Journal of Mathematical Problems, Equations and Statistics

E-ISSN: 2709-9407
P-ISSN: 2709-9393
JMPES 2023; 4(2): 14-16

www.mathematicaljournal.com
Received: 20-06-2023
Accepted: 02-09-2023

Zahraa Qasem Hashem
Middle Technical University, Technical College of Management, Baghdad, Iraq

Corresponding Author:
Zahraa Qasem Hashem
Middle Technical University, Technical College of Management, Baghdad, Iraq
Email: zahraaqasem@mtu.edu.iq

Finding the initial basic solution to the transportation problem with mixed constraints

Zahraa Qasem Hashem

Abstract
There are Many ways to find the initial basic solution (IBFS) in the normal balanced transportation problem (The constraints are equal) and in real life the constraints may not always be equal according to what is available in the sources and also according to what is required in the markets, so the transfer model in this case is (Unbalanced) and the constraints are (Unbalanced) Equal) and called mixed constraints. In this research, the initial basic solution (IBFS) and the optimal solution was found for the transportation problem with unequal constraints, i.e. mixed, where the Matlab program was used to find the total cost.

Keywords: Unbalanced transportation problem, initial basic solution, mixed constraints, optimal solution

1. Introduction

Many researchers dealt with the problem of regular transportation, in which the constraints are in the form of equations (equal constraints) in order to reduce the total cost or reduce the time to the least possible extent, as well as the possibility of maximizing profits.

The transport problem model is one of the commonly used linear programming models due to its great importance in determining the locations of demand and consumption. The transport model consists of sources (factories, ports, warehouses.) and others that provide (goods, products,) and are transported to destinations. Demand, which is (markets, consumption centers,) where each of these sources accommodates a certain amount of goods that must be fulfilled, transported, and meet the demand of the requesting parties according to their absorption in order to achieve the lowest possible cost or the shortest possible time.

In order to facilitate cost reduction and finding a solution, there are many ways to find the primary primary solution to the transport problem. Many new methods have been suggested, which use new algorithms to reduce the cost to the maximum extent possible.

When what is available in the sources meets the needs of the demand parties, then the transportation problem is balanced, i.e. the supply equals the demand, but some sources or demand parties face some problems, then there is a state of imbalance between the two parties. When there is no equilibrium, such models are called transport models with mixed constraints (TPMC).

The researchers developed transport models with mixed constraints, where [4] dealt with the transport problem with mixed constraints and suggested adding an additional source and market to accommodate the shortage [3]. Also dealt with the problem by proposing two additional costs for the standard model of the transport problem, and [8] presented a new way to reduce the time for the model of the transport problem with mixed constraints. He introduced [7] the Zero Point Method, to solve the problem of fuzzy transport to find the optimal solution to the problem of mixed constraints transport [1]. Developed the transport problem with mixed constraints, where the fuzzy method was applied with a multi-objective function.

2. Research problem

The public company faces some challenges in providing products to meet the market need first, or in distributing its products and finding markets that buy the products second. These cases result in an unbalanced transportation model, so a method is developed to solve the transportation problem model with mixed constraints in a way that reduces the cost to the maximum possible extent.

3. The aim of the research

The research aims to solve the problem of transportation with unequal restrictions, that is, mixed restrictions, in order to meet market demand and provide the necessary and sufficient products in sources, through a new method and clear steps that facilitate the process of finding the basic, initial solution to the transportation problem and to reduce the total cost of transportation.

4. Theoretical side

4.1 The general model of the transfer problem with mixed constraints

The transportation problem is one of the decision-making problems that helps the decision maker to find the optimal distribution of resources and the products they contain, and to market and distribute them to demand destinations in a way that ensures the reduction of cost or time. Some decision makers face difficulty in finding a solution to the transportation problem with mixed restrictions, where the quantity available can increase or decrease. The same applies to markets, where the general model of the transportation problem with mixed constraints consists of an objective function of the Min type to minimize the total cost, and the general form of the model [2, 5, 8] is as follows:

$$Minmize\ Z = \sum_{i=1}^{m}\sum_{j=1}^{n} Cij\ Xij \quad (1)$$

Sub. to:

$$\sum\nolimits_{i\in T} Xij = ai \quad i \in S1$$

$$\sum\nolimits_{i\in T} Xij \geq ai \quad i \in S2$$

$$\sum\nolimits_{i\in T} Xij \leq ai \quad i \in S3$$

$$\sum\nolimits_{i\in S} Xij = bj \quad j \in D1$$

$$\sum\nolimits_{i\in S} Xij \geq bj \quad j \in D2$$

$$\sum\nolimits_{i\in S} Xij \leq bj \quad j \in D3$$

$$Xij \ \geq 0 \ \forall\, i \ \in S \ \&\, j \in D$$

The model consists of m sources and n demand entities, where: $i \ \in S = \{1,2,3, \dots \dots m\}$

Sources are divided into three groups:

S1 = is the group that supplies equal to the order quantity

S2 = is the group that supplies the minimum order quantity

S3 = is the group that supplies the most quantity of demand, as well as the demand parties D, namely $j \ \in D = \{1,2,3, \dots \dots n\}$

D1= is the group that receives an amount equal to the order quantity

D2= is the group that receives the least amount of demand

D3= is the group that receives the most order quantity

Cij = the cost of transporting one unit of resources from source i to the demand side j

Xij = the quantity of resources transferred from source i to demand side j

4.2 Finding the basic elementary solution to the transportation problem with mixed constraints

In order to obtain the initial basic solution of the transport problem model with mixed constraints TPMC, we follow the following steps [2]:

1. Building an ESBTP equal and balanced transport model by adding a dummy row (column) to fill in the deficiency, i.e. adding a dummy row in the case $\sum_{i=1}^{m} ai \ < \sum_{j=1}^{n} bj$ or adding a dummy column in the case $\sum_{i=1}^{m} ai \ > \sum_{j=1}^{n} bj$

Where the cost of the added row (column) is 0 if the constraint is of the type (less than or equal to) and 1 if it is of the type (equal, greater or equal)

2. Finding the initial solution of IBFS using Vogel's VAM method, where the number of principal variables is m+n-1.

3. Redistribute the occupied cells in the imaginary row (column) added to the main cells according to the following method:

A. For the dummy row

$$\bar{X}ij = \begin{Bmatrix} \acute{X}ij + \acute{X}i\,n+1\ if \ \sum Xij = D \\ \acute{X}i\,n+1\ otherwise \end{Bmatrix}$$

B. For the dummy column

$$\bar{X}ij = \begin{Bmatrix} \acute{X}ij + \acute{X}m+1\,j\ if \ \sum Xij = S \\ \acute{X}m+1\,j\ otherwise \end{Bmatrix}$$

Whereas

$\bar{X}ij$ is the optimal solution for the basic cells, and $\acute{X}ij$ is the optimal solution for the balanced transport model, and you must choose the lowest cost during the distribution, that is, $Cij = \min cij$

4. Distribution continues until the total cost of the transport problem is obtained and the final flow of goods is known

5. The application side

The research will be applied to the process of distributing the product (rice) from the warehouses (Aden, Al-Shaab, Jamilah) in addition to Al-Karkh, where the demand destinations consist of 8 destinations, where processing is carried out according to the monthly demand, and as it will be clarified:

5.1 Warehouses, demand destinations and transportation costs

The warehouses contain rice, oil and paste products. The rice product will be taken to calculate the total transportation cost. The amount of rice available in the warehouses is shown in the following table:

Table 1: Shows the amount of rice in warehouses in kilograms

The store	Quantity available
Eden store	32700
People's Store	32500
Beautiful store	19,900

As for the demand areas, it consists of 8 areas distributed on the Karkh side, where the monthly demand is in the following table:

Table 2: Shows the order quantity for the requesting parties in kilograms

Destinations	Monthly order
Kadhimiya	5000
Freedom	12380
University neighbourhood	3000
Abu Ghraib	5000
Al-Jihad neighbourhood	500
Taji	19500
Course	4500
Al-Mansour	400

5.2 Transfer model with mixed constraints:

The available quantity of rice product in the three warehouses may vary according to several conditions facing the warehouses, such as storage conditions, sudden additional demand from the requesting authorities, or damage to some products. The model was divided into mixed intakes, as the model was balanced, ie mixed intakes.

