

The Role of Cost and Benefit Techniques in Developing Supply Chain Management Models in the Transportation System (Analytical and Practical Study at Baghdad International Airport)

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Abstract-In a dynamic environment developed by information technology and the accompanying communications devices and modern movements made the world a small village characterized by sharp economic and political fluctuations and financial coincided with the beginning of the twentieth century. It made the investment environment represented by financial resources and their supply chain management play a prominent role in influencing the financial policy of business organizations whether productive or service. It required decision makers to work hard to obtain returns and the lowest possible costs as they pose a clear threat to investment activity because of their impact on the rise or fall in those revenues which he hopes to obtain because of these fluctuations. In the business we must recognize these fluctuations in order to face them in general and work to find methods to be used to ensure the achievement of what aspires to access, and perhaps linear programming using the software ready Q.S.B and TORA. In the current competitive era, the goal of creating a supply chain is to increase the operational effectiveness, profitability, and ability of the organization to compete with supply chain partners, also companies need to focus on their capabilities and resources in order to gain competitive advantage and improve their market position. In fact, the competitiveness of manufacturing companies relies on the development of their competencies. Meanwhile, supply chain management is considered as a powerful tool for promoting corporate growth and creating competitive advantage. Supply chain management operations play a critical role in management decisions, as far as they can have significant effects on corporate profitability and operational success. This

study was designed to shed light on how to transform the transfer problem into linear programming that can be obtained for each variable of the decision maker in the supply chain management. The analysis of these returns using manual solutions and ready-made software referred to above in light of the data obtained for the sample of the study of the civil aviation authority and the air cargo, sea and land at the level of Iraq during the month of April 2018. The study concluded a number of conclusions, the most important is that the best for the airline to rely on ready-made software if it wants to be rational decisions instead of relying on manual solutions. The study came out with a number of recommendations, perhaps the most important of which is the need to establish a special computer lab to process the data and extract the results by the airport administration and the employees of the Iraqi Airways Company which is the advantage that the decision maker cannot succeed without.

Keywords: cost and benefit techniques, supply chain management, Airways Company

1. Introduction

An integrated supply chain is the interconnection between several partners in the business for the transfer of materials and components between partners, the conversion of materials and components into the final product, the creation of value added in the final product, distribution and delivery of products to customers and retailers, and facilitates the exchange of information between different partners. Therefore, the goal of creating a supply chain is to increase the operational effectiveness, profitability, and ability of the organization to compete with supply chain partners [1, 2].

The decision maker in the production or service business organizations shall always search for any means by which their administrative decisions are rationalized in order to maximize resources and reduce costs or losses to the lowest possible level. The Law of Public Companies of the Iraqi State No. 22 of 1997, amended in 2004, In order to push business organizations to work according to the economic theory and achieve the objectives of these organizations as well as the stakeholders associated with these organizations [3]. The airports in Iraq are public companies, especially with regard to the General Company of Iraqi Airways operating at Baghdad International Airport, as one of these organizations is specialized in air cargo, which is marketing the goods available to the various airports of the world using aircraft dedicated for this purpose and thus problematic was addressed In this study through four investigations. Where the first part of the course was devoted to the scientific methodology of the study. The second topic was devoted to the theoretical framework of the study, while the third topic dealt with the analytical framework. The conclusions and recommendations were from the fourth part. The study concluded with a review of Arab and foreign scientific sources and mentioned the supplements extracted from the computer and others.

2. The first topic scientific methodology of the study

2.1. Study problem

The problem of the study is how to diagnose the role of cost and profit techniques in the development of transport models in order to harness them to rationalize the decision-making process, especially in the sample of the study, the Iraqi Airways when used cargo.

2.2. Importance of the study

The importance of the study stems from the importance of its subject as follows:

1. Due to the relationship between the mathematical model of transport and the linear programming through the matrix of transactions based on the values of free values (RSH) and (row) of the coefficients of the objective function, it will open up new horizons for those who wish to solve the transport problems to reach decisions Correct and rational.

2. Linear programming can address large and complex problems that accommodate many methods in quantitative analysis, especially the analysis of the sensitivity of the mathematical model (Sensitivity Analysis) as used in rationalizing the management decisions of the study sample.

3. When the study examined quantitative indicators (Reduced Cost, Total Revenue, and Basis Stars) in the quantitative methods used, these indicators are difficult to obtain within the minimized methods of solutions The problems of transportation, therefore, have emerged as important to the study of transforming this problem into a scientific method by following the linear programming method to deal with each variable of decision [4-8]. The study presented a new knowledge framework through the guidance of the decision-maker to develop solutions to complex problems within the framework of linear programming as a distinct scientific effort added to the rest of applied sciences, especially in the fields of finance and operations research, whether the business organizations in which the decision maker productivity or service.

2.3. Objective of the study

The study aims to achieve the following considerations:

1. Develop a range of alternative solutions aimed at rationalizing the administrative decisions related to the operation of three Iraqi Airways aircraft destined for the transport of goods to a group of Arab and foreign airports.

2. Adopting a new idea in the mathematical model of transport, on the basis of which the model should be developed to have a double objective function that not only reduce costs, but maximize revenues, especially those realized in foreign currency.

3. Setting a cost indicator for any air transport in which the indicator (e) is:

$$e = \frac{\text{Returns from foreign currency}}{\text{Amounts disbursed (costs)}}$$

Where (e) as an indicator is assumed to be consistently high

4. Offer more than one alternative for the carriage of goods using three aircraft (A., B., C.) when there are four or more airports that request these goods.

5. Demonstrate the effectiveness of the methods of solution using the software ready and what analyses can be obtained later (Post Optimality Solution).

2.4. The hypothesis of the study

The study starts from the following main hypotheses:

First, it is not possible to develop normal transport models. It is not possible to rely on a double goal function that combines maximizing revenues from the transfer process and reducing costs. A. An efficient indicator (e) cannot be obtained that would create a relationship between a cost to be used to rationalize the administrative decision.

B. There is no possibility of obtaining different results for the variables of the basic variables (x_{ij}) according to the solution method (manual, use of ready-made software).

Second, the efficiency index (e) does not achieve any returns or returns to the country in foreign currency.

Third: The decision-maker depends on one type of solution to the problems of transportation faced either by manual solution or by using the software ready.

