The paper presents results of cybernetic approach to optimize production of enterprises, optimize portfolios, receivables enterprises optimal redistribution facilities lease, a portfolio of orders, production reallocation of responsibilities of employees serving the company, developed v-stochastic model of enterprise management natural high risk method of determining the volume of sales of bank assets on incomplete information, corporate utility function, determine the probability of loan default by persons who have no credit history, determining the degree of risk in the calculation of the limit of commercial credit companies. Developed objective method of adjusting wages chiefs mining station coal mines The level of security of electronic commerce. Created economic and mathematical model feasibility completeness extraction of coal reserves at mines with small residual stocks, defined permanent break-even point for many food production.

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Optimization models in economics

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CONTENT

INTRODUCTION

The last ten years, in defense of dissertations in economics, specialized Academic Council require that the works were economic and mathematical models. This requirement is based on the understanding that the last fifty or sixty years, all new economic theory based on mathematical models that describe certain economic processes. Thus, this requirement is the knowledge that no modern mathematics economics impossible.

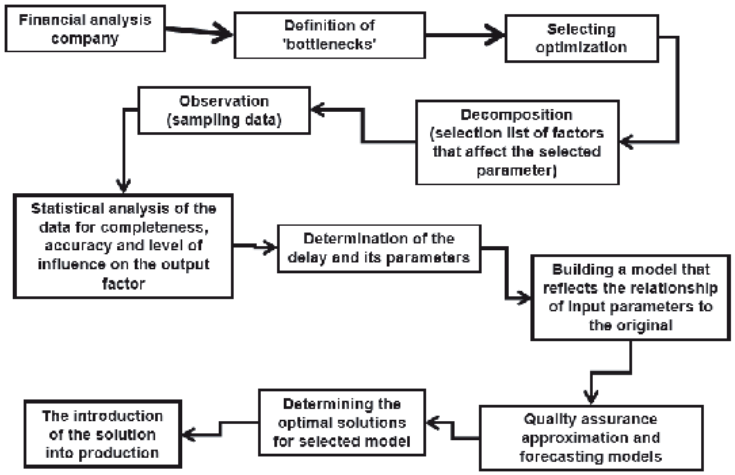
On the other hand, such a requirement is not complete, because the mathematical models that economists make it necessary to provide analysis of the behavior of the model under different conditions, for it is through the analysis of such models were put forward and developed modern economic theory.

This level of analysis of most researchers and economists unavailable due to relatively weak mathematical preparation. Another reason is the fact that most of the economic and mathematical models are micro. In the latter case analysis models do not need a course in addition to analysis of the quality of approximation and forecasting. But very important need is finding values of input factors such model, in which the numerical value of the model took to the best value. That is, find the optimal solution model.

The figure below shows that, given procedure needed to build models optimized.

As shown in the figure, most economists, at best, in his studies comes only to "Building a model." So, making a great job conducting research socio-economic system and building a model, they stop. And the model is only an ornament scientific work, and not a tool for finding the optimal

solution.



This paper will show how to create models and how to find them the best solutions through various routines digital processor Microsoft Excel, and given numerous examples of real development.

Interested researchers can now take the example of some of these developments and use them for modifying its object of investigation.

It is also possible to use not one but several models at the same time forming complexes with existing formulas.

The use of ready-made software makes possible the use described in the methods and techniques of specialists from the original mathematical training.

Note: As each point in sections not connected with others, numbering tables, figures and formulas is within the individual items.

Chapter 1. PRODUCTION

The term "manufacture" This chapter provides economic and mathematical models and their application in enterprises of different types.

1.1. Construction optimal balance on the basis of financial ratios [2]

A certain strategy of behavior on the market can be expressed in financial terms. [3] For each strategy characteristic values of a set of indicators. Most indicators are calculated according to the balance sheet and profit. Thus, the balance sheet and statement of income are interconnected through these figures.

So perhaps choosing the strategy of the company, to set a particular set of desired values financial performance, solve the problem of constructing an optimal [4] balance sheet for which under these restrictions will maximize profits or any other indicator that is selected for this calculation as target function. .

