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The Assignment Problem

Question 1

A Marketing Manager has 4 subordinates and 4 tasks. The subordinates differ in efficiency. The tasks also differ in their intrinsic difficulty. His estimates of the time each subordinate would take to perform each task is given in the matrix below. How should the task be allocated one to one man so that the total man-hours are minimised ?(7 Marks)(Nov. 2004)

	I	*II*	*III*	*IV*
1	*16*	*52*	*34*	*22*
2	*26*	*56*	*8*	*52*
3	*76*	*38*	*36*	*30*
4	*38*	*52*	*48*	*20*

Answer

	I	II	III	IV
1	16	52	34	22
2	26	56	8	52
3	76	38	36	30
4	38	52	48	20

Step 1:

Subtract the smallest element of each row from every element of the corresponding row

	I	II	III	IV
1	0	36	18	6
2	18	48	0	44
3	46	8	6	0
4	18	32	28	0

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Step 2: Subtract the smallest element of each column from every element in that column

	I	II	III	IV
1	0	28	18	6
2	18	40	0	44
3	46	0	6	0
4	18	24	28	0

Step 3: Drew minimum number of horizontal and vertical lines to cover all the zeros

	I	II	III	IV
1	0	28	18	6
2	18	40	0	44
3	46	0	6	0
4	18	24	28	0

The optimal assignment is

1 — I = 16

2 — III = 8

3 — II = 38

4 — IV = 20

82 hours

Minimum time taken = 82 hours

Question 2

A BPO company is taking bids for 4 routes in the city to ply pick-up and drop cabs. Four companies have made bids as detailed below:

Bids for Routes (₹)

Company/Routes	R_1	R_2	R_3	R_4
C_1	4,000	5,000	–	–
C_2	–	4,000	–	4,000
C_3	3,000	–	2,000	–
C_4	–	–	4,000	5,000

Each bidder can be assigned only one route. Determine the minimum cost that the BPO should incur. *(6 Marks)(Nov., 2006)*

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Answer

Reducing minimum from each column element (figure in '000s)

Step 1

	R_1	R_2	R_3	R_4
C_1	1	1	–	–
C_2	–	0	–	0
C_3	0	–	0	–
C_4	–	–	2	1

Step 2

	R_1	R_2	R_3	R_4
C_1	0	0	–	–
C_2	–	0	–	0
C_3	0	–	0	–
C_4	–	–	1	0

Number of lines to connect all zeros nos. is 4 which is optional.

Alternatively you may also reduce the minimum from each row.

Step 1

	R_1	R_2	R_3	R_4
C_1	0	1	–	–
C_2	–	0	–	0
C_3	1	–	0	–
C_4	–	–	0	1

Step 2

	R_1	R_2	R_3	R_4
C_1	0	1	–	–
C_2	–	0	–	0
C_3	0	–	0	–
C_4	–	–	0	0

Number of lines to connect all zeros nos. is 4 which is optional.

All diagonal elements are zeros and are chosen. The minimum cost is ₹ 15,000 $C_1 – R_1$ 4,000; $C_2 – R_2$ 4,000; $C_3 – R_3$ 2,000; $C_4 – R_4$ 5,000; (Total) = 15,000.

Question 3

A company has four zones open and four marketing managers available for assignment. The zones are not equal in sales potentials. It is estimated that a typical marketing manager operating in each zone would bring in the following Annual sales:

Zones	*₹*
East	*2,40,000*
West	*1,92,000*
North	*1,44,000*
South	*1,20,000*

The four marketing manages are also different in ability. It is estimated that working under the same conditions, their yearly sales would be proportionately as under:

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Manager M	*:*	*8*
Manager N	*:*	*7*
Manager O	*:*	*5*
Manager P	*:*	*4*

Required:

If the criterion is maximum expected total sales, find the optimum assignment and the maximum sales. *(11 Marks) (Nov., 2007)*

Answer

Sum of the proportion = (8 + 7 + 5 + 4) = 24

Assuming ₹ 1,000 as one unit, the effective matrix is as follows:

Effective Matrix

Managers	Zones			
	East	West	North	South
M	(8/24) × 240 = 80	(8/24) × 192 = 64	(8/24) × 144 = 48	(8/24) × 120 = 40
N	(7/24) × 240 = 70	(7/24) × 192 = 56	(7/24) × 144 = 42	(7/24) × 120 = 35
O	(5/24) × 240 = 50	(5/24) × 192 = 40	(5/24) × 144 = 30	(5/24) × 120 = 25
P	(4/24) × 240 = 40	(4/24) × 192 = 32	(4/24) × 144 = 24	(4/24) × 120 = 20