2.5. Community and Study Sample

The methods of scientific research confirm the necessity of carrying out the study, taking into account the characterization and precise identification of its original society, in preparation for establishing the sampling criteria that guarantee the selection of the representative sample of this society [9, 10]. The study community is represented by the authority of civil aviation and air, sea and land freight at the level of Iraq as a whole, but for the impossibility of completing the study on the whole of the mentioned society and in parallel with the scientific research, the study sample was selected from this community as shown in Figure 1 below in two steps:

The first is the introduction of local Iraqi companies that should be entered in the sample. Here, a deliberate sample was used targeting Baghdad International Airport and its public company represented by the Iraqi Airways Company as shown in Annex 1.

Second: The selected sample shall represent a public company that contains a fleet of aircraft designated for the air transport operation with the aim of achieving profits and lasting work.

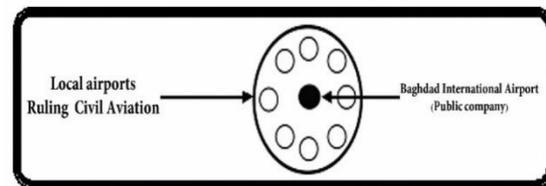


Figure 1. Society and a sample of the study

2.6. Data and duration of the study

Iraqi Airways has a fleet of aircraft operating on different routes and routes, some of which are charter or regular flights. For the purpose of completing this study, three aircraft were chosen, as follows:

First: The plane No. 1 (A-NJ900)

Second: Flight No. (B-747) is located at Baghdad Airport

Third: The plane No. (3) (C-737)

Goods are transported on these aircraft to and from four airports in neighbouring countries

(1) Istanbul / Turkey Airport, (2) Amman / Jordan Airport, (3) Dubai Airport / UAE, (4) Tehran / Iran Airport

The researchers express their aspirations for the Baghdad International Airport through this study, which is an attempt to address the problem of the transport of goods such as (canned dates, a certain type of grain, some industrial products, some large bags of passengers) to these four airports And the loading of goods at Baghdad International Airport to the four airports mentioned above. Data were obtained regarding the volume of cargo expected to be shipped for June 2018 as follows, and the diagram shown in Figure 2:

(1) To Istanbul Airport (20) tons, (2) To Amman Airport (30) tons, (3) To Dubai Airport (30) tons, (4) To Tehran Airport (10) tons.



Figure2. The outline of the transport lines of the airports under study

The capacity of each of the three aircraft owned by Iraqi Airways is as follows:

The capacity of the aircraft A-NJ900 = 30 tons, the capacity of the aircraft B-747 = 40 tons,

The capacity of the C-737 = 20 tons Assuming that Cargo achieves the full capacity above, the Company wishes to streamline decisions regarding

1. Transportation and distribution of goods from Baghdad International Airport to the four airports at the lowest total cost (Kij).

2. Transportation and distribution of goods from Baghdad International Airport to the four airports and to achieve the highest revenue or profit Possible (Wij).

3. Achieve the highest efficiency (e) as $Wij / Kij = e$ in hard currency.

3. The second topic

Theoretical framework ("Development of supply chain management for transport models")

3.1. Site transport model of linear programming:

The typical transport model is part of linear programming models as shown in Figure (3):

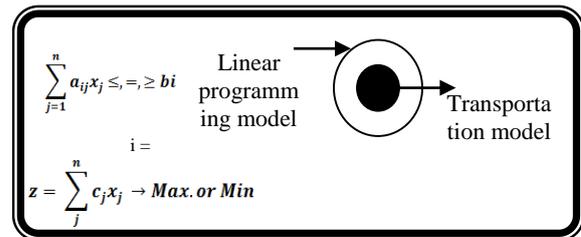


Figure3. Linear programming model

$$\sum_{i=1}^n x_{ij} = ai \quad i = 1, 2, \dots, m$$

$$\sum_{j=1}^m x_{ij} = bi \quad j = 1, 2, \dots, n$$

$$z = \sum_{j=1}^n \sum_{i=1}^m cij xij \rightarrow \text{Min.} \quad xij \geq 0$$

From the transport model in figure (3) above, it is clear that the objective function (Z) goes towards minimizing the cost of transport (Cij). Transport costs here are meant to represent the cash that is spent to transport and market goods or individuals from distribution centres (i) to receiving centres (j). The transport schedule is generally written as shown in Table (1), which presents all variables related to the problem of transporting and marketing goods. Table (1) below consists of a number of boxes, each of which is called the transport cell, which contains all the details related to all transport paths related to the problem, so that any transfer cell in the table is an alternative to transportation alternatives (xij) as well as the cost of transporting goods or individuals (cij) and as in Figure (3) below:

Table 1.The general format of the transport schedule

Dj \ Si	D1	D2	.....	Dn	Ai
S1	C11 X11	C12 X12	.....	C1n X1n	a1
S2	C21 X21	C22 X22	.....	C2n X2n	a2
.
Sm	Cm1 Xm1	Cm2 Xm2	.....	Cmn Xmn	am
Bj	b1	b2	.....	bn	$\sum ai$ $\sum bj$

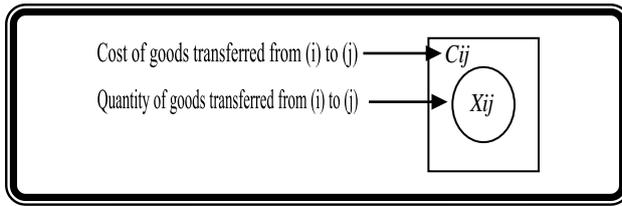


Figure 4. Cell content

In fact, the decision-maker may face a problem of atypical transfer that is different from the previous one. Therefore, the above model must be developed to accommodate and respond to what is required.

To the following:

1. Reduce transportation costs and maximize revenue and profits at the same time.
2. Reduce time allocated and maximize profits.
3. Maximize output and reduce input (raw material, working hours, operational power).
4. Other dual organization problems (double objective function).

