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Application of Mathematical Modeling Methods on Investment Decisions in Agro Industrial Company

Perviz Haciyev

Moscow State University, Lomonosov Moscow State University, GSP-1, Leninskie Gory, Moscow, 119991, Russian Federation

Abstract: The Russian market of flour is one the most competitive food markets. For it the great number of independent manufacturers, the absence of obvious market leaders and the increase of production volumes of raw (grain) during last years, at last, obviously expressed price character of a competition is characteristic. In the present research it is offered to consider the directions and efficiency of use of the agro industrial company means involved as a result of issue. In the article the necessity of application of an optimality principle and a method of dynamic programming is considered at distribution of investments in agro industrial complex. The basic tendencies and features of internal investments of agrarian and industrial enterprises are considered. Necessity of application of dynamic programming methods is proved at accepting of investment decisions. Possibility of data application methods at construction of financially-mathematical models at the enterprise is opened.

Key words: Bellman method · Dynamic programming · Mathematical modeling · Modeling in agriculture

INTRODUCTION

The Russian market of flour is one the most competitive food markets. For it the great number of independent manufacturers, the absence of obvious market leaders and the increase of production volumes of raw (grain) during last years, at last, obviously expressed price character of a competition is characteristic. We will notice that the distribution problem as internal and external investments in the given market is extremely actually in view of specificity of an estimation of a complex of risks inherent in given industry and features of a performance evaluation of investment investments. Thereupon enhancement of tools of the financial management adapted for realities of investment processes in the market of agricultural production is necessary.

Let us notice that in the Russian market of flour today there are a great number of manufacturers, consumers and dealers. The basic manufacturers and suppliers of flour in the Russian Federation are large industrial flour-grinding factories and industrial complexes. In total in Russia there are about 450 large and average industrial flour-grinding enterprises with average capacity on processed grain 265 tons a day [1].

The condition of the flour-grinding enterprises is characterized by extreme heterogeneity. Many of them constructed at the end of the Soviet epoch have modern enough equipment. However as a result of the events of the last 15 years only some of them could conduct its modernization. At the same time within last 15 years in a number of regions there have appeared small enterprises which successfully develop. They were created by agricultural manufacturers and they work on their own grain. There are about 70 similar enterprises.

The feature of flour-grinding industry is the concentration of capacities on large enterprises and availability of a considerable quantity of small enterprises of various patterns of ownership. In flour-grinding industries about 90% of capacities of production are concentrated on 380 large mills and bakeries.

Goods of the flour-grinding industry are in constant and stable requisition in the market of the Russian Federation both owing to its social importance and historic and cultural traditions of the people of the Russian Federation. Flour as foodstuff and as the major raw in production of bread and bakery items enters the minimum set of foodstuff for all socially-economic groups of the Russian Federation. Ultimate consumers of goods

Corresponding Author: Perviz Haciyev, Moscow State University, Lomonosov Moscow State University, GSP-1, Leninskie Gory, Moscow, 119991, Russian Federation.

of the enterprise are bakeries, confectionaries, macaroni factories, the public catering organizations and also the population. Finally goods are focused on the population, the requirement for goods and demand for it has uniform character within a year. For this reason the flour-grinding industry is one of the most attractive industries from the point of view of investment attraction.

MATERIALS AND METHODS

As an example the financial reporting of the company Open Society "Pava" existing on the market since 1999 and being one of the leading enterprises of flour-grinding industries of Russia will be used.

The analysis of quarterly reports of the emitter testifies that issue means will be used for financing of strategic plans of development, namely [2].

- With a view of building and acquisition of the enterprises occupied in all production phases of ready flour-grinding goods, expansions of assortment of issued goods;
- Acquisitions of flour-grinding enterprises of nearby regions;
- The output increases, the caused transfer of all capacities into new hi-tech level;
- Growths in volumes of flour production in various kinds of packing.