Convert the maximization problem to minimization problem

The resultant loss matrix is as follows:

Loss Matrix

Managers	East	West	North	South
M	0	16	32	40
N	10	24	38	45
O	30	40	50	55
P	40	48	56	60

Row operation

Managers	East	West	North	South
M	0	16	32	40
N	0	14	28	35
O	0	10	20	25
P	0	8	16	20

Column operation

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Managers	East	West	North	South
M	0	8	16	20
N	0	6	12	15
O	0	2	4	5
P	0	0	0	0

Managers	East	West	North	South
M	0	6	14	18
N	0	4	10	13
O	0	0	2	3
P	2	0	0	0

Managers	East	West	North	South
M	0	2	10	14
N	0	0	6	9
O	4	0	2	3
P	6	0	0	0

Managers	East	West	North	South
M	[0]	2	8	12
N	0	[0]	4	7
O	4	0	[0]	1
P	8	2	0	[0]

Assignment	Sales
	₹
M – East	80,000
N – West	56,000
O – North	30,000
P – South	20,000
	1,86,000

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Question 4

The cost matrix giving selling costs per unit of a product by salesman A, B, C and D in regions R_1, R_2, R_3 and R_4 is given below:

	A	*B*	*C*	*D*
R_1	*4*	*12*	*16*	*8*
R_2	*20*	*28*	*32*	*24*
R_3	*36*	*44*	*48*	*40*
R_4	*52*	*60*	*64*	*56*

(i) Assign one salesman to one region to minimise the selling cost.

(ii) If the selling price of the product is ₹ 200 per unit and variable cost excluding the selling cost given in the table is ₹ 100 per unit, find the assignment that would maximise the contribution.

(iii) What other conclusion can you make from the above? *(8 Marks)(Nov., 2008)*

Answer

(i)

4	12	16	8
20	28	32	24
36	44	48	40
52	60	64	56

Subtracting minimum element – each row.

0	8	12	4
0	8	12	4
0	8	12	4
0	8	12	4

Subtracting minimum element – each column,

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Minimum no. of lines to cover all zeros = 4 = order of matrix. Hence optimal assignment is possible.

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Minimum cost = 4 + 28 + 48 + 56 = 136.

$= AR_1 + BR_2 + CR_3 + DR_4$

Since all are zeros, there are 24 solutions to this assignment problem.

Viz.	A	B	C	D	
	R_1	R_2	R_3	R_4	
	R_2	R_3	R_4	R_1	
	R_3	R_4	R_1	R_2	
	R_4	R_1	R_2	R_3	
	R_1	R_3	R_4	R_2	etc.

A can be assigned in 4 ways, B in 3 ways for each of A's 4 ways.

(ii) SP – VC = 100 ₹

	A	B	C	D
R_1	96	88	84	92
R_2	80	72	68	76
R_3	64	56	52	60
R_4	48	40	36	44

Subtracting the highest term

0	8	12	4
16	24	28	20
32	40	44	36
48	56	60	52

Subtracting minimum term of each row.

0	8	12	4
0	8	12	4
0	8	12	4
0	8	12	4

Which is the same as the earlier matrix

Maximum contribution = ₹ (96 + 72 + 52 + 44) = ₹ 264.

Alternative Solution:

Maximisation of contribution is same as minimizing cost. Hence, same assignments as in (i) will be the optimal solution.

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Maximum Contribution ₹ (400 – 136) = ₹ 264

(iii) (a) The relative cost of assigning person i to region r does not change by addition or subtraction of a constant from either a row, or column or all elements of the matrix.

(b) Minimising cost is the same as maximizing contribution. Hence, the assignment solution will be the same, applying point (i) above.

(c) Many zero's represent many feasible least cost assignment. Here, all zeros mean maximum permutation of a 4 × 4 matrix, viz. 4 × 3 × 2 × 1 = 24 solutions are possible.

Question 5

In an assignment problem to assign jobs to men to minimize the time taken, suppose that one man does not know how to do a particular job, how will you eliminate this allocation from the solution? (4 Marks)(Nov., 2009)

Answer

In an assignment minimization problem, if one task cannot be assigned to one person, introduce a prohibitively large cost for that allocation, say M, where M has a high the value. Then, while doing the row minimum and column minimum operations, automatically this allocation will get eliminated.

