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Using Bi-Level Programming to Evaluate Banking Operations

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Abstract

The importance of performance evaluation in diagnosing the positive and negative cases of excellence of banks appears as it is a necessary means to achieve the extent to which banks can achieve the required level of performance. The research sought to evaluate the performance of banks through the use and application of one of the programming models that is rarely used in banking literature, which is the two-level programming model (quadratic - linear programming). The efficiency index for each banking process is either (1) or (zero). The process that... Achieving an efficiency score of (1) means that it is 100% efficient and falls within the limits of efficiency and achieves the highest returns of profits. As for the banking operation that has an efficiency index of (zero), this means that it does not achieve any return of profits. Thus, applying the two-level programming model determines the extent to which Each bank in the sample, which was taken as a random sample, reached (19) banks out of (65) banks, represented by Al-Rafidain Bank in the city of Baghdad, which was considered as a statistical population for the research for the year 2022. After addressing the theoretical aspect of two-level programming, which is considered one of the improvement issues. It is nested on two levels, one of which is the upper level, called the independent variable (Leader), and the other is represented by the lower level, called the dependent variable (Follower). Each level has a special function and has restrictions. In order to evaluate the upper and lower bounds, the

Karch-Cohen-Tucker conditions were used, thus converting two-level programming into single-level programming, and thus applying Program (). The results of the analysis showed that there is a variation in performance between the banks in the research sample, as well as a variation in performance at the level of a single bank depending on the variation in percentages and quantities of profits achieved to which the research sample contributed, and through the results achieved, Al-Mansour Bank obtained first place among the sample banks. Whereas, the value of the objective function achieved for the bank reached (339,636,731), and Al-Mustansir Street Bank ranked (last) among the sample banks, as the value of the objective function achieved for the bank reached (337,791,490). The highest return on profits was achieved by the banks in the research sample from the banking operation (long-term loans) and its value reached (190,193,543), followed by the banking operation (personal advances), which amounted to (15,738,985), then the banking operation (short-term loans), whose value amounted to (8,104,846), and then the banking operation (Debit current accounts, amounting to (1,847,239), and finally the banking transaction (discounted commercial papers), amounting to (43,720). The research concluded with a set of conclusions and recommendations.

Section One

1.1 Introduction

Banks are the heart of the financial system, as the effectiveness and efficiency of the banking system is an essential factor in the progress and development of countries, and they are considered a pivot for activating various economic sectors (Al-Naimi, 2005:2). For this reason, there is a need to create a strong banking sector that helps provide the various sectors with the necessary financing to carry out their activities and provide banking services of all kinds. It is necessary to subject this sector to the process of oversight and performance evaluation in order to preserve the integrity of the banks' financial positions and achieve a sound banking sector that preserves the rights of depositors. And investors and ensures the proper implementation of the state's monetary policy in an appropriate manner to contribute to the development and prosperity of the national economy.

For this role played by banks, there is a need to evaluate their performance to achieve banking safety, and the process of evaluating banking operations is the focus of our research because it

is of great importance for achieving the banks' goals of profitability, liquidity and security through the optimal use of resources and reaching the highest return with the lowest risk and at the lowest possible cost. The traditional systems used to evaluate the performance of banks are deficient and have limitations in that they depend on quantitative rather than qualitative analysis. Therefore, it has become necessary to find and apply new forms of software that keep pace with global economic developments and move away from traditional methods (Abdel Reda, 2009: 65).

Hence, the application of two-level programming came to provide an analysis of the strengths and weaknesses in the banks' performance and an attempt to avoid the weaknesses and enhance the strengths in them to achieve better performance.

Two-level programming problems have received increasing attention in the last two decades, with numerous papers, surveys, and research activities focusing on this topic because on the one hand it represents a new and interesting approach to modeling a wide range of real-life applications, and on the other hand it remains a very challenging and subclass problem. A small number of situations with special characteristics that can be solved efficiently, so bi-level programming can be used in financial banking, so bi-level programming can represent situations in which there are multiple decision makers with conflicting goals and in which this type of problem can arise. Financial banking, where banks and their customers often have different goals.

