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Optimal Management of Internal Capital of Company

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Abstract**—**In this paper, dynamic programming is used to determine the optimal management of financial resources in company. Solution of the problem by consider into simpler substructures is constructed. The optimal management of internal capital of company are simulated. The tools applied in this development are based on graph theory. The software of given problems is built by using greedy algorithm. The obtained model and program maintenance enable us to define the optimal version of management of proper financial flows by using visual diagram on each level of investment.

Keywords**—**Management, software, optimal, greedy algorithm, graph-diagram.

I. Introduction

ONE of the features of modern economy is flexibility on each level of management. It defines the realization of different (material, human, financial) flows during planning. The flexibility of economical processes requires the comparison of current, future capital and other expenses. Besides, the flexibility also needs considering other specific financial and indirect economic links on balance-sheet calculation level. Thus, the dynamic process must be balanced and optimal, which exactly represents the specific character of market interaction. The companies (a firm or a branch) strive for the maximum profit or the entire satisfaction of market request and making these processes at minimum expense. The research of this problem requires the importance of creating the appropriate economical-mathematical model.

Economics became more mathematical as a discipline by introduction of new generalized techniques such as graph theory. Optimization problems run through modern economics, with some economic and technical constraints. Economic equilibrium is studied in optimization theory as a key ingredient of economic theorems that in principle could be tested against empirical data. Newer developments have occurred in dynamic programming and modeling optimization with risk and uncertainty, including applications to portfolio theory, the economics of information, and search theory [1]. More concretely, many problems are amenable to analytical (formulaic) solution. Many others may be sufficiently complex to require numerical methods for solution, aided by software. Computable economics is a growing field of research which has been given much attention by scholars in the recent decades. they are devoted to the development of computation methods for the solution of economic problems. [2].

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II. Notations and Definitive Concepts

Reducing inequalities and improving the quality of company environment require material, human, financial resources, and their optimal management [1].

Financial resources are from an economic perspective part of the assets (property) of the organization. Financial resources are from an economic perspective part of the assets (property) of the organization. It is a term which refers to the financial funds of organization.

The implementation of resource management software has become a valuable tool for organizations looking to efficiently manage resources [2].

The paper is devoted to the development of optimal Management of Internal capital of company. The methods applied in this development are based on directed graph theory.

One of the features of modern economy is the dynamism on each level of management. It defines the realization of different (material, human, financial) flows during planning.

The dynamic process must be balanced and optimal. The research of this problem makes the construction of a corresponding economic-mathematical model necessary, because only through computer simulation we can determine the optimal variant of management of the relevant flows of finance or goods in proper time so that they are reflected in the business plans of the company.

We know many papers on the issues of optimal allocation of financial resources, using the appropriate optimization methods such as [3]. But, little work is devoted to the construction of optimal management system in the graphs.

The problem of optimal management of investments relates to the problems of dynamic programming. In the methods of dynamic programming, the initial Information is based on the consideration that in the model the real challenges are:

- Objective;
- Constraint condition;
- Parameters of management, the objective are achieved by these regulations.

We have constructed the optimizer software of “solver parameters” where is including the following fields (Fig. 1):

- Field of “Set Target Cell” to describe the objective of problems (Fig. 1);
- Field of “Subject to the Constraints” to describe the constraint condition (Fig. 1);
- Parameters of management are described in the field of “by Changing Cells” (Fig. 1);
- Optimization criterion is identified by the buttons of “Equal To” field (Fig. 1).