Suppose there is some balance sheet of the enterprise, which includes the statement of losses and gains, SBi ($1 \le i \le N$, where N – amount of balance sheet items) that are associated with each type of correspondent relationships

$$SBi = Fl(SBj) \ (\ 1 \le i, j \le N,\ i \ne j,\ 1 \le l \le K,\ ), \qquad (1)$$

where K – number of correspondent relationships for the balance, Fl – correspondent function (for balance) or settlement bonds (for income statement).

Suppose also, there is a set of financial ratios derived from the balance sheet by forming complexes with them some form

$$ФК_i = \prod_{j=1}^{Z_i} СБ_j^{S_j}, \quad (2)$$

where $1 \leq i \leq M$, M – number of financial ratios, Zi – amount of balance sheet items included in the i-th coefficient, Sj – iqual "1" or "–1".

Based on research we know that each of these factors, there is a limit to values, which more or less balance becomes ineffective, ie

$$FK_i \leq [100\% \cdot Y - (2Y - 1) \cdot OB_i], \quad (3)$$

where OBi – the value of these restrictions and the second factor. $Y = 0$ if restrictions require that the rate was lower for them: $Y = 1$ if greater.

Let diversification in the capital were offered several investment projects that should lead to changes in individual balance sheet items as

$$SB_{Hi} = SB_i + IP_i, \quad (4)$$

where SB_{Hi} – new value balance sheet with the introduction of another investment project proposals IP_i. This implies that the model substituted once all possible investment projects. Otherwise, there is a need to achieve certain financial targets. Then, instead of the project should be considered for reallocation of the amounts of the balance sheet, but the cancellation does not affect the drawing type equations (4).

If IP_i is not associated with other IP_i, its value should be a limit

$$0 \leq IP_i \leq IP_i\,max, \quad (5)$$

where$IP_i\,max$ – the largest possible value IP_i. In sence IP_i there may be financial indicators.

If there is some group $IP_i\,max$, interconnected dependence appearance

$$\Sigma ППi = const, \quad (6)$$

where *const* - the maximum amount that can be invested for this group offers. Then it will be the only limit to this group of proposals on the project. So then, as some of them have positive values, others will be negative, which would reduce some positions balance.

Let's choose now as the objective function, some gender balance *SBo* (such as equity), the statement of income (ie profit before tax) or FK_O financial ratios (eg greatest efficiency of invested capital), that

$$SB_O \rightarrow \min \text{ or } \max \text{ or } FK_O \rightarrow \min \text{ or mah.} \qquad (7)$$

Combining function (7) with defined constraints (1) - (6) can solve the problem regarding optimal IP_i numerical values which show us the size and involvement in a particular investment project.

For example, consider three options for changing the financial condition of the company by implementing the following possible project:

• end of the year the company purchased additional inventories in the amount of *A* UAH and paying in *B* UAH. money, and the other amount received deferred payment.

• end of the year the company sold products in *D* UAH., Received the *E* UAH. money, and the other amount made customer deferral of payment. Cost of goods sold amounted to *F* UAH.

• The company released year-end *G* additional ordinary shares of par value *H* UAH. And *J* bonds worth UAH. Draw financial resources were used to purchase equipment worth *K* UAH. Others were spent on the purchase of raw materials.

In addition, required that such a figure as asset turnover (the ratio of revenue from sales to the amount of non-current assets) exceeded 2.7. In the classical scheme of analysis of these projects would have to consider each of them individually, but the optimal formulation of the problem can create a combination of these projects.