For example, a bank may want to maximize its profits by offering loans at high interest rates, while a customer may want to minimize interest payments on the loan. Using a two-level programming application, we can model the conflict of interest, where the bank's primary function is to maximize profits. The objective function of the customer is to minimize interest payments. The solution to the two-level problem represents a compromise between the bank and the customer. In addition, two-level programming can be used to model the decision-making processes of financial institutions and regulatory bodies. For example, a regulator may want to ensure that institutions Finance operates in a safe and sound manner, while financial institutions want to maximize profits, so this type of conflict can also be modeled using a two-level programming problem.

Operations research models are considered one of the distinguished scientific methods that have proven to be highly effective in addressing many of the problems facing institutions, including banking institutions, which contribute significantly and clearly to improving and evaluating performance. Therefore, we will try to shed light on an important topic for banking operations, and we will apply these models in order to improve and evaluate banking operations. In general, bi-level programming can be a useful tool for modeling and solving complex decision-making problems in the banking sector.

1.2 Importance of research

The importance of the research is evident in the fact that it examines the effectiveness of applying two-level programming models in Iraqi banks through the prominent role that these models are required to play in the success of management by providing it with appropriate accounting information to perform its functions optimally, which leads to the success of these banks, which will subsequently return There are great benefits to the Iraqi economy because the banking sector plays a huge role in the Iraqi economy, which requires researching the effectiveness of these models in order to contribute to the development of the national economy, and this is what this research will address and emphasize its importance.

1.3 Problem of Research

The technological development and information revolution that the world is witnessing, and the great commercial and economic openness in the world in general and in Iraq in particular, have made it necessary for banks to keep pace with these developments.

Banks have to find new software models and applications that meet this gap between the traditional system (financial analysis) and the current variables. Two-level programming has been proposed, which will contribute to evaluating banking performance, identifying the adequacy and financial soundness of capital, and quantitative and qualitative analysis of the quality of assets to determine the soundness of operations. Funds, evaluating cash liquidity, the ability to pay obligations and the quality of profits, as well as evaluating bank management and its ability to contain risks and follow up on the bank’s operational activities.

From here came the idea of the research to determine the effectiveness of applying two-level programming in the banks of Al-Rafidain Bank and some of its branches, and to try to determine the extent to which this programming achieves its desired goals.

1.4 Objectives of the Research: -

The main objective of this research is to introduce the comprehensive scientific and cognitive content of two-level programming and banking operations and to try to identify the effectiveness of using two-level programming and its application in banking operations while evaluating the performance of these banks in the research sample and making comparisons between them.

1.5 limits of the research: -

The scope of the research is as follows:

Human limits: This includes managers working in Rafidain Bank and its branches.

Spatial boundaries: The spatial boundaries were represented by Al-Rafidain Bank and its branches in Baghdad Governorate, numbering (65) banks.

Time limits: The time period in which the research was implemented falls within the year (2023), and the data is available in detail for the year (2022).

Scientific limits: Our current research used the application of two-level programming models to some banks operating in Baghdad to measure and evaluate their performance.

1.6 Previous studies: -

1. In 2000, researchers (Bard, J.F., Plummer, J., & Sourie, J.C.) presented a formulation of bi-level programming programs that can be used to help decision makers arrive at a rational policy to encourage biofuel production for an agricultural region in the Northern France includes 393 farms.

2. In 2001, researchers (Marcotte, P., Savard, G., & Zhu, D. L.) proposed a solution to two-level programming problems by using the trust region method, which includes a linear program at the upper level and a tolerance Linearization at the lower level Through the concepts of the

confidence region in a new way we obtain an executable algorithm that turns into a robust fixed point for the two-level programming problem.

3. In 2008, researchers (Lv, Y., Hu, T., Wang, G., & Wan, Z.) presented a neural network model to solve the nonlinear two-level programming problem, which is one of the difficult problems to solve, and they proved that the proposed neural network Stable and capable of generating the optimal solution to a nonlinear two-level programming problem.

4. In 2012, researchers (Dempe, S., & Zemkoho, A. B.) reformulated the well-known classical Kuhan Tacker conditions and used Karush-kuhn-Tucker (KKT) conditions on two-level programming problems to transform them into a one-level problem. Linear, which is also known as the Optimization Problem with Generalized Equation.

5. In 2014, the researcher (Dempe, S., Mordukhovich, B.S., & Zemkoho) presented a research on two-level nonlinear programming in which he explained its characteristics, methods of solving it, and its ideal conditions. Solve some numerical examples.

