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# MODIFIED METHOD FOR SOLVING BALANCED FUZZY TRANSPORTATION PROBLEM FOR MAXIMIZING THE PROFIT 

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#### Abstract

The most important aim of Fuzzy transportation is toward locate the utmost income price of various produce from side to side a capacitated set of connections, at what time the bring in as well as command of nodes in adding together in the direction of the capacity and charge of limits be represented when fuzzy numbers. In this article we be presenting a fresh classification used for sentence the utmost profit price used for fuzzy transportation difficulty with Using Yager's Ranking Method anywhere fuzzy quantities be changed inside toward brittle quantities. We contain prearranged a arithmetical design toward check the validity of the scheme.


Key Words : Fuzzy objective transport problem, Triangular fuzzy numeral (TFNs), Yager's ranking method, Income maximization.

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## 1. Introduction

Carrying models make available a controlling structure to get together the confront of how to bring in the possessions to the patrons in additional competent behavior. They make certain the well-organized association and appropriate accessibility of rare equipment in addition to over and done with goods. In 1941, Hitchcock [6] originally developed the basic moving problem. In 1953, Charnes et al [3] residential the step stone technique which provided an substitute method of shaping the simplex method in order. In 1963, Dantzig [4] used the simplex method in the direction of the carrying problems as the primal simplex carrying method. Till date, several researchers calculated comprehensively to work out charge minimize moving difficulty in different ways. In real world applications, all the parameters of the carrying problems may not be known precisely due to irrepressible factors. This type of imprecise data is not always well represented by random variable selected from a probability allocation. Fuzzy numbers introduce by Zadeh in 1965. Zimmermann [13] show so as to solution obtained by fuzzy linear encoding are at all times well-organized.

A unclear carrying problem is a carrying problem in which the transportation cost, supply and demand quantities are unclear quantities. The objective of the unclear carrying problem is to agree on the delivery program that minimizes the entirety unclear carrying cost while fulfilling unclear provide and command confines. In this paper the objective is to maximize the entirety earnings, area under discussion to some unclear constraint, the objective function is also careful as a unclear number.
First, we transform the unclear quantities as the cost, coefficients, supply and demands, into crisp quantities by Yager's ranking method which satisfies the properties of compensation, linearity and additivity, and then by using the classical algorithms, obtain the solution of the problem. This method is a systematic procedure, easy to apply and can be utilized for all types of transportation problems.

## 2. Basic Definitions

Definition 1: (unclear set) A unclear set of a base set $A$ is exacting with its membership function $\mu$, where $\mu: A \rightarrow[0,1]$ passing on to each $x$ in $A$ the level or grade to which $x \in A$.

Definition 2: (Triangular unclear Numbers) The unclear number $a=a_{1}, a_{2}, a_{3}$ is a
triangular unclear numbers, denoted by $a_{1,2}, a_{3}$ its membership function $\mu_{a}$.
Definition 3: (Operations of TFNs) Let $a=\left[a_{1}, a_{2}, a_{3}\right]$ and $b=\left[b_{1}, b_{2}, b_{3}\right]$ be two triangular unclear numbers then the arithmetic operations on $a$ and $b$ as follows.
Addition : $a+b=\left(a_{1}+b_{1}, a_{2}+b_{2}, a_{3}+b_{3}\right)$
Subtraction : $a-b=\left(a_{1}-b_{1}, a_{2}-b_{2}, a_{3}-b_{3}\right)$.


Multiplication :

$$
\begin{aligned}
& a \cdot b=\frac{a_{1}}{3}\left(b_{1}+b_{2}+b_{3}\right), \quad \frac{a_{2}}{3}\left(b_{1}+b_{2}+b_{3}\right), \quad \frac{a_{3}}{3}\left(b_{1}+b_{2}+b_{3}\right), \quad \text { if } R(a)>0, \\
& a \cdot b=\frac{a_{3}}{3}\left(b_{1}+b_{2}+b_{3}\right), \quad \frac{a_{2}}{3}\left(b_{1}+b_{2}+b_{3}\right), \quad \frac{a_{1}}{3}\left(b_{1}+b_{2}+b_{3}\right), \quad \text { if } R(a)<0 .
\end{aligned}
$$

