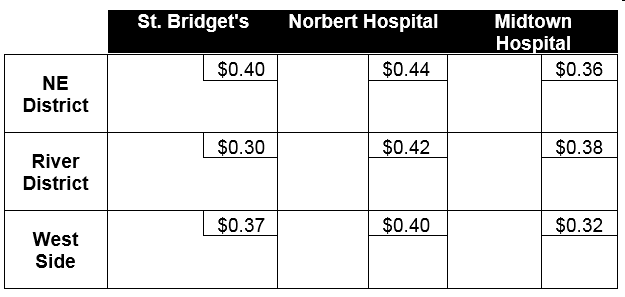
**Module B: The Transportation Models**

**Practice Problems**

**MULTIPLE CHOICE**

A mid-sized town has three major surgical hospitals. Each of them has a fairly consistent monthly need for pints of blood. St. Bridget’s Hospital generally needs 1,000 pints of blood a month; Norbert Hospital generally needs 1,500 pints of blood a month; and Midtown Hospital generally needs 2,500 pints of blood a month. Their needs are met by three city blood collection centers. The Northeast (NE) Center can provide 2,000 pints of blood each month. The River District Center can provide 1,500 pints of blood each month, and the West Side Center can provide up to 2,500 pints per month. Shipping blood requires special handling, and the cost of transporting is given below.



1. Using the northwest corner rule, determine the optimal schedule for shipping blood out of the NE District?

|  |  |
| --- | --- |
| a. | 2,000 pints to Midtown Hospital |
| b. | 2,000 pints to St. Bridget’s |
| c. | 1,000 pints to St. Bridget’s and 1,000 pints to Norbert Hospital |
| d. | 500 pints to Norbert and 1,500 pints to Midtown Hospital |

ANS: C PTS: 1 DIF: Medium

2. Using the northwest corner rule, determine the optimal schedule for shipping blood out of the River District?

|  |  |
| --- | --- |
| a. | 2,000 pints to St. Bridget’s |
| b. | 500 pints to St. Bridget’s and 1,500 pints to Midtown Hospital |
| c. | 1,000 pints to St. Bridget’s and 1,000 pints to Norbert Hospital |
| d. | 500 pints to Norbert Hospital and 1,000 pints to Midtown Hospital |

ANS: D PTS: 1 DIF: Medium

3. Using the northwest corner rule, determine the optimal schedule for shipping blood out of the West Side Center?

|  |  |
| --- | --- |
| a. | 1,000 pints to St. Bridget’s |
| b. | 1,000 pints to Norbert Hospital |
| c. | 1,500 pints to Midtown Hospital |
| d. | 500 pints to St. Bridget’s and 500 pints to Midtown Hospital |

ANS: C PTS: 1 DIF: Medium

4. Having determined an optimal schedule using the northwest corner rule, what would be the total transportation cost?

|  |  |
| --- | --- |
| a. | $180.00 |
| b. | $240.00 |
| c. | $1,910.00 |
| d. | $2,400.00 |

ANS: C PTS: 1 DIF: Hard

5. If the cost of shipping one pint of blood from the NE District to St. Bridget’s changed from $0.40/pint to $0.44, by how much would the entire transshipment cost change?

|  |  |
| --- | --- |
| a. | $0.00 |
| b. | $4.00 |
| c. | $40.00 |
| d. | $44.00 |

ANS: C PTS: 1 DIF: Hard

6. Using the matrix least cost method, determine the optimal schedule for shipping blood out of the River District?

|  |  |
| --- | --- |
| a. | 2,000 pints to St. Bridget’s |
| b. | 500 pints to St. Bridget’s and 1,500 pints to Midtown Hospital |
| c. | 1,000 pints to St. Bridget’s and 500 pints to Norbert Hospital |
| d. | 1,000 pints to St. Bridget’s and 1,000 pints to Midtown Hospital |

