American Journal of Interdisciplinary Research and Development
ISSN Online: 2771-8948
Website: www.ajird.journalspark.org
Volume 10, Nov., 2022

CALCULATING THE OPTIMIZATION OF 3D MEDICAL MATERIALS FOR THE TRANSPORTATION PROBLEM USING POM-QM

Hasanain Hamed Ahmed
Department of Business Administration Management,
Imam AL-Kadhum College, Baghdad, Iraq.
ha2.iraq2.19782@gmail.com

Houda Derbel
Department of Quantitative Methods Faculty of Economic Sciences and Management of Nabeul
derbelhoudfsegn@gmail.com

Abstract
The problem of transport is of great importance in companies and productive institutions, which pay great attention to it, to the problem of transport many types, including bilateral transport, triple transport and quadruple transport, which lags behind from one type to another by adding a variable, for example in the bilateral type uses the transfer of materials from storage sources to processing sources, either triple transport is by adding the variable of backward materials, while quadruple transport is by adding a variable type of vehicles, and in this research the problem of transport was studied The three-dimensional, which includes the transfer of various materials from storage sources to the requesting sources, and a case was studied in one of the Iraqi pharmaceutical companies and the transfer of three materials from two stores belonging to the company to medical savers was studied, where the problem of transportation was solved using linear programming and data analysis by the POM-QM program and the annual transportation costs were reduced by about 10 billion annually.

Keywords: Transportation Problem, Optimality of the 3D-Transport, Medical Material Transportation.

1 Introduction:

Most of the productive and service companies seek to reduce the costs of production or service while maintaining the efficiency of the product provided to the customer and among the most important costs facing the productive institutions in addition to the cost of production and the cost of taxes and other costs is the cost of transportation, which is one of the most important costs that producers seek to reduce through the use of methods and mathematical methods or find alternatives that contribute to reducing these costs, which address several types of transport problems and Which will be explained in the theoretical aspect, and the problems of criticism are solved through the use of linear programming and the use of computer applications, and from the production companies are pharmaceutical companies that work on the production of medicines and medical supplies and one of the important costs facing the company is transportation costs, which include transportation fees, distance and quantity transferred, where transportation costs are calculated for all studied products and three types of products are studied and the cost is annual.

2- Linear Programming:

Linear programming is one of the important applications in the analysis of data and finding optimal solutions to the problems facing companies and productive and service institutions where it works to model problems in a mathematical format and apply mathematical methods to solve them and consists of the goal function, which takes either the function of maximizing profits or reducing costs in addition to the presence of restrictions that work to restrict the problem and the presence of a non-negative restriction where each of the constraints consists of an easier constraint representing variables and a right constraint Represents available resources, and linear programming is one of the models of mathematical programming that addresses the issue of allocation or distribution of resources or specific energies to achieve a certain goal and this goal is expressed by a linear function used to describe the relationship between two or more variables and this relationship directly and changes in the same percentage, that is, when the production clocks change by 10%, the production changes by 10% as well.

The importance of linear programming lies in the fact that it is one of the means used in the study of the behavior of a large number of systems, institutions, and industrial and service facilities and is also used in addressing many complex industrial and governmental programming problems that require large computational procedures and extended mathematical equations and programming is considered one of the mathematical methods aimed at reaching optimization, according to which the specified resources are allocated in order to achieve the specified goal and uses the linear programming model Broadly to solve the problems facing business organizations in many fields such as production, distribution, transportation, and many different activities for the purpose of maximizing (maximizing) profits or returns and reducing costs (Minimize) losses and costs, and there are several ways to solve linear programming models such as [2,8]

2.1 Graphic method:

a. It is the method that solves the problem of linear programming in the form of a graph and is considered one of the easiest ways to solve and that is worked out in the event of a problem with a model A - we convert constraints from inequalities to equations

B- We replace one of the variables in one equation with a value of zero to extract the value of the other variable and then repeat this for the other variable thus we have two points for each equation or called a straight and by means of these two points can draw the line represented by the equation.

After drawing all the lines that represent the constraints, the area of the possible solution, which is called the convex zone, is determined.

(d) Specifies the area of the acceptable primary basic solution (the area of acceptable solutions) and can be pronounced S. B . F . S This area achieves all the restrictions at once.

(e) Determines the optimal solution point, which presents at least one of the points located at the intersection of the lines representing the area of the acceptable primary fundamental solution, which are called extremes.

