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

**Supplementary Chapter A Nonlinear and Non-Smooth Optimization**

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

|  |  |
| --- | --- |
| **Bolton Computer's Laptop**  **Pricing Decision** |  |
|  |  |
| **Inputs** |  |
|  |  |
| **Price** |  |
|  |  |
| **Model** |  |
|  |  |
| **Sales** | -3.85 × price + 1150.9 |
|  |  |
| **Outputs** |  |
|  |  |
| **Total revenue** | sales × price |

1) Bolton Computers are planning to release a new line of low-end laptops. Using Excel's *Solver*, develop a nonlinear model to calculate the optimal price for the laptops, given that sales = -3.85 × price + 1150.9.

A) 342.40

B) 380.90

C) 719.70

D) 149.47

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

2) According to the nonlinear model, which of the following is the expected sales figure based on the computed price?

A) 149.47

B) 719.7

C) 575.45

D) 500

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

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3) According to the nonlinear model, which of the following is the total revenue expected from the sales?

A) 22,340.91

B) 86,011.09

C) 107,571.78

D) 74,733.77

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

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Use the table below to create a nonlinear model based on the table to answer the following question(s).

The Atlas Movies Theater is planning to reprice their ticket rates to maximize revenues. They have three classes of tickets: Classic, Silver, and Gold. The table below provides information on the average ticket sales, revenue and price elasticity on demand. They have a total seating capacity of 300. The table also provides the price range within which they plan to reduce their ticket rates.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Atlas Movie Theater Ticketing** |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Data** |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Ticket Class** | **Current Rate** | **Average Daily Sold** | **Elasticity** | **Total Seating Capacity** | **Price Range** | |
| **Classic** | $8.45 | 150 | -1.5 | 300 | $6.50 | $7.50 |
| **Silver** | $13.25 | 80 | -2 |  | $11.50 | $12.50 |
| **Gold** | $17.50 | 30 | -1 |  | $15.50 | $16.50 |

4) According to the nonlinear model, what is the new price for Classic tickets?

A) $7.50

B) $12.45

C) $6.50

D) $8.20

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

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5) According to the nonlinear model, what is the new price for Silver tickets?

A) $7.40

B) $12.17

C) $11.50

D) $12.50

Answer: B

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

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6) According to the nonlinear model, what is the new price for Gold tickets?

A) $16.50

B) $15.50

C) $16

D) $16.11

Answer: A

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

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7) According to the nonlinear model, which of the following is the projected sales figure for Classic tickets at the new price?

A) 32

B) 90

C) 175

D) 202

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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8) According to the nonlinear model, which of the following is the projected sales figure for Silver tickets at the new price?

A) 93

B) 178

C) 202

D) 101

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

9) According to the nonlinear model, which of the following is the projected sales figure for Gold tickets at the new price?

A) 32

B) 90

C) 33

D) 178

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

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10) According to the nonlinear model, which of the following is the projected revenue figure for Classic tickets based on its new price?

A) $1,314.72

B) $1,116.03

C) $521.68

D) $1,312.52

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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11) According to the nonlinear model, which of the following is the projected revenue figure for Silver tickets based on its new price?

A) $1,163.02

B) $1,132.08

C) $1,224.63

D) $1,316.92

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

12) According to the nonlinear model, which of the following is the projected revenue figure for Gold tickets based on its new price?

A) $432.93

B) $1,316.92

C) $1,116.03

D) $523.29

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

13) According to the nonlinear model, which of the following is the total projected revenue for the new sales figures?

A) $1,637.72

B) $2,970.09

C) $1,316.92

D) $2,865.89

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

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14) Which of the following is true of the nonlinear model created for the Atlas movie ticket repricing scenario?

A) The projected revenue for the Gold class is infeasible within the price range provided.

B) The projected value for most tickets sold is for the Silver class.

C) The total projected tickets sold exceed the total seating capacity.

