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APPLICATION OF ASSIGNMENT PROBLEM IN TRIANGULAR FUZZY NUMBER

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ABSTRACT:

Assignment method consists of assigning a specific (worker) to a specific (job), assuming that the number of persons equal to the number of tasks available. Suppose the problem is taken into account in the fuzzy environment then the uncertainty can be minimized. This paper formulates Triangular Fuzzy Number, then through Matrix Ones Assignment method and direct method the problem is solved. The problem is illustrated through numerical instance primarily based on contemporary lifestyle data.

1.INTRODUCTION:

An assignment problem is a special type of linear programmer whose cause is to offer most excellent challenge for allocating given wide variety of responsibilities to same wide variety of resources. There are many applications of assignment problem in various vectors. They can be successfully used to solve various problems like a problem of allocating sale region to particular sales person, allocating teachers to their respective classes and many more. These selection making issues are regularly solved on the idea of indistinct information.

The concept of Fuzzy Theory was first introduced by Zadeh. Triangular fuzzy number can give a solution to triangular fuzzy assignment problem which was proposed by Kumar etal... Kadhirvel & Balamurugan have proposed fuzzy jobs and workers and they have solved the problem by using Hungarian and Robust ranking method for triangular and trapezoidal fuzzy number. Kalaiarasi etal… they have suggested that the results obtained are optimal and can be applied in all type of assignment problem.

Anuradha have proposed a method for finding a solution to fuzzy solid assignment problem with Robust ranking method. Narayanamoorthy and Vidhya by using Robust ranking method the defuzzification have been done and the trapezoidal fuzzy number in fuzzy assignment problem used a technique called branch and bound. Selvi etal proposed a method for solving fuzzy assignment problem using magnitude ranking method. Centroid ranking method is used as a defuzzification technique in fuzzy assignment problem which is solved by Hungarian algorithm Mary & Selvi. Comparison of effectiveness of solving fuzzy assignment problem which was proposed by TA Thakre etal.

In this paper, basic definitions and operations, theorem, numerical illustration and solution to the fuzzy assignment problem, results and conclusions which is followed by references are given.

2. DEFINITIONS AND THEOREMS:

2.1.Fuzzy Set:

The set which is defined by a following characteristic function is a fuzzy set.

It is stated as,

$$\mu_A : X \to [0,1]$$

$$\mu_A(x) = \begin{cases} 1, if\ X\ is\ totally\ in\ A \\ 0, if\ X\ is\ not\ in\ A \\ (0,1), if\ X\ is\ partially\ in\ A \end{cases}$$

2.2.TYPES OF FUZZY NUMBERS:

There are several types of fuzzy numbers. They are,

Triangular fuzzy number, Trapezoidal fuzzy number, Pentagonal fuzzy number, Hexagonal fuzzy number, Octagonal fuzzy number and so on.

2.3.TRIANGULAR FUZZY NUMBER:

A Fuzzy Number $\tilde{A} = (a_1, a_2, a_3)$ on R defined by membership function is considered as triangular fuzzy number and its membership function is,

$$\mu_A(x) = \begin{cases} \frac{x-a_1}{a_2-a_1} & if\ a_1 \le x \le a_2 \\ 1 & if\ x = a_2 \\ \frac{a_3-x}{a_3-a_2} & if\ a_2 \le x \le a_3 \\ 0 & otherwise \end{cases}$$ where $a_1, a_2, a_3 \in R$.

Here,a_2 represents the middle value or midpoint $(a_2 - a_1), (a_3 - a_2)$ represent the left, right spread of triangular fuzzy number Ã= (a_1, a_2, a_3). These triangular fuzzy numbers can be defuzzified into three types. They are Magnitude ranking method, Centroid ranking method and Robust ranking method.

2.4.DEFUZZIFICATION:

The process of finding singleton value as the average value of triangular fuzzy number is known as defuzzification.

2.5.CENTROID RANKING METHOD:

The centroid of a triangle fuzzy number $\tilde{a}$ (a,b,c; w) as $G_{\tilde{a}}=\left(\frac{a+b+c}{3}, \frac{w}{3}\right)$.

The ranking function of the generalized fuzzy number $\tilde{a}$ = (a, b, c; w) which maps the set of all fuzzy numbers to a set of real numbers is defined as,

$$R(\tilde{a}) = \left(\frac{a+b+c}{3}\right)\ \left(\frac{w}{3}\right).$$

2.6.REDUCTION THEOREM:

In an assignment problem, if we add or subtract a constant to every element of a row or column in the cost matrix, then an assignment which minimizes the total cost on one matrix, also minimizes the total cost on the other matrix.

2.7.THEOREM:

If all $C_{ij} >= 0$ and we can find a set $X_{ij} = x_{ij}$ such that $\sum_i \sum_j C_{ij} X_{ij} = 0$, then the solution is optimal.

3.NUMERICAL ILLUSTRATION AND SOLUTIONS:

The allocation of members (students) to different tasks based on their performances and these tasks is done using maximal fuzzy assignment. Four members are taken as M1, M2, M3 AND M4 along four rows and four tasks(performances) are taken as T1, T2, T3 and T4 along the columns.

$$\begin{bmatrix} (10,13,16) & (7,10,13) & (8,11,14) & (7,10,13) \\ (9,12,15) & (10,13,16) & (8,11,14) & (9,12,15) \\ (5,8,11) & (7,10,13) & (7,10,13) & (5,8,11) \\ (8,11,14) & (6,9,12) & (8,11,14) & (5,8,11) \end{bmatrix}$$

The fuzzy problem is converted into crisp assignment problem by centroid ranking method as,

$$\begin{bmatrix} 4.3 & 3.3 & 3.6 & 3.3 \\ 4 & 4.3 & 3.6 & 4 \\ 2.6 & 3.3 & 3.3 & 2.6 \\ 3.6 & 3 & 3.6 & 2.6 \end{bmatrix}$$

3.1.PROPOSED ALGORITHM FOR SOLVING MATRIX ONES ASSIGNMENT METHOD(MOA):

STEP-1: In a minimization(maximum) problem, by finding the minimum (maximum) element of each row and write it on the right hand side of the matrix. Then divide each of the ith row of the matrix by a_i which will result in atleast one ones in each rows. Then go to step-2.

