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THE MATHEMATIC SHAPING OF SOME ECONOMIC PROCESSES OF THE ENTERPRISE

Case study

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G00

Abstract

The present work proves how the mathematic methods in economy may be a considerable support for the manager of the enterprise. The use by the manager of the mathematic planning methods (computer programming) allows him to take managerial decisions scientifically argued. The resolution processes of the problem, a lot mathematicized, remain inaccessible for the managers of many companies. Aiming to reduce the efforts, which require special preparations of the managers in the area of dynamic programming, we propose a simple algorithm of repartition of the investments between the enterprises of the company in the presented material . The volume of the production for the fixed fund may vary according to the specific of the enterprise, related to the type of the technical, technological progress, to the structure of the final product. We can distinguish different types of technical progress, with different effects of the past work(materialized) contented in the value of the product.(Anastase I. 2010) *The technical progress has an important influence over the proportion between the production and the fixed funds, and helps increasing the efficiency of the machinery. A determinant impact over this process is represented by the allocation of the investments among the productive subdivisions. The analysis off economic efficiency of the enterprise has some essentially different aspects: the most efficient allocation of the income of the enterprise between the accumulation fund and the consumer fund; the best allocation of the productive accumulation fund among different subdivisions; choosing the option of maximum efficiency from many options of project elaborated for a given aim, in the limit of a certain fund allocated for the investment.*

The problem of the continuous rising of the economic efficiency of the productive investments, in the economic conditions of the market from UE, for the enterprises in Romania represents one of the central preoccupations of the managers of the enterprise. The fundamental problems of the enterprises are the use of a methodology of scientific processing of the elaboration and implementation of the versions of activity. The economic efficiency of the investments of the enterprise presents several aspects: qualitative and quantitative.*(*Anastase I. 2011) The use by the manager of the enterprise in the decisional processes of the mathematical programming device does not contradict the intuitive analysis, but brings depth, scientific stringency and accuracy in the intuitive reasoning, lifting the technical-economic analysis of the functioning of the enterprise to a superior level from a qualitative perspective, according to the possibilities of the current stage of development of the economic research. The intuitive analysis of the options cannot take into consideration effectively and properly all the economic aspects. *(*Anastase I. 2010)The allocation of the investments (productive accumulations) between the enterprises of a company is a problem of dynamic programming, for which we can find in the specialized bibliography a string of resolution methods. Enterprises in Romania function in an open economic environment, being engaged in an economic competition with the member countries of the EU. The material, financial, working resources, including qualified work, are limited. The productive potential of the enterprise is determined by a string of exo, endogenous factors: technologic progress, innovational level, the availability of the fixed capital and its efficiency, of the specific consumptions(at a unity of product) of resources, the supply and demand on the market in Romania, from EU; on the economic politics of the enterprise, of the country, of the EU.*(*Anastase I. 2011) The enterprise cannot function efficiently at the moment based on intuitively elaborated programs(plans); it is imposed by the situation to use at a maximum level all the possibilities in order to become an enterprise of the future. However not different the economic processes in different enterprises would be, these can be shaped, exposed in the language of the symbols. Consequently, the problem can be formulated: the enterprise *(*Anastase I. 2010)A can produce n products (k=1,2,...,n), it has a number of s resources (i=1,2,...,s) in the quantities $a_1, a_2, ..., a_i, ..., a_s$. For the production of the products we may use m technologies (j=1,2,..,m); the consumptions of the resources s at a unity of product k after the technology j are known, through which, noted $a_{ik}^{(j)}$ the prices p_k of the k products are known. The problem that emerges is the elaboration of the economical-mathematical model, through which we can determine the optimum structure of the finite products, the technologies through which these are going to be created, in order to assure the maximum income for the enterprise.*(*Anastase I. 2010)

