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A NOTE ON "MULTIATTRIBUTE DECISION MAKING BASED ON INTERVAL-VALUED INTUITIONISTIC FUZZY VALUES AND LINEAR PROGRAMMING METHODOLOGY"

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ABSTRACT

Chen and Huang (Inf. Sci. 381 (2017) 341-351) proposed a linear programming method for solving such MADM (multiattribute decision making) problems in which the weights of attributes and the evaluating values of the attributes of the alternatives are represented by interval-valued intuitionistic fuzzy values. After a deep study of this method, it is noticed that there exist several same types of MADM problems which cannot be solved with Chen and Huang method. To solve these type of MADM problems is a challenging research problem. Therefore, the aim of this note is to make the researchers aware of this open challenging research problem.

Keywords: *Intuitionistic fuzzy sets, Interval-valued intuitionistic fuzzy sets, Interval-valued Intuitionistic fuzzy values, Linear programming methodology, Multiattribute decision making.*

1. INTRODUCTION

Chen and Huang [2, Section 3, pp. 343] chosen some MADM problems in the interval-valued intuitionistic fuzzy environment [2, Example 4.2, pp. 345; Example 4.3, pp. 348] to point out the drawbacks of existing methods [1,3,4]. To resolve these drawbacks, Chen and Huang [2, Section 3, pp. 343] proposed a new method for solving MADM problems in the interval-valued intuitionistic fuzzy environment. In this note, it is shown that there exist several MADM problems in the interval-valued intuitionistic fuzzy environment which cannot be solved by Chen and Huang method [2, Section 3, pp. 343]. Since to find the solution of those MADM problems which cannot be solved by Chen and Huang method [2, Section 3, pp. 343] is a challenging research problem. Therefore, the main aim of this note is to make the researchers aware of this open challenging research problem.

2. NON-APPLICABILITY OF CHEN AND HUANG METHOD

In this section, it is shown that there exist several MADM problems in an interval-valued intuitionistic fuzzy environment which cannot be solved by Chen and Huang method [2, Section 3, pp. 343].

In Chen and Huang method [2, Section 3, pp. 343], an interval-valued intuitionistic fuzzy value $([h_j, y_j], [z_j, g_j])$, $0 \le h_j \le y_j \le 1$, $0 \le z_j \le g_j \le 1$, $0 \le y_j + g_j \le 1$ and $1 \le j \le n$ is used to represent the weight w_j of attribute A_j. Furthermore, this weight is used to find the range of the variable w_j^* of the linear programming problem (P1) [2, Section 3, pp. 343].

$$\text{Maximize } S = \sum_{i=1}^{m} \sum_{j=1}^{n} \left(w_j^* . m_{ij}\right)$$

$$\text{s.t.} \begin{cases} h_j \le w_j^* \le 1 - z_j, \\ \sum_{j=1}^{n} w_j^* = 1, \\ 0 \le w_j^* \le 1, \\ 1 \le j \le n. \end{cases} \quad \text{(P1)}$$

It is pertinent to mention that if the value of the objective function of linear programming problem (P1) will be a real number then there will exist infinite number of optimal values of w_j^*. Since, the ranking of the alternatives depends upon the value of w_j^*. Therefore, for different values of w_j^* different ranking of alternatives will be obtained. Hence, all such MADM problems in interval-valued intuitionistic fuzzy environment for which the objective function of linear programming problem (P1) will be a real number, cannot be solved by Chen and Huang method [2, Section 3, pp. 343].

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For example, it can be easily verified that if in the existing MADM problem [2, Example 4.1, pp. 344] the existing decision

matrix $\widetilde{M} = \left(\widetilde{m}_{ij}\right)_{4\times3} = \begin{pmatrix} ([0.40,0.50],[0.30,0.40]), ([0.40,0.60],[0.20,0.40]), ([0.10,0.30],[0.50,0.60]) \\ ([0.60,0.70],[0.20,0.30]), ([0.60,0.70],[0.20,0.30]), ([0.40,0.70],[0.10,0.20]) \\ ([0.30,0.60],[0.30,0.40]), ([0.50,0.60],[0.30,0.40]), ([0.50,0.60],[0.10,0.30]) \\ ([0.70,0.80],[0.10,0.20]), ([0.60,0.70],[0.10,0.30]), ([0.30,0.40],[0.10,0.20]) \end{pmatrix}$ is

replaced with the decision matrix

$$\widetilde{M} = \left(\widetilde{m}_{ij}\right)_{4\times3} = \begin{pmatrix} ([0.10,0.20],[0.30,0.40]), ([0.20,0.30],[0.40,0.50]), ([0.00,0.10],[0.20,0.30]) \\ ([0.15,0.20],[0.05,0.10]), ([0.25,0.30],[0.15,0.20]), ([0.35,0.40],[0.25,0.30]) \\ ([0.30,0.60],[0.20,0.40]), ([0.20,0.50],[0.10,0.30]), ([0.40,0.70],[0.20,0.30]) \\ ([0.00,0.10],[0.10,0.20]), ([0.10,0.30],[0.20,0.30]), ([0.10,0.20],[0.30,0.50]) \end{pmatrix}.$$

Then, the value of an objective function of linear programming problem (P1) will be zero. Therefore, there will exist infinite number of optimal values of w_j^*. Now, let out of these infinite optimal values of w_j^* the following two optimal values of w_j^* are considered.

(i) $w_1^* = \frac{1}{3}$, $w_2^* = \frac{1}{3}$ and $w_3^* = \frac{1}{3}$.
(ii) $w_1^* = 0.10$, $w_2^* = 0.20$ and $w_3^* = 0.70$.

It can be easily verified that on considering the optimal solution $w_1^* = \frac{1}{3}$, $w_2^* = \frac{1}{3}$ and $w_3^* = \frac{1}{3}$, the obtained ranking of the alternatives is $E_2 > E_3 > E_4 > E_1$. While, on considering the optimal solution $w_1^* = 0.10$, $w_2^* = 0.20$ and $w_3^* = 0.70$, the obtained ranking of the alternatives is $E_2 > E_3 > E_1 > E_4$.

It is obvious that on applying the [2, Section 3, pp. 343], two different rankings of alternatives is obtained for the same MADM problem, which is mathematically incorrect.

3. CONCLUSION

It is shown that there exist MADM problems in an interval-valued intuitionistic fuzzy environment which cannot be solved by Chen and Huang method [2, Section 3, pp. 343]. Furthermore, it is pointed out that to develop a method for solving these types of MADM problems is still an open challenging research problem.

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