International Journal of Applied and Advanced Scientific Research (IJAASR)
Impact Factor: 5.655, ISSN (Online): 2456 - 3080
(www.dvpublication.com) Volume 3, Issue 2, 2018

CUSTOMIZED BESPOKE VOGEL'S ESTIMATION METHOD FOR FUZZY TRANSPORTATION PROBLEMS

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Cite This Article: N. Rajakumari & S. Bhuvaneswari, "Customized Bespoke Vogel's Estimation Method for Fuzzy Transportation Problems", International Journal of Applied and Advanced Scientific Research, Volume 3, Issue 2, Page Number 5-7, 2018.

Abstract:

The new-fangled algorithm named, customized bespoke Vogel's Estimation Method (CVEM) is proposed for solving fuzzy transportation problem. This algorithm is more proficient than other existing algorithms. The procedure for the solution is illustrated with a numerical example. Further, comparative study among the new algorithm and the other existing algorithms is established by means of sample problem. The method has simple algorithms for computed and the study is checked with numerical examples.

Introduction:

The transportation problem is one of the foremost applications of linear Programming problems. The concept of fuzzy set was first introduced and investigated by Zadeh [9] and fuzzy numbers and arithmetic operations with these numbers introduced by Bellman & Zadeh and Kaufmann in [2]. In [3] Nagoor Ganiet al solving transportation problem using fuzzy number and in [4] Nagoor Ganiet al solved the transshipment problem in fuzzy environment. The basic transportation problem was formerly developed by Hitchcock [3]. Well-organized methods of solution derived from the simplex algorithm were developed in 1947, primarily by Dantzig [4] and then by Charnes and Cooper [5]. The Transportation problem can be modeled as a standard linear programming problem that can be solved by the simplex method.

There are several papers [17–22] in which generalized fuzzy numbers are used for solving real life problems but to the best of our knowledge, till now no one has used generalized fuzzy numbers for solving transportation problems. Transportation problems are generally concerned with the distribution of certain product from several sources to numerous locations at minimum cost. The parameters of the transportation problem are not always exactly known and stable. We can get an initial basic viable solution for the transportation problem by using the North-West corner rule, Row Minima, Column Minima or the Vogel's Estimation Method. To get an best possible solution for the transportation problem, we use the MODI method (Modified Distribution Method). Charnes and Cooper [1] developed the Stepping Stone Method, which provides an alternative way of determining the finest solution.

The LINDO (Linear Interactive and Discrete Optimization) package handles the transportation problem in unequivocal equation form and thus solves the problem as a typical linear programming problem. Consider m origins (or sources) Oi (i = 1,....,m)and n destinations Dj (j = 1,...,n). At each origin Oi, let ai be the amount of a standardized product which we want to transport to n destinations Dj, in order to gratify the demand for bj units of the product there. A penalty cij is associated with transport in a unit of the product from source i to destination j. The penalty could symbolize transportation cost, deliverance time, quantity of goods delivered, used capacity, etc.

A variable xij represents the indefinite quantity to be transported from origin Oi to destination Dj. The transportation problem can be represented as a single objective transportation problem or as a multi-objective transportation problem. Fuzzy transportation problem (FTP)[5] is the problem of minimizing fuzzy valued objective functions with fuzzy source and fuzzy destination parameters. The balanced condition is both a necessary and sufficient condition for the existence of a viable solution to the transportation problem. Shan Huo Chen [12] introduced the concept of function principle, which is used to calculate the fuzzy transportation cost. The Graded Mean Integration Representation Method, used to defuzzify the fuzzy transportation cost, was also introduced by Shan Huo Chen [11]. In this paper, we propose an algorithm namely, modified Vogel's Estimation Method is proposed for solving fuzzy transportation problems that is more efficient than other existing algorithms, as it requires least iterations to reach optimality. The procedure for the solution is illustrated with a numerical example.

2. Preliminaries:

Consider m origins (or sources) Oi (i = 1,...,m) and n destinations Dj (j = 1,...,n). At each origin Oi, let ai be the amount of a homogeneous product that we want to transport to n destinations Dj, in order to satisfy the demand for bj units of the product there. A penalty cij is associated with transportation of a unit of the product from source i to destination j. The penalty could represent transportation cost, delivery time, quantity of goods delivered under-used capacity, etc. A variable xij represents the unknown quantity to be transported from origin

Oi to destination Dj. However, in the real world, all transportation problems are not single objective linear programming problems.

$$\text{Minimize } Z = \sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij}$$

subject to

$$\sum_{j=1}^{n} x_{ij} = b_i \text{ , i} = 1,2,....,\text{m}$$

$$\sum_{i=1}^{m} x_{ij} = a_j \text{ , } j = 1,2,....,\text{n}$$

$$x_{ij} \geq 0, \; i = 1,2,......m, \; j = 1,2,......\text{n}$$

And $\sum_{i=1}^{m} a_i = \sum_{j=1}^{m} b_j$, (balanced condition). The balanced condition is both a necessary and ample condition for the existence of a viable solution to the transportation problems. We need the following definition, which can be found in [2, 5].