Taking into account the first type of problem, which is to reduce transport costs and maximize profits, the mathematical expression of such problematic as follows:

If we assume that W is a symbol of profit, and (K) is a symbol of cost,

$W \rightarrow$ PROFIT is the first face of the target function

$K \rightarrow$ COST is the second facet of the target function

Therefore: $Z \rightarrow e = \frac{W}{K}$

The objective function (Z) is replaced with the symbol (e), which expresses the efficiency index. On this basis, the transport cell is in this case as in figure 5 below. And outside the country according to an investment perspective, the cell will be as follows:

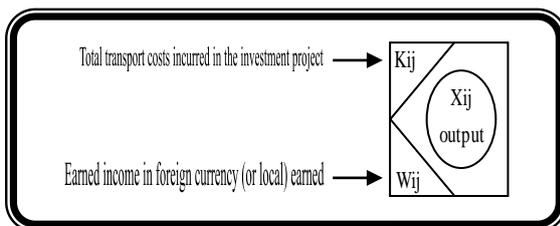


Figure 5. Transport cell

The above idea may be further elaborated, moving from the subject of efficiency (e) to the subject of productivity (p) productivity, where it is required to calculate the productivity index in the transfer process, where it is known that the total productivity is:

$$total\ measures = \frac{good\ and\ services\ produced}{all\ input\ produced\ them}$$

Or in other words that the total productivity is:

$$productivity = \frac{output}{input} \%$$

Hence, the decision-maker may go to employ these mathematical models to serve such problems, especially those related to the elements of production (labor, energy, capital, raw materials, etc.) :

$$multifactor\ measures = \frac{output}{capital + energy + labor}$$

$$partial\ measures = \frac{output}{labor} \frac{output}{machine} \frac{output}{capital} \frac{output}{energy}$$

From the foregoing, the transfer cell can take another form as shown in Figure 6 below:

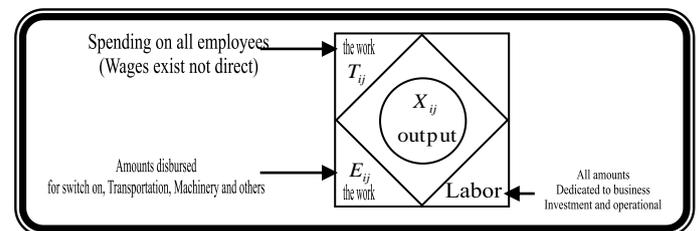


Figure 6. The other shape of the transport cell

3.2. Formulation of the mathematical model of the problem and its schedule

In order to formulate the mathematical model of the problem, all the alternatives for the transport and shipping process were drawn up according to the costs determined by the Baghdad International Airport Administration calculated for each ton and as in figure (7) below

In this way, it is possible to formulate the transfer table with the calculation of the change of the amount of (wij) for each of the above tracks as in Table (2) below:

Table 2. The basic table of sites of costs and quantities

the airport	Istanbul airport	Amman Airport	Dubai airport	Tehran Airport	Ai
The Plane					
The Plane A	W11 X11 K11	W12 X12 K12	W13 X13 K13	W14 X14 K14	a1
The Plane B	W21 X21 K21	W22 X22 K22	W23 X23 K23	W24 X24 K24	a2
The Plane C	W31 X31 K31	W32 X32 K32	W33 X33 K33	W34 X34 K34	a3
b _j	b1	b2	b3	b4	Σ a _i Σ b _j

Therefore, the marital goal function is formulated as follows:

1. Function of cash returns in hard currency:

$$W = W_{11}X_{11} + W_{12}X_{12} + W_{13}X_{13} + W_{14}X_{14} + W_{21}X_{21} + W_{22}X_{22} + W_{23}X_{23} + W_{24}X_{24} + W_{31}X_{31} + W_{32}X_{32} + W_{33}X_{33} + W_{34}X_{34} \rightarrow \text{MAX.}$$

$$w = \sum_{j=1}^n \sum_{i=1}^m w_{ij} x_{ij}$$

2. The function related to the costs associated with operation and investment:

$$K = K_{11}X_{11} + K_{12}X_{12} + K_{13}X_{13} + K_{14}X_{14} + K_{21}X_{21} + K_{22}X_{22} + K_{23}X_{23} + K_{24}X_{24} + K_{31}X_{31} + K_{32}X_{32} + K_{33}X_{33} + K_{34}X_{34} \rightarrow \text{MIN.}$$

$$K = \sum_{j=1}^n \sum_{i=1}^m k_{ij} x_{ij} \quad \text{whereas :}$$

$$W_{11}, W_{22}, \dots, W_{34} \geq 0$$

$$K_{11}, K_{12}, \dots, K_{34} \geq 0$$

$$X_{11}, X_{12}, \dots, X_{34} \geq 0$$

$$e = \frac{w}{k} = \frac{\sum_{j=1}^n \sum_{i=1}^m w_{ij} x_{ij}}{\sum_{j=1}^n \sum_{i=1}^m k_{ij} x_{ij}}$$

3.3. Different methods and methods used to solve the mathematical model

The solution to the mathematical model can be developed using the following methods and methods:

3.3.1. Solution using the manual method

We have three types of solution methods, depending on the type of solution required (possible solution, the best solution, the best solution), as shown below:

1. Find a possible solution Feasible Solution where one of the following methods is used:

A) its North-West Corner road

B) Random Method

2. Find the best solution Best Solution where one of the following methods is used:

A) The way the least expensive element Lest Cost Method

B) Vogl's way of approximation

3. Find the optimal solution Optimal Solution where you can get this solution and relying on the previous best solution using one of the following methods:

A) Stepping Stone Method

B) Method of multiplications Multipliers Method

3.3.2. Solution using TORA software, WIN Q.S.B

This means the adoption of various ready-made software, as the solution using this ready-made software depends on the type and date of issue, including the following:

1. Solution using TORA:

This program can be used to solve directly, after determining the number of goods to be sent in the distribution centres and the total required goods at the receiving centres and cost elements in the target. This program does not provide sufficient sensitivity analysis or post-optimal solution.

2. Solution using Q.S.B^{win}:

The process of solving transport problems in this program requires that the structure of the problem be converted to the linear programming format as follows:

$$\begin{bmatrix} \text{Elements} \\ a_{ij} \\ c_j \end{bmatrix} \begin{bmatrix} R.H.S. \\ b_{ij} \end{bmatrix}$$

In this case, all quantitative indicators will be obtained, especially those indicators that emerge from the analysis of the sensitivity of the mathematical model, which reflect the post-optimization solution, which opens up great horizons to the decision maker to rationalize its various administrative decisions.

