16 *X*22 + 9.65 *X*23 +18.5 *X*24 ≤ 0

B) *Xij*≥ 0, for all *i* and *j*

C) *Xij ≤* 0, for all *i* and *j*

D) 

Answer: B

Diff: 1

Blooms: Apply

Topic: Transportation Models

LO1: Build linear optimization models for a variety of applications.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

24) According to the transportation model, which of the following is the amount shipped from Dallas to Houston?

A) 0

B) 175

C) 1,180

D) 750

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

25) According to the transportation model, which of the following is the amount shipped from Dallas to San Jose?

A) 0

B) 95

C) 230

D) 325

Answer: C

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

26) According to the transportation model, what is the amount shipped from Atlanta to Jacksonville?

A) 950

B) 480

C) 0

D) 95

Answer: B

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

27) According to the transportation model, what is the amount shipped from Atlanta to Memphis?

A) 480

B) 0

C) 230

D) 950

Answer: B

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

28) According to the transportation model, what is the total shipment from Dallas?

A) 750

B) 1,180

C) 430

D) 950

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

29) According to the transportation model, what is the total cost incurred by Riviera Transport Company?

A) $29,016.95

B) $26,698.95

C) $20,331.35

D) $41,978.75

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

30) According to the Sensitivity report on the model, by what price should the unit cost of shipment reduce to make shipment from Dallas to Houston feasible?

A) $8.68

B) $2.16

C) $10.84

D) $3.41

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

31) From the Sensitivity Report on the model, to which of the following cities can Atlanta not ship to without reducing unit cost of production?

A) Houston

B) San Jose

C) Jacksonville

D) Memphis

Answer: D

Diff: 3

Blooms: Apply

AACSB: Analytic Skills

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

32) Based on the Sensitivity Report on the model, which of the following is the savings on a reduction of demand of 2 units at Jacksonville?

A) $2.5

B) $1.25

C) $19.48

D) $16.98

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

33) According to the Sensitivity Report, which of the following is true if the capacity at Atlanta is increased by 230 units?

A) the total cost can be reduced by $.09 per unit

B) the total cost at Atlanta increases by $9

C) the total cost per unit will reduce by $.09 to Memphis

D) the shadow price at Atlanta will increase to $0.09

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

34) In a sensitivity report, a solution is considered a(n) \_\_\_\_\_\_\_\_ solution if the right-hand-side value of any constraint has a zero Allowable Increase or Allowable Decrease.

A) algorithmic

B) unbounded

C) infeasible

D) degenerate

Answer: D

Diff: 1

Blooms: Remember

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

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

Letherin Hides is a company that makes boots specifically targeting college students. Forecasts of sales for the next year are 200 in the summer, 450 in the autumn, and 500 in the winter. Accessories that are used on the boots are purchased from a supplier for $31.66. The cost of capital is estimated to be 24% per year (or 6% per quarter); thus, the holding cost per item is 0.06($31.66) = $1.9 per quarter (rounded figure). Letherin Hides hires freelance art designers at part-time to craft designs during the summer, and they earn $6 per hour. In the autumn, labor is more difficult to keep, and the owner must pay $6.5 per hour to retain qualified help. Because of the high demand for part-time help during the winter holiday season, labor rates are higher in the winter, and workers earn $7.75 per hour. Each boot design takes 2 hours to complete. How should production be planned over the three quarters to minimize the combined production and inventory holding costs?

The table below provides information on Letherin Hides boot design cost and production.

|  |  |  |  |
| --- | --- | --- | --- |
| **Letherin Hides** |  |  |  |
|  |  |  |  |
| **Data** |  |  |  |
|  |  |  |  |
|  | **Summer** | **Autumn** | **Winter** |
| **Unit Production Cost** | 12 | 13 | 15.5 |
| **Unit Inventory Holding Cost** | 1.9 | 1.9 | 1.9 |
| **Demand** | 200 | 450 | 500 |

Use a linear optimization model based on the data to answer the following questions.

35) According to the linear optimization model, what is the total amount to be produced in summer?

A) 200

B) 100

C) 550

D) 0

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Multiperiod Production Planning Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

36) According to the linear optimization model, what is the inventory held at the end of summer?

A) 450

B) 0

C) 200

D) 550

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Multiperiod Production Planning Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

37) According to the linear optimization model, what is the inventory held at the end of autumn?

A) 0

B) 200

C) 950

D) 500

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Multiperiod Production Planning Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

38) According to the linear optimization model, what is the net production for autumn?

A) 200

B) 500

C) 450

D) 50

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Multiperiod Production Planning Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

39) According to the linear optimization model, what is the net production for winter?

A) 0

B) 950

C) 200

D) 500

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Multiperiod Production Planning Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

40) According to the linear optimization model, what is the total cost incurred by Letherin Hides for the combined seasons?