Question 6

A manager was asked to assign tasks to operators (one task per operator only) so as to minimize the time taken. He was given the matrix showing the hours taken by the operators for the tasks.

First, he preformed the row minimum operation. Secondly, he did the column minimum operation. Then, he realized that there were 4 tasks and 5 operators. At the third step he introduced the dummy row and continued with his fourth step of drawing lines to cover zeros. He drew 2 vertical lines (under operator III and operator IV) and two horizontal lines (aside task T_4 and dummy task T_5). At step 5, he performed the necessary operation with the uncovered element, since the number of lines was less than the order of the matrix . After this, his matrix appeared as follows:

Operators

Tasks	*I*	*II*	*III*	*IV*	*V*
T_1	*4*	*2*	*5*	*0*	*0*
T_2	*6*	*3*	*3*	*0*	*3*
T_3	*4*	*0*	*0*	*0*	*1*
T_4	*0*	*0*	*5*	*3*	*0*
T_5 *(dummy)*	*0*	*0*	*3*	*3*	*0*

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(i) What was the matrix after step II ? Based on such matrix, ascertain (ii) and (iii) given below.

(ii) What was the most difficult task for operators I, II and V ?

(iii) Who was the most efficient operators?

(iv) If you are not told anything about the manager's errors, which operator would be denied any task? Why?

(v) Can the manager go ahead with his assignment to correctly arrive at the optional assignment, or should he start afresh after introducing the dummy task at the beginning?

(10 Marks)(June, 2009)

Answer

	I	*II*	*III*	*IV*	*V*
(given)					
T_1	4	2	5	0	0
T_2	6	3	3	0	3
T_3	4	0	0	0	1
T_4	0	0	5	3	0
T_5	0	0	3	3	0
(Dummy)					

Junction values at dummy = 3. 3 was the minimum uncovered element.

Previous step was

7	5	5	0	3
9	6	3	0	6
7	3	0	0	4
0	0	2	0	0
0	0	0	0	0

(i) At step II the matrix was:

7	5	5	0	3
9	6	3	0	6
7	3	0	0	4
0	0	2	0	0

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(ii) For Operator I, Most difficult task will be indicated by hours = T_2

Operator II T_2

Operator V T_2

(iii) Most efficient operator = Operator IV

(iv) If the Manager's mistake was not known,

4	2	5	0	(0)
6	3	3	(0)	3
4	0	(0)	0	1
0	0	5	3	0
0	0	3	3	0

We continue the assignment; T_1 – V,

T_2 – IV, T_3 – III are fixed.

Between T_4 and T_5, I or II Can be allotted.

So, other I or II Can be denied the job.

(v) Yes, the Manager can go ahead with the optimal assignment

Row minimum is not affected by when the dummy was introduced.

Column minimum was affected. But in the process, more zeros were generated to provide better solution.

Question 7

A city corporation has decided to carry out road repairs on 4 main roads in the city.

The Government has agreed to make a special grant of ₹ 50 lacs towards the cost with the condition that the repairs should be carried out at lowest cost. Five contractors have sent their bids. Only road will be awarded to one contractor. The bids are given below:

		Cost of Repairs (₹ in lacs)			
Contractors	Road	R_1	R_2	R_3	R_3
	C_1	9	14	19	15
	C_2	7	17	20	19
	C_3	9	18	21	18
	C_3	10	12	18	19
	C_4	10	15	21	16

You are informed that C_2 should get R_1 and C_4 should get R_2 to minimize costs.

(i) What is the minimum cost allocation?

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(ii) How much is the minimum discount that the eliminated contractor should offer for meriting a contract?

(iii) Independent of (ii) above, if the corporation can negotiate to get a uniform discount rate from each contractor, what is the minimum rate of discount so that the cost is within the grant amount? *(6 Marks)(Nov., 2011)*

Answer

(i) There are 5 rows and 4 columns hence insert a dummy column R_5.

1. C_2 has been allocated to R_1
2. C_4 has been allocated to R_2. Hence the assignment is restricted to

	R_3	R_4	R_5
C_1	19	15	0
C_3	21	18	0
C_5	21	16	0

Column Minimum

	R_3	R_4	R_5
C_1	0	0	0
C_3	2	3	0
C_5	2	1	0

	R_3	R_4	R_5
C_1	0	0	1
C_3	1	2	0
C_5	1	0	0

Hence C_1 has been allotted to R_3, C_3 to R_5 and C_5 to R_4.