These parameters FP_i will be added to the following graph balance sheet and profit:

Assets

Funds -B+E

Receivables +D – E

Inventories – D

Inventories +G*H + J-K+A

Liability

Payables +A – B

Ordinary shares +G*H + J

Fixed assets +K

Statement of Income

Revenues from sales +E

Cost of sales +F

Для вирішення оптимізаційної задачі була утворена система обмежень по залученим та витраченим коштам, у вигляді

$$
\begin{cases}
GH+J+E = B+K \\
0 \le GH+J-K \\
B \le A \\
0 \le K\text{ошти} \\
E \le \text{Inventories} \\
A, B, D, F, F, G, K \ge 0 \\
G - \text{digit} \\
0 \le D - E \\
G*H + J = \text{const.} \\
A \le 2000 \\
\text{Turnover assets} \le 2,7
\end{cases}
$$

As the objective function was taken up by the line "Profit before interest and taxes" and fixing that this option is 8,500 thousand for the

initial values of IPI values are given in Table. 2, will do optimal calculation using the spreadsheet Excel, the function "Search solutions." We received the best value FP_i yield a profit of 10 000,00 thousand. UAH, subject to specified values of "reversible assets" 2.70. For the initial calculation of this index is 2.92. In this case there were changes planned initial operations.

Table 1

The numerical values	*A*	*B*	*D*	*E*	*F*	*G*	*H*	*J*	*K*
The initial values	2000	300	1100	500	800	200	12	1000	2000
Optimal values	2000	2000	4000	2000	800	0	12	3400	3400

Analysis of the results shows that the investment projects should buy materials without delay payment for the full amount; the volume of goods should be increased, while reducing the cost of goods; shares issue is not appropriate, and it is better to issue bonds; should also increase the amount by which the purchased equipment.

The resulting recommendations in terms of reduction of turnover could be regarded as trivial, if they were obtained as a result of solving nonlinear optimal problem. Therefore, this recommendation identity proves the effectiveness of the proposed algorithm.

A similar calculation can be performed if necessary change the balance to achieve certain economic indicators, such as income tax, liquidity ratios and more.

Calculating the optimal balance can be used not only for investment projects, but also to achieve certain financial ratios values. Especially important it is for the banks, whose work is controlled by the NBU thirty indicators. Therefore, further research in this area should carry on building a system of limits for bank balance and for the balance of business on the criterion of a minimum budget allocation.

1.2. Justification of project selection criteria in terms of risky economic conditions [3]

Economy of Ukraine and other post-socialist countries develops in a continuous risk arising from a significant number of factors whose impact is not fully defined. Among them should be divided into four groups [4 - 10]:

1. Restructuring of the economy with its reorientation on the consumption of the population, not the other industries;

2. The economic pressure of foreign goods and services in a free them;

3. Sudden changes in climate and other natural conditions (geological - the extraction of minerals, fish stocks - with the catch in the waters of the world ocean and t. Etc.).

4. Cutting and, in part, changing uncertain political and economic conditions (laws), caused not only a struggle of different groups within the country, but world politics and pressure on the economy.

Therefore, there is the problem of reliable and easy selection criteria of investment projects in these conditions. Moreover, such criteria need not only to local entrepreneurs, but also those foreign businessmen who invest in the economy of the country, hoping to profit.

Widely known is a clean modern setting income NPV [13-23], which has the form

$$NPV = \sum_{t=0}^{T} \frac{(D_t - B_t)}{(1 + E_t)^t}, \quad (1)$$

where T - time horizon of the investment project, t - step calculation of the project, D_t- income for the t-th step of the calculation of the project, Bt- cost of the t-th step of the calculation of the project, E_t- discount rate at the t-th step of calculating investment project. The project is considered profitable when $NPV \leq 0$, and among the several projects chosen one whose NPV is highest.

This approach to the selection of the project is the assumption that the parameter Et fully take into account all possible risks in its implementation. But, actually, this option can only consider the risks of first and second groups [24]. Risks are third and fourth groups can lead to complete loss of all invested in the project capital. Therefore, there is a need to develop such a test the efficiency of the project, which would take into account these negative features. In terms of major climatic changes that led to the crisis in agriculture, increase the number of man-made disasters recognize Ukraine over the decades as a market economy, the creation of such a criterion is particularly relevant.

The solution to this problem start with the assumption that the implementation of the project possible complete or partial loss of the invested funds.