ANS: C PTS: 1 DIF: Medium

7. Using the matrix least cost method, determine the optimal schedule for shipping blood out of the West Side Center?

|  |  |
| --- | --- |
| a. | 1,000 pints to St. Bridget’s |
| b. | 1,000 pints to Norbert Hospital |
| c. | 2,500 pints to Midtown Hospital |
| d. | 500 pints to St. Bridget’s and 500 pints to Midtown Hospital |

ANS: C PTS: 1 DIF: Medium

8. Having determined an optimal schedule using the matrix least cost method, what would be the total transportation cost?

|  |  |
| --- | --- |
| a. | $180.00 |
| b. | $240.00 |
| c. | $1,750.00 |
| d. | $2,400.00 |

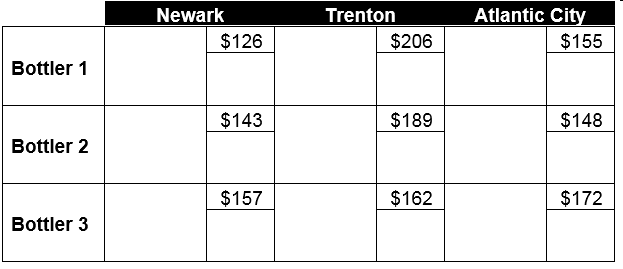
ANS: C PTS: 1 DIF: Hard

9. Using the matrix least cost method, determine the optimal schedule for shipping blood out of the NE District?

|  |  |
| --- | --- |
| a. | 2,000 pints to Midtown Hospital |
| b. | 2,000 pints to St. Bridget’s |
| c. | 500 pints to St. Bridget’s and 1,500 pints to Midtown Hospital |
| d. | 1,000 pints to Norbert Hospital |

ANS: D PTS: 1 DIF: Medium

Brown Beverages supplies sodas to many hotels, amusement parks, and restaurant chains in New Jersey. Brown operates three bottling plants in the state. They have three distribution centers in New Jersey: Atlantic City, Newark, and Trenton. Annually, Bottlers 1, 2, and 3 can supply 3,600,000 cases; 4,800,000 cases; and 5,400,000 cases, respectively. Newark’s distributor has an annual need for 6,000,000 cases. Trenton’s distributor needs 4,800,000 cases per year while Atlantic City’s distributor requires 3,000,000 cases per year. Below, you will find the shipping cost per pallet. A pallet holds 100 cases.



10. Using the northwest corner rule, determine the optimal schedule for shipping pallets out of Bottler 1?

|  |  |
| --- | --- |
| a. | 36,000 pallets to Newark |
| b. | 18,000 pallets to Trenton |
| c. | 18,000 pallets to Newark and 18,000 pallets to Trenton |
| d. | 20,000 pallets to Newark; 8,000 pallets to Trenton; and 8,000 pallets to Atlantic City |

ANS: A PTS: 1 DIF: Medium

11. Using the northwest corner rule, determine the optimal schedule for shipping pallets out of Bottler 2?

|  |  |
| --- | --- |
| a. | 48,000 pallets out of Newark |
| b. | 18,000 pallets to Newark and 30,000 pallets to Atlantic City |
| c. | 20,000 pallets to Newark and 28,000 pallets to Atlantic City |
| d. | 24,000 pallets to Newark and 24,000 pallets to Trenton |

ANS: D PTS: 1 DIF: Medium

12. Using the northwest corner rule, determine the optimal schedule for shipping pallets out of Bottler 3?

|  |  |
| --- | --- |
| a. | 36,000 pallets to Newark and 18,000 pallets to Trenton |
| b. | 26,000 pallets to Newark and 28,000 pallets to Trenton |
| c. | 24,000 pallets to Trenton and 30,000 pallets to Atlantic City |
| d. | 54,000 pallets to Newark |

ANS: C PTS: 1 DIF: Medium

13. What would be the total annual shipping cost based on using the northwest corner rule?

|  |  |
| --- | --- |
| a. | $200,268 |
| b. | $2,268,000 |
| c. | $4,536,000 |
| d. | $21,552,000 |