3.4. Procedures of the manual solution according to previous sports methods

This distribution will be based on available data obtained by the researchers from the airport administration as shown in Table (3):

Table 3.The table that reflects actual problem data

the airport The Plane	Istanbul airport	Amman Airport	Dubai airport	Tehran Airport	Ai
The Plane A	3 X11 20	6 X12 30	4 X13 20	9 X14 40	30 To n
The Plane B	7 X21 30	4 X22 20	8 X23 50	3 X24 10	40 To n
The Plane C	8 X31 40	5 X32 30	4 X33 20	11 X34 60	20 To n
Bj	20	30	30	10	90 90

When adopting one of the previous primary solution methods, the possible solution lies in Table (4) as shown below:

Table 4. is the primary solution to the problem

the airport The Plane	Istanbul airport	Amman Airport	Dubai airport	Tehran Airport	Ai

The Plane A	3 20	6 10 30	4 X13 20	9 X14 40	30 To n
The Plane B	7 X21 30	4 20	8 20 50	3 X24 10	40 To n
The Plane C	8 X31 40	5 X32 30	4 10 20	11 10 60	20 To n
Bj	20	30	30	10	90 90

$$K=20*20 + 30*10 + 20*20 + 50*20 + 20*10 + 60*10 = 2900$$

$$w=3*20 + 6*10 + 4*20 + 8*20 + 4*10 + 11*10 = 510$$

$$e = \frac{w}{k} = \frac{510}{2900} = 0.176$$

In order to ensure that the solution is optimized, the following set of methods will be used, which will lead to the optimal solution, where non-core variables (xij = 0) are selected as in Figure 8:

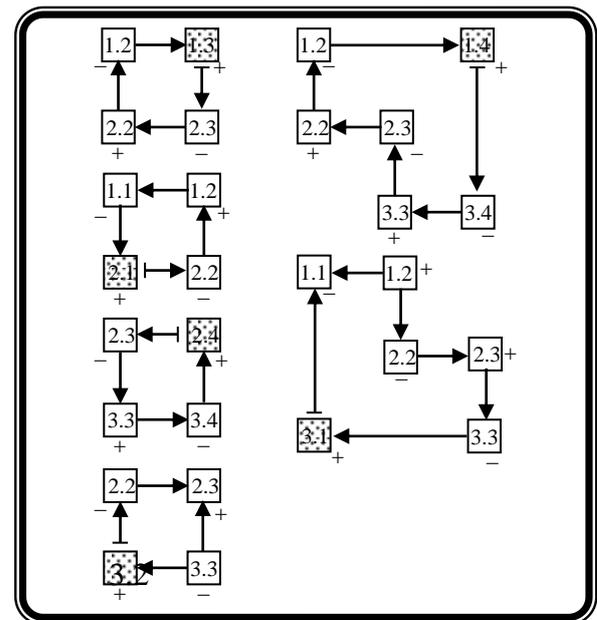


Figure 8.Test cells related to non-essential variables as in Table (4)

For such closed paths it is possible to calculate the change in both the kij and the wij costs. On the basis of:

Δ = Means change

\ominus = Amount that expresses the amount of change in its base variable value

whereas : So the square symbol is (k,l):

$\ominus = \text{MIN} \{X_{K1L1}, X_{K2L2}, \dots, X_{KNLN}\}$ whereas :

$(X_{K1L1}), (X_{K2L2}), \dots, (X_{KNLN})$

It expresses the closed path that the option was signed on if it is also known

K '= adjusted costs

W '= adjusted revenue

Δ "il = The forced sum of elements of the variable wij in the same box or cell within the path of change shown in Figure (6)

Δ "ij = The forced sum of elements of the kij variable in the same box and the cell within the change path shown in Figure (6)

dij = The variable to specify its value

And so he:

$$K' = k + \Theta \cdot \Delta'$$

$$w' = w + \Theta \cdot \Delta''$$

$$\Delta e = e' - e = \frac{w'}{k'} - \frac{w}{k} = \frac{w + \Theta \cdot \Delta''}{k + \Theta \cdot \Delta'} - \frac{w}{k} = \frac{\Theta}{kk'} (\Delta'' \cdot k - \Delta' \cdot w) = \frac{\Theta}{kk'} dij$$

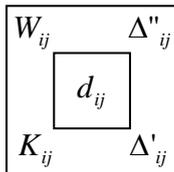
The calculation of the change in the usual (e) and e (e) efficiency index is calculated as follows:

$$\Delta e = e' - e = \frac{w'}{k'} - \frac{w}{k} = \frac{w + \Theta \cdot \Delta''}{k + \Theta \cdot \Delta'} - \frac{w}{k}$$

The dij value is calculated as follows:

$$dij = \left| \frac{\Delta'' w}{\Delta' k} \right|$$

The values of the values referred to in each of the cells are shown in the following cell:



On the basis of the previously closed paths, originally prepared for empty cells (non-core variables), we will obtain the following:

- dla (1,3) $\begin{cases} \Delta'_{13} = k_{13} - k_{23} + k_{22} - k_{12} = -40 \\ \Delta''_{13} = w_{13} - w_{23} + w_{22} - w_{12} = -6 \end{cases}$
- dla (1,4) $\begin{cases} \Delta'_{14} = k_{14} - k_{34} + k_{33} - k_{23} + k_{22} - k_{12} = -60 \\ \Delta''_{14} = w_{14} - w_{34} + w_{33} - w_{23} + w_{22} - w_{12} = -8 \end{cases}$
- dla (2,1) $\begin{cases} \Delta'_{21} = k_{21} - k_{22} + k_{12} - k_{11} = -20 \\ \Delta''_{21} = w_{21} - w_{22} + w_{12} - w_{11} = 6 \end{cases}$
- dla (2,4) $\begin{cases} \Delta'_{24} = k_{24} - k_{23} + k_{33} - k_{34} = -80 \\ \Delta''_{24} = w_{24} - w_{23} + w_{33} - w_{34} = -12 \end{cases}$
- dla (3,1) $\begin{cases} \Delta'_{31} = k_{31} - k_{11} + k_{12} - k_{22} + k_{23} - k_{33} = 60 \\ \Delta''_{31} = w_{31} - w_{11} + w_{12} - w_{22} + w_{23} - w_{33} = 11 \end{cases}$
- dla (3,2) $\begin{cases} \Delta'_{32} = k_{32} - k_{22} + k_{23} - k_{33} = 40 \\ \Delta''_{32} = w_{32} - w_{22} + w_{23} - w_{33} = 5 \end{cases}$

The values of (dij) are calculated as follows:

$$d13 = \left| \frac{-6}{-40} \frac{510}{2900} \right| = 3000 \quad d14 = \left| \frac{-8}{-60} \frac{510}{2900} \right| = 7400$$

$$d21 = \left| \frac{6}{20} \frac{510}{2900} \right| = 7200 \quad d24 = \left| \frac{-12}{-80} \frac{510}{2900} \right| = 6000$$

