A Compromise Solution to Multi Objective Fuzzy Assignment Problem

T. Leelavathy and K. Ganesan
Department of Mathematics, SRM University,
Kattankulathur, Chennai-603 203, INDIA
Email: leelavathy.t@ktr.srmuniv.ac.in; ganesan.k@ktr.srmuniv.ac.in

Abstract

The motive of this paper is to present a new and simple methodology to find the compromised solution to multi objective fuzzy assignment problems where all the parameters are trapezoidal fuzzy numbers. Using new fuzzy arithmetic, ranking method, a fuzzy compromised solution is obtained for the multi objective fuzzy assignment problem without converting the problem into classical form. An illustration is shown to explain the methodology under fuzzy environment.

AMS Subject Classification: 03B52, 03E72, 28E10, 97N60, 66K05.
Key Words and Phrases: Multi objective fuzzy assignment problem, Trapezoidal fuzzy number, Fuzzy arithmetic, Fuzzy compromise solution.

1 Introduction

The assignment problem is to assign each service facility to one and only one job so that the given measure of effectiveness is optimized. To solve an assignment problem, the decision parameters of the problem should be certain. But the real life situations are uncertain and imprecise. This uncertainty is effectively handled by fuzzy set theory proposed by Zadeh [10] in 1965. In 1970, Bellman and Zadeh [2] proposed the concept of
decision making under uncertain environment. After this several authors studied fuzzy assignment problems. Lin and Wen [7] proposed a kind of fuzzy assignment problem and designed a labeling algorithm for it.

Multi-objective optimization deals with the optimization of multiple conflicting objective functions. When an optimization problem involves more than one-objective function, the task of finding one or more optimum solutions is known as multi objective optimization. So, there cannot be a single optimum solution which simultaneously optimizes all objectives. The resulting outcome is a set of optimal solutions with a varying degree of objective values. Geetha et al. [6] provided a solution for a multi-objective assignment problem which minimizes both cost and time. Tsai et al. [9] solved a balanced multi-objective decision making problem which is related with cost, time and quality in fuzzy environment. Bao et al. [1] solved a multi-objective assignment problem converting to crisp environment. Biswas and Pramanik [3] studied MOAP with fuzzy costs. P.K.De et al. [4] proposed a new algorithm using goal programming approach to solve MOAP.

2 Preliminaries

Definition 2.1. A fuzzy set $\tilde{A}$ defined on the set of real numbers $R$ is said to be a fuzzy number, if its membership function $\tilde{A}: R \to [0, 1]$ has the following characteristics:

1. $\tilde{A}$ is convex, (i.e.) $\tilde{A}\{\lambda x_1 + (1-\lambda)x_2\} \geq \min\{\tilde{A}(x_1), \tilde{A}(x_2)\}$, for all $x_1, x_2 \in R$ and $\lambda \in [0, 1]$

2. $\tilde{A}$ is normal, i.e., there exists an $x \in R$ such that $\tilde{A}(x) = 1$

3. $\tilde{A}$ is upper semi-continuous and $\text{supp}(\tilde{A})$ is bounded in $R$.

Definition 2.2. A fuzzy number $\tilde{A}$ is a trapezoidal fuzzy number denoted by $\tilde{A} = (a_1, a_2, a_3, a_4)$ where $a_1, a_2, a_3, a_4$ are real numbers and its membership function $\tilde{A}(x)$ is given below:

$$\tilde{A}(x) = \begin{cases} 
\frac{x - a_1}{a_2 - a_1}, & \text{if } a_1 \leq x \leq a_2 \\
1, & \text{if } a_2 \leq x \leq a_3 \\
\frac{a_4 - x}{a_4 - a_3}, & \text{if } a_3 \leq x \leq a_4 \\
0, & \text{otherwise}
\end{cases}$$
Without loss of generality, we represent the trapezoidal fuzzy number \( \tilde{A} = (a_1, a_2, a_3, a_4) = ([a_2, a_3], \alpha, \beta) = (m, w, \alpha, \beta) \) where \( m = \frac{(a_2 + a_3)}{2} \) and \( w = \frac{(a_3 - a_2)}{2} \) are the midpoint and width of the core \([a_2, a_3]\) respectively. Also \( \alpha = (a_2 - a_1) \) represents the left spread and \( \beta = (a_4 - a_3) \) represents the right spread of the trapezoidal fuzzy number \( \tilde{A} = (a_1, a_2, a_3, a_4) \). We use \( F(R) \) to denote the set of all trapezoidal fuzzy numbers defined on \( R \).

2.1 Ranking of Trapezoidal Fuzzy Numbers

An efficient approach for comparing the fuzzy numbers is by the use of a ranking function based on their graded means. That is, for every \( \tilde{A} = (a_1, a_2, a_3, a_4) \in F(R) \), we define the ranking function \( \mathcal{R} : F(R) \rightarrow R \) by its graded mean as

\[
\mathcal{R}(\tilde{A}) = \left[ \left( \frac{a_2 + a_3}{2} \right) + \left( \frac{\beta - \alpha}{4} \right) \right].
\]

For any two trapezoidal fuzzy numbers \( \tilde{A} = (a_1, a_2, a_3, a_4) \) and \( \tilde{B} = (b_1, b_2, b_3, b_4) \) in \( F(R) \), we have the following comparison:

1. \( \tilde{A} \succeq \tilde{B} \) if and only if \( \mathcal{R}(\tilde{A}) \geq \mathcal{R}(\tilde{B}) \)

2. \( \tilde{A} \preceq \tilde{B} \) if and only if \( \mathcal{R}(\tilde{A}) \leq \mathcal{R}(\tilde{B}) \)

3. \( \tilde{A} \approx \tilde{B} \) if and only if \( \mathcal{R}(\tilde{A}) = \mathcal{R}(\tilde{B}) \)

A trapezoidal fuzzy number \( \tilde{A} = (a_1, a_2, a_3, a_4) \in F(R) \) is said to be positive, if and only if \( \mathcal{R}(\tilde{A}) > 0 \) and is denoted by \( \tilde{A} \succ 0 \).

2.2 Arithmetic Operations on Trapezoidal Fuzzy Numbers

We define a new fuzzy arithmetic on trapezoidal fuzzy numbers based upon core (represented as midpoint and width), left spread and right spread. The midpoint is taken in the ordinary arithmetic, whereas the width, left and right spread are considered to follow the lattice rule which is least upper bound (greatest lower bound) in the lattice \( L \). That is for \( a, b \in L \), we define \( a \lor b = \max\{a, b\} \) and \( a \land b = \min\{a, b\} \).

For arbitrary trapezoidal fuzzy numbers \( \tilde{A} = (m(\tilde{a}), w(\tilde{a}), \alpha_1, \beta_1) \) and \( \tilde{B} = (m(\tilde{b}), w(\tilde{b}), \alpha_2, \beta_2) \) in \( F(R) \), we define

\[
\begin{align*}
\tilde{A} \lor \tilde{B} &= (m(\tilde{a} \lor \tilde{b}), w(\tilde{a} \lor \tilde{b}), \alpha_1, \beta_1) \\
\tilde{A} \land \tilde{B} &= (m(\tilde{a} \land \tilde{b}), w(\tilde{a} \land \tilde{b}), \alpha_2, \beta_2)
\end{align*}
\]
\((m(\tilde{b}), w(\tilde{b}), \alpha_2, \beta_2)\) and \(* = \{+, -, \times, \div\}\), the arithmetic operations on the trapezoidal fuzzy numbers are defined by,

\[
\tilde{A} \ast \tilde{B} = (m(\tilde{a}) \ast m(\tilde{b}), w(\tilde{a}) \lor w(\tilde{b}), \alpha_1 \lor \alpha_2, \beta_1 \lor \beta_2)
\]

\[
= (m(\tilde{a}) \ast m(\tilde{b}), \max\{w(\tilde{a}), w(\tilde{b})\}, \max\{\alpha_1, \alpha_2\}, \max\{\beta_1, \beta_2\})
\]