We draw at the coordinate level (horizontal and vertical).

2.2 Simplex method:

The British mathematician G returns to this method. Dantzig in 1947, and this method begins by finding a possible basic initial solution and then moving to a possible basic solution that is better than the previous solution by replacing one of the non-political variables in the first table and here it is called the internal variable and is chosen on the basis of the percentage of its contribution to the improvement of the target function, and the method is used when the model contains restrictions with variants of a type smaller than or equal to the right methods (i.e. available resources) [5,7]

This process stops when we descend into one of the following cases:

A - Obtaining a final solution and the optimal solution and including the state of multiple solutions and the state of dissolution

B. Identification of an infinite number of solutions

C. The problem has no possible solution (specific)

3 – The general formula of the linear programming model:

The goal of formulating a linear programming model is to reach the stage of solving the model and solving the model means finding the values of variables X_1, X_2, ... , Xn that make the value of the target function larger or smaller than what lies.

Minimum or Maximum $z = C_1 X_1 + C_2 X_2 + \ldots\ldots + CnXn$

S.T

$a_{11} X_1 + a_{12} X_2 + \ldots\ldots\ldots + a_{1n} X_n \leq = \geq b_1$

$a_{21} X_1 + a_{22} X_2 + \ldots\ldots\ldots + a_{2n} X_n \leq = \geq b_2$

.

.

$a_{m1} X_1 + a_{m2} X_2 + \ldots\ldots\ldots + a_{mn} X_n \leq = \geq b_m$

$X_1 , X_2 , \ldots\ldots , X_n \geq 0$

where C represents costs or profits

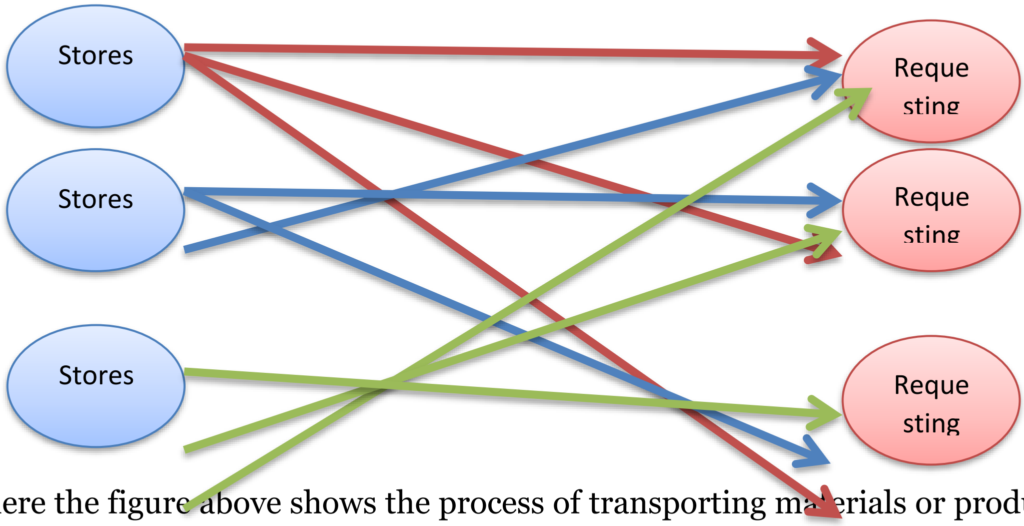
And that X represents the variables under study.

And that a represents the coefficients of variables

The general formula contains the target function, constraints, and non-negative constraints.

3 - Transport models:

Transportation models are useful when companies face problems in transporting materials from a number of different centers to different places and these models look at finding a method with a small cost in transferring resources such as factory products, farms, electrical and hydro energy, etc.) to certain ends (such as warehouses or distribution and marketing centers) in a way that meets the needs of these ends of those resources in the event that the latter is no less than this need or in a way that exhausts all resources In the case of these resources less than the need for those ends, the application of these models is not limited to finding ways with a minimum cost in the transfer of products, but can be applied to situations where the goal is to make the profitable returns as large as possible.



