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INVESTMENT DECISION MAKING WITH ECONOMIC AND MATHEMATIC MODEL

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Abstract: *Every decision is personalized by objectives, the selection criteria and model or class of models that can be used in determining the most feasible solution. All investment decisions are based on mathematical models established by Chomsky hierarchy. The paper use the Markov chain and the linear programming models, in order to determine the optimal investment in a company, respectively the optimal distribution of allocated resources and the possibility to focus efforts to a specific priority area.*
Key words: *investment decision, models, optimization, risk*

1. INTRODUCTION

For an economic analyst, to whom the task of determining the most feasible solution, the first difficulty that we face is to choose the appropriate model which contain essential elements, and which give specificity for a given economic problem. In general he has three alternatives (Adams et al. 2003):

- Using a classical model which, in similar past situations, led to satisfactory results;
- A process leading to an original approach of problem by a combination of classical models;
- Develop a new model in accordance with the requirements of the problem.

Whatever the solution chosen, should not omit the fact that the practice is one that validates the reality of choice, and errors are attributable to the analyst.

In analyzing and evaluating the business, whose field of definition relates to approach the future from the present situation, we need mathematical instruments, more or less complex in terms of relation, but strongly influenced by the volume and accuracy of data and information at a time (when made the treatment of information to prepare the decision). Therefore, it is used, in particular, models of decision under risk and uncertainty conditions (analysis the time and resources of effectiveness evaluation etc.) or heuristic models where the intuition, experience and ability of analyst plays an important role in obtaining feasible results (Schuyler, 2001).

Any investment problem involves a number of possible alternatives (opportunities) that can be achieved with certain resources a certain quality and with a certain quantity availability or producing certain effects and is subject to a criterion of efficiency: maximizing earnings or minimizing efforts. It is the most complete form of expression of a decision motivation and from the mathematical point of view, can be translated as the ultimate goal of the analysis process (the objective) is to maximize the obtained effects or minimize their efforts.

Achieving this goal is by selecting from a finite number of options or opportunities that satisfied the optimum condition defined, with respect to a system defined by the restrictions. Such a problem is based on a mathematical programming model.

All mathematical programming models are based on generation systems which have been proposed for the first time, by the linguistic and philosopher Noam Chomsky. He has used these systems to name the “syntactic” grammar for English.

Among other results on formal grammar, in 1956, it was classified by type, classification which bears his name.

In the future we want to extend this study in investment by comparing more models, or even find a new one, for the investment area in Romania.

2. DEFINING MATHEMATICAL MODELS

Chomsky's theories can be applied in a variety of practical studies and beyond. These theories were to define mathematical models which are useful in all areas.

Modeling is the representation of an object, phenomenon or process in the real world in a given system (mathematics, physics, graphics, information, etc) (Ivan & Visoiu, 2004).

A **model** is created to allow the object study, phenomenon or process in a given context. Following the analysis of the object, phenomenon or process in the real world, the model will retain only those features that are important for representation in the context in which it will work.

In the field of investment, taking into account their specific field of application, the model is subject to two major constraints - completeness of the database and accuracy.

The economic models based on mathematical relationship, devoid of ambiguity, completeness - accuracy can be structured as follows:

- "**Deterministic**" mathematical-models, based on very high accuracy and completeness of the information and data (in general, such a condition is valid when the technique component is preponderant)
- "**Indeterminist**" mathematical models are operational when the volume and accuracy of available data are lower:
- A *probabilistic* model when the accuracy of information, especially those relating to the project, remains high, but decreases the amount of information concerning relations between them,
- A type of *fuzzy* models where completeness of information on regarding the relations between parameters remains high, but decreases the accuracy of information
- Procedural models (**Heuristic**) is based more on ability to quickly make an overall assessment of the raised issue. Appears when the precision and volume of information is reduced or the time available for analysis is too short
- Models of **analog** type used when the information is sufficiently accurate but insufficient to use explicit methods of work,
- Models of **default** type that is based on a complete set of information, but imprecise.

3. OPTIMIZATION OF INVESTMENT DECISIONS

Mathematical models are often solved with the help of linear programming.

Optimization of investment decisions using linear programming involves developing the mathematical model of unicriterial linear programming, stage which starts from defining the vector of variables, which define the possible alternatives or opportunities that you can focus the investment efforts (Levy, 2006).

Next connect the theoretical model to practical application,

as follows:

The unknown vector defines and delimits the investment opportunity. It is the responsibility of policy makers to determine the options it wishes to focus its investment efforts.

The elements of vector by the objective function have the same economic specification as the vector elements, respectively the effort coefficient for a minimum functions and effect for maximum functions. So the objective function has the same meaning as a restriction, but it has a goal: maximum effect / minimum effort (Corunescu & Prodan 2001).