D) The projected revenue is lowest for the Gold tickets.

Answer: D

Diff: 3

Blooms: Understand

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

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15) Which of the following is the rectilinear distance between the points *A*(13,15) and *B*(10,12)?

A) 4

B) 25

C) 6

D) 10

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

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

Shirley Templeton is a real estate agent for Paralol Realty. Shirley is given the responsibility to manage potential customers for 5 of the Realty's bungalows. These 5 bungalows are situated in close proximity. In order to make traveling easier, Shirley decides to move to a location closer to the 5 bungalows. The table below gives the location (X and Y coordinates) of the 5 bungalows along with the number of trips she would have to make to each bungalow. Create a nonlinear model based on the data given in the table below noting that the objective is to reduce the weighted distance between Shirley's accommodation and the 5 bungalows.

|  |  |  |  |
| --- | --- | --- | --- |
| **Bungalow Location** |  |  |  |
|  |  |  |  |
| **Data** |  |  |  |
| **Location** | ***X*-coordinate** | ***Y*-coordinate** | **Trips/Month** |
| **Bungalow 1** | 0 | 0 | 6 |
| **Bungalow 2** | 25 | 100 | 30 |
| **Bungalow 3** | 20 | 75 | 15 |
| **Bungalow 4** | 90 | 80 | 28 |
| **Bungalow 5** | 60 | 100 | 10 |

16) According to the model, what is the *X*-coordinate for the location of Shirley's new accommodation?

A) 54.62

B) 36.53

C) 25

D) 23.12

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

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17) According to the model, what is the *Y*-coordinate for the location of Shirley's new accommodation?

A) 91.16

B) 25.08

C) 98.21

D) 54.62

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

18) According to the model, what is the distance between Shirley's new accommodation and Bungalow 1?

A) 36.53

B) 14.53

C) 98.21

D) 23.12

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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19) According to the model, what is the distance between Shirley's new accommodation and Bungalow 2?

A) 91.16

B) 23.12

C) 98.21

D) 14.53

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

20) According to the model, what is the distance between Shirley's new accommodation and Bungalow 3?

A) 54.62

B) 25.08

C) 36.53

D) 23.12

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

21) According to the model, what is the distance between Shirley's new accommodation and Bungalow 4?

A) 14.53

B) 250.78

C) 54.62

D) 98.21

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

22) According to the model, what is the distance between Shirley's new accommodation and Bungalow 5?

A) 54.62

B) 25.08

C) 14.53

D) 91.16

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

23) According to the model, what is the weighted distance between Shirley's new accommodation and Bungalow 1?

A) 589.25

B) 435.89

C) 346.77

D) 3152.08

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

24) According to the model, what is the weighted distance between Shirley's new accommodation and Bungalow 2?

A) 435.89

B) 250.78

C) 1529.39

D) 589.25

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

25) According to the model, what is the weighted distance between Shirley's new accommodation and Bungalow 3?

A) 3152.08

B) 1529.39

C) 346.77

D) 250.78

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

26) According to the model, what is the weighted distance between Shirley's new accommodation and Bungalow 4?

A) 589.25

B) 346.77

C) 1529.39

D) 3152.08

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

27) According to the model, what is the weighted distance between Shirley's new accommodation and Bungalow 5?

A) 435.89

B) 1529.39

C) 589.25

D) 250.78

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

28) According to the model, what is the total weighted distance that Shirley would travel between the bungalows?

A) 4151.29

B) 1529.39

C) 3152.08

D) 4305.30

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

29) According to the model, which of the following bungalows is Shirley's new accommodation closest to?

A) Bungalow 1

B) Bungalow 5

C) Bungalow 2

D) Bungalow 4

Answer: C

Diff: 2

Blooms: Understand

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

30) Given that *Q* = order quantity, *D* = annual demand, *C* = unit cost of the item, *C*0 = cost per order placed, *i*= inventory carrying charge per unit, which of the following represents the holding cost per unit?