In connection with the above-stated it is required to solve a financial task of optimal investment allocation. For this purpose it is offered to use a principle of Bellman's optimality. According to Bellman the main principle of management optimality of multistage processes can be verbally expressed as follows, "Optimum behavior possesses the property that whatever were the initial condition and initial decision the subsequent decisions should constitute optimum behavior concerning the condition which is turning out as a result of initial decision" [3]. In other words any site of an optimum trajectory including finishing also is optimum and errors in the management leading to deviations from optimum territory subsequently can't be corrected. Certainly, such general position can't be directly applied to the decision of dynamic programming tasks and needs concrete definition.

Dynamic programming represents a computing method for the decision of problems of certain structure. R.Bellman's method in 1953 for storekeeping problems is offered. Essence of a method we will consider on a following example. Let it is necessary to investigate investment process (Ieper) which breaks up on n steps or stages. Thus the indicator of efficiency of project Wj develops from composed Wj, received on separate stages: $w_n = \sum_{j=1}^{n} w_j$. On everyone j's stage Wj it is calculated on iterative algorithm [4].

For each j th stage there is a system of influences on the technological process, providing optimum Wj at a stage j, named further conditional management (UPj). For the decision of such problems mathematical models (MM) of dynamic programming are made. Thus all planned period IPR (T), named further an optimization interval (which in mathematical models of linear programming earlier it was invariable and calculation was conducted on the end of period T), already breaks on n stages. Therefore there is a necessity for dynamic calculation of this indicator Wj. From here the term of dynamic programming is borrowed. It is the directed consecutive search of variants which leads to search of a global extremum.

The general for the listed problems is multistep character of optimization. Replacement of the decision of a n-step-by-step problem with sequence of problems is carried out: single-step, two-step-by-step and etc [5]. For application of a method of dynamic programming of a problem of manufacture should possess following properties:

- The problem should suppose interpretation as n-step-by-step decision-making process.
- The problem should be defined for any number of steps and have the structure which is not dependent on their number.
- By consideration of a k-step-by-step problem some set of the parameters describing a condition of system on which optimum values of variables depend should be set. And this set shouldn't change at increase in number of steps.
- The decision choice (UPj) on j's a step shouldn't influence the previous decisions, except necessary recalculation of variables.

Distribution of the initial sum of means e0 between n enterprises P1, P2 is planned..., Pn. Allocation u^k brings in to enterprise Pk of means the income f_k (u^k). To define, it is necessary to allocate what quantity of means to each enterprise to provide the maximum total income.

Table 1: Investments and Income quantities [7]

Investments		Income	
X	U1 (X)	U2 (X)	U3 (X)
1	6.58	5.14	6.1
2	12.3	4.26	8.5
3	14.5	10.52	11.52
4	20.9	18.54	18.26
5	26.86	25.62	17.4

The investor allocates means in size 5 unit which should be distributed between three enterprises. It is required, using a principle of an optimality of Bellmana, to make the plan of distribution of means between the enterprises, providing the greatest general profit, if each enterprise at investment in it of means X. Profit U (X) under the following data makes [6]:

The Decision:

I Stage. Conditional Optimization: At the first stage of the decision of the problem, named conditional optimization, defines function of Bellmana and optimum managements for all possible conditions on each step, since the last according to algorithm of return prorace. On the last, n's a step optimum control - x*n is defined by function of Bellmana: $F(S) = \max\{W_n(S, x_n)\}$ according to which the maximum gets out of all possible values xn and xn - X.

The further calculations are made according to the recurrent parity connecting function by Bellman on each step with the same function, but calculated on the previous step. In a general view this equation looks like $F_n(S) = \max\{W_n(S, x_n) + F_{k+1}(Sn(S, x_k)\}\ x_k - X$.

This maximum (or a minimum) is defined on all possible for k and S to values of a variable of management X.

Let's explain construction of tables and sequence of carrying out of calculations.

Columns 1, 2 and 3 are identical to all three tables, therefore they could be made the general. The column 4 is filled on the basis of the initial data about functions of the income, value in a column 5 undertake from a column 7 previous tables, a column 6 is filled with the sum of values of columns 4 and 5 (in the table of 3rd step columns 5 and 6 are absent).