Where the figure above shows the process of transporting materials or products from factories or warehouses to requesting entities, shops, or commercial centers

4 - The Problem of Binary Transportation:

We have previously referred to the problem of transport, where the models of the transport problem lie in the transfer of materials, needs, and products from institutions, factories, or warehouses to the requesting party, and the second transport is a variable phase represented by the decrease of the materials of any equipped entity and a requesting destination only regardless of their number, and in other words, the transport model aims to determine the transport plan for a single particular commodity from a number of sources to a number of places of demand and the data of the model includes:

A . The level of supply at each source and the amount of demand everywhere in the place of demand

B - The cost of transporting the unit from the commodity from each source to the places of demand

Since there is only one commodity, the place of demand can obtain the required quantity from a single supply source or from a number of supply sources, and the main objective of the model is to determine the amount that must be transferred from the source of the particular supply to the place of particular demand in order to achieve the lowest total transport cost.

The model is based on the basic assumption that the cost of transportation on a given route is directly related to the number of units transported on that route and the definition of a unit of transport varies based on the cough transported.

5 - Ways to solve models of transport problems:

There are many solutions to solve many mathematical problems, whether linear programming or the problems of any problems that may face the economic and social sectors, but the SPMLX method cannot be used to solve the problem of transport because of the special configuration of the transport matrix where the coefficients of variables are either one or zero and to facilitate the process of testing a non-fundamental variable as a variable inside or the enslavement of a fundamental variable and therefore it is possible to use other methods to solve transport problems is better and therefore it is required to make restrictions In an equal form, the solution is in two stages as follows:

First: Finding a possible initial basic solution:

The problem of transport contains (n + m) of structural constraints and (nm) of variables and in the method of simplex the number of basic variables was equal to the number of structural constraints, as for the problem of transport, the basic variables are (n+m-1) as the problem contains this number of equations and it is possible to find the initial basic solution possible using one of the following methods:

A . Northwest Corner Method:

This method is one of the easy methods where no scientific logic is used to distribute the quantities available in sources to meet the needs of the ends Destination as the process of finding the initial basic solution starts from the Western problematic angle and therefore it is named by this name and this method can be summarized as follows: First of all, we compare the required quantity with the quantities available at the sources in the first box or square of the northwest corner, that is, we compare the quantity required at D1 with the quantity available at S1 and put in this case the least two quantities and then move to the second cell on the same row, which is cell S1D2 and the quantity available to us is the remaining quantity after putting the quantity in the first cell and so we continue to the rest of the cells until the completion of the transfer table.

B . Least Expensive Method:

The method of least cost is better than the method of the northwest corner induction is selected and distributed the occupied cells on the basis of the lowest cost where the table of costs is seen and find the lowest cost and then the required amount is allocated in the end against the box or cell that contains the least cost, and after you finish allocating the required needs or the end of what the sources contain, we observe the table of costs again and monitor the least cost other that has not been selected and what is distributed It remains from the sources of quantities and according to the needs of the ends in the same way.

C. Vogel Method:

In this method determine the difference between the two lowest costs in each row and in each column and then the largest difference between rows and columns must be selected and accordingly a row or column will be selected which corresponds to the largest difference after this is chosen the box that contains the lowest cost in the row or column chosen in the previous step, after this the largest amount available is allocated to pay for the needs of the end of the depletion of the assets of the source.
For the purpose of completing the solution without the slightest form or error, we are obliged to temporarily cancel the row or column whose needs are met or to run out of everything that is at the end of the column and repeat the work of the new table until all the cells that are used to transfer what is in the source are dictated to meet the needs of the ends.

Second: Testing the optimal solution:

We may not get through the use of the previous three methods offer only the initial basic solution and the use of one method without another depends on the student, although the order of preference in its use, that obtaining the initial basic solution does not mean the end of the solution to the problem we must use other methods to test whether the basic solution obtained from the application of one of the previous methods is the optimal solution i.e. the only solution that cannot find a better solution than it Some of the best solution methods are:

A . Critical Path Method:

Work on the occupied squares in the problems of transportation is with the basic variables and the squares not occupied by the non-basic variables, where indirect costs are calculated in each occupied square according to the mechanism of work in this method and to know whether the unoccupied squares can be used in transportation instead of some occupied squares if it is better, the materials are transferred through the unoccupied squares and to enter the solution and within the basic variables.

B . Method of Modified Distribution:

This method is based on the assumption of binary variables of the cost of transport, as these variables are used to evaluate unoccupied squares, this method is easier than the previous method and more efficient than it and has wide applications using electronic computers, in particular.

