Australian Journal of Basic and Applied Sciences, 10(1) January 2016, Pages: 542-545

AUSTRALIAN JOURNAL OF BASIC AND APPLIED SCIENCES

ISSN:1991-8178 EISSN: 2309-8414
Journal home page: www.ajbasweb.com

Ofstf With Non Linear To Linear Equation Method- An Optimal Solution For Transportation Problem

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ARTICLE INFO

Article history:
Received 12 February 2016
Accepted 12 March 2016
Available online 20 March 2016

Keywords:
Assignment problem, Degeneracy, linear and non linear form, Pay Off Matrix (POM), Transportation problem, Quadrants.

ABSTRACT

In this paper a different approach OFSTF (Origin, First, Second, Third, and Fourth quadrants) Method is applied for finding a feasible solution for transportation problems directly by having non linear to linear equation conversion technique. The proposed method is a unique, it gives always feasible (may be optimal for some extant) solution without disturbance of degeneracy condition. This method takes least iterations to reach optimality. A numerical example is solved to check the validity of the proposed method and degeneracy problem is also discussed.

INTRODUCTION

The transportation problem constitutes an important part of logistics management.In addition, logistics problems without shipment of commodities may be formulated as transportation problems. For instance, the decision problem of minimizing dead kilometers (Raghavendra and Mathirajan, 1987) can be formulated as a transportation problem (Vasudevan *et al.*,1993; Sridharan, 1991). The problem is important in urban transport undertakings, *as* dead kilometres mean additional losses. It is also possible to approximate certain additional linear programming problems by using a transportation formulation (e.g., see Dhose and Morrison, 1996).Various methods are available to solve the transportation problem to obtain an optimal solution. Typical/well-known transportation methods include the stepping stone method (Charnes and Cooper, 1954), the modified distribution method (Dantzig, 1963), the modified stepping-stone method (Shih, 1987), the simplex-type algorithm (Arsham and Kahn, 1989) and the dual-matrix approach (Ji and Chu, 2002). Glover *et al.* (1974) presented a detailed computational comparison of basic solution algorithms for solving the transportation problems. Shafaat and Goyal (1988) proposed a systematic approach for handling the situation of degeneracy encountered in the stepping stone method.A detailed literature review on the basic solution methods is not presented. All the optimal solution algorithms for solving transportation problems need an initial basic feasible solution to obtain the optimal solution. There are various heuristic methods available to get an initial basic feasible solution, such as "North West Corner" rule, "Best Cell Method," "VAM — Vogel's Approximation Method" (Reinfeld and Vogel, 1958), Shimshak *et* a/.'s version of VAM (Shimshak *et al.*, 1981), Coyal's version of VAM (Goyal, 1984), Ramakrishnan's version of VAM (Ramakrishnan, 1988) etc. Further, Kirca and Satir (1990) developed a heuristic, called TOM (Total Opportunity-cost Method), for obtaining an initial basic feasible solution for the transportation problem. Gass (1990) detailed the practical issues for solving

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To Cite This Article: K. Thiagarajan, A. Amaravathy, S. Vimala, K. Saranya., Ofstf With Non Linear To Linear Equation Method- An Optimal Solution For Transportation Problem. ***Aust. J. Basic & Appl. Sci.,*** *10(1): 542-545, 2016*

Australian Journal of Basic and Applied Sciences, 10(1) January 2016, Pages: 542-545

transportation problems and offered comments on various aspects of transportation problem methodologies along with discussions on the computational results, by the respective researchers. Recently, Sharma and Sharma (2000) proposed a new heuristic approach for getting good starting solutions for dual based approaches used for solving transportation problems. Even in the above method needs more iteration to arrive optimal solution. Hence the proposed method helps to get directly optimal solution with less iteration. The proposed method is given below.