In a column 7 the maximum value of the previous column for the fixed initial condition registers and in 8 column management from 2 columns on which the maximum in 7 is reached registers.

Stage II. Unconditional Optimization: After function of Bellmana and corresponding optimum managements are found for all steps with n th on the first, the second stage

The first step. k = 3

Table 2: First step calculations

e^2	u^3	$e^3 = e^2 - u^3$	$f_3(u^3)$	$F^*_3(e^3)$	$u_3(e^3)$
1	0	1	0.00	0.00	0
	1	0	6.10	6.10	1
2	0	2	0.00	0.00	0
	1	1	6.10	0.00	0
	2	0	8.50	8.50	2
3	0	3	0.00	0.00	0
	1	2	6.10	0.00	0
	2	1	8.50	0.00	0
	3	0	11.52	11.52	3
4	0	4	0.00	0.00	0
	1	3	6.10	0.00	0
	2	2	8.50	0.00	0
	3	1	11.52	0.00	0
	4	0	18.26	18.26	4
5	0	5	0.00	0.00	0
	1	4	6.10	0.00	0
	2	3	8.50	0.00	0
	3	2	11.52	0.00	0
	4	1	18.26	18.26	4
	5	0	17.40	0.00	0

The second step. k = 2

Table 3: Second step calculations

e^1	u^2	$e^2=e^1-u^2$	$f_2(u^2)$	$F^*_2(e^1)$	$F_1(u^2,e^1)$	$F^*_2(e^2)$	$u_2(e^2)$
1	0	1	0.00	6.10	6.10	6.10	0
	1	0	5.14	0.00	5.14	0.00	0
2	0	2	0.00	8.50	8.50	0.00	0
	1	1	5.14	6.10	11.24	11.24	1
	2	0	4.26	0.00	4.26	0.00	0
3	0	3	0.00	11.52	11.52	0.00	0
	1	2	5.14	8.50	13.64	13.64	1
	2	1	4.26	6.10	10.36	0.00	0
	3	0	10.52	0.00	10.52	0.00	0
4	0	4	0.00	18.26	18.26	0.00	0
	1	3	5.14	11.52	16.66	0.00	0
	2	2	4.26	8.50	12.76	0.00	0
	3	1	10.52	6.10	16.62	0.00	0
	4	0	18.54	0.00	18.54	18.54	4
5	0	5	0.00	18.26	18.26	0.00	0
	1	4	5.14	18.26	23.4	0.00	0
	2	3	4.26	11.52	15.78	0.00	0
	3	2	10.52	8.50	19.02	0.00	0
	4	1	18.54	6.10	24.64	0.00	0
	5	0	25.62	0.00	25.62	25.62	5

of the decision of the problem, named unconditional optimization is carried out [8]. Using that on the first step (k = 1) a system condition is known is its initial condition S_n, it is possible to find optimum result for all n steps and optimum control on the first step x1 which this result delivers. After application of this management the system will pass in other condition $S_n(S, x^*1)$, knowing which, it

The third step. k = 1

Table 4: Third step calculations

e^0	u^1	$e^1=e^0-u^1$	$f_1(u^1)$	$F^*_1(e^0)$	$F_0(u^1,e^0)$	$F^*_1(e^1)$	$u_1(e^1)$
1	0	1	0.00	6.10	6.10	0.00	0
	1	0	6.58	0.00	6.58	6.58	1
2	0	2	0.00	11.24	11.24	0.00	0
	1	1	6.58	6.10	12.68	12.68	1
	2	0	12.30	0.00	12.30	0.00	0
3	0	3	0.00	13.64	13.64	0.00	0
	1	2	6.58	11.24	17.82	0.00	0
	2	1	12.30	6.10	18.40	18.40	2
	3	0	14.50	0.00	14.50	0.00	0
4	0	4	0.00	18.54	18.54	0.00	0
	1	3	6.58	13.64	20.22	0.00	0
	2	2	12.30	11.24	23.54	23.54	2
	3	1	14.50	6.10	20.60	0.00	0
	4	0	20.90	0.00	20.90	0.00	0
5	0	5	0.00	25.62	25.62	0.00	0
	1	4	6.58	18.54	25.12	0.00	0
	2	3	12.30	13.64	25.94	0.00	0
	3	2	14.50	11.24	25.74	0.00	0
	4	1	20.90	6.10	27.00	27.00	4
	5	0	26.86	0.00	26.86	0.00	0

is possible, using results of conditional optimization, to find optimum control on the second step x*2 and so on to last n th step. The computing scheme of dynamic programming can be built on network models and also on algorithms of direct prorace (from the beginning) and return prorace (from the end to the beginning).