A) *D/Q*

B) *iC*

C) *(D/Q)C*0

D) *iCQ/2*

Answer: B

Diff: 2

Blooms: Remember

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

31) In an Economic Order-Quantity (EOQ) model, \_\_\_\_\_\_\_\_ is the estimate on how long it takes an order to be received after it is placed.

A) lead time

B) safety stock

C) time limit

D) cycle time

Answer: A

Diff: 2

Blooms: Remember

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

32) Which of the following is the ideal next step if you get the message "*Solver* has converged to the current solution./All constraints are satisfied," when using *Solver* for nonlinear optimization models?

A) Accept the values, but run *Solver* again from the current solution.

B) Do not accept the *Solver* values and re-run *Solver* with the starting values.

C) Accept the values and run simulations with different values.

D) Accept the values, and then tweak the values, and re-run *Solver* on tweaked values.

Answer: A

Diff: 2

Blooms: Understand

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

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

Jonathan Reese is considering three stocks in which to invest with a fixed budget. The table below provides information on Jonathan's expected returns for each stock. The table also provides information, collected from market researchers, on the variance-covariance matrix of the individual stocks. He expects a total return of at least 10%.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Reese's Stock Investment Plan** |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Data** |  |  |  |  |  |  |
|  | **Expected** |  |  | **Variance-Covariance Matrix** | | |
|  | **Return** |  |  | **Stock 1** | **Stock 2** | **Stock 3** |
| **Stock 1** | 10% |  | **Stock 1** | 0.021 | 0.018 | -0.003 |
| **Stock 2** | 11% |  | **Stock 2** | 0.018 | 0.070 | 0.006 |
| **Stock 3** | 9% |  | **Stock 3** | -0.003 | 0.006 | 0.003 |
| **Target Return** | 10% |  |  |  |  |  |

Develop a quadratic optimization model to find the optimal allocation of the budget to each stock, and variance calculations for squared terms and cross-products based on the variance-covariance matrix.

33) According to the model, what percentage of the budget should be allocated to Stock 1?

A) 10%

B) 25%

C) 50%

D) 40%

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Quadratic Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

34) According to the model, what percentage of the budget should be allocated to Stock 2?

A) 90%

B) 25%

C) 50%

D) 75%

Answer: B

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Quadratic Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

35) According to the model, what percentage of the budget should be allocated to Stock 3?

A) 40%

B) 20%

C) 25%

D) 75%

Answer: C

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Quadratic Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

36) According to the model, what is the squared term value for Stock 1 variance?

A) 0.00065

B) 0.00535

C) 0.01132

D) 0.00283

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Quadratic Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

37) According to the model, what is the squared term value for Stock 2 variance?

A) 0.00236

B) -0.00031

C) 0.00080

D) 0.00430

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Quadratic Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

38) According to the model, what is the squared term value for Stock 3 variance?

A) 0.00018

B) 0.00080

C) 0.00096

D) 0.00194

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Quadratic Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

39) According to the model, what is the cross-product value for Stock 1 variance?

A) 0.00176

B) 0.00450

C) -0.00047

D) 0.00194

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Quadratic Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

40) According to the model, what is the cross-product value for Stock 2 variance?

A) 0.00080

B) -0.00080

C) -0.00075

D) 0.01132

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Quadratic Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

41) According to the model, what is the cross-product value for Stock 3 variance?

A) 0.00049

B) 0.00283

C) -0.00047

D) 0.00074

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Quadratic Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

42) According to the model, what is the expected total return on all stocks?

A) 18%

B) 10%

C) 11%

D) 12%

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Quadratic Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

43) According to the model, what is the expected variance of the resulting portfolio?