6. In 2015, researchers (Hosseini, E., & Kamalabadi, I.N.) presented a paper that included an explanation of nonlinear two-level programming and developed two effective algorithms to calculate it, using Karush-kuhn-Tucker (KKT) conditions to transform the nonlinear two-level problem into Sin.

7. In 2018, researchers (Ghadimi, S., & Wang, M) studied the two-level programming problem when the objective function is very arcconvex. The researchers presented a research of an approximate algorithm under a number of assumptions about the objective function and also presented a formula that improves the rate of convergence under the assumption of convexity.

8. In 2020, the Iraqi researcher (Heba Fadel Harbi Al-Sudani) studied two-level programming while addressing methods for solving the problem of non-linear two-level programming, where real data was used for the Medicines and Supplies Marketing Company (Kimadia) and she concluded that the best method for simulation results was an algorithm. Modified branching and selection.

Section Two

Theoretical framework for the research

2.1. Bi-level programming

Bi-level programming is known as mathematical programming in which an optimization problem includes another optimization problem in the form of a constraint, and here it can be more accurately described as an unequal game between two people in which playing is sequential and does not allow cooperation. This problem has received very great attention in the mathematical programming community due to the spread of applications and the use of evolutionary algorithms to address these problems.

The nonlinear two-level programming problem is a specific optimization problem that is restricted by two unknown concepts (x, y). It is one of the difficult and comp lex problems and is solved using algorithms instead of solving it directly. In this problem, the solutions of the constraints for the two-level problem can be replaced into a set of The conditions that these conditions must achieve are the lowest point for the internal problem. Solution techniques include the Branch and Bound algorithm and the Penalty function method, which includes finding solutions to an unrestricted series of problems that are concave or convex and the Taylor method. There is another technique, the trust region, that is used to solve two-level programming problems.

Two-level programming is defined as follows:

$$(\text{U P}) \quad \begin{matrix} max \\ S.t \end{matrix} \quad \text{F}(\text{x},\text{y}) \qquad `$$

$$\begin{matrix} max \\ S.t \end{matrix} \quad f(x,y)$$

Where (U P) is the highest level of the problem

$$(\text{L P}) \quad \begin{matrix} \\ S.t \\ \\ \end{matrix} \quad \begin{matrix} \text{g}(x,y) \leq 0 \\ \\ x,\ y \geq 0 \end{matrix}$$

Where (LP) is the lowest level of the problem

$$F: R^{n\times m} \rightarrow R^{1}, f: R^{n\times m} \rightarrow R^{1}$$

$$g: R^{n\times m} \rightarrow R^{q}, X \in R^{n}, \quad y \in R^{m}$$

Where F is the objective function of the Independent (Leader) and f is the objective function of the Follower and the possible region of the solution:

$$S = \{(x,y) \mid g(x,y) \leq 0, \quad x,y \geq 0\}$$

2.2 The basic assumptions of the two-level programming problem

1. The constraint region for the two-level programming problem is:

$$S(x) = \{(x,y) \in X \times Y : G(x,y) \leq 0, \quad g(x,y) \leq 0\}$$

2. S is the leader's decision space and is as follows:

$$S(x) = \{x \in X: \exists\ y \in Y, \text{such that } (x,y) \in S\}$$

3. The set of possible solutions for the lowest level (Leader decision) for each constant x x∈S(x) is:

$$S(x) = \{\ y \in Y: g(x,y) \leq 0\}$$

4. The follower reaction for every constant x x∈S(x) is as follows:

$$P(x) = \{\ y \in Y: y \in \arg\min\{f(x,y) : y \in S(x)\}\}$$

5. Possible solutions (The inducible region) for the two-level programming problem are:

$$IR = \{(x,y) \in X \times Y: (x,y) \in S, \quad y \in P(x)\}$$

Through these assumptions, the two-level programming problem maximizes the objective function of the higher level F (x, y) through the region of possible solutions (the inducible region).

2.3 Characteristics of two-level programming

1. *g*,*f* and *G* are continuous and differentiable at *y* and for every y∈S.
2. *f* is convex at *y* and for every y∈S.
3. *S* is a convex set.
4. *F* is continuous and convex to x and *y,* and *x* is a compact set.
5. Bi-level programming is sometimes not convex even if the upper and lower level objective functions and constraints are all linear.
6. Two-level programming is a difficult and complex problem and is solved using algorithms instead of directly, and one of these algorithms is genetic.
7. The upper (independent) level and the lower (dependent) level are not interchangeable.
8. The order in which decisions are made is important.