Hence the Minimum cost is = 7+12+19+16+0 = 54Lacs

(ii) C3 should reduce2 lacs for R_1, 6lacs for R_2, 2lacs for R_3 and 2 lacs for R_4

Minimum Discount = 2 Lacs for any of R_1, R_3, R_4

(iii) Minimum rate of Discount (54-50) = 4/54 = 7.41%

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Question 8

The following matrix was obtained after performing row minimum operations on rows R_1 and R_2 in an assignment problem for minimization. Entries "xx" represent some positive numbers. (It is not meant that all "xx" numbers are equal). State two circumstances under which an optimal solution is obtained just after the row minimum and column minimum operations.

(Candidates may use cell references as C_i R_j for uniformity. e.g. C_1 R_1 represents the cell at the intersection of Column1 (C_1) and Row 1 (R_1) etc.

	C_1	C_2	C_3
R_1	0	xx	xx
R_2	xx	0	xx
R_3	xx	xx	xx

(4 Marks)(May, 2012)

Answer

Situation 1 :On performing minimum operation in Row 3, if C_3R_3 is zero, the optimal solution is obtained.

0	xx	xx
xx	0	xx
xx	xx	0

Optimal solution = C_1R_1, C_2R_2 & C_3R_3

Situation 2:On performing minimum operation in Row 3, if C_2R_3 is zero, then it necessitates the performance of minimum operation in C_3. On account of this, if either C_3R_3 or C_3R_2 is zero then the optimal solution is obtained

0	xx	xx
xx	0	xx
xx	0	xx

And

0	xx	xx
xx	0	xx
xx	0	0

or

0	xx	Xx
xx	0	0
xx	0	Xx

Optimal = C_1R_1, C_2R_2& C_3R_3

OR

Optimal = C_1R_1, C_2R_3& C_3R_2

(i.e., C_2R_3 and C_3R_3 are zero after Row minimum and column minimum operation respectively)

(or C_2R_3 and C_3R_2 are zero after Row minimum and column minimum operation respectively).

Situation 3 :On performing minimum operation in Row 3, if C_1R_3 is zero, then it necessitates the performance of minimum operation in C_3. On account of this, if either C_3R_3 or C_3R_1 is zero then the optimal solution is obtained.(i.e., C_1R_3 and C_3R_3 are zero after Row minimum and column minimum operation respectively).

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0	xx	xx		0	xx	xx		0	xx	0	Optimal = C_1R_1, C_2R_2& C_3R_3
xx	0	xx	and	xx	0	0	or	Xx	0	Xx	OR
0	xx	xx		0	xx	0		0	0	Xx	Optimal = C_1R_3, C_2R_2& C_3R_1

(ie., C_1R_3 and C_3R_3 are zero after Row minimum and column minimum operation respectively)

or C_1R_3 and C_3R_1 are zero after Row minimum and column minimum operation respectively).

Question 9

A production supervisor is considering how he should assign five jobs that are to be performed to five operators. He wants to assign the jobs to the operators in such a manner that the aggregate costs to perform the job is the least. He has the following information about the wages paid to the operators for performing these jobs.

Operators	*Jobs*				
	1	*2*	*3*	*4*	*5*
A	*10*	*3*	*3*	*2*	*8*
B	*9*	*7*	*8*	*2*	*7*
C	*7*	*5*	*6*	*2*	*4*
D	*3*	*5*	*8*	*2*	*4*
E	*9*	*10*	*9*	*6*	*10*

Required:

Assign the jobs to the operators so that the aggregate cost is the least. (8 Marks)(Nov., 2012)

Answer

The given problem is a minimization problem

Subtracting minimum element of each row from all the elements of that row, the given problem reduces to the following:

	Job1	Job2	Job3	Job4	Job5
A	8	1	1	0	6
B	7	5	6	0	5
C	5	3	4	0	2
D	1	3	6	0	2
E	3	4	3	0	4

Subtracting the minimum element of each column from all the elements of that column

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	Job1	Job2	Job3	Job4	Job5
A	7	0	0	0	4
B	6	4	5	0	3
C	4	2	3	0	0
D	0	2	5	0	0
E	2	3	2	0	2

Since the minimum number of lines covering all zeros is equal to 4, which is less than the number of columns/rows(=5), the above table does not provide the optimal solution.