A) 0.014

B) 0.010

C) 0.009

D) 0.012

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Quadratic Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

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

Pickson Luthiers Corporation is studying where to locate a phone charging point on the factory floor. The locations of five production cells are expressed as *X*- and *Y*-coordinates on a rectangular grid of the factory layout. The daily demand for the charging point (measured as the number of trips to the charging point) at each production cell is also known. Because of the nature of the equipment layout in the factory and for safety reasons, workers must travel along marked horizontal and vertical aisles to access the charger. Thus, the distance from a cell to the charger is measured as rectilinear distance.

The table below provides the relevant information.

|  |  |  |  |
| --- | --- | --- | --- |
| **Pickson Luthiers Corporation** | **Phone Recharging Points** |  |  |
|  |  |  |  |
| **Data** |  |  |  |
|  |  |  |  |
| **Cell** | ***X*-coordinate** | ***Y*-coordinate** | **Demand** |
| **Measurements** | 2 | 5 | 27 |
| **Paint** | 1 | 3 | 12 |
| **Electricals** | 4 | 2 | 25 |
| **Testing** | 3.5 | 5 | 5 |
| **Packaging** | 3 | 3 | 7 |
|  |  |  |  |
| **Maximum** | 4 | 5 |  |

The optimal location should minimize the total weighted distance between the charging point and all production cells, where the weights are the daily number of trips to the phone charging point.

Create a nonsmooth optimization model, based on the data, to answer the following questions. (Hint: Choose the closest answers.)

44) According to the model, which of the following is the *X*-coordinate for the phone charger location?

A) 2.00

B) 3.00

C) 3.50

D) 4.00

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

45) According to the model, which of the following is the *Y*-coordinate for the phone charger location?

A) 1.50

B) 1.00

C) 3.00

D) 5.00

Answer: C

Diff: 1

Blooms: Apply

AACSB: Analytic Skills

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

46) According to the model, which of the following is the weighted distance between the phone charger and Measurements cell?

A) 12.00

B) 75.00

C) 7.00

D) 54.00

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

47) According to the model, which of the following is the weighted distance between the phone charger and Paint cell?

A) 36.00

B) 12.00

C) 24.00

D) 0

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

48) According to the model, which of the following is the weighted distance between the phone charger and Electricals cell?

A) 75.00

B) 125.00

C) 100.00

D) 112.50

Answer: A

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

49) According to the model, which of the following is the weighted distance between the phone charger and Testing cell?

A) 7.00

B) 17.50

C) 22.50

D) 27.50

Answer: B

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

50) According to the model, which of the following is the weighted distance between the phone charger and Packaging cell?

A) 10.50

B) 0

C) 7.00

D) 14.00

Answer: C

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

51) According to the model, what is the total weighted distance between the 5 production cells and the phone charger?

A) 253.50

B) 113.00

C) 172.50

D) 165.50

Answer: D

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Develop and solve nonlinear optimization models for different applications.

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

52) According to the model, which of the following production cells covers the most distance according to its demand when using the phone charger?

A) Measurements

B) Paint

C) Electricals

D) Testing

Answer: C

Diff: 2

Blooms: Understand

AACSB: Analytic Skills

Topic: Evolutionary Solver for Non-smooth Optimization

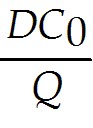
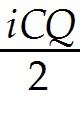
LO1: Develop and solve nonlinear optimization models for different applications.

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

53) From the data in the table below, calculate the total annual cost using the economic order quantity (EOQ) model.

|  |  |
| --- | --- |
| **Data** |  |
|  |  |
| **Annual Demand Rate** | 10,000 |
| **Ordering Cost** | $150 |
| **Unit Cost** | $16 |
| **Carrying Charge Rate** | 0.2 |
| **Order Quantity** | 1,000 |

Answer: Using the data in the table given, the total annual cost can be calculated using the formula

 + 

where

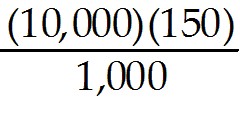
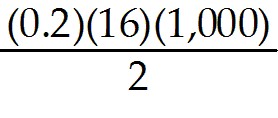
*Q* = order quantity = 1,000

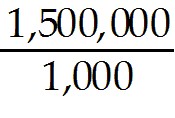
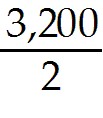
*D* = annual demand = 10,000

*C* = unit cost of the item = $16

*C*0 = cost per order placed = $150

*i* = inventory carrying charge per unit = 0.2

Therefore, total annual cost =  + 

=  + 

= 1,500 + 1,600

= 3,100.