Definition 4: (Defuzzification) Defuzzification be the method of sentence singleton value (crisp value) which represents the average value of the TFNs. Here use Yager's ranking to defuzzify the TFNs because of its straightforwardness and accuracy.
Definition 5 : (Yager's Ranking Technique) Yager's ranking method [6] which satisfy compensation, linearity, additivity properties and provides results which consists of human intuitions ( R ) represents the set of all TFNs.
It $R$ be any ranking function, then,

$$
F(R)=\int_{0}^{1}(0.5)\left(a_{\alpha}^{L}, a_{\alpha}^{U}\right) d \alpha
$$

where $\left(a_{\alpha}^{L}, a_{\alpha}^{U}\right)=\{(b-1) \alpha+a, c-(c-b) \alpha\}$.
Definition 6: (unclear balanced carrying problem) The unbiased unclear carrying problem, in which a choice manufacturer is vague about the precise values of carrying cost, accessibility and command, may be prepare as LPP as follows

$$
\text { Minimize } \sum_{i=1}^{p} \sum_{j=1}^{q} c_{i j} * x_{i j}
$$

subject to

$$
\begin{aligned}
\sum_{j=1}^{q} x_{i j} & =a_{i}, \quad i=1,2, \cdots, p \\
\sum_{i=1}^{p} x_{i j} & =b_{j}, \quad j=1,2, \cdots, q \\
\sum_{i=1}^{p} a_{i} & =\sum_{j=1}^{q} b_{j}
\end{aligned}
$$

Here $x_{i j}$ is a non- negative trapezoidal fuzzy number, where

$$
\begin{aligned}
& p \quad=\text { entirety number of sources } \\
& q \quad=\text { entirety number of destinations } \\
& a_{i} \quad=\text { the unclear accessibility of the product at } i \text {-th basis } \\
& b_{j} \quad=\text { the unclear demand of the product at } j \text {-th end } \\
& c_{i j} \quad=\text { the unclear transportation price for unit measure } \\
& \text { of the product from } i \text {-th source to } j \text {-th end } \\
& x_{i j} \quad=\text { the unclear extent of the creation that be made-up to be } \\
& \text { transported beginning } i \text {-th basis to } j \text {-th end to } \\
& \text { Minimize the total unclear transportation cost } \\
& \sum_{i=1}^{p} a_{i} \quad=\text { total unclear accessibility of the product, } \\
& \sum_{j=1}^{q} b_{j} \quad=\text { total unclear demand of the creation } \\
& \sum_{i=1}^{p} a_{i} a_{i} \sum_{j=1}^{q} c_{i j} * x_{i j}=\text { total fuzzy transportation cost. }
\end{aligned}
$$

In LPP minimize $(Z)=-$ maximize $(-Z)$, i.e. to maximize the profit is equal to minimize the cost. If $\sum_{i=1}^{p} a_{i}=\sum_{j=1}^{q} b_{j}$, then the unclear carrying problem is said to be unbiased unclear carrying problem, otherwise it is called unbalanced unclear carrying problem. Consider transportation with m unclear origins (rows) and n unclear destinations (Columns). Let $C_{i j}=\left[C_{i}^{(1)}, C_{i j}^{(2)}, C_{i j}^{(3)}\right]$ be the cost of carrying one unit of the creation from ith unclear origin to $j$-th fuzzy destination, $a_{i}=\left[a_{i}^{(1)}, a_{i}^{(2)}{ }_{,}{ }_{i}^{(3)}\right]$ be the quantity of commodity available at unclear origin $i$ and $b_{i}=\left[b_{i}^{(1)}, b_{i}^{(2)}, b_{i}^{(3)}\right]$ be the quantity of commodity requirement at unclear destination $j . X_{i j}=\left[X_{i j}^{(1)}, X_{i j}^{(2)}, X_{i j}^{(3)}\right]$ is quantity transported from ith unclear origin to $j$-th unclear objective.

## 3. Algorithm for Vogel Approximation Method

Step 1: Find the crusty charge of the known unclear carrying problem by means of Yager's Ranking.

Step 2: Stability the given unclear carrying complexity if furthermore (total Supply $>$ total demand) or (total supply $<$ total require).