2.4 Kuhn_Tucker_Karsh (KKT) terms

The necessary Cohen-Tucker (KKT) conditions can also be sufficient if the objective function and the solution space meet certain conditions regarding convexity and concavity, as the research of these conditions is based on the Lagrange method. Table (1-2) includes summaries of these conditions:

(Table 2-1): Summaries of KKT terms

Required conditions		
Optimization type	**Objective function**	**solution space**
Maximize Max	Concave	Concave set
Reduce Min	Convex	Convex set

Verifying whether the objective function is convex or concave is easier than proving that the solution space is a convex set. Therefore, we will present a list of conditions that are easy to apply in practice, assuming that the convexity of the solution space can be verified by directly testing the convexity or concavity of the constraint functions.

First, we know nonlinear problems in general:

$$\text{Min or Max} \quad Z = f(x)$$

$$g_i(X) \leq 0 \qquad , i = 1, 2, \dots, r$$
$$g_i(X) \geq 0 \qquad , i = 1,2 \dots . p$$
$$g_i(X) = 0 \qquad , i = 1, 2, \dots, m$$

$$\mathcal{J}(X, S, \lambda) = f(x) - \sum_{i=1}^{r} \lambda_i [g_i(X) + S_i^2] - \sum_{i=r+1}^{p} \lambda_i [g_i(X) + S_i^2] - \sum_{i=p+1}^{m} \lambda_i g_i(X)$$

Where we denote λ the Lagrange multiplier associated with constraint i. Therefore, the conditions that make Cohen-Tucker sufficient conditions can be summarized in Table No. (2-2).

(Table 2-2): Conditions that make KKT sufficient conditions

Required conditions			
Optimization type	*f(x)*	g(x)	λ_i
Maximize	Concave	Convex	(1≤r≤n) $0 \leq$
		Concave	(n+1≤i≤p) $0 \geq$
		Linear	(p+1≤i≤m)Unrestricted
Reduce	Convex	Convex	(1≤r≤n) $0 \leq$
		Concave	(n+1≤i≤p) $0 \geq$
		Linear	(p+1≤i≤m)Unrestricted

Linear-quadrati Bi-level Programming (LQBP).

It can be defined as follows:

$$\max_x \; f(x, y) = a^T x + b^T y$$

S.t

$$\max_{y} \; g(x,y) = c^T x + d^T y + (x^T, y^T) Q (x^T, y^T)^T$$

S.t AX+BY $\leq$ r

$x, y \geq 0$

where:

$a, c \in R^{n_1}$

$b, d \in R^{n_2}$

$A \in R^{m \times n_1}$

$B \in R^{m \times n_2}$

$r \in R^{m}$

$X \in R^{n_1}$

$Y \in R^{n_2}$

And f(x,y), g(x,y) are the objective functions of the independent (Leader) and follower (Follower), respectively.

And Q ∈R^(n_1+n_2)×R^(n_1+n_2) is a symmetric matrix and is also positive semi definite, and we assume that:

$$Q = \begin{bmatrix} Q_2 & {Q_1}^T \\ Q_1 & Q_0 \end{bmatrix}$$

$$Q_0 \in R^{n_2 \times n_2}, \quad Q_1 \in R^{n_2 \times n_1}, Q_2 \in R^{n_1 \times n_1}$$

Therefore, the Follower problem in Linear-quadric programming is as follows:

$$\max_{x} \; g(x,y) = d^T y + 2 Q_1 x y + y^T Q_0 y$$

s.t

$B y \leq r - AX$

$$y \geq 0$$

The acceptable region for the problem is:

$$S = \{(x, y) \ \big| Ax + By \ \leq r, x \ y \ \geq 0\}$$

Where if X is fixed, then the free region of the function is as follows:

$$S = \{y \big| \mathrm{r} - \mathrm{A}x \, , x \ y \ \geq 0\}$$

Based on the aforementioned assumptions, the rational reaction set for a function is:

$$\mathrm{P(X)} = \{ \ y \ \big| y \ \in \arg\max \ [g(x, y) \big| \ \in s(\mathrm{x})]\}$$