In particular for any two trapezoidal fuzzy numbers \(\tilde{A} = (m(\tilde{a}), w(\tilde{a}), \alpha_1, \beta_1)\) and \(\tilde{B} = (m(\tilde{b}), w(\tilde{b}), \alpha_2, \beta_2)\), we define:

(i) Addition \(\tilde{A} + \tilde{B} = (m(\tilde{a}) + m(\tilde{b}), w(\tilde{a}) + w(\tilde{b}), \alpha_1 + \alpha_2, \beta_1 + \beta_2)\)

\[
= (m(\tilde{a}) + m(\tilde{b}), \max\{w(\tilde{a}), w(\tilde{b})\}, \max\{\alpha_1, \alpha_2\}, \max\{\beta_1, \beta_2\})
\]

(ii) Subtraction \(\tilde{A} - \tilde{B} = (m(\tilde{a}) - m(\tilde{b}), w(\tilde{a}) - w(\tilde{b}), \alpha_1 - \alpha_2, \beta_1 - \beta_2)\)

\[
= (m(\tilde{a}) - m(\tilde{b}), \max\{w(\tilde{a}), w(\tilde{b})\}, \max\{\alpha_1, \alpha_2\}, \max\{\beta_1, \beta_2\})
\]

(iii) Multiplication \(\tilde{A} \times \tilde{B} = (m(\tilde{a}) \times m(\tilde{b}), w(\tilde{a}) \times w(\tilde{b}), \alpha_1 \times \alpha_2, \beta_1 \times \beta_2)\)

\[
= (m(\tilde{a}) \times m(\tilde{b}), \max\{w(\tilde{a}), w(\tilde{b})\}, \max\{\alpha_1, \alpha_2\}, \max\{\beta_1, \beta_2\})
\]

(iv) Division \(\tilde{A} \div \tilde{B} = (m(\tilde{a}) \div m(\tilde{b}), w(\tilde{a}) \div w(\tilde{b}), \alpha_1 \div \alpha_2, \beta_1 \div \beta_2)\)

\[
= (m(\tilde{a}) \div m(\tilde{b}), \max\{w(\tilde{a}), w(\tilde{b})\}, \max\{\alpha_1, \alpha_2\}, \max\{\beta_1, \beta_2\})
\]

3 Multi Objective Fuzzy Assignment Problem

An assignment problem with fuzzy parameters having multiple objectives is called a multi objective fuzzy assignment problem.

3.1 Mathematical Formulation of Multi Objective Fuzzy Assignment Problem

Consider a multi objective fuzzy assignment problem of assigning 'n' jobs (operations) to 'n' persons (operators) whose cost coefficients are trapezoidal fuzzy numbers. Let \(\tilde{c}_{ij}\) be the fuzzy assignment cost incurred in assigning the ith person to jth job.

The Mathematical model of Multi Objective Fuzzy Assignment Problem is as follows:
min $\tilde{z}^k(\tilde{x}) \approx \sum_{i=1}^{n} \sum_{j=1}^{n} \tilde{c}_{ij}^k \tilde{x}_{ij}, \ k = 1, 2, \ldots K$

subject to $\sum_{i=1}^{n} \tilde{x}_{ij} \approx \tilde{1}, \ j = 1, 2, \ldots n, \ (3.1)$

$\sum_{j=1}^{n} \tilde{x}_{ij} \approx \tilde{1}, \ i = 1, 2, \ldots n$

and $\tilde{x}_{ij} \in \{0, 1\}$

where $\tilde{x}_{ij} \approx \begin{cases} \tilde{1}, & \text{if ith person is assigned to jth job} \\ 0, & \text{otherwise} \end{cases}$