ANS: D PTS: 1 DIF: Hard

14. Using the matrix least cost method, determine the optimal schedule for shipping pallets out of Bottler 1?

|  |  |
| --- | --- |
| a. | 36,000 pallets to Newark |
| b. | 18,000 pallets to Trenton |
| c. | 18,000 pallets to Newark and 18,000 pallets to Trenton |
| d. | 20,000 pallets to Newark; 8,000 pallets to Trenton; and 8,000 pallets to Atlantic City |

ANS: A PTS: 1 DIF: Medium

15. Using the matrix least cost method, determine the optimal schedule for shipping pallets out of Bottler 2?

|  |  |
| --- | --- |
| a. | 48,000 pallets out of Newark |
| b. | 24,000 pallets to Newark and 24,000 pallets to Atlantic City |
| c. | 20,000 pallets to Newark and 28,000 pallets to Atlantic City |
| d. | 20,000 pallets to Newark; 18,000 pallets to Trenton; and 10,000 pallets to Atlantic City |

ANS: B PTS: 1 DIF: Medium

16. Using the matrix least cost method, determine the optimal schedule for shipping pallets out of Bottler 3?

|  |  |
| --- | --- |
| a. | 36,000 pallets to Newark and 18,000 pallets to Trenton |
| b. | 26,000 pallets to Newark and 28,000 pallets to Trenton |
| c. | 6,000 pallets to Atlantic City and 48,000 pallets to Trenton |
| d. | 54,000 pallets to Newark |

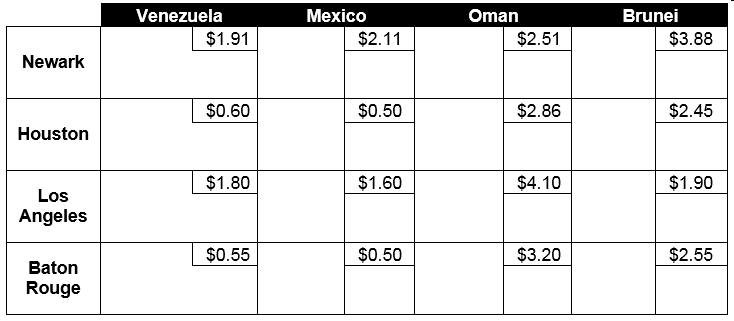
ANS: C PTS: 1 DIF: Medium

17. What would be the total annual shipping cost based on using the matrix least cost method?

|  |  |
| --- | --- |
| a. | $200,268 |
| b. | $2,268,000 |
| c. | $4,536,000 |
| d. | $20,328,000 |

ANS: D PTS: 1 DIF: Hard

Osborne Oil is a small oil company. They have contracts with four countries (Venezuela, Mexico, Oman, and Brunei) to obtain a supply of crude oil. Osborne plans on shipping the crude from these four countries to oil refineries in the United States. According to their contracts, Venezuela can supply 600,000 barrels per year; Mexico could supply 900,000 barrels per year; Oman could supply 1,000,000 barrels per year; and Brunei could supply 600,000 barrels per year. Osborne can utilize refineries in four U.S. cities. The refinery in Newark can process 300,000 barrels per year. The refinery in Houston can process 750,000 barrels per year. The refinery in Los Angeles can process 1,200,000 barrels per year, and the refinery in Baton Rouge can process 850,000 barrels per year. The shipping costs among the oil producers and the refineries are given below.