We note $x_k^{(j)}$ the volume of the products k created by the technology j, k=1,2,...,n; j=1,2,...,m. The initial data, necessary for the elaboration of the economical-mathematical model, are presented in table 1. *(*Anastase I. 2010)The criterium of optimization: the total income from the commercialization of all the made products, after all the technologies, meaning

$$F = \sum_{k=1}^{n} p_k x_k^{(1)} + \sum_{k=1}^{n} p_k x_k^{(2)} + ... + \sum_{k=1}^{n} p_k x_k^{(j)} + ... + \sum_{k=1}^{n} p_k x_k^{(m)} = \sum_{j=1}^{m} \sum_{k=1}^{n} p_k x_k^{(j)}$$

Regrouping the terms of the function-aim, we get

$$F = \sum_{j=1}^{m} p_1 x_1^{(j)} + \sum_{j=1}^{m} p_2 x_2^{(j)} + ... + \sum_{j=1}^{m} p_k x_k^{(j)} + ... + \sum_{j=1}^{m} p_n x_n^{(j)}$$

The aim-function F can be written and interpreted economically more explicitly.

$$F = \left(P_1 x_1^{(1)} + P_2 x_2^{(1)} + \ldots + P_k x_k^{(1)} + \ldots + P_n x_n^{(1)}\right) + \left(P_1 x_1^{(2)} + P_2 x_2^{(2)} + \ldots + P_k x_k^{(2)} + \ldots + P_n x_n^{(2)}\right) + \ldots + \left(P_1 x_1^{(j)} + P_2 x_2^{(j)} + \ldots + P_k x_k^{(j)} + \ldots + P_n x_n^{(j)}\right) + \ldots + \left(P_1 x_1^{(m)} + P_2 x_2^{(m)} + \ldots + P_k x_k^{(m)} + \ldots + P_n x_n^{(m)}\right)$$

The total income from the commercialization of all the made products according to	The total income from the commercialization of all the made products according to	The total income from the commercialization of all the made products according to technology	The total income from the commercialization of all the made products according to technology

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$$F = \left(P_1 x_1^{(1)} + P_1 x_1^{(2)} + \ldots + P_1 x_1^{(j)} + \ldots + P_1 x_1^{(m)}\right) + \left(P_2 x_2^{(1)} + P_2 x_2^{(2)} + \ldots + P_2 x_2^{(j)} + \ldots + P_2 x_2^{(m)}\right) + \ldots + \left(P_k x_k^{(1)} + P_k x_k^{(2)} + \ldots + P_k x_k^{(j)} + \ldots + P_k x_k^{(m)}\right) + \ldots + \left(P_n x_n^{(1)} + P_n x_n^{(2)} + \ldots + P_n x_n^{(j)} + \ldots + P_n x_n^{(m)}\right)$$

The total income from the commercialization of products 1,made according to all technologies	The total income from the commercialization of products 2,made according to all technologies	The total income from the commercialization of products k,made according to all technologies	The total income from the commercialization of products *n*,made according to all technologies

The maximum value of the aim-function*F*may be determined if the following conditions are respected:

$$\sum_{k=1}^{n} a_{ik}^{(1)} x_k^{(1)} + \sum_{k=1}^{n} a_{ik}^{(2)} x_k^{(2)} + \ldots + \sum_{k=1}^{n} a_{ik}^{(j)} x_k^{(j)} + \ldots + \sum_{k=1}^{n} a_{ik}^{(m)} x_k^{(m)} \le a_i, i = 1,2,\ldots,s$$

or $\sum_{j=1}^{m} \sum_{k=1}^{n} a_{ik}^{(j)} x_k^{(j)} \le a_i, i = 1,2,\ldots,s$.

These restrictions may be written and interpreted in the following way:

$a_{11}^{(1)}x_1^{(1)}+a_{12}^{(1)}x_2^{(1)}+...+a_{1k}^{(1)}x_k^{(1)}+...+a_{1n}^{(1)}x_n^{(1)}$	+	$a_{11}^{(2)}x_1^{(2)}+a_{12}^{(2)}x_2^{(2)}+...+a_{1k}^{(2)}x_k^{(2)}+...+a_{1n}^{(2)}x_n^{(2)}$	+... +	$a_{11}^{(j)}x_1^{(j)}+a_{12}^{(j)}x_2^{(j)}+...+a_{1k}^{(j)}x_k^{(j)}+...+a_{1n}^{(j)}x_n^{(j)}$	+... +	$a_{11}^{(m)}x_1^{(m)}+a_{12}^{(m)}x_2^{(m)}+...+a_{1k}^{(m)}x_k^{(m)}+...+a_{1n}^{(m)}x_n^{(m)}$	≤	a_1
$a_{21}^{(1)}x_1^{(1)}+a_{22}^{(1)}x_2^{(1)}+...+a_{2k}^{(1)}x_k^{(1)}+...+a_{2n}^{(1)}x_n^{(1)}$	+	$a_{21}^{(2)}x_1^{(2)}+a_{22}^{(2)}x_2^{(2)}+...+a_{2k}^{(2)}x_k^{(2)}+...+a_{2n}^{(2)}x_n^{(2)}$	+... +	$a_{21}^{(j)}x_1^{(j)}+a_{22}^{(j)}x_2^{(j)}+...+a_{2k}^{(j)}x_k^{(j)}+...+a_{2n}^{(j)}x_n^{(j)}$	+... +	$a_{21}^{(m)}x_1^{(m)}+a_{22}^{(m)}x_2^{(m)}+...+a_{2k}^{(m)}x_k^{(m)}+...+a_{2n}^{(m)}x_n^{(m)}$	≤	a_2
...	...	...	...	...	...	...	...	...
$a_{i1}^{(1)}x_1^{(1)}+a_{i2}^{(1)}x_2^{(1)}+...+a_{ik}^{(1)}x_k^{(1)}+...+a_{in}^{(1)}x_n^{(1)}$	+	$a_{i1}^{(2)}x_1^{(2)}+a_{i2}^{(2)}x_2^{(2)}+...+a_{ik}^{(2)}x_k^{(2)}+...+a_{in}^{(2)}x_n^{(2)}$	+... +	$a_{i1}^{(j)}x_1^{(j)}+a_{i2}^{(j)}x_2^{(j)}+...+a_{ik}^{(j)}x_k^{(j)}+...+a_{in}^{(j)}x_n^{(j)}$	+... +	$a_{i1}^{(m)}x_1^{(m)}+a_{i2}^{(m)}x_2^{(m)}+...+a_{ik}^{(m)}x_k^{(m)}+...+a_{in}^{(m)}x_n^{(m)}$	≤	a_i
...	...	...	...	...	...	...	...	...
$a_{s1}^{(1)}x_1^{(1)}+a_{s2}^{(1)}x_2^{(1)}+...+a_{sk}^{(1)}x_k^{(1)}+...+a_{sn}^{(1)}x_n^{(1)}$	+	$a_{s1}^{(2)}x_1^{(2)}+a_{s2}^{(2)}x_2^{(2)}+...+a_{sk}^{(2)}x_k^{(2)}+...+a_{sn}^{(2)}x_n^{(2)}$	+... +	$a_{s1}^{(j)}x_1^{(j)}+a_{s2}^{(j)}x_2^{(j)}+...+a_{sk}^{(j)}x_k^{(j)}+...+a_{sn}^{(j)}x_n^{(j)}$	+... +	$a_{s1}^{(m)}x_1^{(m)}+a_{s2}^{(m)}x_2^{(m)}+...+a_{sk}^{(m)}x_k^{(m)}+...+a_{sn}^{(m)}x_n^{(m)}$	≤	a_s
↓		↓		↓		↓		↓
The consuming of the resources 1;2;...;*i*;...;*s* for making the products 1;2;...;*k*;...;*n* according to technology 1		The consuming of the resources 1;2;...;*i*;...;*s* for making the products 1;2;...;*k*;...;*n* according to technology2		The consuming of the resources 1;2;...;*i*;...;*s* for making the products 1;2;...;*k*;...;*n* according to technology*j*		The consuming of the resources 1;2;...;*i*;...;*s* for making the products 1;2;...;*k*;...;*n* according to technology *m*		Disponibilul de resurse 1;2;...;*s*

Tabelul 1. – The initial data necessary for the elaboration of the economico-mathematical model