Let $\tilde{z}^k(\tilde{x}) \approx \{\tilde{z}^1(\tilde{x}), \tilde{z}^2(\tilde{x}), \ldots \tilde{z}^K(\tilde{x})\}$ is a vector of k objective functions. Since the objective functions conflict with each other, a complete fuzzy optimal solution doesn’t exist always, so a new solution concept called fuzzy compromise solution is obtained for multi objective fuzzy assignment problem. A Simple method would be to form a composite objective function as the weighted sum of the objectives, where a weight for an objective is proportional to the preference factor assigned to that particular objective.

### 3.2 Weighted sum (or) Scalarization method

The weighted sum method, minimizes a positively weighted convex sum of the objective, that is,

$$\min \tilde{z}_w^* = \sum_{k=1}^{K} w_k \tilde{Z}_k, \text{ where } \sum_{k=1}^{K} w_k = 1, \text{ and } w_k > 0. \quad (3.2)$$

The minimizer of this single objective function is an efficient solution for the original multi objective problem.

**Definition 3.1.** (Non-dominated solution). A feasible vector $\tilde{x}^0 \in S$ (S is the feasible region) yields a non-dominated solution of (3.1), if and only if, there is no other feasible vector $\tilde{x} \in S$, such that, $\sum_{i=1}^{m} \sum_{j=1}^{n} \tilde{c}_{ij}^k \tilde{x}_{ij} \preceq \sum_{i=1}^{m} \sum_{j=1}^{n} \tilde{c}_{ij}^k \tilde{x}_{ij}^0$, for all $k$ and $\sum_{i=1}^{m} \sum_{j=1}^{n} \tilde{c}_{ij}^k \tilde{x}_{ij} \prec \sum_{i=1}^{m} \sum_{j=1}^{n} \tilde{c}_{ij}^k \tilde{x}_{ij}^0$, for some $k$, $k = 1, 2, \ldots K$. 
Definition 3.2. (Efficient solution). A point $\tilde{x}^0 \in S$ efficient iff there does not exist another $\tilde{x} \in S$, such that $\sum_{i=1}^{m} \sum_{j=1}^{n} \tilde{c}_{ij} \tilde{x}_{ij} \preceq \sum_{i=1}^{m} \sum_{j=1}^{n} \tilde{c}_{ij} \tilde{x}_{ij}^0$, for all $k$ and $\sum_{i=1}^{m} \sum_{j=1}^{n} \tilde{c}_{ij} \tilde{x}_{ij} \not\preceq \sum_{i=1}^{m} \sum_{j=1}^{n} \tilde{c}_{ij} \tilde{x}_{ij}^0$, for some $k$.

Definition 3.3. (Compromise solution). A feasible vector $\tilde{x}^* \in S$ is called a compromise solution of (3.1) if and only if $\tilde{x}^* \in E$ and $\tilde{Z}(\tilde{x}^*) \land x \in S \tilde{Z}(\tilde{x})$, where $\land$ stands for "minimum" and $E$ is the set of efficient solutions.

4 Algorithm to solve Multi Objective Fuzzy Assignment Problem

Consider a multi objective fuzzy assignment problem involving trapezoidal fuzzy numbers.

**Step 1:** Solve the multi-objective fuzzy assignment problem as $k$ single objective fuzzy assignment problems by taking one objectives at a time.

**Step 2:** Let $x^{(1)}, x^{(2)}, \ldots, x^{(k)}$, are the optimal solutions of the $k$ different assignment problems. Evaluate each objective function at all these $k$ optimum solutions.

**Step 3:** Thus we have matrix of evaluation of objectives, $z_{ij} = z_j(x^i), (i = 1, 2, \ldots, n; j = 1, 2, \ldots, n)$, which depicts the lower and upper bound for each objective.

