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Finding an Optimal Solution of an Assignment Problem by Improved Zero Suffix Method

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Abstract - In this paper improved Zero Suffix Method is applied for finding an optimal solution for assignment problem. This method requires least iterations to reach optimality, compared to the existing methods available in the literature. Here numerical examples are solved to check the validity of the proposed method.
Keywords - Assignment Problem, Optimal Solution, Linear Programming Problem, Cost minimization Assignment problem, improved Zero suffix method.

I. INTRODUCTION

The assignment problem is one of the earliest applications and is a special case of linear programming problem, which deals with available sales-force to different regions: vehicles to routes; products to factories; contracts to bidders; machines to jobs; development engineering to several construction sites and so on. Since all supplies, demands, and bounds on variables are integral, the assignment problem relies on a nice property of transportation problems that the optimal solution will be entirely integral. As you will see, the goal of the objective of the assignment problem (unlike transportation problems) may not have anything to do at all with moving anything.Generally the management makes assignment on a one-to-one basis in such a manner that the group maximizes the revenue from the sales; the vehicles are deployed to various routes in such a way that the assignment cost is minimum and so on.Applications of assignment problems are varied in the real world. Certainly it can be useful for the classic task of assigning employees to tasks or machines to production jobs, but its uses are more widespread. It could be used to assign fleets of aircrafts to particular trips, or assigning school buses to routes, or networking computers. In rare cases, it can even be used to determine marriage partners.A considerable number of methods have been so far presented for assignment problem in which the Hungarian method is more convenient method among them. Different methods have been presented for transportation problem and various articles have been published on the subject. Many of the authors [1] - [3] have done the transportation problems in different methods. Pandian and Natarajan [4] proposed new method for finding an optimal solution directly for transportation problem. An Optimal Solution for Transportation Problems solved by [5], [6] using zero suffix method and ASM method respectively. The more for less method to distribution related problems was established by [7].

By a complete assignment for a cost matrix n × n, we mean an assignment plan containing exactly n assigned independent zeros, one in each row and one in each column. The main concept of assignment problem is to find the optimum allocation of a number of resources to an equal number of demand points. An assignment plan is optimal if optimizes the total cost or effectiveness of doing all the jobs.

Hence we applied new method named improved zero suffix method, which is different from the preceding methods to apply in the assignment problems.

II. IMPROVED ZERO SUFFIX METHOD

The working rule of finding the optimal solution is as follows:

Step 1: Construct the assignment problem.

Step2: Subtract each row entries of the assignment table from the row minimum element.

Step 3: Subtract each column entries of the assignment table from the column minimum element.

Step 4: In the reduced cost matrix there will be at least one zero in each row and column, and then find the suffix value of all the zeros in the reduced cost matrix by following simplification, the suffix value is denoted by S.

$$S=\frac{\text{Sum of non zero costs in the ith row and jth column}}{\text{No of zeros in the ith row and jth column}}$$

Step 5: Choose the maximum of S, if it has one maximum value then assign that task to the person and if it has more than one maximum value then also assign the tasks to their respective persons (if the zeros don’t lie in the same column or row).

And if the zeros lie in the same row or column then assign the job to that person whose cost is minimum.

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Now create a new assignment table by deleting that row & column which has been assigned.
Step 6: Repeat step 2 to step 3 until all the tasks has not been assigned to the persons.
A. Examples
(i) Consider the following cost minimization assignment problem

	J_1	J_2	J_3	J_4
B_1	15	11	13	15
B_2	17	12	12	13
B_3	14	15	10	14
B_4	16	18	11	17

Solution: On applying row minimum operation we get

	J_1	J_2	J_3	J_4
B_1	4	0	2	4
B_2	5	0	0	1
B_3	4	5	0	4
B_4	5	7	0	6

Again on applying column minimum operation we get

	J_1	J_2	J_3	J_4
B_1	0	0	2	3
B_2	1	0	0	0
B_3	0	5	0	3
B_4	1	7	0	5

Now find the suffix value of each element whose value is zero & write the suffix value within the bracket [ ]. The suffix value is calculated by using the formula

$$S = \frac{\text{Sum of non zero costs in the ith row and jth column}}{\text{No of zeros in the ith row and jth column}}$$