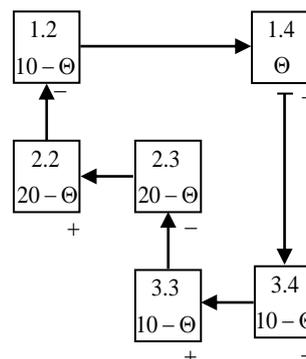
$$d31 = \left| \frac{11}{60} \frac{510}{2900} \right| = 1300 \quad d14 = \left| \frac{5}{40} \frac{510}{2900} \right| = -5900$$

Therefore, the table showing the above values is Table (5). In this table, we find the largest value (dij) in the box (1, 4). This will reduce the value of (e) $\min \{10, 20, 10\} = 10$

Table 5. Table showing the previous values

	1	2	3	4	
1	30 20 20	6 10 30	-6 4 -40 20	-8 9 -60 40	W=510 K=2900 e = w/k =0.176
2	40 20 30	6 7 20 20	8 20 50	-12 3 -80 10	
3	20 8 60 40	11 5 1300 40 30	4 5 -5900 20	11 10 60	
	20	30	30	10	

From the above it is clear that the amount of the value (e) is 0.176, and so the process continues on the basis that the starting point is the cell point (1.4)



Thus, the process continues until the last stage, where all dij values are negative. Table (6) shows that the value of (e) becomes (0.214) showing the other final results related to the values of the variable wij, kij:

Table 6. Final Results

		1	2	3	4	
1	3	-6	6	4	4	
	0	3600	30	20	-600	
		-20			20	40
						W=450
2	4	7	10	8	10	
	0	20	20	5400	10	
		30		40	50	
						K=2100
						$e = \frac{w}{k}$
						=0.214
3	2	-1	1	4	6	
	0	2100	2100	20	5400	
		0	0		40	60
		20	30	30	10	

Where the efficiency factor was calculated at this stage is the highest compared to the previous as follows:

$$e = \frac{w}{k} = \frac{450}{2100} = 0.214$$

If this indicator is measured for any local operation, $e = 0.214 \frac{\text{dolar}}{\text{local currency}}$

It thus expresses the relationship between the foreign currency and the local currency.

4. The third topic

An Analytical framework of the study

4.1. Formulation of the mathematical model under the dual objective function

The explanation of the idea is based on the first case of calculating the efficiency index (e). The mathematical model that expresses this function is as follows:

$$e = \frac{W}{K} = \frac{\sum_{j=1}^n \sum_{i=1}^m w_{ij} x_{ij} \rightarrow \text{Max.}}{\sum_{j=1}^n \sum_{i=1}^m k_{ij} x_{ij} \rightarrow \text{Min.}}$$

Where the indicator (e) means the effectiveness of exploitation and investment of funds and their ability to achieve the return or profit from hard currency (dollar, euro, etc.)

From the application of mathematical models to the problem of transport, the final results were reached, which shows that the use of two types of applications is:

1. Manual solution.
2. Solution using the ready-made software.

Details of the use of each type will be presented as follows:

4.1.1. Manual solution and show results

The results of the hand-held solution in applying the Stepping Ston Method show that we obtain the value of the indicator of efficiency (e) as shown above, as well as the values of the basic and non-basic variables (xij). This results in an explanation that the management of Baghdad International Airport if it got 1000 units of currency from a certain currency, this could provide \$ 214 The plan to transport the optimal transport of goods on the available aircraft is as follows:

	The PlaneA	The PlaneB	The PlaneC
X ₁	X ₁₁ = 0	X ₅	X ₂₁ = 20 X ₉
X ₂	X ₁₂ = 20	X ₆	X ₂₂ = 10 X ₁₀
X ₃	X ₁₃ = 10	X ₇	X ₂₃ = 0 X ₁₁
X ₄	X ₁₄ = 0	X ₈	X ₂₄ = 10 X ₁₂
			X ₃₁ = 0 X ₃₂ = 0 X ₃₃ = 10 X ₃₄ = 0

This means that aircraft A should be used to transport goods to Amman Airport and Dubai Airport in quantities of 10 to 20 tons, while aircraft B is supposed to transport goods in the following quantities (20 tons to Istanbul airport, 10 tons to Amman airport, 10 tons to Tehran airport), And finally, the C plane has to transport only 20 tons to Dubai airport.

4.1.2: Solution using ready-made software

Under this method of solution requires the provision of software and computers or mobile phones, which is mentioned in this case a set of software:

- (1) Q.S.B^{win}, program, (2) TORAProgram, (3) Q.M program, (4) LINDO program, (5)AMPLE program In order to implement the solution to the current problem using

Variables Software	Determine the winning variables												The value function is the target	effectiveness E	
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12			
	X11	X12	X13	X14	X21	X22	X23	X24	X31	X32	X33	X34			
The manual solution		⊙	⊙		⊙	⊙		⊙			⊙			W=450 K=2100	0.214
Solution using TORA		⊙			⊙		⊙		⊙			⊙		W=680 K=1700	0.400
Solution using Q.S.B win	⊙				⊙		⊙	⊙			⊙			W=700 K=1700	0.410

⊙ Selected Variable (Winner)

5. The fourth topic.

Conclusions and recommendations

5.1. Conclusions

The study reached a number of conclusions as follows:

First, the analytical results showed that there is a possibility to develop supply chain management for transport model according to the requirements of the problem to become transfer models for the predetermined problem. This is what we found in the formulation of the mathematical model in the framework of the dual objective function, so it contradicts the hypothesis of the first main study. This possibility has been demonstrated through the following:

A. The results showed that the efficiency index (e) with the three values ($e = 0.214$, $e = 0.400$, $e = 0.410$) gave the decision maker the opportunity to develop quantitative indicators. X11, X12, X34, which also requires the adoption of one of the types of software, and **this is contrary to the hypothesis of the first sub-study of the first hypothesis.**

B. On the basis of Table (11), Iraqi Airways operating at Baghdad International Airport has different alternatives for the use of the three planes (A., B., C.) between the different local and international airports. **This results in the results of the analysis, The second sub-study of the first hypothesis.**

Second. Through the results of the analysis, the efficiency index was found to generate returns in foreign currency, which is expressed by the symbol (w), since the airlines are clearly interested in imports of foreign currency, and this **is contrary to the second main hypothesis.**

Third. The decision maker has flexibility in the process of choosing the type of solution to the transport problems. If the problem is small, it is possible to rely on the manual solution, while if it is large and with different variables and quantitative analysis is required (sensitivity analysis), it is better for the airlines this is confirmed by the results of the analysis, **which indicates its contradiction with the hypothesis of the third main study.**

5.2. Recommendations

In light of the conclusions referred to in the preceding paragraph, the study recommends that:

First: The decision maker of the production or service organizations should work on the use of linear programming, including transportation models, in the face of the transportation problems facing them. The cost and profit techniques have an impact on the formulation of the mathematical model, especially as the objective function has two main objectives: (Double objective function), which means that there is a possibility to develop transport models and move them from the specific function phase to reduce costs or increase in profits (one goal function) to (double objective function), which in itself is a face of Evolution of transport models.