Therefore the total annual cost is $3,100.

Diff: 2

Blooms: Apply

AACSB: Analytic Skills

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

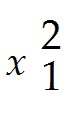
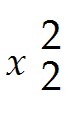
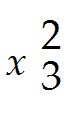
54) Jonathan Reese is considering three stocks in which to invest with a fixed budget. The table below provides information on Jonathan's expected returns for each stock. The table also provides information, collected from market researchers, on the variance-covariance matrix of the individual stocks. He expects a total return of at least 10%.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Reese's Stock Investment Plan** |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Data** |  |  |  |  |  |  |
|  | **Expected** |  |  | **Variance-Covariance Matrix** | | |
|  | **Return** |  |  | **Stock 1** | **Stock 2** | **Stock 3** |
| **Stock 1** | 10% |  | **Stock 1** | 0.021 | 0.018 | -0.003 |
| **Stock 2** | 11% |  | **Stock 2** | 0.018 | 0.070 | 0.006 |
| **Stock 3** | 9% |  | **Stock 3** | -0.003 | 0.006 | 0.003 |
| **Target Return** | 10% |  |  |  |  |  |

Using the table above, provide the objective function for minimal variance, and the constraints for creating an optimization model.

Answer: The model here is a quadratic optimization model that seeks to minimize the risk of a portfolio of stocks subject to a constraint on the portfolio's expected return.

From the above data, the objective function for minimal variance =

0.0212  + 0.070 + 0.003 + 2(0.018)*x*1*x*2 + 2(-0.003)*x*1*x*3 + 2(0.006)*x*2*x*3

where*x*1, *x*2, *x*3 are stock variables or the fractions of the portfolio to invest in stocks 1, 2, 3 respectively.

The constraints must first ensure that we invest 100% of our budget. Because the variables are defined as fractions, we must have

*x*1+*x*2 +*x*3= 1

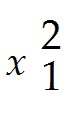
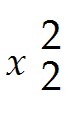
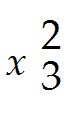
Second, the portfolio must have an expected return of at least 10%. The return on a portfolio is simply the weighted sum of the returns of the stocks in the portfolio. This results in the constraint

10*x*1 +11*x*2 +9*x*3≥ 10

Finally, we cannot invest negative amounts:

*x*1, *x*2, *x*3 ≥ 0

Therefore, the complete model is

0.0212 + 0.070 + 0.003 + 2(0.018)*x*1*x*2 + 2(-0.003)*x*1*x*3 + 2(0.006)*x*2*x*3

*x*1+*x*2 +*x*3= 1

10*x*1 +11*x*2 +9*x*3≥ 10

*x*1, *x*2,, *x*3 ≥ 0

Diff: 2

Blooms: Understand

Topic: Quadratic Optimization

LO1: Recognize a quadratic optimization model.

55) Pickson Luthiers Corporation is studying where to locate a phone charging point on the factory floor. The locations of five production cells are expressed as *X*- and *Y*-coordinates on a rectangular grid of the factory layout. The daily demand for the charging point (measured as the number of trips to the charging point) at each production cell is also known. Because of the nature of the equipment layout in the factory and for safety reasons, workers must travel along marked horizontal and vertical aisles to access the charger. Thus, the distance from a cell to the charger is measured as rectilinear distance.