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	J_1	J_2	J_3	J_4
	D_1	D_2	D_3	D_4
B_1	0 [2.3]	0 [5.6]	2	3
B_2	1	0 [3.25]	0 [0.6]	0 [4]
B_3	0 [3.3]	5	0 [2.5]	3
B_4	1	7	0 [5]	5

From all of the above suffix, 5.6 is the maximum so assign the job J_2 to the person B_1
Next delete the 1^{st} row and 2^{nd} column from the above table and apply the same process.

	J_1	J_3	J_4
B_2	1	0[0.25]	0[4.5]
B_3	0[2.5]	0[0.75]	3
B_4	1	0[2]	5

From all of the above suffix, 4.5 is the maximum so assign the job J4 to the person B2
Next delete the 2^{nd} row and 4^{th} column from the above table and apply the same process.

	J_1	J_3
B_3	0[0.5]	0[0]
B_4	1	0 [0.5]

From the above table, it is clear that the job J_1 should be assigned to the person B_3 and the job J_3 should be assigned to the person B_4. Finally the assignments are as follows $B_1 \rightarrow J_2$, $B_2 \rightarrow J_4$, $B_3 \rightarrow J_1$, $B_4 \rightarrow J_3$
& the minimum assignment cost = Rs (11 + 13 + 14 + 11)
= Rs 49

(ii) Consider the following travelling salesman problem

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O_1	∞	30	0	24
O_2	1	∞	10	0
O_3	50	0	∞	28
O_4	4	4	0	∞

Solution: On applying row minimum operation we get

	D_1	D_2	D_3	D_4
O_1	∞	30	0	24
O_2	0	∞	10	0
O_3	49	0	∞	28
O_4	3	4	0	∞

Again on applying column minimum operation we get

	D_1	D_2	D_3	D_4
O_1	∞	46	16	40
O_2	41	∞	50	40
O_3	82	32	∞	60
O_4	40	40	36	∞

Now find out the suffix value of each element whose value is zero & write the suffix value within the bracket [ ]. The suffix value is calculated by using the formula

$$S=\frac{\text{Sum of non zero costs in the ith row and jth column}}{\text{No of zeros in the ith row and jth column}}$$

	D_1	D_2	D_3	D_4
O_1	∞	30	0[32]	24
O_2	0[53]	∞	10	0[41]
O_3	49	0[111]	∞	28
O_4	3	4	36[8.5]	∞

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From all of the above suffix, 111 is maximum, so assign the origin O_3 to the Destination D_2. Next delete the 3rd row and 2nd column from above table and repeat the same process

	D_1	D_3	D_4
O_1	∞	0[17]	24
O_2	0[13.5]	10	0[12]
O_4	3	0[6.5]	∞

Now find out the suffix value of each element whose value is zero

	D_1	D_3	D_4
O_1	∞	0	24
O_2	0	10	0
O_4	3	0	∞

From all of the above suffix, 17 is maximum, so assign the origin O_1 to the Destination D_3
Next delete the 1st row and 3rd column from above table and repeat the same process

	D_1	D_4
O_2	∞	0[28]
O_4	0[28]	28

From the above table it is clear that $O_2 \rightarrow D_4$, $O_4 \rightarrow D_1$
The optimum assignment is $O_1 \rightarrow D_3$, $O_2 \rightarrow D_4$, $O_3 \rightarrow D_2$, $O_4 \rightarrow D_1$
& the minimum cost = Rs (16 + 40 + 32 + 40)
=Rs 128

III.CONCLUSION

The proposed algorithm carries systematic procedure, and very easy to understand. From this paper, it can be concluded that Improved zero suffix Method provides an optimal solution in fewer iterations, for the assignment problems. As this method consumes less time and is very easy to understand and apply, so it will be very helpful for decision makers.