18. Using the northwest corner rule, determine the optimal schedule for shipping barrels of oil out of Venezuela?

|  |  |
| --- | --- |
| a. | 600,000 barrels to Newark |
| b. | 300,000 barrels to Houston and 300,000 to Newark |
| c. | 600,000 barrels to Los Angeles |
| d. | 600,000 barrels to Baton Rouge |

ANS: B PTS: 1 DIF: Medium

19. Using the northwest corner rule, determine the optimal schedule for shipping barrels of oil out of Mexico?

|  |  |
| --- | --- |
| a. | 900,000 barrels to Houston |
| b. | 250,000 barrels to Houston and 650,000 barrels to Los Angeles |
| c. | 450,000 barrels to Houston and 450,000 barrels to Los Angeles |
| d. | 50,000 barrels to Houston; 600,000 barrels to Los Angeles; and 250,000 barrels to Baton Rouge |

ANS: C PTS: 1 DIF: Medium

20. Using the northwest corner rule, determine the optimal schedule for shipping barrels of oil out of Oman?

|  |  |
| --- | --- |
| a. | 1,000,000 barrels to Newark |
| b. | 200,000 barrels to Newark and 800,000 to Houston |
| c. | 250,000 barrels to Baton Rouge and 750,000 to Houston |
| d. | 400,000 barrels to Newark and 600,000 to Houston |

ANS: C PTS: 1 DIF: Medium

21. Using the northwest corner rule, determine the optimal schedule for shipping barrels of oil out of Brunei?

|  |  |
| --- | --- |
| a. | 600,000 barrels to Newark |
| b. | 300,000 barrels to Houston and 300,000 to Baton Rouge |
| c. | 600,000 barrels to Los Angeles |
| d. | 600,000 barrels to Baton Rouge |

ANS: D PTS: 1 DIF: Medium

22. What would be the total shipping cost for Osborne Oil based on the northwest corner rule?

|  |  |
| --- | --- |
| a. | $3,750,000 |
| b. | $4,256,000 |
| c. | $7,103,000 |
| d. | $8,127,000 |

ANS: C PTS: 1 DIF: Medium

23. Using the matrix least cost method, determine the optimal schedule for shipping barrels of oil out of Venezuela?

|  |  |
| --- | --- |
| a. | 600,000 barrels to Newark |
| b. | 300,000 barrels to Houston and 300,000 to Baton Rouge |
| c. | 600,000 barrels to Los Angeles |
| d. | 600,000 barrels to Baton Rouge |

ANS: D PTS: 1 DIF: Medium

24. Using the matrix least cost method, determine the optimal schedule for shipping barrels of oil out of Mexico?

|  |  |
| --- | --- |
| a. | 900,000 barrels to Houston |
| b. | 650,000 barrels to Houston and 250,000 barrels to Baton Rouge |
| c. | 450,000 barrels to Houston and 450,000 barrels to Los Angeles |
| d. | 50,000 barrels to Houston; 600,000 barrels to Los Angeles; and 250,000 barrels to Baton Rouge |

ANS: B PTS: 1 DIF: Medium

25. Using the matrix least cost method, determine the optimal schedule for shipping barrels of oil out of Oman?

|  |  |
| --- | --- |
| a. | 1,000,000 barrels to Newark |
| b. | 200,000 barrels to Newark and 800,000 to Houston |
| c. | 300,000 barrels to Newark; 100,000 to Houston; and 600,000 to Los Angeles |
| d. | 400,000 barrels to Newark and 600,000 to Houston |

ANS: C PTS: 1 DIF: Medium

26. Using the matrix least cost method, determine the optimal schedule for shipping barrels of oil out of Brunei.

|  |  |
| --- | --- |
| a. | 600,000 barrels to Newark |
| b. | 300,000 barrels to Houston and 300,000 to Baton Rouge |
| c. | 600,000 barrels to Los Angeles |
| d. | 600,000 barrels to Baton Rouge |

