Tutorial Sheet on Transportation, Assignment, And Transshipment Problems

Question No. 1

Consider the transportation problem with following data

		Destination					
		1	**2**	**3**	**4**	**5**	**Supply**
Source	1	2	4	6	5	7	4
	2	7	6	3	*M*	4	6
	3	8	7	5	2	5	6
	4	0	0	0	0	0	4
Demand		4	4	2	5	5	

Use each of the following methods to obtain an initial BF solution. Compare the values of the objective function for these solutions.
(a) Northwest corner rule (b) Least cost method (c) Vogel's approximation method

Question No. 2

The coach of an age group swim team needs to assign swimmers to a 200-yard medley relay team to send to the Junior Olympics. Since most of his best swimmers are very fast in more than one stroke, it is not clear which swimmer should be assigned to each of the four strokes. The five fastest swimmers and the best times (in seconds) they have achieved in each of the strokes (for 50 yards) are

Stroke	Carl	Chris	David	Tony	Ken
Backstroke	37.7	32.9	33.8	37.0	35.4
Breaststroke	43.4	33.1	42.2	34.7	41.8
Butterfly	33.3	28.5	38.9	30.4	33.6
Freestyle	29.2	26.4	29.6	28.5	31.1

The coach wishes to determine how to assign four swimmers to the four different strokes to minimize the sum of the corresponding best times.

(a) Formulate this problem as an assignment problem.
(b) Obtain an optimal solution.

Question No. 3

The Onenote Co. produces a single product at three plants for four customers. The three plants will produce 60, 80, and 40 units, respectively, during the next time period. The firm has made a commitment to sell 40 units to customer 1, 60 units to customer 2, and at least 20 units to customer 3. Both customers 3 and 4 also want to buy as many of the remaining units as possible. The net profit associated with shipping a unit from plant i for sale to customer j is given by the following table:

		Customer			
		1	2	3	4
	1	$800	$700	$500	$200
Plant	2	$500	$200	$100	$300
	3	$600	$400	$300	$500

a) Formulate this problem as a transportation problem where the objective function is to be maximized by constructing the appropriate parameter table that gives unit profits.
(b) Now formulate this transportation problem with the usual objective of minimizing total cost by converting the parameter table from part (*a*) into one that gives unit costs instead of unit profits.

Question No. 4

The Build-Em-Fast Company has agreed to supply its best customer with three widgets during *each* of the next 3 weeks, even though producing them will require some overtime work. The relevant production data are as follows:

Week	Maximum Production, Regular Time	Maximum Production, Overtime	Production Cost per Unit, Regular Time
1	2	2	$300
2	3	2	$500
3	1	2	$400

The cost per unit produced with overtime for each week is $100 more than for regular time. The cost of storage is $50 per unit for each week it is stored. There is already an inventory of two widgets on hand currently, but the company does not want to retain any widgets in inventory after the 3 weeks. Management wants to know how many units should be produced in each week to minimize the total cost of meeting the delivery schedule.
(a) Formulate this problem as a transportation problem by constructing the appropriate parameter table.
(b) Obtain an optimal solution.

Question No. 5

Four cargo ships will be used for shipping goods from one port to four other ports (labeled 1, 2, 3, 4). Any ship can be used for making any one of these four trips. However, because of differences in the ships and cargoes, the total cost of loading, transporting, and unloading the goods for the different ship-port combinations varies considerably, as shown in the following table:

		Port			
		1	2	3	4
Ship	1	$500	$400	$600	$700
	2	$600	$600	$700	$500
	3	$700	$500	$700	$600
	4	$500	$400	$600	$600

The objective is to assign the four ships to four different ports in such a way as to minimize the total cost for all four shipments.
(a) Describe how this problem fits into the general format for the assignment problem.
(b) Obtain an optimal solution.