**Step 4:** Using weighted sum method, the problem is converted as a single objective weighted sum fuzzy assignment problem. According to the decision maker preference, for various weights, we will get different set of compromised solutions using LINGO software package, which lie between the lower and upper bounds. Thus, the solution of this single objective function is an efficient solution for the original multi objective problem.

5 Numerical Example

Consider the tri-objective fuzzy assignment problem with the three objectives cost, time and quality (ineffectiveness) represented by trapezoidal fuzzy number.
Table 5.1: Balanced Multi Objective Fuzzy Assignment problem

<table>
<thead>
<tr>
<th>TASK-A</th>
<th>TASK-B</th>
<th>TASK-C</th>
<th>TASK-D</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP-1</td>
<td>[4, 6, 7, 9]</td>
<td>[5, 7, 10]</td>
<td>[6, 7, 10, 12]</td>
</tr>
<tr>
<td></td>
<td>[7, 9, 11, 13]</td>
<td>[6, 9, 10, 12]</td>
<td>[9, 10, 11, 13]</td>
</tr>
<tr>
<td></td>
<td>[0.15, 0.16]</td>
<td>[0.10, 0.11]</td>
<td>[0.14, 0.16]</td>
</tr>
</tbody>
</table>

| TASK-B | [2, 3, 5, 7] | [5, 7, 8, 11] | [6, 7, 10, 12] | [4, 7, 9, 11] |
|        | [9, 12, 14, 17] | [7, 8, 10, 11] | [6, 8, 12, 13] | [6, 8, 12, 13] |
|        | [0.09, 0.12] | [0.14, 0.16] | [0.20, 0.21] | [0.15, 0.18] |

| TASK-C | [3, 4, 5, 7] | [4, 5, 7, 9] | [6, 7, 8, 11] | [3, 4, 6, 7] |
|        | [0.18, 0.20, 0.21] | [0.13, 0.15, 0.17] | [0.20, 0.22] | [0.15, 0.16, 0.18] |
|        | [0.22, 0.24] | [0.17, 0.19] | [0.24, 0.27] | [0.18, 0.20] |

| TASK-D | [5, 7, 10, 12] | [4, 6, 8, 10] | [4, 5, 7, 8] | [5, 9, 11, 15] |
|        | [0.15, 0.18] | [0.19, 0.21] | [0.12, 0.13] | [0.10, 0.14] |
|        | [0.20, 0.22] | [0.23, 0.25] | [0.14, 0.15] | [0.16, 0.18] |

Table 5.2: Fuzzy Assignment Problem with first Objective in terms of parametric form

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>R=6.5</td>
<td>[6.5, 0.5, 2.2]</td>
<td>[6.1, 2.3]</td>
<td>[5, 1, 1, 3]</td>
</tr>
<tr>
<td></td>
<td>R=6.25</td>
<td>R=8.75</td>
<td>R=5.5</td>
</tr>
<tr>
<td>R=4.25</td>
<td>R=7.25</td>
<td>R=7</td>
<td>R=7.5</td>
</tr>
<tr>
<td></td>
<td>R=9</td>
<td>[9.5, 2.5, 2.2]</td>
<td>[8, 1, 1, 1]</td>
</tr>
<tr>
<td>R=9</td>
<td>R=9.5</td>
<td>R=8</td>
<td>R=6.25</td>
</tr>
<tr>
<td>[8, 5, 1, 5, 4, 2]</td>
<td>[5]</td>
<td>[10, 5, 0.5, 3, 2]</td>
<td>[8, 5, 1, 5, 2, 4]</td>
</tr>
<tr>
<td>R=8</td>
<td>R=8.75</td>
<td>R=10.25</td>
<td>R=9</td>
</tr>
</tbody>
</table>

Using ranking function, row wise choose the least element and subtract the least element of each row from other elements of the corresponding row using the fuzzy arithmetic operations. After then, repeat the above procedure for each column.