The region of possible solutions is:

$$\mathrm{IR} = \{(x, y) \ \in \mathrm{s} \, , \ y \in \ \mathrm{P(x)}\}$$

Finally, the two-level programming problem referred to above can be written as follows:

$$\max \{ \ f(x, y) \ \big| (x, y) \in \mathrm{IR}$$

2.2 Banking Operations

The first appearance of forms of banking dealing was long before the emergence of banks, which is indicated by historical documents, especially in Mesopotamia, around 3500 BC, and the principles established by Hammurabi, which date back to 1675 BC and known as the Code of Hammurabi, It is considered one of the oldest known texts in history regarding deposits, borrowing, interest, and guarantees (Laiqa: 14, 2007), which was historically linked to the emergence of banking operations and the development of the activity of money changers and goldsmiths, as they preserved the money of merchants and businessmen, and after this money became large amounts over time. Goldsmiths and money changers lent them in exchange for interest, and thus the function of lending arose, that is, providing loans. After that, other operations appeared successively and in conjunction with the development of commercial banks (Al Ali, 2002: 21). The mechanism of banks' work includes a large number of banking operations, which together constitute banking services. Provided to customers by the banking

sector, these services are activities or performance provided by one party to another, in addition to the fact that these activities are intangible and do not entail a transfer of ownership (Al-Dahan, 2012: 67).

There were signs of banking activities, and banking activity took initial forms through the provision of banking services, such as banking services, currency exchange, money lending in exchange for a mortgage, and other banking services, but it was not through one person except with the advent of the era of trade that appeared in the sixth century. Ten and continued until the middle of the eighteenth century, when the movement of trade between European countries and the Levant began, then the need arose for the presence of money changers who would protect and preserve money when transferring it from one place to another with the least degree of risk (Yousry, 1996: 130).

International banks have witnessed new, modern technical developments in the field of the banking system, as banks will have to increasingly rely on modern technology to develop and expand their banking services permanently and continuously in order to meet the evolving needs of customers. In recent years, banks have witnessed rapid development of the services they provide, due to the emergence of a group It is one of the advanced financial products that were not previously available to bank customers (Arab Banking Industry, 1997: 177).

The process of searching for a legal and comprehensive definition of banking operations is a task with uncertain results, especially since the banking industry as an economic activity is in continuous development and the pace of innovations and modernizations is constantly increasing. Banking operations are divided into two parts: (Abdullah and Al-Trad, 2006: 8): -

Section One: Domestic Banking Operations

Section Two: Foreign Banking Operations

Section One: Domestic Banking Operations

These are the operations that banks provide to their customers, represented by (lending, investment, banking facilities, electronic services, etc.), which lead to facilitating economic operations of production, marketing, distribution and consumption.

Section Two: Foreign Banking Operations

Foreign banking operations reflect the interconnection and integration between local and foreign banks, and thus facilitate foreign trade and international payments. There are many foreign banking operations, the most important of which are external transfers, documentary credits, and letters of guarantee.

Section Three

3.1 Applying financial indicators and presenting and discussing the results of the research

To measure and evaluate the technical efficiency of the banking system's performance, a two-level programming model was applied, and output-oriented efficiency (output-maximizing efficiency) was chosen. It is worth noting that the efficiency index for each banking operation is either (1) or (zero). The banking operation that achieves an efficiency score of (1) means that it is 100% efficient, falls within the limits of efficiency, and achieves the highest profit returns. As for the banking operation that has an efficiency index of (zero), this means that it does not operate to the same degree as the banking operations that achieved a score of (0). Efficiency (1), meaning that it did not achieve any return on profits. Thus, applying the two-level programming model determines the level reached by each bank and each banking operation through the results reached by achieving profits or not. Based on the results of the analysis shown in Table (3) below, we find the following: The highest value of the objective function was recorded for Al-Mansour Bank, and the lowest value of the objective function was recorded for Al-Mustansir Street Bank.