A problem that should be avoided in constructing the model is to establish the concordance between the objective function and restrictions. If the restriction is the maximum effect then you must have at least a minimum restriction (resources) and vice versa.

May be difficulties in the operational phase of the model, not because the algorithm of calculation but because of overcoming of available resources from the restrictions system. Avoiding such a situation is achieved by removing these restrictions. This will get a "program completion" whose purpose is to determine what can be achieved within available additional resources which remain after the allocation needs to respect the conditions, in terms of efficiency.

4. CASE STUDY

A company wants to achieve investment in three sectors, A, B, C. For these investment is proposing a fund of 2000 euro. Using mathematical and economic models we determine the best way to distribute by sectors these funds. We expect that this distribution to determine increase of company's profit with at least 300 euro.

To solve this kind of problems, first is need to elaborate the mathematic model.

The systems of restrictions which require the allocation of resources are:

1. Investments - regardless of the allocation of 2000 euro, investment funds that back the three sectors can not exceed this amount:

$$x_1 + x_2 + x_3 \le 2000$$

2. The profit increase obtained from the implementation of the investment program to be more than 300 euro.

$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 \ge 300$, aij represent the profit obtain with 1 euro investment

3. The function objective / purpose are to achieve highest level of income:

$Max.f(x) = c_1x_1 + c_2x_2 + c_3x_3$ where c_i represent the revenue per unit of invested money.

The next step in problem resolving is to load the model.

Investment restriction is:

$$x_1 + x_2 + x_3 \le 2000$$

Regarding the profit restriction we find that there is no concordance between the economic significance of the "a_{ij}" coefficients so we should make the correlation with a preliminary operation.

$$a_{ij} = \frac{Q_j}{Cf_j} \cdot \frac{Cf_j}{I_j} \left(\frac{1000 - \frac{C_j}{Q_j}1000}{1000} \right)$$

To achievement the study specialist of company shall provide the following information:

Indicators	A	B	C
Revenues at 1000 Euro fixed capital	1250	1625	1450
Operating expenses came to 1000 euros	870	907,6	900
Share of fixed capital in total investment %	94	92	95

Tab. 1. Indicator of sectors

$a_{21} = 1{,}25 \times 0{,}94 \times (1 - 0{,}87) = 0{,}15275$

$a_{22} = 1{,}625 \times 0{,}92 \times (1 - 0{,}9076) = 0{,}13814$

$a_{23} = 1{,}45 \times 0{,}95 \times (1 - 0{,}9) = 0{,}13775$

$\Rightarrow 0{,}15275x_1 + 0{,}13814x_2 + 0{,}13775x_3 \ge 300$

Based on the findings, we determine the „c_i" coefficients – revenues to 1 euro invested, to obtain the objective function thus:

$c_i = \frac{Q_j}{Cf_j} \times \frac{Cf_1}{I_j}$, so

$1{,}25 \times 0{,}94x_1 + 1{,}625 \times 0{,}92x_2 + 1{,}45 \times 0{,}95x_3 - \max$

Finally, the model of related issue is:

$\max.F(x) = 1{,}175x_1 + 1{,}495x_2 + 1{,}378x_3$

$x_1 + x_2 + x_3 \le 2000$

$0{,}15275x_1 + 0{,}13814x_2 + 0{,}13775x_3 \ge 300$

To resolve such a model is need to use the simplex algorithm which is possible with informatics programs.

After solving the system obtained the following results regarding the allocation of the 1000 Euro:

$x_1 = 1623{,}546$, investment for sector A

$x_2 = 376{,}454$, investment for sector B

$x3 = 0$, investment for sector C

Using such a model, we determined the optimal allocation of funds, which represent 2000 euro, on base of efficiency criteria.

Following the implementation of this program will obtain a surplus profit of 300 euro per year to those areas A and B of which: A sector 248 euro and 52 euro for B sector.

Additional revenue will rise to 2470.47 euro of which: 1907.67 euro in A sector and 562.8 euros in B sector.

5. CONCLUSIONS

Issue acts of decision making of investment projects are of great diversity and require properly economic and mathematical instruments.

Using mathematical and economic models in the investment decision, it is possible the optimal distribution of allocated resources. Also is possible to focus efforts to a specific priority area.

Advantages of using such a model for determining optimal investment are also the low investment risk and to maximize the profit; they can estimate the additional revenue after achievement of the investment. Of case study we estimate the risk of investment in a sector.

A disadvantage of such model is the fact that is not has the pulse of society: an investment is profitable even if as the account the risk it is high. This is the analyst who has a very large role in decision to invest. Because the human factor the error was substantially increases.

Comparing the advantages and disadvantages of such a model can be concluded that by using such a mathematical model of companies risk for in making an investment to diminish considerably.

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