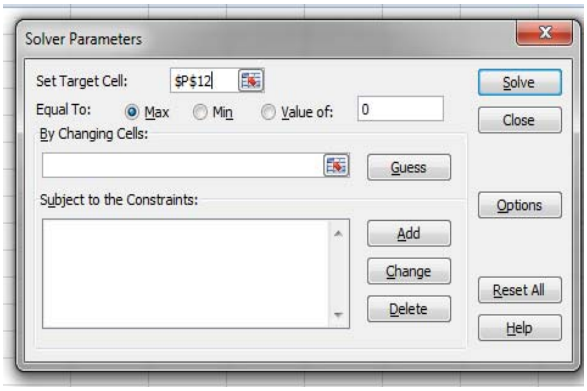

Fig. 1 Window of solver parameters

The software is based on the following procedure (Fig. 1):

- To fill the fields for the particular value
- Choose the button of criteria
- Click on the button "options"
- Fill the following fields of widow "solver options" (Fig. 2)

1. "Max time"-write number of seconds;
2. "Iterations"- write number of iterations;
3. "Precision"- write number of approximation;
4. "Tolerance"- write number of tolerance;
5. "Convergence"-state of converging;
6. Choose the Assume;
7. Choose the regime of "show iteration results";
8. Choose the buttons of "estimates";
9. Choose the buttons of "derivatives";
10. Choose the buttons of Search;
11. Click button of "save model";
12. Click on the button "ok";

- Click on the button "solve".

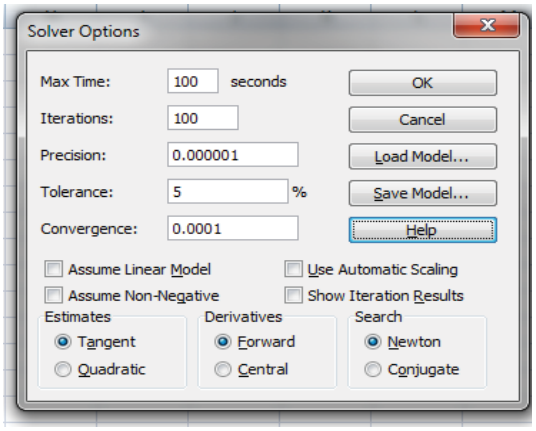

Fig. 2 Window of solver options

Solution of the problems is obtained by using a method based on dividing the investment operations into the multi-stage recursive procedures. Profit during the entire operation is achieved from a sequence of profit at each stage separately.

Window of "solver parameters" (Fig. 1) by using the dynamic programming algorithm gives the best solution of optimization problem in generally.

The problem of optimal resources management is from the class of the addition tasks.

In the present work, we have considered the practical problems of optimal management of resources of company. It is required to find the tour of investing projects to obtain the best available benefit given in the defined financial domain. We used method of modeling with regard to graph-diagram [4], because graph is a particular way for visualization of the storing and organizing dates of the investments and corresponding profits.

In particular, we use directed graphs and arrowheads from a commonly used graphical convention to show their orientation and provide this information more effectively [5].

Let us introduce the following notations: $\{C_{ij}\}_{i,j=1}^{m,n}$- matrix of parameters for the investment management of projects in company, $\{R_{ij}\}_{i,j=1}^{m,n}$- matrix of corresponding benefit investment of projects in company, n- number of stages; m- number of projects; S- total sum of investment.

III. Statement Problem

Problem. It is required to construct $\{C_{ij}\}_{i,j=1}^{m,n}$-matrix of parameters for the optimal management investment of projects in company, and to satisfy the following constraint condition:

$$\sum_{i}^{n}\sum_{j}^{m} C_{ij} \le S$$

and with regard to the following criterion of optimization:

$$\sum_{i}^{n}\sum_{j}^{m} R_{ij} \Rightarrow \max$$

For the simplest case, we have considered the solution of the problem for the following particular values (Table I).

TABLE I
Parameters of Projects

project	P1		P2		P3	
A	C1	R1	C2	R2	C3	R3
B	0	0	0	0	0	0
C	1	5	1	8	1	3
D	2	6	2	9	-	-
E	-	-	3	12	-	-

The graph-diagram of investment management of projects in company, corresponding the dates of the table are constructed and has the following form (Fig. 3) The nodes of graph are used for storing the sum invests of given stage (from the beginning to the end). The nodes 0 and 5 are terminal points: 0 (only variant) defines the initial position of system, 5 (only variant) are used for the stored constraint condition. The lines of graphs are used to label by the benefit corresponding

of investing plan. For example: The label of line connected the fourth node of P2 column to the fifth node of P3 column is labeled by the benefit -3 mln corresponding to the investement-1mln of third stage.