Suppose there is a sum of R, which may venture investor to risk for investment projects, bearing in mind that in case of failure of the project, this amount will be lost completely. This amount is the insurance factor of security investment project [21-23]. We use return code [8, 10-13]

$$I_{pr} = NPV / R, \qquad (2)$$

where R - the size of the investment, given the beginning of the investment period $R = \sum_{t=0}^{T} \frac{R_t}{(1+E_t)^t}$, (3)

where R_t- size of investment in t-th step of the calculation of the project.

Introduce the concept of security parameters of the project, as the ratio of the reduced amount of capital R factor in the insurance provision

$$PZ = R / P. \qquad (4)$$

Create a safety index as the ratio of the index return Ipr to setting security project software $I_B = I_{pr} / PZ$, or in general

$$I_B = \frac{P\sum_{t=0}^{T}\frac{(D_t - B_t)}{(1+E_t)^t}}{\left(\sum_{t=0}^{T}\frac{R_t}{(1+E_t)^t}\right)^2}, \qquad (5)$$

Then, among several investment projects need to choose the one for which the security code (5) is the largest.

A good example to show the effect of this index.

Suppose there are three investment projects for three years (hence, time horizon $T = 3$). Step calculating them $t = 1$ year. Availability factor of the project or the amount which the company can take the risk investor for an investment project, bearing in mind that in case of failure of the project, this amount will be lost completely $P = 30$ thousand. UAH. Investment occur only at the beginning of the project. Other parameters of the project are summarized in Table. 1.

Table 1

Initial data and results of calculation of the index Safety

Progect	The effectiveness of the project (D_t- B_t) (thousand. UAH) To step calculation, t, years				Net current income NPV, (ths. UAH).	Profitability index, I_{pr}	Setting security investment project, PZ	Index safe investment project I_B
	0	1	2	3				
1	-30	20	50	100	46,8857	1,5628	1	1,5628
2	-50	70	80	300	133,959	2,6791	1,666667	1,6075
3	-10	20	20	20	16,7449	1,6744	0,333333	5,0234

In terms of net income contemporary design is best №2, because there's largest *NPV*. But this project is the most risky, because the amount of investment required to implement it exceeds 20 thousand. UAH. the amount which the company can take the risk. In terms of profitability index has №3 project comes in second place, slightly ahead of the project №1.

But comparing safety indexes of these projects shows that the project №3 is the leader because it is three times safer for projects №1 and 2.

Found an option to compare different investment projects is convenient to use because it is based on the known calculation factors such as NPV and IPA. On the other hand, it takes into account the possible risk of losing the entire investment amount. If an investor determine the right amount of money, which he can take the risk, the choice of the project is simple and straightforward.

Found the safety code requires further research towards clarifying the impact of risk on it depending on their type. Obviously, the most appropriate approach is Bayesian probabilities for clarification occurrence of an adverse event, and determine the impact of the utility function [24] The person who decides to choose the criterion of the project (5).

1.3. Analysis of models bankruptcy economic conditions Dnipropetrovsk region [28]

In modern society due to changes in economic conditions of the functioning of different industries, a number of new challenges and tasks that were previously not considered. One of them - finding ways to prevent bankruptcy. This problem is one of the most pressing issues of economic theory and is central to modern business practices. Predicting bankruptcy and preventing it is especially important for businesses wholesale and retail trade in the Dnipropetrovsk region. In addition, these business entities is very dynamic compared to other industries enterprises and require immediate reliable determination of economic status.

Prices for wholesale and retail trade is characterized by high turnover of working capital, high dynamics of economic and other relations, rapid response to changes in the socio-economic, political life of the state, region, city or area. In

this regard, most importantly of economic policy preventing bankruptcy wholesale and retail trade.

Integral prerequisite for the formation of such a policy is the development of financial measures on the basis of international research and practice leading countries with a developed market economy, as well as the historical and economic and social characteristics Ukraine.