Second, it is imperative for the decision maker to use the quantitative values in the efficiency index (e) for any air transport operation as it represents the proceeds from the foreign currency divided by the disbursed amounts. (A, B, C) for four or more airports required for the transport of these goods (ie, high flexibility) as it uses the software types ready for the Post Optimality Solution.

Third: The decision-maker must sample the study between the alternatives he obtained to transport the goods through the three types of aircraft understudy to the local and international airports, where the process of trade-offs at the lowest cost and higher than the profit to become rational.

Fourth: In light of the information that the decision maker can obtain (availability of information). Given the fact that the cost and profit indices are important measures that ensure the sustainability of the work of the productive or service organizations at the local and international levels, Being Are related to the size of the returns obtained by these organizations, especially the study sample, and are sensitive to economic changes and other environmental factors.

Fifth: The airport administration and the employees of Iraqi Airways should establish a computer lab whose administrators will analyse the data related to any transfer and purchase of ready-made software (Q.S.B^{win}, TORA) in order to identify the problems facing transportation, processing the data and extract the results, Under the traditional methods of transport, and then converting the problem into linear programming will lead to the development of processors for each variable of decision.

Sixth: The decision-maker should make decisions if he wants to make his decisions sound and rational to involve the employees in the computer lab with seminars and workshops managed by specialized scientific staff working to increase their skills and make them in constant communication with the movement of local and global markets as well as participate in the economic bulletins to be on Sufficient knowledge of the importance of dealing in foreign currencies and the proceeds resulting from their role in achieving a factor of reassurance to the investor represented by the study sample to avoid the occurrence of losses and because of the direct correlation with the circumstances surrounding the market.

Seventh, the decision maker should make use of the quantitative indicators obtained (eg, REDUCED COST, TOTAL CONTRIBUTION, BASIS STARS) and employ them in the process of developing solutions to transport problems facing the airport administration, And permanently to lead to the development of the airport and its growth.

References

- [1] Al-Fadl, Moayad Abdul-Hussein, "Quantitative Approach in Business Administration", published by Al-Warraq Publishing & Distribution, Jordan / Amman 2008.
- [2] Al-Fadl, Mo'ied Abdul-Hussein, "Accounting Operations Operations / Applications in National Productive Business Organizations", Dar Athera Publishing and Distribution, Jordan, Amman 2009.
- [3] Al-Fadl, Muayad Abdul Hussain, Ali, Hussein Ali "Model Management Decisions" Part I and Part II - Yawzi Publishing and Distribution, Jordan, Amman 2001.
- [4] Al-Obeidi Mohammed and Al-Fadhil, "Operations Research", published by Al-Warraq Publishing and Distribution, Amman, 2005
- [5] Jazaa, Abdul Dhiab "Operations Research - Assets and Principles" issued by the Ministry of Higher Education - University Press / Iraq 1985.
- [6] Najem, Aboud Najm "Quantitative Methods, and Applications", published by Al-Warraq Publishing and Distribution, Jordan, Amman 2010.
- [7] H. Krinski , A. BADACH” Zastosowania Matematyki Do Podejmowania Decyzji Ekonomicznych” PWN , W0WA ,2006.
- [8] H.Krunski , A.BADACH “Zastosowania Matgmatyki Do Podejmowania Decyzji Ekonmicznych” PWN,W-WA ,2002.
- [9] L.Lapin “Quantitative Methods-For Business Decisions With Cases” Marcrow Hill, USA,1995.
- [10] T.Hamdi “Operotions Research – An Introduction” Printice Hall , USA , 2008.

Appendix

Baghdad International Airport Sample Study

Baghdad International Airport is one of the largest airports in Iraq, located 16 km west of the Iraqi capital Baghdad, where administratively belongs to the Abu Grab district, which is the headquarters of all operations of Iraqi Airways. The airport dates back to 1979 and 1982 When Iraq relied on Methane airport in the center of the capital. The construction of Baghdad International Airport has two foreign companies, one French and the other British. Construction costs exceeded \$ 900 million in time. It is designed for civilian use (passengers, air cargo) and military. After the Second Gulf War and after the imposition of the economic embargo on Iraq, With the exception of some local flights and some charity trips to transport medicines and food to Iraq by international charities'. In 2003, after the Americans entered Iraq, particularly on 3 April, the airport was occupied by US forces after three days of fierce fighting. By mid-2003, the airport was turned into a US military camp. Since August 25, 2004, Iraqi Airways and Royal Jordanian Airlines have been allowed to organize flights between Baghdad and Amman. The airport was exposed to a security crisis due to shelling by armed groups, and because of the events in Fallujah, the airport was closed on 8/11/2008. After its opening, the capacity of Baghdad International Airport is estimated at 7.5 million passengers per year. The airport has four main halls: Babel, Nineveh, Samarra, and Karbala. Each gate includes six mobile bridges to connect passengers to aircraft, as well as VIP lounges for referees and heads of state. The airport lounges have been fully rehabilitated to compete with international airports. Events of 2003.



**The road leading to the airport
Baghdad International Airport from the inside**

The main airlines operating at the airport are Iraqi Airways.