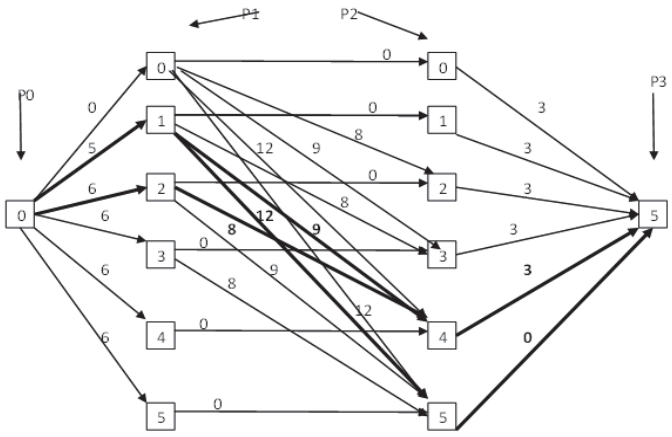

Fig. 3 Graph of optimal investment plan where, Pj (j=0, 1, 2, 3) designates the stage financial process for the given projects

IV. Solution of Problem

We will consider the dynamical process of investment. The solution of complex problems is based on breaking them down into simpler substructure [4]:

- In the first stage, the financial resources for the first company are invested, there are the six possible ways of investment between 0 flow-of- investment and 5 flow-of-investment (look at nodes o the column p1of graph), in the nodes the column P1 (first stage) the date of initial investment first stages is stored.
- In the second stage, the rest financial resource of company is invested. There are the six possible ways of investment, in the nodes of column P2 (second stage), and the sum invested together with the first and second stages are stored.
- In the third stage, the rest financial resources for company is invested. There is the only variant of investment, according to the methods of dynamic programming, in the terminal node of column P3 (third –final stage) the total sum of investment (from the beginning to the end) is stored and receives value of financial constraints-5mln.

Solving model according to the method of the dynamic programming is considered from the terminal node of column P3 before the initial node of the column P0 of graph.

There are six possible ways of the conditional optimal profit between P2 and P3(look graph-diagram), for example: one of them: the way 1 - 5 defined: in P2 put in 1mln investment and in P3 put in 4 mln investment, then 3 mln. Conditional optimal profit is given. Analogically, may be considered the conditional optimal profit between P1and P2, and there are six possible ways too (look graph-diagram), for example:

$$0 \rightarrow 0+15=15;$$

$$1 \rightarrow 5+12=17;$$

$$2 \rightarrow 6+11=17;$$

$$3 \rightarrow 6+8=14;$$

$$4 \rightarrow 6+3=9;$$

$$5 \rightarrow 6+0=6.$$

One of them: the way 1 – 4 defined: in P1 put in 1 mln investment and in P2 put in 3mln investment, then 3 mln conditional optimal profit are given (9+3=12). For column P0-initial node (only variant) there are six possible ways of conditional optimal profit between P0 and P1: We have 21 alternative investment plans of company. After consider all tour investing projects [6], the best profit-20 mln is chosen, by regarding the following tour of investment: 0-1-4-5 defined: in P1 put 1 mln, in P2 put 3 mln, and in P3 put 1mln, then the cost of tour equal: 5+12+3=20 (Fig. 3). This method is based on considering all the ways to invest all alternatively projects for choosing the best profit and is called “consider all plans for selecting optimal value " [7], but the obtained results in a non-reasonable time are given. The alternatives are many, such as using a greedy algorithm, which picks the locally optimal choice at each branch in the road. The locally optimal choice may be a poor choice for the overall solution. While a greedy algorithm does not guarantee an optimal solution, it is often faster to calculate. Fortunately, some greedy algorithms (such as minimum spanning trees) are proven to lead to the optimal solution.