6- The problem of three-dimensional transport:

The problem of transport is concentrated in the transport of materials from the producing parties to the requesting parties through certain methods, which results in costs, and one of the problems of transportation is the problem of bilateral transport where a certain type of material is transferred from the sources of processing (factories or establishment) to the sources of demand (shops or sales centers) and the goal is to determine the quantities of goods (homogeneous) that are transported through all roads so that the total cost of transportation is minimized, but this does not exist in practice. Be that the enterprise is working to increase its profits and transfer multiple coughs to sources of demand [1,3,4]

A Binary transport model has been developed into a more realistic model, the three-dimensional model, and the problem of three-dimensional transport arises when we need to move heterogeneous units of products from a source I to location j as well as the type of mode of transport or product type, assuming it's K. [11,6]

And this model has become a model that has a kind of complexity because of the many constraints in it, so the special methods are unable to solve this model, so we resort to the general method.

7- Linear Model:

$$\text{Min } Z = \sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{k=1}^{p} C_{ijk}X_{ijk}$$

S.to

$\sum_{j=1}^{n} X_{ijk} =$ ....(1)B_{ik} , $i = 1,2 \ldots .m$, $k = 1,2 \ldots .p$

$\sum_{i=1}^{m} X_{ijk} =$ ....(2) A_{jk} , $j = 1,2 \ldots .n$, $k = 1,2 \ldots .p$

$\sum_{k=1}^{p} X_{ijk} =$ ....(3)E_{ij} , $i = 1,2 \ldots .m$, $j = 1,2 \ldots .n$

The budget constraints are as follows:

$\sum_{k=1}^{m} B_{ki}$, $k = 1,2 \ldots .p$ .... (4) $= \sum_{k=1}^{n} A_{jk}$

$\sum_{i=1}^{n} E_{ij}$, $i = 1,2 \ldots .m$ .... (5) $= \sum_{i=1}^{p} B_{ki}$

$\sum_{j=1}^{p} A_{jk}$, $j = 1,2 \ldots .n$ .... (6) $= \sum_{j=1}^{m} E_{ij}$

$\sum_{j=1}^{n}\sum_{k=1}^{p} A_{jk} = \sum_{k=1}^{p}\sum_{i=1}^{m} B_{ki} = \sum_{i=1}^{m}\sum_{j=1}^{n} E_{ij}$ .... (7)

Since this Amodel includes m of sources) and n of sites ((Destination and K types of types) in addition to that we assume the following:

X_{ijk} Represents the quantity of goods transported from source i to location j and l k of types.

C_{ijk} Represents the variable cost per unit of goods transported from source i to location j and l k of types.

A_{jk}: Represents the quantities of demand and for k of goods from source i to location j.

B_{ki}: represents the quantity displayed of k of goods available at source i that it displays toall j-sites.

E_{ij}: Represents the total quantities which include multiple types of goods displayed from source i to location j.

Practical aspect:

3.1 Data:

The data was collected through the data of the company under study and according to the advertiser on its official website, which through the construction of the linear model of the transport problem of Samarra Pharmaceuticals, which works on

3.2 Description of the data:

First: From equation number 4, the stock balance of the company's products of medicines and of the three products under study shall be shown in the following table:

Bik stock balance and by units of measurement for each type of product					
Pronounced like t	Stores Materials	Measurement Module	Quantities in Cartons	Second Officers	Railway
1	Grain	Pill	847	7200	6000
2	Capsule	Capsule	125	1200	1650
3	Beverage	vial	63	500	650

Second: From equation No. 5, the monthly demand quantities of the requesting entities for pharmaceutical products are shown in the following table:

Aki demand and by units of measurement for each type of product					
Pronounced like t	Reservoirs Materials	Measurement Module	Quantities in Cartons	Al , Harithia	Al , Saadoun
1	Grain	Pill	847	7000	6200
2	Capsule	Capsule	125	1400	1450
3	Beverage	vial	63	500	650

Third: From equation number 6, the total quantities transferred from the warehouses to the reservoirs are:

Total materials transported from warehouses to warehouses		
Reservoirs **Stores**	Al , Harithia	Al , Saadoun
Second Officers	4500	4400
Railway	4400	3900

Fourth: The cost of transporting pharmaceutical products from the warehouses, which number 2 to the requesting entities, was calculated based on the distance between them measured in kilometers and was determined by the application of GPS, which determined the distances between the areas of Salah al-Din Governorate, the city of Samarra, which is the debtor that contains the headquarters of the company and its operating stores, and multiplies in the quantities transferred from the stores to the stores of medicines distributed in Baghdad province, which are 2 and multiplied by the cost of transportation and which was determined by the company, which is 1% of

the value of the sale of the studied production materials according to the following equation:
Transportation cost per product = cost of transporting the product * Distance between the store and the stock * The quantity transferred from the store to the store
The cost of transportation and each of the three products under study was explained using equation No. 7 in the following tables:

The cost of transporting grain (the first product) from warehouses to slaughterhouses is one thousand dinars		
Reservoirs / **Stores**	Al , Harithia	Al , Saadoun
Second Officers	126258.75	127281
Railway	121539	111120.75

The cost of transporting the capsule (the second product) from the warehouses to the slaughterhouse is one thousand dinars		
Reservoirs / **Stores**	Al , Harithia	Al , Saadoun
Second Officers	289089	291429.6
Railway	3498088	254428.2

The cost of transporting the drink (the third product) from the warehouses to the slaughterhouse is one thousand dinars		
Reservoirs / **Stores**	Al , Harithia	Al , Saadoun
Second Officers	3633930	3663352
Railway	3498088	3198234

Whereas, I found the total transport costs of the three products from the warehouses to the warehouses amounted to (18,812,838,300) Iraqi dinars during the year, then the above data analysis was done using the POM-QM program , which worked to find the optimal transfer process at the lowest possible costs and according to the following results:

Objective

Maximize

Minimize

Note

Multiple optimal solutions exist The solution is degenerate. A basic variable has a value of 0. Interpret its reduced cost carefully.

Linear Programming Results

ANALZY1 Solution

	X111	X121	X211	X221	X112	X122	X212	X222	X113	X123
Minimize	-126258.8	-127281	-121539	-111120.8	-289089	-291429.6	-3498088	-254428.2	-3633930	-3663352
Constraint 1	1	1	0	0	0	0	0	0	0	0
Constraint 2	0	0	1	1	0	0	0	0	0	0
Constraint 3	0	0	0	0	1	0	0	1	0	0
Constraint 4	0	0	0	0	1	1	0	0	0	0
Constraint 5	0	0	0	0	0	0	1	1	0	0
Constraint 6	0	0	0	0	0	0	0	0	1	1
Constraint 7	1	0	1	0	0	0	0	0	0	0
Constraint 8	0	1	0	1	0	0	0	0	0	0
Constraint 9	0	0	0	0	1	0	1	0	0	0
Constraint 10	0	0	0	0	0	1	0	1	0	0
Constraint 11	0	0	0	0	0	0	0	0	1	0
Constraint 12	0	0	0	0	0	0	0	0	0	1
Solution->	1000	6200	6000	0	200	1450	500	0	0	650

ANALZY1 Solution

1	X221	X112	X122	X212	X222	X113	X123	X213	X223		RHS	Dual
539	-111120.8	-289089	-291429.6	-3498088	-254428.2	-3633930	-3663352	-3498088	-3198234			
	0	0	0	0	0	0	0	0	0	<=	7200	126258.8
	1	0	0	0	0	0	0	0	0	<=	6000	121539
	0	1	0	0	1	0	0	0	0	<=	1200	0
	0	1	1	0	0	0	0	0	0	<=	1650	289089
	0	0	0	1	1	0	0	0	0	<=	500	3498088
	0	0	0	0	0	1	1	0	0	<=	650	465118
	0	0	0	0	0	0	0	0	0	<=	7000	0
	1	0	0	0	0	0	0	0	0	<=	6200	1022.2
	0	1	0	1	0	0	0	0	0	<=	1400	0
	0	0	1	0	1	0	0	0	0	<=	1450	2340.59
	0	0	0	0	0	1	0	1	0	<=	500	3498088
	0	0	0	0	0	0	1	0	1	<=	650	3198234
)	0	200	1450	500	0	0	650	500	0		-8004293...	

X_{111} = 1000 , X_{121} = 6200 , X_{211} = 6000 , X_{221} = 0 , X_{112} = 200 , X_{122} = 1450 , X_{212} = 500 , X_{222} = 0 , X_{113} = 0 , X_{123} = 650 , X_{213} = 500 , X_{223} = 0

Z = 8,004,293,000

It is noted from the above model that the value of Z, which represents the function of the target, which was aimed at reducing costs, is 8004293000 that is, the annual transportation costs that were 18812838300 were reduced, and this is an important reduction for the annual costs and for the three products of the General Company for Pharmaceutical Industries.