- Fly Baghdad.
- Saudi Arabian Airlines.
- Nasser Aviation.
- Saqr Al Rafidain.
- Royal Jordanian.
- Jordan Aviation.
- Turkish Airlines.
- Pegasus Lines (Turkey).
- Atlas Jet (Turkey)
- Mahan Air
- Job Air.
- Ishtar Aviation.
- Memphis Flight.
- Gulf Air (Bahrain).
- Bahrain Air (Bahrain).
- Emirates Airline (UAE)

Annex (2) Table (8) Results of the solution using win Q.S.B in the case of the target W

22:45:13		MONDAY			APRIL	16	2018	
Decision Variable	Solution Value	Unit Cost Or Profit C(J)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. C(J)	Allowable Max. C(J)	
1	X1	20.0000	11.0000	220.0000	0	Basic	8.0000	M
2	X2	0	4.0000	0	-5.0000	At bound	-M	9.0000
3	X3	0	5.0000	0	0	Basic	4.0000	5.0000
4	X4	10.0000	8.0000	80.0000	0	Basic	8.0000	M
5	X5	0	3.0000	0	-7.0000	At bound	-M	10.0000
6	X6	30.0000	8.0000	240.0000	0	Basic	3.0000	M
7	X7	10.0000	4.0000	40.0000	0	Basic	4.0000	5.0000
8	X8	0	7.0000	0	0	At bound	-M	7.0000
9	X9	0	9.0000	0	-3.0000	At bound	-M	12.0000
10	X10	0	4.0000	0	-6.0000	At bound	-M	10.0000
11	X11	20.0000	6.0000	120.0000	0	Basic	4.0000	M
12	X12	0	3.0000	0	-6.0000	At bound	-M	9.0000
Objective	Function	(Max.)=	700.0000	(Note:	Alternate	Solution	Exists	
Constraint	Left Hand Side	Direction	Right Hand Side	Slack Or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS	
1	C1	30.0000	=	30.0000	0	1.0000	30.0000	40.0000
2	C2	40.0000	=	40.0000	0	0	40.0000	M
3	C3	20.0000	=	20.0000	0	2.0000	20.0000	30.0000
4	C4	20.0000	=	20.0000	0	10.0000	10.0000	20.0000
5	C5	30.0000	=	40.0000	0	8.0000	0	30.0000
6	C6	30.0000	=	30.0000	0	4.0000	20.0000	30.0000
7	C7	10.0000	=	10.0000	0	7.0000	0	10.0000

Appendix (3) Table (9) preparation of model data for the solution by adopting the function(k)

X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₂₁	X ₂₂	X ₂₃	X ₂₄	X ₃₁	X ₃₂	X ₃₃	X ₃₄	BJ
1	1	1	1	0	0	0	0	0	0	0	0	30
0	0	0	0	1	1	1	1	0	0	0	0	40
0	0	0	0	0	0	0	0	1	1	1	1	20
1	0	0	0	1	0	0	0	1	0	0	0	20
0	1	0	0	0	1	0	0	0	1	0	0	30
0	0	1	0	0	0	1	0	0	0	1	0	30
0	0	0	1	0	0	0	1	0	0	0	1	10
20	30	20	40	30	20	50	10	40	30	20	60	MIN

Appendix (4) Table (10) Results of Solution Using Q.S.B^{win} In the case of a function K

22:45:13		MONDAY			APRIL	16	2018	
Decision Variable	Solution Value	Unit Cost Or Profit C(J)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. C(J)	Allowable Max. C(J)	
1	X1	20.0000	20.0000	40.0000	0	Basic	-M	30.0000
2	X2	0	30.0000	0	10.0000	At bound	20.0000	M
3	X3	10.0000	20.0000	200.0000	0	Basic	10.0000	20.0000
4	X4	0	40.0000	0	30.0000	At bound	10.0000	M
5	X5	0	30.0000	0	10.0000	At bound	20.0000	M
6	X6	30.0000	20.0000	600.0000	0	Basic	-M	30.0000
7	X7	0	50.0000	0	30.0000	At bound	20.0000	M
8	X8	10.0000	10.0000	100.0000	0	Basic	-M	40.0000
9	X9	0	40.0000	0	20.0000	At bound	20.0000	M
10	X10	0	30.0000	0	10.0000	At bound	20.0000	M
11	X11	20.0000	20.0000	400.0000	0	Basic	20.0000	30.0000
12	X12	0	60.0000	0	50.0000	At bound	10.0000	M
Objective	Function	(MIN.)=	1.700.0000	(Note:	Alternate	Solution	Exists	
Constraint	Left Hand Side	Direction	Right Hand Side	Slack Or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS	

1	C1	30.0000	=	30.0000	0	0	30.0000	50.0000
2	C2	40.0000	=	40.0000	0	0	40.0000	M
3	C3	20.0000	=	20.0000	0	0	20.0000	M
4	C4	20.0000	=	20.0000	0	20.0000	0	20.0000
5	C5	30.0000	=	40.0000	0	20.0000	0	30.0000
6	C6	30.0000	=	30.0000	0	20.0000	10.0000	30.0000
7	C7	10.0000	=	10.0000	0	10.0000	0	10.0000

TORA Optimization System - Windows® version 1.00
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 Friday, May 04, 2018 13:25

LINEAR PROGRAM -- ORIGINAL DATA

Title: maximiz TORA

A

	x1	x2	x3	x4	x5	x6
Maximize	3.00	6.00	4.00	9.00	7.00	4.00
Subject to						
(1)	1.00	1.00	1.00	1.00	0.00	0.00
(2)	0.00	0.00	0.00	0.00	1.00	1.00
(3)	0.00	0.00	0.00	0.00	0.00	0.00
(4)	1.00	0.00	0.00	0.00	1.00	0.00
(5)	0.00	1.00	0.00	0.00	0.00	1.00
(6)	0.00	0.00	1.00	0.00	0.00	0.00
(7)	0.00	0.00	0.00	1.00	0.00	0.00
Lower Bound	0.00	0.00	0.00	0.00	0.00	0.00
Upper Bound	infinity	infinity	infinity	infinity	infinity	infinity
Unrestr'd (y/n)?	n	n	n	n	n	n

	x7	x8	x9	x10	x11	x12
(1)	8.00	3.00	8.00	5.00	4.00	11.00
(2)	0.00	0.00	0.00	0.00	0.00	0.00
(3)	1.00	1.00	0.00	0.00	0.00	0.00
(4)	0.00	0.00	1.00	1.00	1.00	1.00
(5)	0.00	0.00	1.00	0.00	0.00	0.00
(6)	1.00	0.00	0.00	0.00	1.00	0.00
(7)	0.00	1.00	0.00	0.00	0.00	1.00
Lower Bound	0.00	0.00	0.00	0.00	0.00	0.00
Upper Bound	infinity	infinity	infinity	infinity	infinity	infinity
Unrestr'd (y/n)?	n	n	n	n	n	n

(1)	=	30.00
(2)	=	40.00
(3)	=	20.00
(4)	=	20.00
(5)	=	30.00
(6)	=	30.00
(7)	=	10.00