The table below provides the relevant information.

|  |  |  |  |
| --- | --- | --- | --- |
| **Pickson Luthiers Corporation** | **Phone Recharging Points** |  |  |
|  |  |  |  |
| **Data** |  |  |  |
|  |  |  |  |
| **Cell** | ***X*-coordinate** | ***Y*-coordinate** | **Demand** |
| **Measurements** | 2 | 5 | 27 |
| **Paint** | 1 | 3 | 12 |
| **Electricals** | 4 | 2 | 25 |
| **Testing** | 3.5 | 5 | 5 |
| **Packaging** | 3 | 3 | 7 |
|  |  |  |  |
| **Maximum** | 4 | 5 |  |

The optimal location should minimize the total weighted distance between the charging point and all production cells, where the weights are the daily number of trips to the phone charging point.

From the above table, provide the objective function for the best location of the charging point. What kind of solution technique from *Solver* can be used to make the optimization model based on the data?

Answer: To formulate an optimization model for the best location, define (*X*, *Y*) as the location coordinates of the charging point. The weighted distance between the charging point and each cell is expressed by the objective function minimize 27(|*X*-2|+|*Y*-5|) + 12(|*X*-1|+|*Y*-3|) + 25(|*X*-4|+|*Y*-2|) + 5(|*X*-3.5|+|*Y*-5|) + 7(|*X*-3|+|*Y*-3|)

The absolute value functions used in this objective function create a non-smooth model. Thus, *EvolutionarySolver* is the appropriate solution technique.

Diff: 1

Blooms: Knowledge

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Identify non-smooth optimization models and when to use Evolutionary Solver.

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

56) Rectilinear distance is the measure of distance as a straight line between two points.

Answer: FALSE

Diff: 1

Blooms: Remember

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Identify non-smooth optimization models and when to use Evolutionary Solver.

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

57) The economic order quantity is the amount to order that minimizes the total cost of ordering and holding.

Answer: TRUE

Diff: 1

Blooms: Remember

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

58) A global optimum solution is one for which all points close by are no better than the solution.

Answer: TRUE

Diff: 1

Blooms: Remember

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Develop and solve nonlinear optimization models for different applications.

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

59) All quadratic optimization models have nonlinear constraints.

Answer: FALSE

Diff: 1

Blooms: Remember

Topic: Quadratic Optimization

LO1: Recognize a quadratic optimization model.

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

60) For nonlinear models, the Lagrange multipliers are only approximate indicators of shadow prices.

Answer: TRUE

Diff: 1

Blooms: Remember

Topic: Quadratic Optimization

LO1: Interpret Solver reports for nonlinear optimization.

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

61) Absolute value functions, in optimization models, result in non-smooth functions.

Answer: TRUE

Diff: 1

Blooms: Remember

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Identify non-smooth optimization models and when to use Evolutionary Solver.

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

62) List the four major categories of inventory costs and explain how they are influenced by the timing of the ordering decision and amount ordered.

Answer: Inventory costs fall into four major categories:

(1) Purchase costs–unit costs per item to purchase from suppliers.

(2) Order preparation costs–costs involve the time spent preparing and placing orders, such as clerical, telephone, receiving, and inspection time.

(3) Inventory-holding cost–all expenses associated with carrying inventory, such as rent on storage space, utilities, insurance, taxes, and the cost of capital.

(4) Shortage costs–additional costs for shipping, invoicing, and labor for back orders or lost profit opportunities and possible future loss of revenues because of lost sales.

These costs are influenced by the amount ordered and the timing of the ordering decision.

For example, if many small orders are placed, then the ordering cost will be high, but little inventory will be carried, reducing holding costs. On the other hand, if few large orders are placed, then ordering costs will be low, but inventory-holding costs will be high. Similarly, if orders are placed too early, excessive holding will result. If orders are placed too late, the firm risks running out of stock and incurring shortages. Thus, decision makers seek a minimum-cost balance among these costs.