Table 5.3: Optimum Assignment of First Objective Fuzzy Assignment Problem

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP-1</td>
<td>[5, 1, 5, 3, 2]</td>
<td>[1, 1, 5, 3, 3]</td>
<td>[1, 5, 1, 5, 3, 3]</td>
</tr>
<tr>
<td>FP-2</td>
<td>[0, 1, 1, 2, 2]</td>
<td>[3, 5, 1, 5, 4, 3]</td>
<td>[0.5, 1, 5, 4, 3]</td>
</tr>
<tr>
<td>FP-3</td>
<td>[3, 1, 2, 2]</td>
<td>[3, 5, 2, 5, 4, 2]</td>
<td>[0, 1, 5, 4, 2]</td>
</tr>
<tr>
<td>FP-4</td>
<td>[0, 1, 5, 4, 2]</td>
<td>[0, 1, 5, 4, 2]</td>
<td>[0, 1, 5, 4, 2]</td>
</tr>
</tbody>
</table>

Each row and column has one and only one marked zero. Hence optimum allocation is attained. Therefore, the optimum assignment schedule is $1 \rightarrow D, 2 \rightarrow A, 3 \rightarrow C, 4 \rightarrow B$ Hence, minimum total cost is $[5, 1, 1, 3] + [4, 1, 1, 2] + [8, 1, 1, 1] + [8, 5, 1, 5, 1, 2] = [25.5, 1.5, 1, 3] = (m, w, \alpha, \beta)$ Also minimum total cost in terms of trapezoidal fuzzy number, $[a_1, a_2, a_3, a_4] = [23, 24, 27, 30]$. Similarly, applying the proposed algorithm for the second objective fuzzy assignment problem, we get the following optimum allocation table.

Table 5.4: Optimum Assignment of Second Objective Fuzzy Assignment Problem

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP-1</td>
<td>[0, 5, 0.5, 3, 2]</td>
<td>[0, 5, 0.5, 3, 2]</td>
<td>[0, 1, 1, 3]</td>
</tr>
<tr>
<td>FP-2</td>
<td>[0, 1, 5, 1, 2]</td>
<td>[4, 5, 1, 5, 3, 3]</td>
<td>[0.5, 1, 5, 1, 2]</td>
</tr>
<tr>
<td>FP-3</td>
<td>[0, 1, 5, 1, 2]</td>
<td>[1, 5, 1, 3, 2]</td>
<td>[0, 1, 1, 3]</td>
</tr>
<tr>
<td>FP-4</td>
<td>[1, 1, 5, 2, 2]</td>
<td>[1, 5, 1, 3, 2]</td>
<td>[0, 1, 1, 1]</td>
</tr>
</tbody>
</table>
Therefore optimum assignment is 1 → B, 2 → A, 3 → D, 4 → C. Thus, minimum total time is 
\[ [29, 1.5, 3, 2] = (m, w, \alpha, \beta) \]. Also minimum total time in terms of trapezoidal fuzzy number 
\[ [a_1, a_2, a_3, a_4] = [24.5, 27.5, 30.5, 32.5] \].

Similarly for the third objective, the following optimum allocation is attained.

**Table 5.5: Optimum Assignment of Third Objective Fuzzy Assignment Problem**

<table>
<thead>
<tr>
<th></th>
<th>(0.05, 0.01)</th>
<th>(0.03, 0.02)</th>
<th>(0.01, 0.02)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0.015, 0.015)</td>
<td>(0.035, 0.015)</td>
<td>(0.075, 0.015)</td>
</tr>
<tr>
<td></td>
<td>(0.03, 0.03)</td>
<td>(0.04, 0.03)</td>
<td>(0.08, 0.03)</td>
</tr>
<tr>
<td></td>
<td>(0.02, 0.02)</td>
<td>(0.02, 0.02)</td>
<td>(0.02, 0.02)</td>
</tr>
</tbody>
</table>

Therefore optimum assignment is 1 → D, 2 → A, 3 → B, 4 → C. Thus, minimum total quality (ineffectiveness) is 
\[ [0.515, 0.545, 0.575, 0.605] = (m, w, \alpha, \beta) \]. Also minimum total quality (ineffectiveness) in terms of 
trapezoidal fuzzy number \[ [a_1, a_2, a_3, a_4] = [0.465, 0.495, 0.525, 0.555] \].