Below, we have constructed the software by using the graph drawing method [8] to obtain the graphical conventions and information visualization of investment process.

The software is based on using greedy algorithm. Greedy algorithms [9] look for simple, easy-to-implement solutions to complex, multi-step problems by deciding which next step will provide the most obvious benefit. A greedy strategy does not produce an optimal solution in general, but nonetheless a greedy heuristic may locally yield to the optimal solutions that approximate a global optimal solution in a reasonable time.

The software is based on the following procedure [10]:

1. To construct the table of date for the particular value from Table I (Fig. 4)

We use buttons “draw” and “clear”:

- Button “draw” is drawing the graph of investment projects corresponding the dates of table;
- Button “clear” is correcting or deleting the dates of table.

2. Drawing the graph-diagram, corresponding the dates of table (Fig. 5)

The “dark blue color” indicates the tour of the approximate optimal plan investment project. Result using the greedy algorithm is following: 5+8+3=16. In this model, the effective version of management of proper financial flows on each level of investment is defined [11].

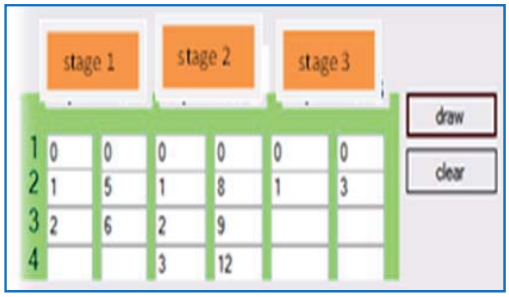

Fig. 4 Table of date

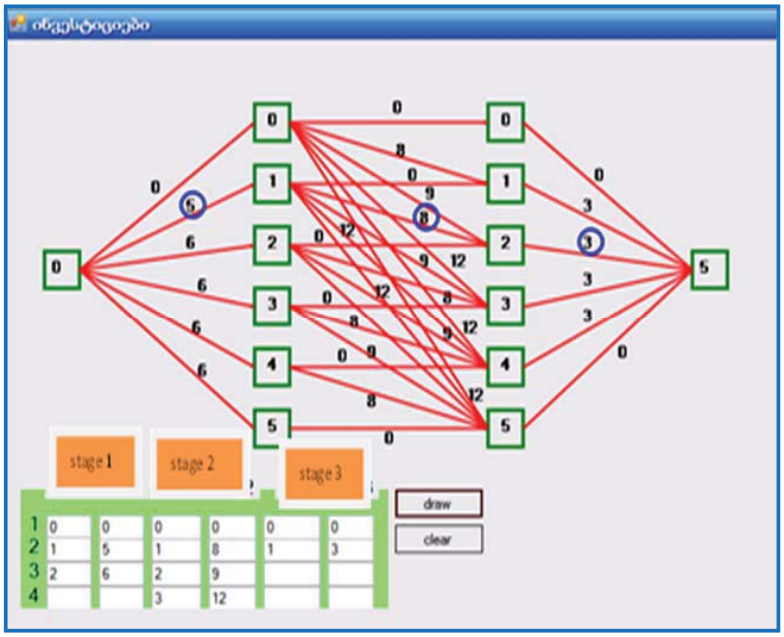

Fig. 5 Graph-diagram

V. Conclusion

Thus, mathematical model and software of solver parameters of resource company are constructed. Graphical conventions and information visualization of investment process for internal capital of company have been obtained.

Applications for optimization include [12]:

- Developing the best plan of investment and destinations
- Determining the optimal way to deliver finances
- Determining the right attributes of concept elements prior to concept testing

Appropriate methods [13] for evaluating the benefits consequences at the company are represented. The found algorithms and offered approach to determination of effective values of considered parameters can be recommended for use by development and realization of optimal management internal capital of company [14]. The tools applied in this development are based on dynamic programming method, graph drawing method, and greedy algorithm.

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