A) $17,885

B) $15,605

C) $15,700

D) $18,700

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Multiperiod Production Planning Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

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

Pickson Luthiers Corporation makes four models of electric guitars, ScarCT, Dela Mort, Warax, and Invazen. Each guitar must flow through five departments, assembly, painting, sound testing, inspection, and packaging. The table below shows the relevant data. Production rates are shown in units/hour. (ScarCT is assembled elsewhere). Pickson wants to determine how many guitars to make to maximize monthly profit.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Pickson Luthiers Corporation** |  |  |  |  |  |
|  |  |  |  |  |  |
| **Data** |  |  |  |  |  |
| **Guitar Model** | **Selling price/Unit** | **Variable cost/Unit** | **Min Sales** | **Max Sales** |  |
| ScarCT | 750.00 | 660.00 | 0 | 2500 |  |
| Dela Mort | 788.00 | 680.00 | 0 | 2000 |  |
| Warax | 800.00 | 700.00 | 100 | 1000 |  |
| Invazen | 850.00 | 800.00 | 80 | 500 |  |
|  |  |  |  |  |  |
| **Production rates (units/hour)** | ScarCT | Dela Mort | Warax | Invazen | **Hours Available** |
| Assembly | - | 35 | 25 | 20 | 220 |
| Painting | 35 | 20 | 15 | 10 | 220 |
| Sound Testing | 20 | 10 | 20 | 18 | 220 |
| Inspection | 10 | 12 | 8 | 5 | 220 |
| Packaging | 9 | 10 | 5 | 8 | 220 |

Use a linear optimization model based on the data to answer the following question.

41) According to the linear optimization model, what would be the total time spent on inspecting the Dela Mort models?

A) 158.33

B) 12.5

C) 85

D) 48

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Models with Bounded Variables

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

42) According to the linear optimization model, what would be the total time spent for sound testing the Warax model?

A) 5

B) 4

C) 6

D) 10.5

Answer: A

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Models with Bounded Variables

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

43) According to the linear optimization model, what would be the total time spent for assembling the Invazen models?

A) 8

B) 4

C) 16

D) 10

Answer: B

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Models with Bounded Variables

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

44) According to the linear optimization model, what would be the total time spent for packaging the Invazen models?

A) 8

B) 16

C) 20

D) 10

Answer: D

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Models with Bounded Variables

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

45) According to the linear optimization model, what is the total hours spent for painting all the models?

A) 220

B) 94.94

C) 109.67

D) 199.44

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Models with Bounded Variables

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

46) According to the linear optimization model, which of the following departments uses all the time that it is allocated to finish its job?

A) assembly

B) painting

C) inspection

D) packaging

Answer: D

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Models with Bounded Variables

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

47) According to the linear optimization model, what is the total number of ScarCTs produced?

A) 2500

B) 750

C) 0

D) 100

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Models with Bounded Variables

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

48) According to the linear optimization model, what is the net profit per unit on Dela Mort?

A) $205,200

B) $108

C) $680

D) $90

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Models with Bounded Variables

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

49) According to the linear optimization model, what is the total profit contribution by the Invazen model?

A) $205,200

B) $20,000

C) $10,000

D) $4,000

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Models with Bounded Variables

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

50) According to the linear optimization model, what is the total profit for the Pickson Luthiers Corporation?

A) $10,000

B) $199,880

C) $205,200

D) $219,200

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Models with Bounded Variables

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

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

51) According to the Sensitivity Report, by how much should the unit profit on ScarCT be increasedin order for its production to be feasible?

A) $30

B) $90

C) $60

D) $120

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Models with Bounded Variables

LO1: Correctly interpret the Solver Sensitivity report for models that have bounded variables.

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

52) Keychain Publishing is planning to release two books, simultaneously, by the same author. One is a fictional book, while the other is the author's autobiography. The details of its cost, production, and demand are given in the table below.

|  |  |  |
| --- | --- | --- |
| **Keychain Publishing** |  |  |
|  |  |  |
| **Data** |  |  |
|  | **Fictional** | **Autobiography** |
| **Cost/book** | $1.75 | $1.50 |
| **Price/book** | $11.49 | $9.86 |
|  |  |  |
| **Base demand** | 50,000 | 65,000 |
| **Increase/$1 Adv.** | 25 | 35 |
| **Min. percent requirement** | 35% |  |
| **Max. percent limitation** | 70% |  |
|  |  |  |
| **Total Budget** | $150,000 |  |

Keychain Publishing has $150,000 available to bind books and advertise them with an objective of maximizing profit contribution. Provide the objective function for maximizing profits, along with its constraints.

Answer: To formulate this model, let

*F* = number of the fictional copies produced

*B* = number of the autobiographical copies produced

*Af*= dollar amount spent on the advertising of fictional copies

*Ab* = dollar amount spent on the advertising of autobiographical copies

The objective is to maximize the profits, which is revenue minus cost.