Question No. 6

The Childfair Company has three plants producing child push chairs that are to be shipped to four distribution centers. Plants 1, 2, and 3 produce 12, 17, and 11 shipments per month, respectively. Each distribution center needs to receive 10 shipments per month. The distance from each plant to the respective distributing centers is given to the right:

		Distance			
		Distribution Center			
		1	2	3	4
Plant	1	800 miles	1,300 miles	400 miles	700 miles
	2	1,100 miles	1,400 miles	600 miles	1,000 miles
	3	600 miles	1,200 miles	800 miles	900 miles

The freight cost for each shipment is $100 plus 50 cents per mile. How much should be shipped from each plant to each of the distribution centers to minimize the total shipping cost?
(a) Formulate this problem as a transportation problem by constructing the appropriate parameter table.
(b) Draw the network representation of this problem.
(c) Obtain an optimal solution.
Question No. 7

The network in the figure gives the shipping routes from nodes 1 and 2 to nodes 5 and 6 by way of nodes 3 and 4. The unit shipping costs are shown on the respective arcs.

(a) Develop the corresponding transshipment model.

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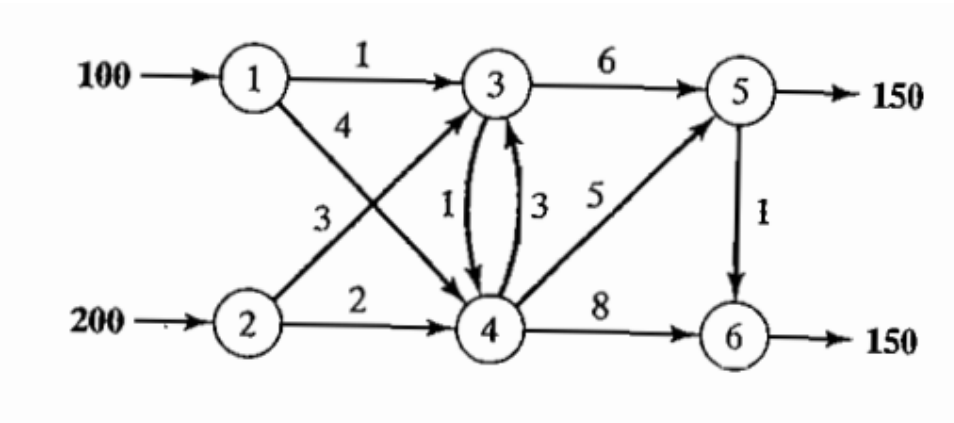
(b) Solve the problem, and show how the shipments are routed from the sources to the destinations.



Question No. 8

Consider the following transshipment problem with two destinations. The costs for shipment in rupees are given below:

		Source		Destination		Supply
		S_1	S_2	D_1	D_2	
Source	S_1	0	1	3	4	5
	S_2	1	0	2	4	25
Destination	D_1	3	2	0	1	-
	D_2	4	4	1	0	-
Demand		-	-	20	10	

Determine the optimum shipping schedule.

Question No. 9

Find the non-degenerate basic feasible solution for the following transportation problem using

a) NWCR
b) VAM

						Supply
Destination		1	2	3	4	
	1	10	20	5	7	10
	2	13	9	12	8	20
Source	3	4	5	7	9	30
	4	14	7	1	9	40
	5	3	12	5	19	50
Demand		60	60	20	10	

Question No. 10

a) Solve the minimal assignment problem whose cost matrix is given below. Also, give all possible optimal solutions.

	1	2	3	4
I	2	3	4	5
II	4	5	6	7
III	7	8	9	8
IV	3	5	8	4

b) Four new machines M_1, M_2, M_3, and M_4 are to be installed in a machine shop. There are vacant places A, B, C, D, and E available. Because of limited space, machine M_2 cannot be placed at A. The cost matrix is shown below.

	A	B	C	D	E
M_1	4	6	10	5	4
M_2	7	4	-	5	4
M_3	-	6	9	6	2
M_4	9	3	7	2	3