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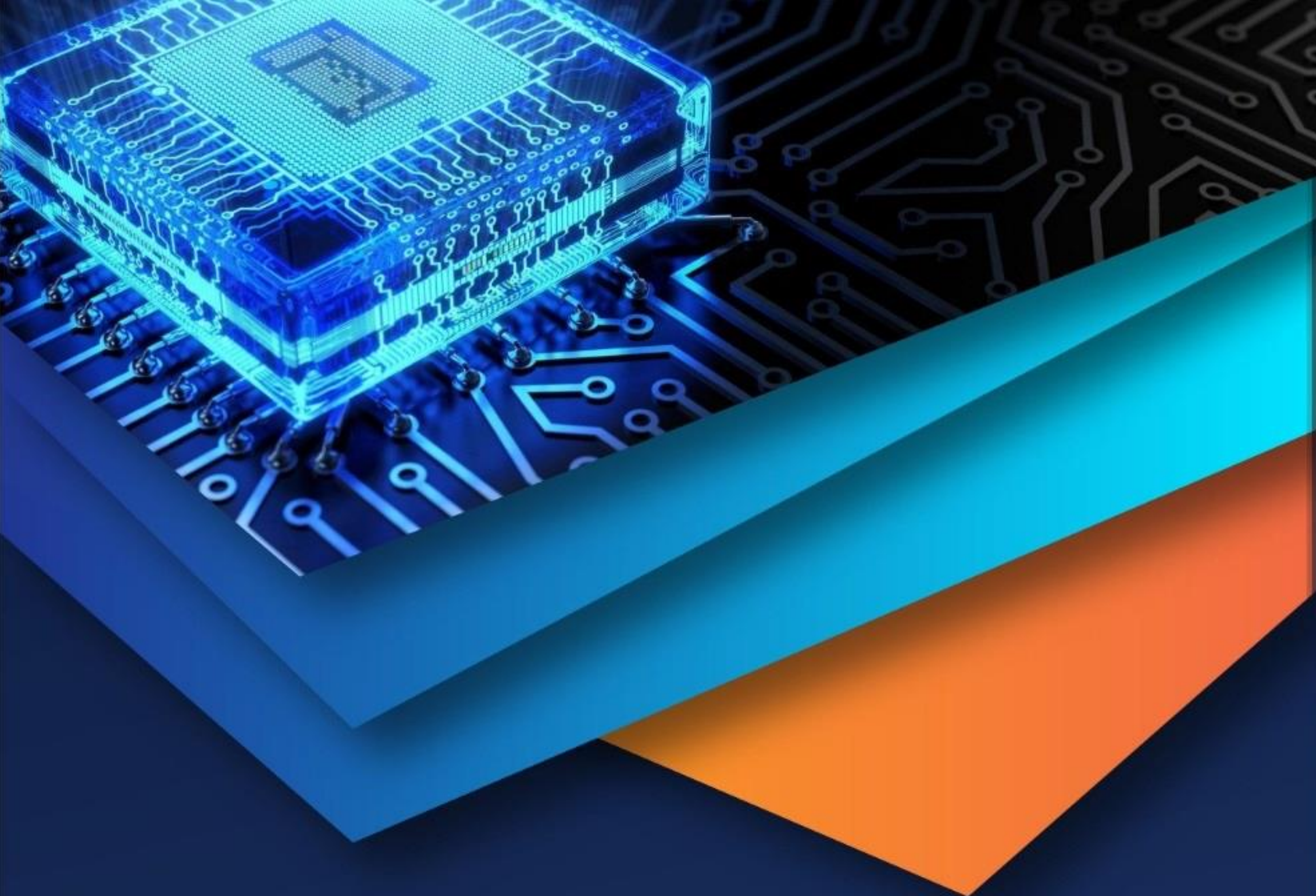

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