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NEW ROW MAXIMA METHOD TO SOLVE MULTI-OBJECTIVE TRANSPORTATION PROBLEM USING C – PROGRAMME AND FUZZY TECHNIQUE

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ABSTRACT

The transportation problem is one of the sub-classes of linear programming problems in which the objective is to move different amounts of a solitary homogeneous items. We propose a modified algorithm for fathoming MOTP. Proposed method is a modified method to new row maxima method. Rather than considering normal we have considered min-max arrangement for multiple objectives. In this problem we get improved answer for two of the three objectives when contrasted with new row maxima method.In the genuine circumstance, all transportation problems are not single objective. The transportation problem includes multiple clashing and incommensurable objective functions are called as multi-objective transportation problem.

Keywords: Transportation, Problem, Multi-Objective, Row, Maxima

I. INTRODUCTION

The transportation problem is one of the sub-classes of linear programming problems in which the objective is to move different amounts of a solitary homogeneous items that are at first put away at different causes to different destinations so that the total transportation cost is minimum the source parameter (ai) might be production offices product houses and so on Whereas the destination parameter (bj) might be product house, deals outlet and so forth. The punishment cij for example the coefficient of the objective function could speak to transportation cost, delivery time, number of goods translated, unfulfilled interest and numerous others. Accordingly multiple punishment models may exists simultaneously which prompts the exploration deal with multi-objective transportation problem. Up to this point numerous scientists have an incredible enthusiasm for multi-objective transportation problem and various methods had been proposed for understanding it.

II. TRANSPORTATION PROBLEM THEORY

May there be m beginnings, i^{th} starting point having a_i units of a specific product, while there will be n destinations (n might possibly be equivalent) with destination j requiring b_j units. Costs of delivery of a thing from every one of m sources to every one of the n destinations are known either legitimately or in a roundabout way as far as mileage, dispatching hours and so forth. Let c_{ij} be the cost of transportation one unit product from i^{th} source to j^{th} destination. Let 'x_{ij}' be the sum to be delivered from i^{th} starting point to j^{th} destination. Presently the problem is to decide non-negative values of 'x_{ij}' satisfying both, the accessibility limitation:

$$\sum_{j=1}^{n} x_{ij} = a_i, \quad \text{For } i= 1, 2, \ldots, m$$

As well as the requirement constraint:

$$\sum_{i=1}^{m} x_{ij} = b_j \quad \text{For } j= 1, 2, \ldots, n$$

2.1 Tabular representation of transportationproblem

Table 1 Tabular representation of transportationproblem

Origin	**Destination**					
		1	**2**	**…**	**N**	**Supply**
	1	x11 c11	x12 c12	…	x1n c1n	a_1
	2	x21 c21	x22 c22	…	x2n c2n	a_2
	…	…	…	…	…	…
	M	xm1 cm1	xm2 cm2	…	xmn cmn	a_m
	Demand	b_1	b_2	…	b_n	

The transportation table speaks to a matrix inside a matrix. The one is the cost matrix speaking to unit transportation costs cij, showing the cost of delivery a unit from the i^{th} origin to the j^{th} destination. Superimposed on this matrix is the matrix of transportation factors xij, demonstrate the sum sent from i^{th} source to j^{th} destination. Right and base sides of the transportation table point out the measures of provisions a_i accessible at source I and the sum requested bj at destination j.

III. MULTI-OBJECTIVE TRANSPORTATION PROBLEM THEORY

In the genuine circumstance, all transportation problems are not single objective. The transportation problem includes multiple clashing and incommensurable objective functions are called as multi-objective transportation problem. The mathematical model of MOTP can be communicated as follows:

$$Minf^k(x) = \sum_{i=1}^{m}\sum_{j=1}^{n} C_{ij}^k x_{ij}$$ k=1, 2,………p (1)

Subject to the constraints

$$\sum_{j=1}^{n} x_{ij} = a_i$$ For i = 1, 2, …,n (2)

$$\sum_{i=1}^{m} x_{ij} = b_j$$,for j=1,2,…,n ....(3)

$x_{ij} \leq 0$, i=1,2,….,N and j=1,2,…n ....(4)

The superscript on $f^k(x)$ and C^k_{ij} denote the kth penalty criterion, ai> 0 for all i, bj> 0 for all j, $C^k_{ij} \geq 0$ for all (i, j) and $\sum^m_{i=1}$ai=$\sum^m_{j=1}$bj(balanced condition).

The decent condition is both fundamental and adequate for taking care of the transportation problem in both the cases single and multiple objectives.

IV. NEW ROW MAXIMAMETHOD

Step 1 Discover the membership value for every cell and for every objective table.