Diff: 2

Blooms: Understand

Topic: Modeling and Solving Nonlinear Optimization Problems

LO1: Recognize when to use nonlinear optimization models.

LO2: Describe the major tools and criteria for decision making.

63) What are the assumptions made when developing an economic order quantity (EOQ) model?

Answer: To develop an EOQ model, we need to make several important assumptions:

(1) Only a single inventory item is considered.

(2) The entire quantity arrives at one time.

(3) The demand for the item is constant over time.

(4) No shortages are allowed.

Diff: 1

Blooms: Remember

Topic: Modeling and Solving Nonlinear Optimization Problems

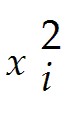
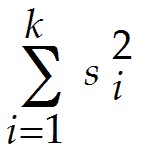
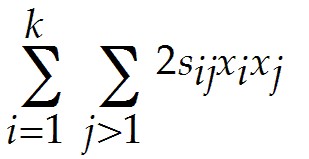
LO1: Recognize when to use nonlinear optimization models.

LO2: Describe the major tools and criteria for decision making.

64) Explain how the Markowitz portfolio model is a quadratic optimization model.

Answer: The Markowitz portfolio model is a classic quadratic optimization model in finance that seeks to minimize the risk of a portfolio of stocks subject to a constraint on the portfolio's expected return. The decision variables are the percent of each stock to allocate to the portfolio. In the Markowitz model, the objective function is to minimize the risk of the portfolio as measured by its variance. Because stock prices are correlated with one another, the variance of the portfolio must reflect not only variances of the stocks in the portfolio but also the covariance between stocks.

Define *xj* to be the fraction of the portfolio to invest in stock *j*. The variance of a portfolio is the weighted sum of the variances and covariances:

variance of portfolio =  + 

where

= the sample variance in the return of stock *i*

*sy*= the sample covariance between stocks *i* and *j.*

Diff: 1

Blooms: Remember

Topic: Quadratic Optimization

LO1: Recognize a quadratic optimization model.

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

65) What is a job-sequencing problem? How can we find an optimal solution for such problems?

Answer: Job-sequencing problems involve finding an optimal sequence, or order, by which to process a set of jobs. For any job sequence, we may compute the completion time for each job by successively adding the processing times of that job and all that were completed before it. We may then compare the completion times with the requested due dates to determine if the job is either completed early or late. Lateness (*Li*) is the difference between the completion time (*Ci*) and the due date (*Di*), which can either be positive or negative. Tardiness (*Ti*) is the amount of time by which the completion time exceeds the due date; thus, tardiness is zero if a job is completed early). Hence, for job *i*,

*Li* = C*i* - *Di*

*Ti* = max {0, *Li*}

Researchers have shown that sequencing jobs in order of shortest processing time (SPT) first will minimize the average completion time for all jobs. Sequencing by earliest due date (EDD) first will minimize the maximum number of tardy jobs.

Diff: 1

Blooms: Understand

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Identify non-smooth optimization models and when to use Evolutionary Solver.

LO2: Describe the major tools and criteria for decision making.

66) Explain the travelling salesperson problem with examples.

Answer: The traveling salesperson problem (TSP) can be described as follows. A salesperson needs to visit each of *n* different cities and return home in the minimum total distance. A route that visits each city exactly once and returns to the start is called a tour. Many practical problems can be formulated as a TSP. For example, drivers for FedEx and UPS must deliver packages to customers and return to their central location. Soft-drink vendors must collect money and replenish bottles for a set of retail locations and then return to the warehouse. Other examples are programming drilling machines to drill holes in circuit boards and picking orders within a warehouse. In all these applications, the goal is to perform the task in minimum total time or distance.

Diff: 1

Blooms: Understand

Topic: Evolutionary Solver for Non-smooth Optimization

LO1: Identify non-smooth optimization models and when to use Evolutionary Solver.

LO2: Describe the major tools and criteria for decision making.