Subtracting the minimum uncovered element (=2) from all uncovered elements and adding the same to the elements lying at the intersection of two lines, we get the following matrix:

	Job1	Job2	Job3	Job4	Job5
A	9	0	0	2	6
B	6	2	3	0	3
C	4	0	1	0	0
D	0	0	3	0	0
E	2	1	0	0	2

Since the minimum number of horizontal and vertical lines to cover all zeros is equal to five, which is equal to the order of the matrix, the above table gives the optimal solution.

The optimal assignment is given below:

Operator	Job	Wages (`)
A	2	3
B	4	2
C	5	4
D	1	3
E	3	9
Total		21

Question 10

Prescribe the steps to be followed to solve an assignment problem. *(5 Marks)(May, 2013)*

Answer

The assignment problem can be solved by applying the following steps:

Step1: Subtract the minimum element after row operation of each row from all the elements in

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that row. From each column of the matrix so obtained, subtract its minimum element. The resulting matrix is the starting matrix for the following procedure.

Step2: Draw the minimum number of horizontal and vertical lines that cover all the zeros. If this number of lines is *n*, order of the matrix, optimal assignment can be made by skipping steps 3 and 4 and proceeding with step 5. If, however, this number is less than *n*, go to the next step

Step3: Here, we try to increase the number of zeros in the matrix. We select the smallest element out of these which do not lie on any line. Subtract this element from all such (uncovered) elements and add it to the elements which are placed at the intersections of the horizontal and vertical lines. Do not alter the elements through which only one line passes.

Step4: Repeat steps 1, 2 and 3 until we get the minimum number of lines equal to *n.*

Step5 (A): Starting with first row, examine all rows of matrix in step 2 or 4 in turn until a row containing exactly one zero is found. Surround this zero by □, indication of an assignment there. Draw a vertical line through the column containing this zero. This eliminates any confusion of making any further assignments in that column. Process all the rows in this way.

Step5 (B): Apply the same treatment to columns also. Starting with the first column, examine all columns until a column containing exactly one zero is found. Mark □ around this zero and draw a horizontal line through the row containing this marked zero. Repeat steps 5A and B, until one of the following situations arises:

(i) No unmarked (□) or uncovered (by a line) zero is left,

(ii) There may be more than one unmarked zero in one column or row. In this case, put around one of the unmarked zero arbitrarily and pass 2 lines in the cells of the remaining zeros in its row and column. Repeat the process until no unmarked zero is left in the matrix.

Question 11

Answer the following independent situations relating to an assignment problem with a minimization objective:

(i) Just after row and column minimum operations, we find that a particular row has 2 zeroes. Does this imply that the 2 corresponding numbers in the original matrix before any operation were equal? Why?

(ii) Under the usual notation, where a_{32} means the element at the intersection of the 3rd row and 2nd column, we have, in a 4 × 4 assignment problem, a_{24} and a_{32} figuring in the optimal solution. What can you conclude about the remaining assignments? Why?

(5 Marks)(Nov., 2013)

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Answer

(i) Under the Hungarian Assignment Method, the prerequisite to assign any job is that each row and column must have a zero value in its corresponding cells. If any row or column does not have any zero value then to obtain zero value, each cell values in the row or column is subtracted by the corresponding minimum cell value of respective rows or columns by performing row or column operation. This means *if any row or column have two or more cells having same minimum value then these row or column will have more than one zero.* However, having two zeros does not necessarily imply two equal values in the original assignment matrix just before row and column operations. *Two zeroes in a same row can also be possible by two different operations i.e. one zero from row operation and one zero from column operation*.

(ii) The order of matrix in the assignment problem is 4 × 4. The total assignment (allocations) will be four. In the assignment problem when any allocation is made in any cell then the corresponding row and column become unavailable for further allocation. Hence, these corresponding row and column are crossed mark to show unavailability. In the given assignment matrix two allocations have been made in a_{24} (2nd row and 4th column) and a_{32} (3rd row and 2nd column). This implies that 2nd and 3rd row and 4th and 2nd column are unavailable for further allocation.

Therefore, the other allocations are at either at a_{11} and a_{43} or at a_{13} and a_{41}.

Question 12

A salesman has to visit five cities. He wishes to start from a particular city, visit each city once and then return to his starting point. Cost (in ₹'000) of travelling from one city to another is given below You are required to find out the least cost route.