To quickly identify potential threat of bankruptcy and the timely development of measures for its early warning using special methods of forecasting - testing with financial indicators [32], [34] and discriminant Ex-Ante Analysis. Discriminant analysis is carried out on the basis of the development and recalculated special discriminant functions (models). In foreign and domestic practice using a number of models predicting bankruptcy, the most famous of which is the model Altman [31] model Sprinheyta coefficient of probability of bankruptcy [31], the universal discriminant function bankruptcy prediction coefficient Beaver coefficient Cash-Flow, economic and statistical model definition probability of bankruptcy catering developed by VP Martynenko [36].

Comparative analysis of the financial performance of companies with models determine the probability of bankruptcy will make it possible to conclude on the practical usefulness of these models when used to analyze the economic situation of the enterprises of wholesale and retail trade in the Dnipropetrovsk region.

Based on the data of wholesale and retail trade, trade with vehicles and companies that provide repair services for thirty-four units Dnepropetrovsk region (Dnepropetrovsk, Krivoy Rog, of Dneprodzerzhinsk, Nikopol, Novomoskovsk city .Pavlohrad, m.Ordzhonikidze, m.Marhanets, Zhovti Vody, m.Synelnikove, m.Vilnohirsk, m.Pershotravensk, m.Ternivka, Apostolivskyy district Vasilkovsky area Verhnedneprovsky district, Dnipropetrovsk region, Krivoy Rog area Krinichansky area Magdalinovskiy area Mezhova Raion, Nikopol district, Novomoskovsk district Pavlogradsky area Paul district, St.

Basil's area Pyatykhatky area Sinelnikovskoye area Solonyansky area, Sophia area Tomakivskyyy area Tsarychans'kyy area Shyroke Raion, Petrikov district) for 2000 - 2003, which have different profit margins, calculations were made twenty-one financial indicator and seven models of risk assessment bankruptcy. Data were taken on summary indicators of each unit.

Sample calculation results are given in Table. 1, which was used the following notation: dm, IR - very small, very high probability of bankruptcy by Altman; *NB*, *PB* - not bankrupt the potential bankrupt Sprinheytom by 92%; m - minimum (10%) probability of bankruptcy at a rate of probability of bankruptcy [31]; fs, *NAPB* - the company is financially stable (they are not threatened bankruptcy), the company is napivbankrutom by discriminant function; *UL* - unsatisfactory balance sheet structure on Beaver; *UL*, *RSC* - unsatisfactory balance sheet structure, satisfactory balance sheet structure at a rate Cash-Flow; district, *DV* in - low, very high, high probability of bankruptcy by Martynenko.

Integral coefficient of the threat of bankruptcy Altman (*ZA*). For Dnepropetrovsk. He is on 01. 01. 2003 3.65434 on 31. 12. 2003 2.36784 alone, indicating a very low probability of bankruptcy. But coverage ratio at 01. 01. 2003 equal to 0.90137 at 31. 12. 2003 is 0.98700, although very low probability of bankruptcy it must be greater than 1, net working capital must be greater than 0, and it is on 01. 01. 2003 -9,711,170 thousand. UAH., at 31. 12. 2003 - 1,656,655 thousand. UAH. solvency ratio must be greater than 0.5, and he is on 01. 01. 2003 -0.00999, 31 . 12. 2003 0.04491. This means that in fact there is a poor situation.

Model Sprinheyta. For m. Krivoy Rog its value is at 01. 01. 2003 2.2099 on 31. 12. 2003 1.63156 alone, indicating that the company is not bankrupt. But coverage ratio at 01. 01. 2003 equal to 0.87513 at 31. 12. 2003 is 0.96943, but when the company is not bankrupt, it must be greater than 1, net working capital must be greater than 0, and it is at 01. 01. 2003 -10,467,087 thousand. UAH., at 31. 12. 2003 -3,177,161 thousand. UAH. solvency ratio must be greater than 0.5,

and he is on 01. 01. 2003 -0.0452 at 31. 12. 2003 0.01750. This means that in fact there is a poor situation.