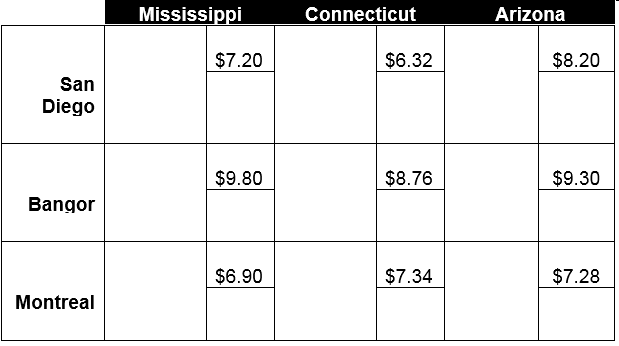
ANS: C PTS: 1 DIF: Medium

27. What would be the total shipping cost for Osborne Oil based on the matrix least cost method?

|  |  |
| --- | --- |
| a. | $3,750,000 |
| b. | $4,256,000 |
| c. | $5,419,000 |
| d. | $6,127,000 |

ANS: C PTS: 1 DIF: Medium

Flo-Dynamics produces electronic fluid controls for turbine engines. They are the major supplier of such controls for regulating the flow of fuel to helicopter engines in the United States. These helicopter engine controls are produced in San Diego, Bangor, and Montreal. They are shipped to the three major helicopter manufacturers, which are located in Arizona, Connecticut, and Mississippi. The demand for controls at the Arizona helicopter plant will be 400 units. The demand at the Connecticut plant will be 750 control units, and the demand at the Mississippi plant will be 350 units. Flo-Dynamics’ plant in San Diego can produce 600 engine controls per year. The Bangor plant can produce up to 400 units, and the Montreal plant could produce 500 units per year. These units need to be carefully packed and transported. The shipment costs are provided below.



28. Using the northwest corner rule, determine the optimal schedule for shipping units out of the San Diego plant.

|  |  |
| --- | --- |
| a. | 300 units to Mississippi and 300 units to Connecticut |
| b. | 200 units to Mississippi and 400 units to Connecticut |
| c. | 200 units to Mississippi, 200 units to Connecticut, and 200 units to Arizona |
| d. | 400 units to San Diego and 200 units to Connecticut |

ANS: D PTS: 1 DIF: Medium

29. Using the northwest corner rule, determine the optimal schedule for shipping units out of the Bangor plant.

|  |  |
| --- | --- |
| a. | 400 units to Connecticut |
| b. | 200 units to Connecticut and 200 units to Arizona |
| c. | 150 units to Connecticut and 250 units to Arizona |
| d. | 350 units to Connecticut and 50 units to Arizona |

ANS: A PTS: 1 DIF: Medium

30. Using the northwest corner rule, determine the optimal schedule for shipping units out of the Montreal plant.

|  |  |
| --- | --- |
| a. | 350 units to Mississippi, 100 units to Connecticut, and 50 units to Arizona |
| b. | 150 units to Connecticut and 350 units to Arizona |
| c. | 250 units to Mississippi, 150 units to Connecticut, and 100 units to Arizona |
| d. | 350 units to Mississippi, 50 units to Connecticut, and 100 units to Arizona |

ANS: B PTS: 1 DIF: Medium

31. What would be the total shipping cost when using the northwest corner rule?

|  |  |
| --- | --- |
| a. | $9,652 |
| b. | $10,031 |
| c. | $10,938 |
| d. | $11,297 |

ANS: D PTS: 1 DIF: Medium

32. Using the matrix least cost method, determine the optimal schedule for shipping control units out of San Diego.

|  |  |
| --- | --- |
| a. | 300 units to Mississippi and 300 units to Connecticut |
| b. | 200 units to Mississippi and 400 units to Connecticut |
| c. | 200 units to Mississippi, 200 units to Connecticut, and 200 units to Arizona |
| d. | 600 units to Connecticut |

ANS: D PTS: 1 DIF: Medium

33. Using the matrix least cost method, determine the optimal schedule for shipping control units out of Bangor.

|  |  |
| --- | --- |
| a. | 400 units to Connecticut |
| b. | 200 units to Connecticut and 200 units to Arizona |
| c. | 150 units to Connecticut and 250 units to Arizona |
| d. | 350 units to Connecticut and 50 units to Arizona |

