Chapter 7

1. You are the logistics manager of a shoe manufacturer. The company has three production plants in Dallas, Charlotte, and San Diego, which ship daily to three warehouses in Atlanta, Boston, and Denver. The overall goal is to minimize daily cost of shipping from plants to warehouses. The following table contains the supply for each production plant, demand for each warehouse, and shipping cost per box per each route between plants and warehouses:

From/To:	**Atlanta**	**Boston**	**Denver**	**Supply**
Dallas	$2,30	$1,75	$4,50	**3000**
Charlotte	$2,90	$3,35	$3,05	**3500**
San Diego	$1,99	$2,80	$365	**5000**
Demand	**5000**	**4000**	**2500**	

   a. Represent the problem with a network diagram.
   b. Use Excel to create a template and calculate total transportation costs.
   c. Use Solver to suggest how many boxes should be shipped from each plant to each warehouse.
   d. Perform sensitivity analysis and provide managerial recommendations for future shipments.
   e. Represent the solution with a simplified network diagram.
   f. Assume that the demand in Denver increases from 2500 to 3000 boxes. How will this change impact the distribution?

   Answer: see *ch7_P1shoes_solution.xlsx*

2. An Energy Production Company (EPC) has ten fossil plants that must receive a certain amount of coal per week to sustain energy generation. Each plant, respective region, and weekly demand is as follows:

Plant	Region	Demand
A	East	450 tons/week
B	West	100 tons/week
C	West	50 tons/week
D	East	135 tons/week
E	West	75 tons/week
F	East	125 tons/week
C	East	150 tons/week
H	East	900 tons/week
I	South	50 tons/week
J	South	50 tons/week

EPC has three main coal suppliers, all of which have different capacities in regard to how many tons of coal they can deliver per week. EPC pays an average of $10000 per ton with each supplier. The supplier capacities are as follows:

SCSX	1,650 tons/week
SUSX	800 tons/week
SRTV	1,225 tons/week

The coal must first be brought to a regional storage facility for operational reasons, such as quality inspection and inventory control. However, each regional warehouse has a maximum processing capacity as follows:

EAST	900 tons/week
WEST	1,500 tons/week
SOUTH	1,350 tons/week

Generally, coal is transported to plants from their respective regional storage facility. However, there are times when demand exceeds the processing capacity at the regional storage facility, and coal must be transported from another regional storage facility. There is an additional cost associated with doing this. The costs are as follows:

Region	Percent Surcharge
EAST-WEST	33% surcharge
EAST-SOUTH	25% surcharge
WEST-SOUTH	15% surcharge

How should EPC plan its transportation of coal between the suppliers, regional storage facilities, and coal plants to minimize the overall costs, under the limitations of regional storage facilities and supplier capacities while still meeting demand at each coal plant? Specifically:

a. Formulate the transshipment model as a linear programming model.
b. Represent the problem with a network diagram.
c. Use Excel to create a template and calculate total transportation costs.
d. Solve the problem and perform sensitivity analysis to generate managerial recommendations.
e. Represent the solution with a simplified network diagram.

Answer: see *ch7_P4coal_solution.xlsx*

3. Transshipment models are usually less complicated than transportation models.
    a. True
    b. *False

4. Decision variables for the transportation model can be defined as the amount of units to be transported from a given source to a given destination during the planning period.
    a. *True
    b. False

5. The transportation model is always constructed with a minimization objective function.
    a. True
    b. *False

6. The transportation model is a special case of linear programming models.
    a. *True
    b. False

7. When the total supply of the product generated by all sources equals the total demand consumed by all destinations, then transportation constraints can be formulated as equality constraints.
    a. *True
    b. False

8. Any value assigned to the dummy source row as part of the final solution is considered to be unmet demand.
    a. *True
    b. False

9. The sensitivity analysis of a transportation model is similar to that for linear programming models.
    a. *True
    b. False

10. A zero value for the shadow price of a constraint indicates that the reduction or increase in the value of the right-hand-side value of that constraint will not impact the objective function.
    a. *True
    b. False

11. In the transportation model, shadow prices are effective in the ranges defined by the allowable increase and allowable decrease values.
    a. *True

b. False

12. The transshipment model is an extension of the transportation model.
    a. *True
    b. False

13. Which of the following is not a source layer in the transportation model?
    a. Machines
    b. Plants
    c. Cities
    d. Warehouses
    e. *All of the above can serve as source layer in the transportation model.

14. Which of the following is not a destination layer in the transportation model?
    a. Machines
    b. Warehouses
    c. Cities
    d. *All of the above can serve as destination layer in the transportation model.

15. Which of the following is not an element of network diagrams used to represent shipment models?
    a. Nodes
    b. Arcs
    c. *The objective function
    d. All of the above are contained in a network diagram.

16. The constraints in a transportation model stipulate that:
    a. The sum of units from all sources delivered to a destination is greater than or equal to the demand of the destination.
    b. The sum of units to all destinations originated from a source is less than or equal to the available units in that source.
    c. The sum of units delivered from a given source to a given destination is non-negative.
    d. *All of the above.

17. Which of the following situations results in an infeasible transportation model?
    a. When the total supply for the product generated by all sources equals the total demand consumed by all destinations
    b. When the total supply for the product generated by all sources is greater than the total demand consumed by all destinations
    c. *When the total supply for the product generated by all sources is less than the total demand consumed by all destinations

d. None of the above

18. The modeler can assign a very high value to the shipment cost for the units originating from:
    a. Dummy destinations.
    b. *Dummy sources.
    c. Original destinations.
    d. Original sources.

19. Regarding the demand constraints of the transportation model, the shadow price indicates how much it will cost to ship a marginal container:
    a. *To a respective destination.
    b. From a given source.
    c. From a given source to a respective destination.
    d. Any of the above

20. In the transportation model, the reduced costs indicate:
    a. The cost-per-unit change so that a shipment can be assigned to routes that do not have any assignment in the current solution.
    b. The cost-per-unit change so that a shipment cannot be assigned to routes that currently have assignments.
    c. *Either a or b
    d. Neither a nor b

21. The transshipment model seeks to minimize the total transportation cost:
    a. From plants to warehouses.
    b. From warehouses to retail stores.
    c. *Both a and b
    d. Neither a nor b

22. The objective function of the transshipment models represents:
    a. The scalar product of quantities shipped from a given plant to a given warehouse with their respective transportation costs per unit.
    b. The scalar product of quantities shipped from a given warehouse to a given retail store with their respective transportation costs per unit.
    c. *The sum of two scalar products indicated in a and b above.
    d. None of the above represents the objective function of the transshipment models.