Table 3: Shows the mixed restrictions with the transportation cost

Destinations Stores	Kadhimiya	Alhuriya	University Neighbourhood	Abu Ghraib	Jihad district	Altaaji	Aldawra	Mansour	D9	
Eden store	0.32	0.18	0.32	2.50	1.10	2.16	1.25	0.59	1	=32,700
Alshaeb Store	1.20	1.22	1.20	4.60	2.50	2.72	2.30	1.40	1	≤ 35,500
Jamila store	1.02	1.15	1.10	4.00	2.00	2.88	2.06	1.25	0	≥19,900
	5000≤	12380=	3000	5000≤	12380=	3000	5000≤	12380=	3000	

5.3 Solving Model: The model was solved according to the steps of the approved method and the balance of the model. The model was solved using the VAM method, and the results were as follows:

Destinations Stores	Kadhimiya	Alhuriya	University neighbourhood	Abu Ghraib	Jihad district	Altaaji	Aldawra	Mansour	D9	
Eden store	5000	12380	3000	5000	500	1920	4500	400		32700=
Alshaeb Store						17580			17920	35500≤
Jamila store									19900	19900≥
	5000≤	12380	5000≤	12380	5000≤	12380	5000≤	12380	5000≤	

After applying the other steps to complete the solution, the following results were obtained, at a cost of (97168.2) dollars, and with a flow of (68,200) tons.

Destinations Stores	Kadhimiya	Alhuriya	University neighbourhood	Abu Ghraib	Jihad district	Altaaji	Aldawra	Mansour	
Eden store	5000	12380	3000	5000	500	1920	4500	400	32,700=
Alshaeb Store	17920					17580			35,500≤
Jamila store	5000≤	12380	5000≤	12380	5000≤	12380	5000≤	12380	19,900≥

6. Optimization of the model

After finding the initial solution according to the method used and distributing the quantities of rice to meet the demand, the optimal solution was found using the modified distribution method MODI, as it was found that the solution is optimal, i.e. the transportation cost remains and the distribution remains as planned according to the solution

7. Conclusions and recommendations

1. The total cost has been reduced, as the company's cost was 120,900.6 dollars, i.e. it was reduced by 19.6%
2. The method proved that it was able to reduce the cost, reaching $97,168.2
3. The solution method is distinguished by the ease and clarity of the steps, as the initial basic solution is close to the optimal solution of the model
4. The method makes the best use of distributing products according to the available quantity and according to the market demand, so that it meets the demand as much as possible.
5. The company can benefit from the method to solve the model with mixed constraints and work within the available capabilities.

References

1. Shnaishil JA. Multi-objective constrained fuzzy transfer with mixed constraints using different belonging functions, Journal of Administrative and Economic Sciences. 2018;107(24):614-629.
2. Aminur F, Md. Sharif. Mixed Constraints Cost Minimization Transportation Problem: An Effective Algorithmic Approach, American Journal of Operational Research. 2021;11(1):1-7.
3. Heinz I. Solving the transportation problem with mixed constraints. Zeitschrift für Operations Research. 1982;26(1):251-257.
4. Klingman D, Russell R. The transportation problem with mixed constraints. Journal of the Operational Research Society. 1974;25(3):447-455.
5. Mondal RN, Hossain R. Solving Transportation Problem with Mixed Constraints, Proceedings of the International Conference on Industrial Engineering and Operations Management Istanbul, Turkey; c2012.
6. Pandian P, Natarajan G. Fourier Method for Solving Transportation problem with mixed constraints. Int. J Contemp. Math. Sciences. 2010;5(28):1385-1395.
7. Pandian P, Natarajan G. An optimal more-for-less solution to fuzzy transportation problems with mixed constraints. Applied Mathematical Sciences. 2010;4(29):1405-1415.
8. Kumar R. A Minimax Method for Time Minimizing Transportation Problem with Mixed Constraints, International Journal of Computer & Mathematical Sciences, 2018, 7(3). ISSN 2347 – 8527