From the table of 1st step it is had F*3 ($e^0 = 5$) = 27. That is the maximum income of all system at quantity of means $e^0 = 5$ is equal 27. From the same table it is received that 1 enterprise should allocate u*1 ($e^0 = 5$) = 4.

Thus the rest of means will make: $e^1 = e^0 - u^1$; $e^1 = 5 - 4 = 1$. From the table of 2nd step it is had F*2 ($e^1 = 1$) = 6.1.

That is the maximum income of all system at quantity of means e1 = 1 is equal 6.1.

From the same table it is received that 2 enterprise should allocate:

u*2 ($e^1 = 1$) = 0.

Thus the rest of means will make:

$e^2 = e^1 - u^2$

$e^2 = 1 - 0 = 1$

To last enterprise gets 1.

The stage of unconditional optimization of method DP is finished.

So, investments at a rate of 5 are necessary for distributing as follows:

To 1 enterprise to allocate 4,
To 2 enterprise to allocate 0,
To 3 enterprise to allocate 1.

The given distribution of investments will provide the maximum income equal 27 unit.

On the given step from the corresponding basic table we chose that lower case fragment which corresponds to optimum value already found on the previous step x*2 = 4. This fragment contains only one line and one value of management which is optimum: u*3 = 1, x*3 = 5.

Thus the optimum task decision is constructed and looks like (0; 4; 1) and it is specified unequivocally. The optimum trajectory looks like

x*0 = 0, x*1 = 0, x*2 = 4, x*3 = 5.

The stage of unconditional optimization method of DP is finished.

Thereby the task in view decision is conducted completely. Considering economic sense of variables and functions introduced when drawing up an economic-mathematical model we formulate the definite answer to the task.

CONCLUSION

The basic necessary properties of problems to which probably to apply this principle: the problem should suppose interpretation as n-step-by-step decision-making process. Besides, the problem should be defined for any number of steps and have the structure which is not dependent on their number.

By consideration of a k-step-by-step problem some set of the parameters describing a condition of system on which optimum values of variables depend should be set. And this set shouldn't change at increase in number of steps.

The choice of the decision (management) on k's a step shouldn't render influence on the previous decisions, except necessary recalculation of variables.

In the present economic conditions agriculture development is strictly connected with actualization of applied methods of the analysis of investment processes and perfection of control systems.

Modern methods of reengineering of business processes allow to reconsider existing systems of financial management in system of agrarian and industrial complex and to adapt internal investment processes for current economic conditions.

It is necessary to notice that developed at the enterprises of agriculture the situation causes necessity of formation of new methodical bases and working out of practical recommendations about construction of control systems by the finance, in particular investment activity as one of the major conditions of development of the domestic enterprises entering into structure of agrarian and industrial complex and backbone factors of increase of efficiency of activity of the enterprises of agrarian and industrial complex.

Efficiency of distribution of financial resources concerns constant problems of the enterprises of agriculture that is connected with features of the business dealing, the raised brave component, limitation of free financial resources in the given segment of a national economy.

Dynamic problem of optimization of a portfolio of projects, problem of optimization of financing of a number investment projects within the limits of the target program of financing with long enough term of realization - an actual example of use of methods of financial management in current conditions. Dynamic programming is one of the most effective methods of the decision of similar problems, than and the urgency of given article speaks. It is necessary to add that the resulted example of optimization of financial resources is one of components of effective financial planning. According to the author, the given method is expedient for using in aggregate with arrangement process priority and risk-component of projects.

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