ANS: C PTS: 1 DIF: Medium

34. Using the matrix least cost method, determine the optimal schedule for shipping control units out of Montreal.

|  |  |
| --- | --- |
| a. | 350 units to Mississippi, 100 units to Connecticut, and 50 units to Arizona |
| b. | 400 units to Mississippi and 100 units to Arizona |
| c. | 250 units to Mississippi, 150 units to Connecticut, and 100 units to Arizona |
| d. | 350 units to Mississippi, 50 units to Connecticut, and 100 units to Arizona |

ANS: B PTS: 1 DIF: Medium

35. What would be the total shipping cost when using the matrix least cost method?

|  |  |
| --- | --- |
| a. | $9,652 |
| b. | $10,031 |
| c. | $10,919 |
| d. | $11,387 |

ANS: C PTS: 1 DIF: Medium

Reliance Metals processes ores into metal ingots for other industries. Due to recent acquisitions, Reliance has entered the aluminum processing industry. They now have processing plants in New York, California, Oregon, and South Carolina. Aluminum processing plants require electrical power and bauxite ore. Reliance Metals has agreements with mine operators in Guinea, India, Guyana, and Brazil. The contract with Guinea allows for the shipment of 12,000 tons a year. India has the capacity of supplying 59,000 tons of bauxite. Guyana can provide 6,000 tons a year, and Brazil can provide 37,000 tons a year. The plant in Staten Island can process 40,000 tons of bauxite ore per year. The San Diego plant has a capacity of 24,000 tons a year, and the Portland plant’s capacity is 30,000 tons per year. The fourth plant, in Charleston, has a capacity of 20,000 tons annually. The transportation cost per ton is provided below.



36. Using the northwest corner rule, determine the optimal schedule for shipping a ton of bauxite out of Guinea?

|  |  |
| --- | --- |
| a. | 6,000 tons to Staten Island and 6,000 tons to Charleston |
| b. | 12,000 tons to Staten Island |
| c. | 7,000 tons to Staten Island and 5,000 tons to Charleston |
| d. | 12,000 tons to Charleston |

ANS: B PTS: 1 DIF: Medium

37. Using the northwest corner rule, determine the optimal schedule for shipping a ton of bauxite out of India.

|  |  |
| --- | --- |
| a. | 24,000 tons to San Diego; 30,000 tons to Portland; and 5,000 tons to Charleston |
| b. | 20,000 tons to San Diego; 30,000 tons to Portland; and 9,000 tons to Charleston |
| c. | 29,000 tons to San Diego and 30,000 tons to Portland |
| d. | 28,000 tons to Staten Island; 24,000 tons to San Diego; and 7,000 tons to Portland |

ANS: D PTS: 1 DIF: Medium

38. Using the northwest corner rule, determine the optimal schedule for shipping a ton of bauxite out of Guyana.

|  |  |
| --- | --- |
| a. | 6,000 tons to Staten Island |
| b. | 6,000 tons to San Diego |
| c. | 6,000 tons to Portland |
| d. | 6,000 tons to Charleston |

ANS: C PTS: 1 DIF: Medium

39. Using the northwest corner rule, determine the optimal schedule for shipping a ton of bauxite out of Brazil.

|  |  |
| --- | --- |
| a. | 23,000 tons to Staten Island and 14,000 tons to San Diego |
| b. | 23,000 tons to Staten Island and 14,000 tons to Portland |
| c. | 17,000 tons to Portland and 20,000 tons to Charleston |
| d. | 23,000 tons to Staten Island; 7,000 tons to Portland; and 7,000 tons to San Diego |

ANS: C PTS: 1 DIF: Medium

40. What would be the total shipping cost for Reliance Metals based on the northwest corner rule?

|  |  |
| --- | --- |
| a. | $67,921 |
| b. | $226,910 |
| c. | $299,213 |
| d. | $301,763 |