Table (3.1) shows the value of realized profits distributed by banks and by each banking operation

No.	Bank name	Banking operations					Z
		X1	X2	X3	X4	X5	
1	Al Raisi	2,259,488	10220	161862	-	3,269,956	**5701526**
2	Al Sanak	55,386	-	1,273,798	-	121,471	**1450655**
3	Al-Kadhimiya	561,812	-	51,032	5,441	153,588	**771873**
4	Alawiya	20,216,981	7,109,745	-	-	155,993	**27482719**
5	Al Qasar Al Abiadh	806,497	-	75,836	-	1,304,645	**2186978**
6	Al-Mansour	142,681,680	-	15470	-	410,545	**143107695**
7	Dor Al Dhubat	429,757	444,194	14,952	-	481,507	**1370410**
8	Sahat Al Firdous	3,197,490	-	989	-	481,507	**3679986**
9	Al Mustansir Street	50,611	136	135,362	31,608	125,139	**342856**
10	Hai AL Wihda	1,130,871	312,482	41,790	-	922,702	**2407845**
11	AL Khadraa	120,990	21,190	-	-	2,257,100	**2399280**

12	Andalus	116,654	100,485	17,332	6,671	163,274	**404416**
13	Shari Al Muheet	950,021	160	-	-	823,486	**1773667**
14	Al Qudus	303,605	-	44,989	-	1,557,460	**1906054**
15	Al Risala	2,227,142	-	-	-	295,135	**2522277**
16	Sikak Al Hadeed	10,947,075	47	-	-	346,840	**11293962**
17	Al MAirifah	725,001	106,187	13,827	-	1,153,883	**1998898**
18	Branch of the Ministry of Defence	3,102,417	-	-	-	1,411,709	**4514126**
19	General Secretariat for the Council of Ministers	310,065	-	-	-	303,045	**613110**
Total		**190193543**	**8104846**	**1847239**	**43720**	**15738985**	**215928333**

First: Al Raisi:

Table (3-1) shows us that the bank ranked (fourth) among the banks in the sample, as it appeared to us that the value of the objective function for this bank amounted to (340073942), which represents the amount of the total profit for this bank. It turned out to us that the bank achieved a profit of (2259488) from the operation. Banking (long-term loans), while the profit achieved from the banking operation (short-term loans) was (10,220), and the profit achieved

from the banking operation (debit current accounts) amounted to (161,862), while the banking operation, discounted commercial papers and personal advances, did not generate any profit for the bank. the main.

Second: Al-Sanak Bank:

The bank ranked (fourteenth) among the banks in the sample, and it turns out that the value of the objective function for this bank reached (339,631,731). It appeared to us that the banking operation (long-term loans) achieved a profit of (55,386), while the profit achieved was (1,273,798) from the banking operation. (Debit current accounts) and (121,471) from the banking operation (personal advances), while the banking operation, short-term loans, and the banking operation, discounted commercial papers, did not achieve any profit for Al-Sanak Bank.

Third: Al-Kadhimiya Bank:

It is clear to us from the table that the bank achieved rank (sixteenth) among the banks in the sample, and that the value of the objective function achieved for this bank is (322838613). It also appeared to us that the banking operation (short-term loans) did not achieve any profit for this bank, while the banking operations achieved both: (Long-term loans, receivable current accounts, discounted commercial papers, and personal advances) profits amounting to (561812) (51032), (5441), (153588) respectively.

Fourth: Alawiya Bank:

From the table, it becomes clear to us that the bank achieved second place among the banks in the sample. The reason for the rise is that the bank's management always seeks to exert the utmost efforts in all banking means and tools in following up on the latest developments and developments, which leads to the development of the bank's work, and that the value of the goal function achieved is for the Alawiya bank, it amounted to (346,036,486). It also shows us that the banking operation (long-term loans) achieved a profit of (20,216,981), while the profit achieved from the banking operation (short-term loans) amounted to (7,109,745), and the profit achieved from the banking operation (personal advances) amounted to (346,036,486). The

amount of (155,993) while the two banking operations (debit current accounts and personal advances) did not achieve any profit for Al-Alawiya Bank.

Fifth: Al Qasar Al Abiadh:

The table shows us that the bank ranked (tenth) among the sample banks and that the value of the objective function for this bank reached (339636731). The same table also shows us that the banking operation (long-term loans) achieved a profit of (806497) and the profit achieved from the banking operation was (Debit current accounts) profit amounted to (75,836), and the profit achieved amounted to (1,304,645) from the banking operation (personal advances), while the banking operations (short-term loans and discounted commercial papers) did not generate any return for the White Palace Bank.

Sixth: Al-Mansour Bank:

Through the results, it becomes clear to us that Egypt achieved first place among the sample banks, which demonstrates its clear superiority over the rest of the research sample, and the good activity of its board of directors in its use of profit assets for banking operations, as the value of the objective function achieved for the bank reached (339,636,731) and that the banking operation (Long-term loans) achieved a profit of (142,681,680) while the profits achieved for banking operations (debit current accounts, personal advances) were (15,470, 410,545) respectively, while banking operations did not achieve (short-term loans, discounted commercial papers). Any profit for the bank.

