

### UNIT-3a: Transportation Model

Q1. Explain the following in the context of transportation problem.

- a) Degenerate transportation problem
- b) Modified distribution method.

Q2. What is degeneracy in transportation problem? How it can be resolved?

Q3. What are the conditions for the application of optimality test in case of transportation problem? Briefly explain as to why these conditions should be satisfied?

Q4. Find the feasible solution of the following transportation problem using North West corner method.

	$W_1$	$W_2$	$W_3$	$W_4$	Supply
Factory $F_1$	14	25	45	5	6
$F_2$	65	25	35	55	8
$F_3$	35	3	65	15	16
Requirement	4	7	6	13	30 (Total)

Q5. Find the initial basic feasible solution of the following transportation problem using Vogel's approximation method.

	$W_1$	$W_2$	$W_3$	$W_4$	Capacity
Factory $F_1$	19	30	50	10	7
$F_2$	70	30	40	60	9
$F_3$	40	8	70	20	18
Requirement	5	8	7	14	34 (Total)

Q6. Find the initial basic feasible solution of the following transportation problem using North West corner method and Vogel's approximation method.

	A <sub>1</sub>	B <sub>1</sub>	C <sub>1</sub>	D <sub>1</sub>	E <sub>1</sub>	Supply
Origin A	2	11	10	3	7	4
B	1	4	7	2	1	8
C	3	9	4	8	12	9
Requirement	3	3	4	5	6	

Q7. Solve the transportation problem for which the cost, origin, availability and destinations requirements are given below:

	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	D <sub>5</sub>	D <sub>6</sub>	a <sub>i</sub>
O <sub>1</sub>	1	2	1	4	5	2	30
O <sub>2</sub>	3	3	2	1	4	3	50
O <sub>3</sub>	4	2	5	9	6	2	75
O <sub>4</sub>	3	1	7	3	4	6	20
b <sub>j</sub>	20	40	30	10	50	25	175 (Total)

Q8. A departmental store wishes to purchase the following quantities of ladies' dresses:

Dress type	A	B	C	D
Quantity	150	100	75	250

Tenders are submitted by three different manufacturers who undertake to supply not more than the quantities below:

Manufacturer	W	X	Y
Total Quantity	350	250	150

The store estimates that its profit per dress will vary with the manufacturer as shown in the matrix below. How should orders be placed?

Dress

	A	B	C	D
Manufacturer	2.75	3.50	4.25	2.25
W				
X	3.00	3.25	4.50	1.75
Y	2.50	3.50	4.75	2.00

Q9. A fertilizer company has three plants A, B and C which supply to six major distribution centres 1,2,3,4,5,6. the table below gives the transportation cost per case, the plant annual capacities and predicted annual demand at different centres in terms of thousands of cases. The variable production cost per case are Rs.8.50, 9.40, 7.20 respectively at plants A,B and C. Determine the minimum cost production and transportation allocation.

	1	2	3	4	5	6	Annual production in thousands of cases
Plant A	2.50	3.50	5.50	4.50	1.50	4.00	220
B	4.60	3.60	2.60	5.10	3.10	4.10	3400
C	5.30	4.30	4.80	2.30	3.30	2.80	1800
Annual production in thousands of cases	850	750	420	580	1020	920	

Prove that if variable production cost are same at every plant , one can obtain an optimal allocation by using transportation costs only.

Q10. A production control superintendent finds the following information on his desk: In department A,B,C the number of surplus pallet is 18,27,21 resp. In department G,H,I and J the no. of pallets required is 14,12,23, 17 resp. The time in minutes to move a pallet from one department to another is given below:

From	To	G	H	I	J
A		13	25	12	21
B		18	23	14	9
C		23	15	12	16

What is the optimal distribution plan to minimize the moving cost?

Q11. Solve the following transportation problem:

From	To	A	B	C	D	E	Supply
1		20	19	14	21	16	40
2		15	15		19	16	60
3		18	20	18	20		90
Demand		30	40	70	40	60	

Q12. A manufacturing company has three factories  $F_1, F_2, F_3$  with monthly manufacturing capacities of 7000, 4000, 10000 units of a product. The product is to be supplied to seven stores. The manufacturing costs of these factories are slightly different but the important factor is the shipping cost from each factory to a particular store. Following table represent the factory capacities, store requirement and unit cost in rupees of shipping from each factory to each store and slack. Here slack is difference between total factory capacity and total store requirement.