LINEAR PROGRAMMING OUTPUT SUMMARY

Title: maximiz TORA
 Final Iteration No.: 13
 Objective Value = 680

Variable	Value	Obj Coeff	Obj Val Contrib
x1:	0.00	3.00	0.00
x2:	30.00	6.00	180.00
x3:	0.00	4.00	0.00
x4:	0.00	9.00	0.00
x5:	10.00	7.00	70.00
x6:	0.00	4.00	0.00
x7:	30.00	8.00	240.00
x8:	0.00	3.00	0.00
x9:	10.00	8.00	80.00
x10:	0.00	5.00	0.00
x11:	0.00	4.00	0.00
x12:	10.00	11.00	110.00

Constraint	RHS	Slack-/Surplus+
1 (=)	30.00	0.00
2 (=)	40.00	0.00
3 (=)	20.00	0.00
4 (=)	20.00	0.00
5 (=)	30.00	0.00
6 (=)	30.00	0.00
7 (=)	10.00	0.00

B

Sensitivity Analysis

Variable	Current Obj Coeff	Min Obj Coeff	Max Obj Coeff	Reduced Cost
x1:	3.00	-infinity	9.00	6.00
x2:	6.00	3.00	infinity	0.00
x3:	4.00	-infinity	10.00	6.00
x4:	9.00	-infinity	12.00	3.00
x5:	7.00	4.00	7.00	0.00
x6:	4.00	4.00	7.00	0.00
x7:	8.00	3.00	infinity	0.00
x8:	3.00	-infinity	10.00	7.00
x9:	8.00	8.00	11.00	0.00
x10:	5.00	-infinity	5.00	0.00
x11:	4.00	-infinity	9.00	5.00
x12:	11.00	8.00	infinity	0.00

Constraint	Current RHS	Min RHS	Max RHS	Dual Price
1 (=)	30.00	20.00	30.00	12.00
2 (=)	40.00	30.00	40.00	10.00
3 (=)	20.00	10.00	20.00	11.00
4 (=)	20.00	20.00	30.00	-3.00
5 (=)	30.00	30.00	40.00	-6.00
6 (=)	30.00	30.00	40.00	-2.00
7 (=)	10.00	10.00	infinity	0.00

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 Friday, May 04, 2018 13:37

LINEAR PROGRAM -- ORIGINAL DATA

Title: Minimize TORA

A

	x1	x2	x3	x4	x5	x6
Minimize	20.00	30.00	20.00	40.00	30.00	20.00
Subject to						
(1)	1.00	1.00	1.00	1.00	0.00	0.00
(2)	0.00	0.00	0.00	0.00	1.00	1.00
(3)	0.00	0.00	0.00	0.00	0.00	0.00
(4)	1.00	0.00	0.00	0.00	1.00	0.00
(5)	0.00	1.00	0.00	0.00	0.00	1.00
(6)	0.00	0.00	1.00	0.00	0.00	0.00
(7)	0.00	0.00	0.00	1.00	0.00	0.00
Lower Bound	0.00	0.00	0.00	0.00	0.00	0.00
Upper Bound	infinity	infinity	infinity	infinity	infinity	infinity
Unrestr'd (y/n)?	n	n	n	n	n	n
	x7	x8	x9	x10	x11	x12
(1)	50.00	10.00	40.00	30.00	20.00	60.00
(2)	0.00	0.00	0.00	0.00	0.00	0.00
(3)	1.00	1.00	0.00	0.00	0.00	0.00
(4)	0.00	0.00	1.00	1.00	1.00	1.00
(5)	0.00	0.00	1.00	0.00	0.00	0.00
(6)	0.00	0.00	0.00	1.00	0.00	0.00
(7)	1.00	0.00	0.00	0.00	1.00	0.00
(8)	0.00	1.00	0.00	0.00	0.00	1.00
Lower Bound	0.00	0.00	0.00	0.00	0.00	0.00
Upper Bound	infinity	infinity	infinity	infinity	infinity	infinity
Unrestr'd (y/n)?	n	n	n	n	n	n
(1)	=	30.00				
(2)	=	40.00				
(3)	=	20.00				
(4)	=	20.00				
(5)	=	30.00				
(6)	=	30.00				
(7)	=	10.00				

LINEAR PROGRAMMING OUTPUT SUMMARY

Title: Minimize TORA
 Final Iteration No.: 14
 Objective Value = 1700

Variable	Value	Obj Coeff	Obj Val Contrib
x1:	20.00	20.00	400.00
x2:	0.00	30.00	0.00
x3:	10.00	20.00	200.00
x4:	0.00	40.00	0.00
x5:	0.00	30.00	0.00
x6:	30.00	20.00	600.00
x7:	0.00	50.00	0.00
x8:	10.00	10.00	100.00
x9:	0.00	40.00	0.00
x10:	0.00	30.00	0.00
x11:	20.00	20.00	400.00
x12:	0.00	60.00	0.00

Constraint	RHS	Slack-/Surplus+
1 (=)	30.00	0.00
2 (=)	40.00	0.00
3 (=)	20.00	0.00
4 (=)	20.00	0.00
5 (=)	30.00	0.00
6 (=)	30.00	0.00
7 (=)	10.00	0.00

B

Sensitivity Analysis

Variable	Current Obj Coeff	Min Obj Coeff	Max Obj Coeff	Reduced Cost
x1:	20.00	0.00	40.00	0.00
x2:	30.00	10.00	infinity	-20.00
x3:	20.00	0.00	40.00	0.00
x4:	40.00	0.00	infinity	-40.00
x5:	30.00	10.00	50.00	0.00
x6:	20.00	-infinity	40.00	0.00
x7:	50.00	30.00	infinity	-20.00
x8:	10.00	-infinity	50.00	0.00
x9:	40.00	20.00	infinity	-20.00
x10:	30.00	10.00	infinity	-20.00
x11:	20.00	-infinity	40.00	0.00
x12:	60.00	0.00	infinity	-60.00

Constraint	Current RHS	Min RHS	Max RHS	Dual Price
1 (=)	30.00	20.00	30.00	0.00
2 (=)	40.00	30.00	40.00	10.00
3 (=)	20.00	10.00	20.00	0.00
4 (=)	20.00	20.00	30.00	20.00
5 (=)	30.00	30.00	40.00	10.00
6 (=)	30.00	30.00	40.00	20.00
7 (=)	10.00	10.00	infinity	0.00