ANS: B PTS: 1 DIF: Hard

41. Using the matrix least cost method, determine the optimal schedule for shipping a ton of bauxite out of Guinea.

|  |  |
| --- | --- |
| a. | 6,000 tons to Staten Island and 6,000 tons to Charleston |
| b. | 12,000 tons to Staten Island |
| c. | 7,000 tons to Staten Island and 5,000 tons to Charleston |
| d. | 12,000 tons to Charleston |

ANS: B PTS: 1 DIF: Medium

42. Using the matrix least cost method, determine the optimal schedule for shipping a ton of bauxite out of India.

|  |  |
| --- | --- |
| a. | 24,000 tons to San Diego; 30,000 tons to Portland; and 5,000 tons to Charleston |
| b. | 20,000 tons to San Diego; 30,000 tons to Portland; and 9,000 tons to Charleston |
| c. | 29,000 tons to San Diego and 30,000 tons to Portland |
| d. | 5,000 tons to Staten Island; 24,000 tons to San Diego; and 30,000 tons to Portland |

ANS: D PTS: 1 DIF: Medium

43. Using the matrix least cost method, determine the optimal schedule for shipping a ton of bauxite out of Guyana.

|  |  |
| --- | --- |
| a. | 6,000 tons to Staten Island |
| b. | 6,000 tons to San Diego |
| c. | 6,000 tons to Portland |
| d. | 6,000 tons to Charleston |

ANS: D PTS: 1 DIF: Medium

44. Using the matrix least cost method, determine the optimal schedule for shipping a ton of bauxite out of Brazil.

|  |  |
| --- | --- |
| a. | 23,000 tons to Staten Island and 14,000 tons to San Diego |
| b. | 23,000 tons to Staten Island and 14,000 tons to Portland |
| c. | 23,000 tons to Staten Island and 14,000 tons to Charleston |
| d. | 23,000 tons to Staten Island; 7,000 tons to Portland; and 7,000 tons to San Diego |

ANS: C PTS: 1 DIF: Medium

45. What would be the total shipping cost for Reliance Metals based on the matrix least cost method?

|  |  |
| --- | --- |
| a. | $67,921 |
| b. | $140,410 |
| c. | $199,213 |
| d. | $201,763 |

ANS: B PTS: 1 DIF: Hard

46. When the number of occupied cells is less than the number of origins and the number of destinations, the situation

|  |  |
| --- | --- |
| a. | needs to add a supply dummy |
| b. | needs to add a destination dummy |
| c. | is referred to as degeneracy |
| d. | is totally unsolvable |

ANS: C PTS: 1 DIF: Easy

47. In Problem 36, Guyana can now provide 12,000 tons of bauxite rather than 6,000 tons. By how much would this change the total transportation cost?

|  |  |
| --- | --- |
| a. | $0.00 |
| b. | $7,680 |
| c. | $14,280 |
| d. | $66,080 |

ANS: A PTS: 1 DIF: Easy

48. In Problem 36, Guinea can now provide 20,000 tons of bauxite rather than 12,000 tons. By how much would this change the total transportation cost?

|  |  |
| --- | --- |
| a. | $0.00 |
| b. | $23,680 |
| c. | $30,000 |
| d. | $24,780 |

ANS: A PTS: 1 DIF: Easy

49. Assume that the supply contracts remain fixed, but Charleston’s processing capability increases by 5,000 tons per year. By how much would this change the total transportation cost?

|  |  |
| --- | --- |
| a. | $0.00 |
| b. | $6,400 |
| c. | $7,100 |
| d. | $14,800 |

ANS: A PTS: 1 DIF: Easy

50. Assume that the supply contracts remain fixed, but Charleston’s processing capability increases by 5,000 tons per year. By how much would this change the total transportation cost?

|  |  |
| --- | --- |
| a. | $0.00 |
| b. | $11,900 |
| c. | $14,750 |
| d. | $18,750 |

ANS: A PTS: 1 DIF: Easy