STEP-2: By finding the minimum element of each column in the assignment matrix and write it below the jth column of the matrix. Then divide each element of the jth column of the matrix by b_j which will result in the creation of atleast one ones in each column. If no feasible solution is achieved from step-1 and step-2 then go to step-3.

STEP-3: Draw the minimum number of lines to cover all the ones of the matrix. If the number of lines is exactly equal to n, then the complete assignment will be obtained else go to step-4.

STEP-4:Select the smallest element which do not lie on any of the lines in the above step and divide each element of the uncovered rows or columns by $d_{ij.}$ This will result in creating some new ones to this row or column. If still a optimal assignment is not achieved in the new matrix, then use step-4 and step-3 iteratively. By repeating the same procedure the optimal assignment will be obtained.

By using step-1taking the row minimum from each row, the below matrix is obtained,

Row mini

$$\begin{bmatrix} 4.3 & 3.3 & 3.6 & 3.3 \\ 4 & 4.3 & 3.6 & 4 \\ 2.6 & 3.3 & 3.3 & 2.6 \\ 3.6 & 3 & 3.6 & 2.6 \end{bmatrix} \quad \begin{matrix} 3.3 \\ 3.6 \\ 2.6 \\ 2.6 \end{matrix}$$

Now, divide each element of the ith row of the matrix by minimum number, the matrix obtained is,

Row mini

$$\begin{bmatrix} 1.3 & 1 & 1.0 & 1 \\ 1.1 & 1.1 & 1 & 1.1 \\ 1 & 1.2 & 1.2 & 1 \\ 1.3 & 1.1 & 1.3 & 1 \end{bmatrix} \quad \begin{matrix} 3.3 \\ 3.6 \\ 2.6 \\ 2.6 \end{matrix}$$

By using step-2 taking the column minimum from each column, the below matrix is obtained

Row mini

$$\begin{bmatrix} 1.3 & 1 & 1.0 & 1 \\ 1.1 & 1.1 & 1 & 1.1 \\ 1 & 1.2 & 1.2 & 1 \\ 1.3 & 1.1 & 1.3 & 1 \end{bmatrix} \quad \begin{matrix} 3.3 \\ 3.6 \\ 2.6 \\ 2.6 \end{matrix}$$

Col min 1 1 1 1

Now, divide each element of the jth column of the matrix by minimum value of that column, then matrix obtained is,

Hence, the complete assignment is possible.

Row mini

$$\begin{bmatrix} 1.3 & [1] & 1.0 & 1 \\ 1.1 & 1.1 & [1] & 1.1 \\ [1] & 1.2 & 1.2 & 1 \\ 1.3 & 1.1 & 1.3 & [1] \end{bmatrix} \quad \begin{matrix} 3.3 \\ 3.6 \\ 2.6 \\ 2.6 \end{matrix}$$

Col mini 1 1 1 1

Then the fuzzy optimal solution is 12.1.

3.2. PROPOSED ALGORITHM FOR SOLVING DIRECT METHOD:

STEP-1: Consider assignment problem which is balanced. Subtract each row from minimum element of that row to get new matrix.

STEP-2: Here by identifying for each column the zero position of (i,j)th place and make assignment where zero has unique position and the corresponding row and column will be deleted simultaneously. By doing this the optimal assignment will be obtained.

STEP-3: Find the value of nest successor of zero is some rows have same columns and do allocation to the row where the successor with maximal value is found. If again the tie is observed for these maximum values, then get the next successor of zero and assignment for value which is maximum.

STEP-4: Subtract row minimum from that particular row in the reduced matrix if each row is not having atleast one zero.

STEP-5: Get the optimal Assignment by going repeatedly through step 3 to 5

By using matrix form 3.1 in step-1 of this algorithm the matrix obtained is,

$$\begin{bmatrix} 1 & 0 & 0.3 & 0 \\ 0.4 & 0.7 & 0 & 0.4 \\ 0 & 0.7 & 0.7 & 0 \\ 1 & 0.4 & 1 & 0 \end{bmatrix}$$

By step-3 and step-4 the position and the solution of the optimal assignment will be obtained .

$$\begin{bmatrix} 1 & [0] & 0.3 & 0 \\ 0.4 & 0.7 & [0] & 0.4 \\ [0] & 0.7 & 0.7 & 0 \\ 1 & 0.4 & 1 & [0] \end{bmatrix}$$

The optimal value for direct method is 12.1.

4.RESULTS :

In this paper, two techniques Matrix ones assignment method (MOA) and Direct method is used and compared .The comparison of two models of fuzzy assignment problem has been done. Four members are allowed to four classes using matrix ones assignment method and direct method where M1 is placed to T2, M2 is placed toT3, M3 is placed to T1 and M4 is placed toT4. We further more can solve this problem till n members.

5.CONCLUSIONS:

In this paper, maximum fuzzy assignment for the four members (students) to four classes based on their performances is solved. Centroid ranking method is used to convert fuzzy problem into a crisp problem and the two methods Matrix ones assignment method and direct method are used to find out the optimal assignment and solution. It is observed that the optimal solution by these two methods are same. The solution of the fuzzy assignment problem is more relevant and gives the effective solution to place a suitable person at the suitable place.

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