	1						**2**						**...**	**J**						**...**	**m**						
	1	2	...	k	...	n	1	2	...	k	...	n	...	1	2	...	K	...	n	...	1	2	...	k	...	n	
1	$a_{11}^{(1)}$ $x_1^{(1)}$	$a_{12}^{(1)}$ $x_2^{(1)}$	...	$a_{1k}^{(1)}$ $x_k^{(1)}$	...	$a_{1n}^{(1)}$ $x_n^{(1)}$	$a_{11}^{(2)}$ $x_1^{(2)}$	$a_{12}^{(2)}$ $x_2^{(2)}$	...	$a_{1k}^{(2)}$ $x_k^{(2)}$	...	$a_{1n}^{(2)}$ $x_n^{(2)}$	...	$a_{11}^{(j)}$ $x_1^{(j)}$	$a_{12}^{(j)}$ $x_2^{(j)}$	...	$a_{1k}^{(j)}$ $x_k^{(j)}$	...	$a_{1n}^{(j)}$ $x_n^{(j)}$	...	$a_{11}^{(m)}$ $x_1^{(m)}$	$a_{12}^{(m)}$ $x_2^{(m)}$	...	$a_{1k}^{(m)}$ $x_k^{(m)}$	...	$a_{1n}^{(m)}$ $x_n^{(m)}$	a_1
2	$a_{21}^{(1)}$ $x_1^{(1)}$	$a_{22}^{(1)}$ $x_2^{(1)}$	...	$a_{2k}^{(1)}$ $x_k^{(1)}$	...	$a_{2n}^{(1)}$ $x_n^{(1)}$	$a_{21}^{(2)}$ $x_1^{(2)}$	$a_{22}^{(2)}$ $x_2^{(2)}$	...	$a_{2k}^{(2)}$ $x_k^{(2)}$	...	$a_{2n}^{(2)}$ $x_n^{(2)}$	...	$a_{21}^{(j)}$ $x_1^{(j)}$	$a_{22}^{(j)}$ $x_2^{(j)}$	...	$a_{2k}^{(j)}$ $x_k^{(j)}$	...	$a_{2n}^{(j)}$ $x_n^{(j)}$	...	$a_{21}^{(m)}$ $x_1^{(m)}$	$a_{22}^{(m)}$ $x_2^{(m)}$	...	$a_{2k}^{(m)}$ $x_k^{(m)}$	...	$a_{2n}^{(m)}$ $x_n^{(m)}$	a_2
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
i	$a_{i1}^{(1)}$ $x_1^{(1)}$	$a_{i2}^{(1)}$ $x_2^{(1)}$	...	$a_{ik}^{(1)}$ $x_k^{(1)}$	...	$a_{in}^{(1)}$ $x_n^{(1)}$	$a_{i1}^{(2)}$ $x_1^{(2)}$	$a_{i2}^{(2)}$ $x_2^{(2)}$	...	$a_{ik}^{(2)}$ $x_k^{(2)}$	...	$a_{in}^{(2)}$ $x_n^{(2)}$	...	$a_{i1}^{(j)}$ $x_1^{(j)}$	$a_{i2}^{(j)}$ $x_2^{(j)}$	...	$a_{ik}^{(j)}$ $x_k^{(j)}$	...	$a_{in}^{(j)}$ $x_n^{(j)}$	...	$a_{i1}^{(m)}$ $x_1^{(m)}$	$a_{i2}^{(m)}$ $x_2^{(m)}$	...	$a_{ik}^{(m)}$ $x_k^{(m)}$	...	$a_{in}^{(m)}$ $x_n^{(m)}$	a_i
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
s	$a_{s1}^{(1)}$ $x_1^{(1)}$	$a_{s2}^{(1)}$ $x_2^{(1)}$	...	$a_{sk}^{(1)}$ $x_k^{(1)}$	...	$a_{sn}^{(1)}$ $x_n^{(1)}$	$a_{s1}^{(2)}$ $x_1^{(2)}$	$a_{s2}^{(2)}$ $x_2^{(2)}$	...	$a_{sk}^{(2)}$ $x_k^{(2)}$	...	$a_{sn}^{(2)}$ $x_n^{(2)}$	...	$a_{s1}^{(j)}$ $x_1^{(j)}$	$a_{s2}^{(j)}$ $x_2^{(j)}$	...	$a_{sk}^{(j)}$ $x_k^{(j)}$	...	$a_{sn}^{(j)}$ $x_n^{(j)}$	...	$a_{s1}^{(m)}$ $x_1^{(m)}$	$a_{s2}^{(m)}$ $x_2^{(m)}$	...	$a_{sk}^{(m)}$ $x_k^{(m)}$	...	$a_{sn}^{(m)}$ $x_n^{(m)}$	a_s
	d_1 P_1 M_1 Y_1	d_2 P_2 M_2 Y_2	...	d_k P_k M_k Y_k	...	d_n P_n M_n Y_n	d_1 P_1 M_1 Y_1	d_2 P_2 M_2 Y_2	...	d_k P_k M_k Y_k	...	d_n P_n M_n Y_n	...	d_1 P_1 M_1 Y_1	d_2 P_2 M_2 Y_2	...	d_k P_k M_k Y_k	...	d_n P_n M_n Y_n	...	d_1 P_1 M_1 Y_1	d_2 P_2 M_2 Y_2	...	d_k P_k M_k Y_k	...	d_n P_n M_n Y_n	