II. Transportion Problem through OFSTF Method (Origin, First, Second, Third, and Fourth quadrants) from Non-Linear to Linear Equation Conversion Technique:

2.1. Step 1:

Given three equations in linear form with four unknown constants. Here M is the total minimum cost of transportation which is stated and solved in [21].

2.2. Step 2:

To solve these equations and to find the values for the unknown constants namely ($X_{1,}$ $Y_{1,}$ $Z_{1,}$ P_1), the following steps are to be followed.

2.3. Step 3:

Introduce a new duplicate equation in which at a time only one variable value is defined that will be equated to the value of M to get the corresponding defined variables value, while the remaining variables having the value zero. The step is repeated simultaneously for each and every variable.The introduction of duplicate equation makes the given equation into non-linear form.

2.4. Step 4:

To convert the equation from non-linear to linear form, substitute the values of the variables namely (X_1, $Y_{1,}$ $Z_{1,}$ P_1) in the given non-linear equations. By substituting we will be getting three equations with three unknown constants.

2.5. Step 5:

Solve the three equations by the method of simultaneous linear equations to find the value for the unknown variables namely (Y_1, Z_1, $P_{1)}$ simultaneously.

2.6. Step 6:

The non- linear to linear equation having four unknown constants with three equations are solved successfully for the transportation problem.

III. Numerical Example:

Consider the following linear equation transportation problem.

$3X_1 + Y_1 +7Z_1 + 4P_1 =300$

$2X_1 + 6Y_1+ 5Z_1 + 9P_1 = 400$

$8X_1 + 3Y_1 + 3Z_1 +2P_1 = 500$

By the introduction of the duplicate equation, the equations turn into non-linear form.

$3X_1 + Y_1 +7Z_1 + 4P_1 =300$

$2X_1 + 6Y_1+ 5Z_1 + 9P_1 = 400$

$8X_1 + 3Y_1 + 3Z_1 +2P_1 = 500$

$aX_1^2 + 0Y_1^2 + 0Z_1^2 +0P_1^2 = M$

Here X_1^2 variable value is equated to the value of M, in which the remaining variables value falls to zero. By solving the duplicate equation we will get $X_1= (M/a)^2$

Similarly the process repeated to find the value of Y_1, $Z_1^{\backslash}$, P_1 simultaneously.

Substitute the values of the variables namely (X_1, $Y_{1,}$ $Z_{1,}$ P_1) in the given non-linear equations. By substituting we will be getting three equations with three unknown constants. The above example becomes

$3(M/a)^2 + Y_1 +7Z_1 + 4P_1 =300$

$2(M/a)^2+ 6Y_1+ 5Z_1 + 9P_1 = 400$

$8(M/a)^2 + 3Y_1 + 3Z_1 +2P_1 = 500$

Similarly the process repeated to find the value of Y_1, $Z_1{}^{,\backslash}$, P_1 simultaneously.

$Y_1 +7Z_1 + 4P_1 =300- 3(M/a)^2$

$6Y_1 + 5Z_1 + 9P_1 = 400 - 2(M/a)^2$
$3Y_1 + 3Z_1 + 2P_1 = 500 - 8(M/a)^2$

Solve the three equations by the method of simultaneous linear equations to find the value for the unknown variables namely (Y_1, Z_1, P_1) simultaneously.

The non- linear to linear equation having four unknown constants with three equations are solved successfully for the transportation problem.

IV. Conclusion and Future work:

Thus the OFSTF method of linear equation provides an feasible value of the objective function for the transportation problem. The proposed algorithm carries systematic procedure, and very easy to understand. It can be extended to assignment problem and travelling salesman problems to get optimal solution. The proposed method is important tool for the decision makers when they are handling various types of logistic problems, to make the decision optimally.

ACKNOWLEDGEMENT

The authors would like to thank Prof.Ponnammal Natarajan, Former Director of Research, Anna University, Chennai, India for her intuitive ideas and fruitful discussions with respect to the paper's contribution and support to complete this paper.

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