Step 3: Transform the settled maximization complexity into a minimization difficulty by multiplying the cost basics by -1 . The modified minimization complexity be able to be solved by following the exceptional steps.
Step 4 : Institute the sentence accuse for every one row and column by subtracting the lowest cell charge in the row or article from the subsequent to that lowest cell cost in the similar row or column.
Step 5: Wish the row or column among the maximum sentence cost (breaking ties arbitrarily or choosing the lowest-cost cell).
Step 6 : Allocate as much as possible to the feasible cell with the lowest transportation charge in the row or column with the maximum penalty cost.
Step 7 : Repeat steps 2, 3 and 4 awaiting all supplies have been meet. Step 8: calculate total carrying cost for the possible allocations.

## 4. Numerical Example

Consider the unclear carrying problem for maximizing the profit. A firm owns facilities at seven places. It has developed undergrowth at spaces A, B and C with daily creation of $(13,23,33),(34,44,54),(23,33,43)$ units respectively. At point D, E, F and G it has four warehouses with daily demands of $(13,23,33),(21,31,41)(6,16,26)$ and $(20$, $30,40)$ units respectively. Per unit shipping costs are given in the following table. Find the maximum profit of the firm?

Since the given problem is a maximization type, first change this into a minimization problem by multiplying the cost fundamentals by -1 . The customized minimization problem can be solved in the standard approach.
Since $\sum_{i=1}^{p} a_{i}=\sum_{j=1}^{q} b_{j}=100$ there exist a basic feasible solution to this problem and is display in the following table by using VAM.

## Wholesaler

| Plant | 1 | 1 | 2 | 3 | 4 | 5 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | (.02, .05, .07) | (.05, .07, .09) | .08, .10. .12) | (.13, . $15, .15$ ) | (.13, .15,.12) |
|  | 2 | (.06, . $08, .10$ ) | (.04, .06, .08) | (.07, .09, .11) | (.10, .12. .14) | (.12, .14, .16) |
|  | 3 | (.08, .10, .12) | (.07, .09, .11) | (.06, . $08, .10$ ) | (.08, .10, .12) | $(.13, .15, .17)$ |

Solution : Since the total capacity of the plant is more than the supply to the wholesalers, the given problem is an unbalanced transportation problem. We introduce a dummy wholesaler and assign him a quantity $27,500-25,000(=2,500)$ units. All the transportation costs from the plants to this destination are assumed to be zero. Now, since the direct costs of production of each unit are given as Re. 1. Re. 0.90 and Re. 0.80 at plants 1,2 and 3 respectively, we get the following modified balanced transportation problem:

## Wholesalers

| Plant | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 5,000 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 1.05 | 1.07 | 1.10 | 1.15 | 1.15 | 0 |  |
|  | 2 | 0.98 | 0.96 | 0.99 | 1.02 | 1.04 | 0 | 10,000 |
|  | 3 | 0.90 | 0.89 | 0.88 | 0.90 | 0.95 | 0 | 12,500 |

Using Vogel's Approximation Method for initial basic feasible solution and MODI method for optimum solution, we get optimum solution in table. 15.89:


Hence, the optimum allocation is given by
$x_{11}=2,500, x_{21}=500, x_{22}=3,000, x_{23}=2,500, x_{25}=4,000, x_{33}=7,500$ and $x_{34}=5,000$.

The transportation cost involved in this route is
$2,500 \times 1.05+500 \times 0.98+3,000 \times 0.96+2,500 \times 0.99+4,000 \times 1.04+7,500 \times 0.88+5,000 \times 0.90$.
i.e., Rs. 23,730.

We are given that the total units to be supplied to all the five wholesalers are 25,000 and also that these units are supplied to the wholesalers at a fixed price of rs. 250 per unit. Therefore, the total cost involved in the transportation of all these units is Rs. $25,000 \times$ 2.50 or Rs. 62,500 .

Hence, the maximum profit to the manufacturer is given by

$$
\text { Rs.62, } 500-\left(\text { Rs. } 23,730+R s .27,000^{*}\right)=R s .11,770 . .
$$

* The fixed cost of production for the three plants is $5,000+10,000+12,000=$ Rs.27, 000 .


## 5. Conclusion

In this paper, the carrying costs are considered as inexact numbers by fuzzy numbers which are more practical and general in nature. More over fuzzy transportation problem of triangular numbers has been transformed into crisp transportation problem using Yagers ranking indices. Numerical examples show that by this method we can have the
fuzzy optimal solution (maximum profit). This technique can also be used for solving profit maximization of balanced Fuzzy Assignment problems.

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