As for the process of transporting the masked from the warehouses to the reservoir and the types transported, it is explained in the table below:

Schedule of the optimal transfer process from warehouses to stores and transported types		
Store	Reservoir	Type of treatment transferred
Officers	Al , Harithia	Grain
Officers	Al , Saadoun	Grain
Railway	Al , Harithia	Grain
Railway	Al , Saadoun	Grain
Officers	Al , Harithia	Capsule
Officers	Al , Saadoun	Capsule
Railway	Al , Harithia	Capsule
Officers	Al , Saadoun	Drink
Railway	Al , Harithia	Drink

It can also be explained that the axes of transport that are not recommended because they bear many and unoptimal costs in the process of transportation in the following table:

Schedule of the optimal transfer process from warehouses to stores and transported types		
Store	Reservoir	Type of treatment transferred
Railway	Al , Saadoun	Grain
Railway	Al , Saadoun	Capsule
Officers	Al , Harithia	Drink
Railway	Al , Saadoun	Drink

Discussion and Conclusion

The analysis of the data was done by the POM-QM program, which showed through the analysis that there are costs for transportation from the stores in the company to the stores at a cost of 18,812,838,300 and by applying linear programming and addressing the problem of transportation, costs were reduced to 8,004,293,000 and more than half where the routes to be transported were determined by materials and which indicates the efficiency of linear programming in addressing the problem of transportation and reducing costs to reach the optimal solution, and the researcher recommends studying the problem of the problem of transportation The triangle is at the four-dimensional level, i.e. by adding the type of vehicle in which the material is transported.

References

1. Abdul-Jabbar Khader Bakhith and Suhad Faisal Abboud, "Solving the Three-Dimensional Transfer Problem Using Linear Programming" Journal of Economic and Administrative Sciences, Issue 103, Volume 23, pp. 395-410, 2017 .
2. Al-Kubaisi, Abdul-Rahman Obaid Juma'a and Al-Kubaisi Laith Salah Al-Din Mahmoud, "Profit Maximization in Islamic Banks Using the Programming Method" The line: The Iraqi Islamic Bank for Investment and Development as a model, Tikrit University - College of Administration and Economics / Tikrit Journal of Administrative Sciences The Economic / Volume (4) Issue (44), 2018 .
3. Basher Faisal Mohammed , Obaid Mahmmood Mohsin Alzawbaee, Altaiyb Omer Ahmed Mohmmed , " Building a three dimensional maritime transport model to find the best solution by using the heuristic algorithm " , B.F. Mohammed et.al, Gen. Lett. Math. , 7(2), 87-99 , 2019
4. Faten Farouk Al-Badri and Hussein Adnan Al-Kawaz, "Comparing linear programming with other methods to find the optimal solution to the transportation problem," Journal of Economic and Administrative Sciences, No. 101, Vol. 23, pp. 476-494, 2017.
5. FREDERICK S. HILLIER & GERALD J. LIEBERMAN , "INTRODUCTION TO OPERATIONS RESEARCH "Seventh Edition , The McGraw-Hill Companies,Inc , 2001 .
6. Hamdy A.Taha , "OPTIMIZATION Research An Introduction "Eighth Edition , by Pearson Eduaction.Inc , 2007
7. Khalil Ismail Aziz and Abeer Abbas Hammadi "Using Linear Programming in Evaluating the Performance of Oil Refineries in Iraq" (Model Course Filter), Tikrit University / College of Administration and Economics / Tikrit Journal of Administrative and Economic Sciences, Volume 16, Issue 2, 2020 , pp. 247-262 .
8. Samira Khalil Ibrahim and Amjad Abdul-Hussein Jassim, "Solving the problem of privatization using multi-objective programming" Journal of Economic and Administrative Sciences, Issue 105, Volume 25, 2017, pp. 583-592.
9. SUKANTA NAYAK , " FUNDAMENTALS OF OPTIMIZATION TECHNIQUES WITH ALGORITHMS " Elsevier Inc. All rights reserved , 2020

10. Wayne L. Winston , “Operations Research AP P LI CATI O N S AND A LGORITHMS “F O U R T H E D I T I O N , Brooks/Cole, a division of Thomson Learning, Inc. 2004 .
11. Yan Su . A. & Jane H. Davidson , “A three-dimensional phonon energy transport model based on the nondimensional lattice Boltzmann method “ , International Journal of Heat and Mass Transfer VOL127 , 0017-9310 , PP 303–318 , 2018 .