The conditions of the problem must be completed with additional restrictions. As we know, productive costs (C) are functions of the volume of the production (X), which means *C*=*f*(*X*). The costs *C*are made of Fixed Cost, FCand Variable Cost, *VC*(*X*), which means *C*(*X*)=*FC*+*VC*(*X*). The income of the company depends on the price P from the positions, on the volume of the commercialized products. *(*Anastase I. 2011)The growing of the volume X contributes to the reduction of the fixed costs per unity for the product *X*; to the growing of the variable costs *VC* (figure 1).

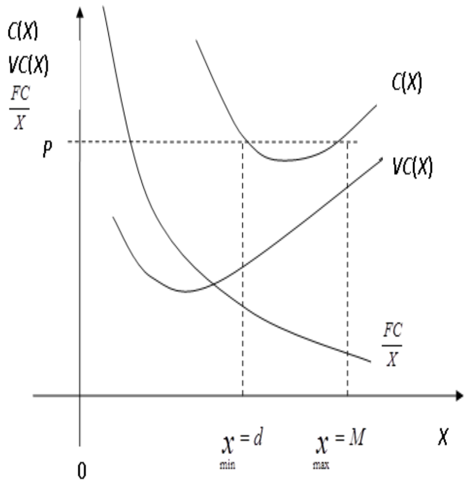

Fig. 1. The acceptable minimal and maximum values of the volume of the production

If the company produces a volume *x*<*d*, then the productive costs will overcome the income, the company will have losses.(Anastase.I .et.al.Nicolaie .C.2011),(A.I,Bocanete .P 2011)The same thing is happening when the company will produce a volume *x*>*M*. So, we must include in the problem additional restrictions: the company must produce productsx_k according to all the technologies in a volume not smaller than d_k and not bigger than M_k; otherwise, the respective variable x_k=0.

The additional restrictions may be formulized, using the variable Bul:

$$\mathrm{Y}_k = \begin{cases} 0, daca\_x_k < d_k\_sau\_x_k > M_k; \\ 1, daca\_d_k < x_k < M_k \end{cases}$$

The quantum $M_k$may be determined: by the level of the prices; by the capacity of production; by the availability of the resources of raw materials. *(*Anastase I. 2011)For every finite product 1;2;...;*k*;...*n*we may impose the following restrictions: $\sum_{j=1}^{m} x_k^{(j)} \geq \mathrm{Y}_k d_k$; $\sum_{j=1}^{m} x_k^{(j)} \leq \mathrm{Y}_k M_k$. *(*Anastase I. 2013)If, for instance Y_k=0, then the relations(the restriction) $\sum_{j=1}^{m} x_k^{(j)} \leq \mathrm{Y}_k^1 M_k = 0$ and, because $x_k \geq 0$ for*k*=1,2,...,*n*, the restriction $\sum_{j=1}^{m} x_k^{(j)} \leq 0$ will be satisfied only for $x_k^{(1)} = x_k^{(2)} = x_k^{(m)} = 0$.