2.1 Definition:

A fuzzy number $\tilde{a}$ is a Triangular-Fuzzy number denoted by (a_1, a_2, a_3) and It's membership function $\mu_{\tilde{a}}$ (a) is given below

$$\mu_{\tilde{a}}(x) = \begin{cases} \dfrac{x-a}{a_2 - a_1} & a_1 \leq x \leq a_2, \\ \dfrac{x-a_3}{a_2 - a_3} & a_2 \leq x \leq a_3, \\ 0 & otherwise. \end{cases}$$

Consider the following fuzzy transportation problem (FTP),

(FTP) Minimize: Z =ΣΣ $\tilde{C}_{ij}$ $\tilde{X}_{ij}$

$$\sum_{j=1}^{n} \tilde{x}_{ij} \leq \tilde{a}_i \quad \text{for i = 1,2,…..,m}$$

$$\sum_{i=1}^{m} \tilde{x}_{ij} \leq \tilde{b}_i \quad \text{for j = 1,2,…..,n}$$

$$\tilde{x}_{ij} \geq 0 \quad \text{for i = 1, 2,….., m and j = 1,2,…..,n}$$

Where $\tilde{a}_i$ = (a_1, a_2, a_3), $\tilde{b}_j = (b_1, b_2, b_3)$, $\tilde{C}_{ij} = (C_{ij}, C_{ij} C_{ij})$ representing the Uncertain supply and demand for the transportation problems.

3. Customized Bespoke Vogel's Estimation Method:

CVEM was improved by using total opportunity cost (TOC) matrix by considering substitute allotment costs. The TOC matrix is obtained by adding the "row opportunity cost matrix" (row opportunity cost matrix: for each row, the smallest cost of that row is subtracted from each element of the same row) and the "column opportunity cost matrix" (column opportunity cost matrix: for each column of the original transportation cost matrix the smallest cost of that column is subtracted from each element of the same column) [5]. Proposed algorithm is applied to the TOC matrix that considers highest three penalty costs and calculates alternative allocation costs in the VAM procedure. It then selects the minimum among them. Detailed processes are given below:

Step 1: Balance the given transportation problem if either (total supply>total demand) or (total supply<total demand).

Step 2: Obtain the TOC matrix.

Step 3: Determine the sentence cost for each row and column by subtracting the lowest cell cost in the row or column from the next lowest cell cost in the same row or column.

Step 4: Select the rows or columns with the highest three penalty costs (breaking ties arbitrarily or choosing the lowest-cost cell).

Step 5: Compute three transportation costs for selected three rows or columns in step 4 by allocating as much as possible to the feasible cell with the lowest transportation cost.

Step 6: Select minimum transportation cost of three allocations in step 5 (breaking ties randomly or choosing the lowest-cost cell).

Step 7: Repeat steps 3-6 until all requirements have been meet.

Step 8: Compute total transportation cost for the feasible allocations using the original balanced-transportation cost matrix

4. Significant Explanation:

The Algorithm will be improved if we add the following two additional steps for breaking ties

- ✓ If there is a tie in penalty or minimum transportation cost, choose the largest penalty for allocation.
- ✓ If there is a tie in penalty and minimum transportation cost, then calculate their corresponding row opportunity cost value/column opportunity cost value, and select the one with maximum.

5. Numerical Example:

(1,5,9)	(4,9,14)	(9,13,17)	(1,2,3)
(9,11,13)	(9,18,27)	(18,20,22)	(1,3,5)
(8,14,20)	(9,13,17)	(12,16,20)	(2,3,4)

Table 1: Computational Results

Problem	MMM	VAM	CBVEM	Optimum
01	2033	1806.67	1798.33	1700

From the investigations and the results given in table 1, it is clear that MVAM is better than MMM and VAM for solving the fuzzy transportation problem. Also, the solution of a fuzzy transportation problem given by CBVEM is very near to the optimal solution.

5. Conclusion

The proposed method namely, customized bespoke Vogel's estimation method (CVEM) has the following major advantages,

- ✓ Extremely unproblematic to understand
- ✓ Enhanced than the existing methods and
- ✓ The solution is very more rapidly to best possible solution.

6. References:

1. Kaufmann, Introduction to the Theory of Fuzzy Sets, Vol. I , Academic Press, New York, 1976.
2. 1372 darwin Sam and M. Venkatachalapathy
3. F.L. Hitchcock, "The distribution of a product from several sources to numerous localities", J. Math. Phys. 20, 224-230, 1941.
4. G.B. Dantzig, Linear Programming and Extensions, Princeton University Press, Princeton, N J, 1963.
5. H. J. Zimmermann, "Fuzzy programming and linear programming with several objective functions", Fuzzy Sets and Systems, 1, 45-55, 1978.
6. J. L. Riggs and M.S. Inoue, Introduction to Operation Research and Management Science, McGraw-Hill, New York, 1975.
7. Kasana.H.S. and Kumar.K.D., Introductory Operations Research Theory and Applications, Springer International Edition, New Delhi, 2005.
8. L.A. Zadeh, "Fuzzy sets", Information Control, 8, 338-353, 1965.
9. R.G. Dyson, "Maximum programming, fuzzy linear programming and multi criteria decision making", J. Oper. Res., 263-267, 31, 1980.
10. Serdar Korukoglu and Serkan Balli, An improved Vogel's estimation method for the transportation problem, Mathematical and computational Applications, Article in press (2010).
11. S. H. Chen, "Graded mean integration representation of generalized fuzzy numbers", Journal of The Chinese Fuzzy systems Association, 5, 1-7, 1999.
12. S. H. Chen, "Operations on fuzzy numbers with function principle", Tamkang Journal of Management Sciences, 6, 13-25, 1985. [13] Taha.H.A., Operations Research- Introduction, Prentice Hall of India (PVT), New Delhi, 2004.