Using scalarization method the multi objective fuzzy assignment problem (3.1) is rewritten as single objective weighted 
sum fuzzy assignment problem (3.2), subject to same constraints.

i.e., Minimize \( \bar{Z}^*_w(\bar{x}) \approx w_1\bar{Z}_1(\bar{x}) + w_2\bar{Z}_2(\bar{x}) + w_3\bar{Z}_3(\bar{x}) \).

According to the decision marker preference, for various weights, we will get different set of compromised solutions for the single objective weighted sum fuzzy assignment problem, which is solved by using LINGO software package and the results are displayed in the following table.

**Table 5.6: Weighted fuzzy objective values for the fuzzy compromise solution with various weights**

<table>
<thead>
<tr>
<th>(w_1)</th>
<th>(w_2)</th>
<th>(w_3)</th>
<th>Compromise Solution</th>
<th>Optimal Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>0.3</td>
<td>0.5</td>
<td></td>
<td>1 → B, 2 → A, 3 → D, 4 → C</td>
</tr>
<tr>
<td>0.1</td>
<td>0.2</td>
<td>0.7</td>
<td>(x_{12} = x_{21} = x_{34} = x_{43} = 1, x_{12} = 0) otherwise</td>
<td>1 → B, 2 → A, 3 → D, 4 → C</td>
</tr>
<tr>
<td>0.1</td>
<td>0.1</td>
<td>0.8</td>
<td>(x_{12} = x_{21} = x_{34} = x_{43} = 1, x_{12} = 0) otherwise</td>
<td>1 → B, 2 → A, 3 → D, 4 → C</td>
</tr>
<tr>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>(x_{12} = x_{21} = x_{34} = x_{43} = 1, x_{12} = 0) otherwise</td>
<td>1 → B, 2 → A, 3 → D, 4 → C</td>
</tr>
</tbody>
</table>

**Table 5.7: Objective values of the compromise solution**

<table>
<thead>
<tr>
<th>Objective Values</th>
<th>(z_1(\bar{x}))</th>
<th>(z_2(\bar{x}))</th>
<th>(z_3(\bar{x}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>([22.5, 27.5, 30.5])</td>
<td>([24.5, 27.5, 30.5, 32.5])</td>
<td>([0.515, 0.545, 0.575, 0.605])</td>
</tr>
<tr>
<td></td>
<td>([22.5, 27.5, 30.5])</td>
<td>([24.5, 27.5, 30.5, 32.5])</td>
<td>([0.515, 0.545, 0.575, 0.605])</td>
</tr>
<tr>
<td></td>
<td>([22.5, 27.5, 30.5])</td>
<td>([24.5, 27.5, 30.5, 32.5])</td>
<td>([0.515, 0.545, 0.575, 0.605])</td>
</tr>
<tr>
<td></td>
<td>([22.5, 27.5, 30.5])</td>
<td>([24.5, 27.5, 30.5, 32.5])</td>
<td>([0.515, 0.545, 0.575, 0.605])</td>
</tr>
</tbody>
</table>
6 Conclusion

In this paper we studied a new and simple methodology to obtain the compromise solution to a multi objective fuzzy assignment problem with trapezoidal fuzzy numbers. The proposed algorithm provides various fuzzy objective values for the optimal compromise solutions. Further, the minimum fuzzy objective values obtained by the proposed algorithm is better than the existing methods. The decision maker can select the appropriate fuzzy compromise solution according to his satisfaction level. Also this method is providing more alternatives for the decision maker to select the preferred solution.

References