From / *To*	*P*	*Q*	*R*	*S*	*T*
P	-	*6*	*12*	*4*	*6*
Q	*6*	-	*10*	*4*	*6*
R	*12*	*10*	-	*12*	*8*
S	*4*	*4*	*12*	-	*12*
T	*6*	*6*	*8*	*12*	-

(5 Marks) (May, 2014)

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Answer

Row Operation

Cities	P	Q	R	S	T
P	-	2	8	0	2
Q	2	-	6	0	2
R	4	2	-	4	0
S	0	0	8	-	8
T	0	0	2	6	-

Column Operation

Cities	P	Q	R	S	T
P	-	2	6	0	2
Q	2	-	4	0	2
R	4	2	-	4	0
S	0	0	6	-	8
T	0	0	0	6	-

Since the minimum number of lines covering all zeros is equal to 4 which is less than the number of columns / rows (=5), the above table will not provide optimal solution. Subtract the minimum uncovered element (=2) from all uncovered elements and add to the elements lying on the intersection of two lines, we get the following matrix-

Cities	P	Q	R	S	T
P	-	0	4	0	2
Q	0	-	2	0	2
R	2	0	-	4	0
S	0	0	6	-	10
T	0	0	0	8	-

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Or

Cities	P	Q	R	S	T
P	-	0	4	0	2
Q	0	-	2	0	2
R	2	0	-	4	0
S	0	0	6	-	10
T	0	0	0	8	-

The routes and their associated costs are as follows:

From	To	Cost (₹)
P	Q	6,000
Q	S	4,000
R	T	8,000
S	P	4,000
T	R	8,000
	Total	30,000

P → Q → S → P route does not cover the destination R and T so, these routes are not optimal and alternative route should be find out.

Let us find out alternative routes from the obtained reduced matrix.

Cities	P	Q	R	S	T
P	-	0	4	0	2
Q	0	-	2	0	2
R	2	0	-	4	0
S	0	0	6	-	10
T	0	0	0	8	-

From	Possible Routes	Route Selected	Reasoning
P	P → Q, P → S	P → S	P → Q has already been rejected.
Q	Q → P, Q → S, Q → R, Q → T	Q → R	Q → P does not cover the other cities. Q → S has already been rejected. So we need to move towards next lowest cost destination i.e. '2'. There

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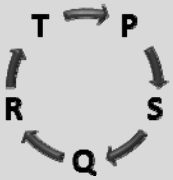
			are two possibilities i.e. Q → R or Q → T. Q→ T is not possible as destination T has already been selected.
R	R → Q, R → T	R → T	R → T has already been selected.
S	S → P, S → Q.	S → Q	S → P has already been rejected.
T	T → P, T → Q T → R	T → P	Destination Q and R have already been selected.

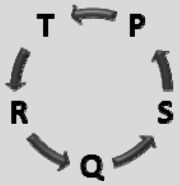
The possible least cost route is P → S → Q → R → T → P

From	To	Cost (₹)
P	S	4,000
S	Q	4,000
Q	R	10,000
R	T	8,000
T	P	6,000
	Total	32,000

☞ Path Shown in Solution:



Alternative Path:



Possible Least Cost is ₹ 32,000 in both of the cases.

Question 13

Can there be (i) more than one dummy row or column or (ii) one dummy row and a dummy column in a given problem of (a) assignment (b) transportation? Why? (In other words, state whether and why each of situations A, B, C and D is possible or not):

	Assignment	*Transportation*
More than one dummy row or column	*A*	*B*
One dummy row and one dummy column	*C*	*D*

(4 Marks) (May, 2014)

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Answer

Situation	Assignment	Transportation
More than one Dummy row or column	A: Possible Reason: In assignment problem, the pay off matrix should be square matrix i.e. no. of rows should be equal to no. of column. In case of unbalanced assignment problem where pay off matrix is not square matrix, either dummy rows or dummy columns, which may be one or more than one, would be added to make it a square matrix.	B: Not Possible Reason: Requirement to solve a transportation problem is that the problem should be balanced i.e. total capacity (or supply) should be equal to total requirement (or demand). In case of a unbalanced transportation problem, a dummy destination or a dummy origin in form of either only one dummy row or one dummy column is introduced in the transportation table to absorb excess capacity or excess demand and to find solution
One Dummy row and one Dummy column	C: Not Possible Reason: As explained in situation-A either dummy rows or dummy columns would be added to transform unbalanced payoff matrix into square matrix, both row and column cannot be added together otherwise problem would remain unbalanced, thus remain unsolved.	D: Not Possible Reason: In case of unbalanced transportation problem, there would be mismatch of demand and supply. To solve this one problem, either one dummy row or one dummy column is required to absorb either excess demand or excess supply.

☞ Conceptually correct brief reason along with the possibility of situation (Possible or Not Possible) is sufficient.

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