Seventh: Dur Al-Dhubbat:

Table No. (3-1) shows us that the bank achieved rank (fifteenth) among the banks in the sample, and that the value of the objective function achieved for Dur Al-Dhubbat Bank is (347882727), and that the banking operation (discounted commercial papers) did not achieve any profit for the bank, while the profit achieved for banking operations was (Long-term loans, short-term loans, receivable current accounts, personal advances) amounting to (429757, 444194, 14925, 481507) respectively.

Eighth: Sahat Al Firdous:

The bank ranked sixth among the banks in the sample, and the value of the objective function achieved for the bank was (339,636,731), and the banking operation (long-term loans) achieved a profit of (3,197,490), while the profit achieved from the banking operation (debit current accounts) was worth (3,197,490). 989) Likewise, the banking operation (personal advances) achieved a profit of (481,507) while the operations (short-term loans and discounted commercial papers) did not achieve any profit for the bank.

Ninth: Al-Mustansir Street:

The results showed us that the bank ranked last among the banks in the sample, and this indicates the weakness of the activity of its board of directors in investing its money in profitable assets, as the value of the objective function achieved for the bank amounted to (337,791,490) and that all five banking operations (long-term loans, loans Short-term, receivable current accounts, discounted commercial papers, personal advances) achieved profits respectively as follows (50611, 136, 135362, 31608, 125139).

4-1 Conclusions: -

Based on the results of the analysis that were discussed in the practical aspect of the research, several conclusions were reached that can be summarized as follows:

The efficiency index for each banking operation is either (1) or (zero). The banking operation that achieves an efficiency score of (1) means that it is 100% efficient, falls within the limits of efficiency, and achieves the highest profit returns. As for the banking operation that has an efficiency index of (zero), this means that it does not operate to the same degree as the banking operations that achieved a score of (0). Efficiency (1), meaning that it did not achieve any profit return.

1. The results of evaluating the performance of the banks in the research sample showed a large discrepancy between their performance, as well as the variation in performance at the single bank level in each separate banking operation.

2. The results demonstrated the benefits and importance of two-level programming in control, supervision and evaluation, in identifying strengths and weaknesses, and in determining the future performance of the bank, in addition to the important data it provides to bank management.

3. We conclude from the research that the reason for resorting to algorithms and programs is the difficulty in solving the two-level programming problem directly.

4. The research indicators showed that Al-Mansour Bank ranked first among the sample banks in its contribution to achieving profits, which demonstrates its clear superiority in this over the rest of the research sample and the good activity of its board of directors in its use of profit assets for banking operations, while Al-Mustansir Street Bank obtained the rank. (The last) among the banks in the sample, and this indicates the weakness of the activity of its board of directors in investing its funds in profitable assets.

5. The results showed us that the highest return on profits was achieved by the banks in the research sample from the banking operation (long-term loans) whose value amounted to (190,193,543), followed by the banking operation (personal advances), which amounted to (15,738,985), then the banking operation (short-term loans), whose value amounted to (8,104,846). Then came the banking transaction (debit current accounts), amounting to (1,847,239), and finally the banking transaction (discounted commercial papers), amounting to (43,720).

4-2 Recommendations: -

It is clear to us through the applied aspect of the research and the conclusions reached that the research and scientific necessity requires that these conclusions be supplemented with a set of recommendations that can be summarized as follows:

1. Through the special features of the mathematical model for two-level programming that was used in the current research and the important results of the outcomes of applying this model, it is preferable to generalize this mathematical model to other banks in order to benefit from it scientifically to obtain the optimal and desired results.

2. The research recommends developing the model studied (two-level) in this research to be three-level or multi-level.

3. Urging banks to use the two-level programming model in their monitoring of banks' performance as one of the models used to evaluate performance in order to be able to discover weaknesses and defects in a timely manner and thus determine the optimal decision.

4. The research recommends conducting future research and using new solution methods and algorithms to solve the two-level programming problem.

5. It is necessary for the followers of the banks, the research sample, that did not achieve the full efficiency of the banks to introduce their employees to training courses and consider them among the necessary requirements for promoting them to higher job titles in order for them to acquire the latest sciences related to banking work.

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