Step 2 Develop another table in which every cell having normal membership value of every single objective table.

Step 3 Take the principal row and search greatest membership value, allot this cell however much as could reasonably be expected to get edge condition, edge condition either in flexibly or sought after, or in both.

Step 4 If edge condition is in row (for example in gracefully), then go to next row and rehash step 3. If edge condition is in column (for example sought after), then hunt next most extreme membership value in same row and distribute this cell however much as could be expected to get edge condition.

Step 5 Rehash step 3 and step 4 until flexibly and request are depleted.

V. MULTI-OBJECTIVE TRANSPORTATION PROBLEM

In the reality, anyway all transportation problems are not single objective. The transportation problem was portrayed by multiple objective functions. The decision creator might want to limit set of p objectives all the while.

The mathematical model of MOTP can be composed as follows:

$$Min\ f^k(x) = \sum_{i=1}^{m}\sum_{j=1}^{n} C_{ij}^k x_{ij} \quad k = 1,2,\ldots p \quad \ldots\ldots\ldots (5)$$

Subject to the constraints

$$\sum_{j=1}^{n} x_{ij} = a_i \quad \text{For } i=1, 2,\ldots, m \ (6)$$

$$\sum_{i=1}^{m} x_{ij} = b_j \quad \text{For } j=1, 2,\ldots, n \ (7)$$

$x_{ij} \geq 0$, i=1, 2, … . ,m and j= 1, 2, … …,n (8)

The superscript on $f^k(x)$ and C^k_{ij} are used to identify the number of objective functions, ai> 0 for all i, bj> 0

for all j, $C^k_{ij} \geq 0$ for all (i, j) and $\sum^m_{i=1} a_i = \sum^n_{j=1} b_j$ (balanced condition).

The decent condition is both fundamental and adequate for solving the transportation problem in both the cases single and multiple objectives.

VI. THEOREMS ON TRANSPORTATION PROBLEM

- **Theorem 1:**

An essential and adequate condition for the doable solution of a transportation problem is

$\sum a_i = \sum b_j$ (i=1, 2, ..m and j=1,2, ...n) (9)

Proof: The condition is necessary. Let there exist a feasible solution to the transportation problem. Then,

$$\left.\begin{aligned}\sum_{i=1}^{m}\sum_{j=1}^{n} x_{ij} &= \sum_{i=1}^{m} a_i \\ \sum_{j=1}^{n}\sum_{i=1}^{m} x_{ij} &= \sum_{j=1}^{n} b_j\end{aligned}\right\} \Leftrightarrow \sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j$$

The condition is sufficient. Let

$$\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j = k$$

If $\lambda i \neq 0$ be any real no. such that

$xij= \lambda ibj$ for all i and j then λi is given by

$$\sum_{j=1}^{n} x_{ij} = \sum_{j=1}^{n} \lambda_i b_j = \lambda_i \sum_{j=1}^{n} b_j = k\lambda_i$$

or

$$\lambda_i = \frac{1}{k}\sum_{j=1}^{n} x_{ij} = \frac{a_i}{k}$$

Thus,

$xij= \lambda ibj=aibj/k$, for all i and j

$xij\geq 0$, since $ai > 0$, $bj > 0$, $f$or all i and j

Hence a feasible solution exists.

- **Theorem 2:**

Number of essential factors in a transportation problem is at the most m+n-1.

Proof: If it is conceivable to demonstrate that equations (6) and (7) are m+n-1 linearly free equations in mn factors consequently, number of essential factors will be at the most m+n-1.

To demonstrate this, first include m row-equations (6) and afterward take away from the total of first (n-1) column equations (7), thereby getting

$$\sum_{j=1}^{n-1}\sum_{i=1}^{m} x_{ij} - \sum_{i=1}^{m}\sum_{j=1}^{n} x_{ij} = \sum_{j=1}^{n-1} b_j - \sum_{i=1}^{m} a_i$$

Or

$$\left(\sum_{j=1}^{n}\sum_{i=1}^{m} x_{ij} - \sum_{i=1}^{m} x_{in}\right) - \sum_{i=1}^{m}\sum_{j=1}^{n} x_{ij} = \left(\sum_{j=1}^{n} b_j - b_n\right) - \sum_{i=1}^{m} a_i$$

Or

$$\sum_{i=1}^{m} x_{in} = b_n$$ [By equation … … . (10)]

This is the last column equation.

Accordingly, out of m+n equations, one (any) is repetitive and remaining m+n-1 form a linearly free set. Subsequently the theorem is demonstrated.

It is concluded that a fundamental doable solution will consist of all things considered m + n – 1 positive variable, others being zero. In the ruffian case, a portion of the essential factors will likewise be zero, that is number of positive factors will turn out to be not as much as m + n – 1.