If, for instance,Y_k=1, then from the relation $\sum_{j=1}^{m} x_k^{(j)} \leq \mathrm{Y}_k M_k$ we obtain $\sum_{j=1}^{m} x_k^{(j)} \leq M_k$; from the restriction $\sum_{j=1}^{m} x_k^{(j)} \geq \mathrm{Y}_k d_k$ we obtain $\sum_{j=1}^{m} x_k^{(j)} > d_k$; if x_k=0 from the restriction $\sum_{j=1}^{m} x_k^{(j)} \geq \mathrm{Y}_k d_k$ we obtain Y_k=0; if $x_k \geq d_k$, then the restriction $\sum_{j=1}^{m} x_k^{(j)} \geq \mathrm{Y}_k d_k$ is satisfied for any value from the possible ones Y_k=0; Y_k=1, and from the restriction $\sum_{j=1}^{m} x_k^{(j)} \leq \mathrm{Y}_k M_k$ we obtain Y_k=1.

(Bărbulescu C1995)For solving the problem with the methods of linear programming, we introduce the following restrictions:

$$\begin{cases} x_1^{(1)} + x_1^{(2)} + \ldots + x_1^{(j)} + \ldots + x_1^{(m)} \geq d_1 \\ x_1^{(1)} + x_1^{(2)} + \ldots + x_1^{(j)} + \ldots + x_1^{(m)} = 0 \\ x_2^{(1)} + x_2^{(2)} + \ldots + x_2^{(j)} + \ldots + x_2^{(m)} \geq d_2 \\ x_2^{(1)} + x_2^{(2)} + \ldots + x_2^{(j)} + \ldots + x_2^{(m)} = 0 \\ \ldots \\ x_k^{(1)} + x_k^{(2)} + \ldots + x_k^{(j)} + \ldots + x_k^{(m)} \geq d_k \\ x_k^{(1)} + x_k^{(2)} + \ldots + x_k^{(j)} + \ldots + x_k^{(m)} = 0 \\ \ldots \\ x_n^{(1)} + x_n^{(2)} + \ldots + x_n^{(j)} + \ldots + x_n^{(m)} \geq d_n \\ x_n^{(1)} + x_n^{(2)} + \ldots + x_n^{(j)} + \ldots + x_n^{(m)} = 0 \end{cases}$$

(Buletinul Statistic de Prețuri 2013)

Conclusions

Among the methods elaborated in the last years, aiming to provide the manager with modalities, the economic-mathematic methods must occupy an important place because of their importance and constructivism, through their efficiency as well as the richness of the options that may be examined.

The application of the mathematical methods, of the calculation technique in the managerial activities of the entrepreneur contribute to the growing of the productive potential of the enterprise; at a better organization of the process of using the alive working, materialized. It is necessary for the managers of the enterprise to know well enough the possibilities offered by the methods of the mathematic programming.(Blanovschi A.&, Mironic A 2005)The mathematical methods, being universal, may be used, applied in the most diverse processes and economic activities.

As new ordering, programare, methods are discovered and introduced, the managers must elaborate better and more effcient algorythms. The struture of the activities of the enterprises in Romania is getting more complicated daily, the scientific methods are becoming indispensable for the orientation in this type of combinatorial difficulties.(Bohatereţ V.M 2002) In the countries members of the EU, the use of optimization methods is a normal thing, it has become a necessity.The enterprises in Romania in this context are obliged by the risk of bankruptcy, to improve the managerial methods through the implementation of the methods of mathematical programare. In certain activities, very complex, it may happen, that through a first display of the problem, incompatible conditions may exist. Noticing this sort of aspects becomes useful for the manager. So, using mathematical methods allow not only to improve the effciency of the enterprise, but also may be the base of a concept, of certain principles in managerial activities, of determining the productive potential of the eneterprise.In many activity programs of the enterprise, certain events have a special significance, meaning that the further progress of the following activities depends on their result.(Bold I1984)Consequently, the manager cannot establish for the enterprise an unique, optimal, universal program. In this kind of situation, the additional, empirical decisions of the manager of the enterprise are required.

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