= (11.49F + 9.86B) - (1.75F + 1.5B +*Af* + *Ab*)

= 9.74*F* + 8.36*B -Af*- *Ab*

The constraints are defined as follows:

1. Budget cannot be exceeded:

1.75F + 1.5B +*Af* + *Ab* ≤ $150,000

2. Contractual requirements must be met:

.35 ≤ *F /* (*F* + *B*) ≤ 0.7

3. Production must not exceed demand:

*F ≤* 50,000 + 25*Af*

*B ≤* 65,000 + 35*Ab*

4. Nonnegativity:

All variables *F*, *B*, *Af, Ab* ≥ 0

Diff: 3

Blooms: Apply

Topic: A Production/Marketing Allocation Model

LO1: Build linear optimization models for a variety of applications.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

53) The mathematical form *Y* ≤ 450 would be considered as representing a simple bounds constraint.

Answer: TRUE

Diff: 1

Blooms: Remember

Topic: Types of Constraints in Optimization Models

LO1: Describe the different categories of constraints that are typically used in optimization models.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

54) Nonnegativity of the decision variables is an example of an explicit constraint.

Answer: FALSE

Diff: 1

Blooms: Remember

Topic: Types of Constraints in Optimization Models

LO1: Describe the different categories of constraints that are typically used in optimization models.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

55) Degeneracy does not impact the interpretation of sensitivity analysis information.

Answer: FALSE

Diff: 1

Blooms: Remember

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

56) Linear optimization cannot be used on problems having multiple time periods.

Answer: FALSE

Diff: 1

Blooms: Understand

Topic: Multiperiod Production Planning Models

LO1: Build linear optimization models for a variety of applications.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

57) When interpreting sensitivity analysis information for changes in model parameters, all other model parameters are held constant.

Answer: TRUE

Diff: 1

Blooms: Remember

Topic: A Production/Marketing Allocation Model

LO1: Ensure that assumptions underlying the use of sensitivity information hold when interpreting Solver reports.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

58) List out the different types of constraints that help model formulation.

Answer: The most challenging aspect of model formulation is identifying constraints. Understanding the different types of constraints can help in proper identification and modeling. Constraints generally fall into one of the following categories:

• Simple Bounds

• Limitations

• Requirements

• Proportional Relationships

• Balance Constraints

Diff: 1

Blooms: Remember

Topic: Types of Constraints in Optimization Models

LO1: Describe the different categories of constraints that are typically used in optimization models.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

59) Give an account of balance constraints with some examples of verbal clues.

Answer: Balance constraints essentially state that input = output and ensure that the flow of material or money is accounted for at locations or between time periods. Examples include production in June plus any available inventory must equal June's demand plus inventory held to July, the total amount shipped to a distribution center from all plants must equal the amount shipped from the distribution center to all customers, or the total amount of money invested or saved in March must equal the amount of money available at the end of February.

Diff: 1

Blooms: Remember

Topic: Types of Constraints in Optimization Models

LO1: Describe the different categories of constraints that are typically used in optimization models.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

60) What is degeneracy in linear optimization? Give an example.

Answer: Linear optimization solutions can exhibit degeneracy. A solution is a degenerate solution if the right-hand-side value of any constraint has a zero Allowable Increase or Allowable Decrease. For example, reduced costs and shadow prices may not be unique, and objective function coefficients may have to be changed beyond their allowable increases or decreases before the optimal solution will change.

Diff: 1

Blooms: Remember

Topic: Transportation Models

LO1: Use Excel to evaluate scenarios for linear optimization models and gain practical insights into the solutions.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

61) How does *Solver* handle simple lower bounds and upper bounds compared to ordinary constraints?

Answer: Solver handles simple lower bounds (e.g., C ≥500) and upper bounds (e.g., D≤1,000) quite differently from ordinary constraints in the Sensitivity report. In Solver, lower and upper bounds are treated in a manner similar to nonnegativity constraints, which also do not appear explicitly as constraints in the model. Solver does this to increase the efficiency of the solution procedure used; for large models this can represent significant savings in computer-processing time.

Diff: 1

Blooms: Remember

Topic: Models with Bounded Variables

LO1: Correctly interpret the Solver Sensitivity report for models that have bounded variables.

LO2: Identify different business uses for statistics and the major statistical tools businesses use

62) How does Excel's *Solver* help interpret reduced cost as shadow price for bounded variables?

Answer: Interpreting reduced costs as shadow prices for bounded variables can be confusing. Excel's *Solver* has a unique feature to make this easier. In the spreadsheet model, define auxiliary variables–a new set of cells for any decision variables that have upper- or lower-bound constraints by referencing, not copying, the original changing cells. Then in the *Solver* model, use these auxiliary variable cells–not the changing variable cells as defined–to define the bound constraints.

Diff: 1

Blooms: Remember

Topic: Models with Bounded Variables

LO1: Use auxiliary variables to model bound constraints and obtain more complete sensitivity information.

LO2: Identify different business uses for statistics and the major statistical tools businesses use