	$S_1$	$S_2$	$S_3$	$S_4$	$S_5$	$S_6$	$S_7$	Slack	Factory capacity
Factory $F_1$	5	6	4	3	7	5	4	0	7000
$F_2$	9	4	3	4	3	2	1	0	4000
$F_3$	8	4	2	5	4	8	3	0	10000
Store requirement	1000	2000	4500	4000	2000	3500	3000	1000	

Work out a transportation plan so as to minimize the transportation cost.

Q13. General electrode is a big electrode manufacturing company. It has two factories and three main distribution centers in three cities. The supply and demand conditions for units of electrode are given below along with unit cost of production. How should the trips be scheduled so that cost of production is minimized?

The present cost of transportation is around Rs.3100/month. What can be the maximum saving by proper scheduling?

Centers	A	B	C
Requirement	50	50	150
Cost per trip from X plant	25	35	10
Cost per trip from Y plant	20	5	80
Capacity of plant X	150 units of electrodes		
Capacity of plant Y	100 units of electrodes		

Q14. A company has three plants at location A,B,C which supply warehouses located at D,E,F,G,H.. Monthly plant capacities are 800,500,900 units resp. Monthly warehouse requirements are 400,350, 250,900. the unit transportation cost in rupees given below:

From	To	D	E	F	G	H
A		8	8	9	4	3
B		5	8	5	11	6
C		8	9	7	3	3

Determine an optimum distribution for the company in order to minimize the total transportation cost. How much is the cost?

Q15. Priyanshu enterprise has three auditors. Each auditor can work up to 160 hours during the next month, during which time 3 projects must be completed. Project I will take 130 hours, project II will take 140 hours and III will take 160 hours. The amount in rupee per hour that can be billed for assigning each auditor to each project is given below:

	Project 1	Project 2	Project 3
Auditor 1	1200	1500	1900
2	1400	1300	1200
3	1600	1400	1500

Find the optimal solution. Also find the maximum total billing during the next month.

Q16. Four suppliers have submitted sealed bids that quote the price per case of hairnets delivered to four regional stores of the army. The bids are summarized in the following table. The regional stores requirements as well as supplying capacities of suppliers are also shown. Supplier 4 has quoted for only region 1. Because of previous contractual obligations, region 3 will have to get a minimum of 200 cases from supplier 2.

	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	Max. Supply (cases)
Supplier S <sub>1</sub>	30	25	40	35	800
S <sub>2</sub>	35	32	38	40	1000
S <sub>3</sub>	28	30	35	38	1500
S <sub>4</sub>	25	-	-	-	600
Requirement (cases)	1000	800	1200	750	

- Formulate this problem as a transportation model including all constraints.
- Find the initial basic solution using V.A.M.
- Use Modi method to establish whether the above solution obtained is optimal or not.

Q17. A company has factories at location A, B, C which supply warehouses at D, E, F, G. Monthly factory capacities are 250,300,400 units resp. for regular production. If overtime production is utilized, factories A and B can produce 50 & 75 additional units respectively at overtime incremental cost of Rs.4 and 5 resp. The current warehouse requirements are 200,225, 300 units resp. Unit transportation cost in rupees from factories to warehouse are as follows:

From	To	D	E	F	G
A		11	13	17	14
B		16	18	14	10
C		21	24	13	10

Determine the optimum distribution for this company to minimize cost.

Q18. A company produces a small component for an industrial product and distributes it to five wholesalers at a fixed delivered price of Rs. 250 per unit. Sales forecasts indicate that monthly deliveries will be 300,300,100,500,400 units to wholesalers 1, 2,3,4,5 resp. The direct costs of production of each unit are Rs.100, 90, 80 at plants 1, 2, 3 resp. The transportation cost of shipping a unit from plants to wholesaler are given below:

	Wholesaler 1	2	3	4	5
Plant 1	5	7	10	15	15
2	8	6	9	12	14
3	10	9	8	10	15

Find how many components each plant must supply to each wholesaler to maximize the profit? What is the maximum total profit? Take the monthly production capacities of plant 1, 2 and 3 as 500,100, 1250units resp.