VII. SOLVING MULTI-OBJECTIVE TRANSPORTATION PROBLEM USING FUZZY PROGRAMMING TECHNIQUE - MODIFIED METHOD

We have seen the new row maxima method proposed by A.J.Khan and D.K.Das discussed. The new method called parallel method which considers minimum of the membership functions discussed we discuss the modified method of getting the solution of multi – objective transportation problem which considers the min – max composition of fuzzy relation.

We have proposed a method to take care of the Multi-Objective Transportation Problem (MOTP). Here, fuzzy programming technique is utilized with fuzzy linear membership function for different costs and min – max composition of fuzzy relation to illuminate MOTP. The proposed method is modified method can be utilized for multiple objectives. It gives better outcomes for solving MOTP at last, same numerical example shown to check achievability of the proposed examination.

A transportation problem for a multiple objective can be expressed as:

$$Min\ f^k(x) = \sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij}^k x_{ij}$$ k=1, 2,…,K , (11)

Subject to constraints

$$\sum_{j=1}^{n} x_{ij} = a_i$$ for i = 1, 2, … n … … … (12)

$$\sum_{i=1}^{m} x_{ij} = b_j$$, for j = 1, 2, … , n … … … (13)

The superscript on ck signify the k^{th} penalty criterion, ai > 0 for all i, bj> 0 for all j, ≥0 for all (i, j) (adjusted condition).

The decent condition is both essential and adequate for solving the transportation problem in both the cases single and multiple objectives.

VIII. SOLUTION OF MULTI – OBJECTIVE TRANSPORTATION PROBLEM BY NEW ROW MAXIMA METHOD AND PARALLEL METHOD USING C – PROGRAMME

We have built up a C – Program to get the solution of Multi-objective Transportation Problem using New Row Matrix Maxima Method and Parallel method. Different software resembles TORA, Lpsolve and LINGO are created to get the underlying fundamental possible solution and optimum solution of single objective transportation problem, yet for MOTP no such software is accessible to give solution by using different methods. So we built up a C-program for two methods (New row matrix maxima method and parallel method) which gives the solution of MOTP by entering the cost matrix. This program is created using basic C – proclamations. Toward the end by running system for different examples yield is acquired and checked whether it matches with solution got physically.

- **Algorithm for both themethods**

Stepwise procedure to run the C – Programme

Step 1:

i. Enter the number of matrices (number of cost matrix).

ii. Enter the matrix one by one (while entering, enter the matrix rowwise).

iii. Enter the supplyunits.

iv. Enter the demandunits.

Step 2:

i. It checks the problem is balanced one or not, if not it makes the problem balanced for every cost matrix.

ii. It prints the given cost matrix along with the demand and supply units one by one.

Step 3:

i. Finds maximum cost and minimum cost for each cost matrix and then calculates membership values for all cost matrices.

ii. Prints the membership matrix for each cost matrix.

Step 4:

i. Calculates the averaged matrix of all the membership cost matrices.

ii. Prints the average matrix.

Step 5:

i. The rows of averaged membership matrix are arranged in descending order.

ii. Prints the descending order matrix.

Step 6:

i. Making allocations by New Row Maxima method.

ii. Prints the allocations with remaining supply units and required demand units for that particular source and destinationrespectively.

Step 7:

i) Calculates the total cost for all the cost matrices for new row maxima method.

ii) Prints the total cost for all matrices.

Step 8:

i) Calculates the matrix of minimum from all the membership matrices.

ii) Prints the minimum matrix obtained above.

Step 9:

i) Calculates ties in the minimum matrix.

ii) Prints the ties matrix obtained above.

Step 10:

i) The rows of minimum membership matrix are arranged in descending order.

ii) Prints the descending order matrix.

Step 11:

i. Making allocations by Parallel method.

ii. Prints the allocations with remaining supply units and required demand units for that particular source and destinationrespectively.

Step 12:

i. Calculates the total cost for all the cost matrices using Parallelmethod.

ii. Prints the total cost for all matrices.

IX. CONCLUSION

Proposed method is a modified method to new row maxima method. Rather than considering normal we have considered min-max arrangement for multiple objectives. A numerical example is settled by this method and got results are contrasted and a portion of the methods in writing. In this problem we get improved answer for two of the three objectives when contrasted with new row maxima method and by contrasting and different methods in the second objective it is improved yet not for the first and third objectives. The pentagonal fuzzy transportation problem that we talked about will decrease the computational weight. The table says that the pentagonal fuzzy value that we got is equivalent to the current methods. This method will fill in as a key for decision producers while taking care of different sorts of circumstances and, in actuality, problems.

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