Likelihood ratio for bankruptcy [3]. For Apostol district he is on 01. 01. 2003 9.604 at 31. 12. 2003 alone 12.006, indicating the minimum (10%) probability of bankruptcy. But coverage ratio at 01. 01. 2003 is 0.8247, at 31. 12. 2003 is 0.890, although very low probability of bankruptcy it must be greater than 1, net working capital must be greater than 0, and it is 01. 01. 2003 -9,382 thousand. UAH., at 31. 12. 2003 -18 277 thousand. UAH. solvency ratio must be greater than 0.5, and he is on 01. 01. 2003 -0.1156 at 31. 12 . 2003 -0.003. This means that in fact there is a poor situation.

Universal discriminant function predicting bankruptcy. For Apostol area it is important to 3.266 01. 01. 2003 alone, indicating that the company is financially stable (they are not threatened bankruptcy). But coverage ratio at 01. 01. 2003 is 0.8247, but when the company is financially stable, it must be greater than 1, net working capital must be greater than 0, and it is on 01. 01. 2003 - 9,382 thousand. UAH ., solvency ratio must be greater than 0.5, and he is on 01. 01. 2003 -0.1156. This means that in fact there is a poor situation.

Beaver factor. For m. Dneprodzerzhinska it is at 31. 12. 2003 0,004 alone, indicating that the company has a poor balance sheet structure. But coverage ratio at 31. 12. 2003 is 1,050, when the company is financially stable, it must be greater than 1 (the condition is met), net working capital must be greater than 0, and it is at 31. 12. 2003 7380 thousand. UAH ., absolute liquidity ratio must be greater than 0, and it is on 31. 12. 2003 0.148 (the condition is met). This means that in fact there is a satisfactory situation.

Ratio Cash-Flow. For Vasilkovsky area he is at 0.146 01. 01. 2002 alone, indicating that companies have poor balance sheet structure. But coverage ratio at 01. 01. 2002 is 1.332, when companies have a satisfactory balance sheet structure, it must be greater than 1 (which is true), net working capital must be greater than 0, and it is at 01. 01. 2002 12,408 thousand. UAH. solvency ratio

must be greater than 0.5, and he is on 01. 01. 2003 0.567. This means that in fact there is a satisfactory situation.

Model bankruptcy Martynenko. For Solonyansky area it is important to 3.374 01. 01. 2003 alone, indicating that companies have a high probability of bankruptcy. But coverage ratio at 01. 01. 2003 is 1,181, when the company is financially stable, it must be greater than 1, net working capital must be greater than 0, and it is at 01. 01. 2003 430 thousand. UAH. Solvency ratio must be greater than 0.5, and he is on 01. 01. 2003 0.644. This means that in fact there is a satisfactory situation.

A similar analysis can be carried out for other combinations of financial ratios and models bankruptcy.

Based on the above, should make such a conclusion that the most famous in the foreign and domestic practice of bankruptcy prediction model, including model is Altman model Sprinheyta coefficient of probability of bankruptcy, discriminant function universal bankruptcy prediction coefficient Beaver coefficient Cash-Flow, economic and statistical model likelihood of bankruptcy catering developed by VP Martynenko not reflect the true financial situation of wholesale and retail trade

Table 1

Calculation of financial ratios and models determine the bankruptcy of wholesale and retail trade, Dnipropetrovsk region.

Name financial index	Dnepropetrovsk	
	on 01. 01. 2003	on 31. 12. 2003
Coefficient of depreciation	0.23486	0.28121
The coverage ratio	0.90137	0.98700
Quick ratio	0.79238	0.86642
Absolute liquidity ratio	0.03554	0.04756
Net working capital thousand UAH.	-9711170	-1656655
Solvency ratio	-0.00999	0.04491
Factor financing	-101.0674	21.2648
Ratio of working capital	-0.09863	-0.01300
Agility equity ratio	9.25207	-0.25530
Asset turnover ratio	2.588	1.727

Name financial index	Dnepropetrovsk	
	on 01. 01. 2003	on 31. 12. 2003
Payable turnover ratio	3.354	2.238
Accounts receivable turnover ratio	2.26128	1.50879
Maturity payable, days	107.32	160.85
Maturity of receivables days	159.20	238.60
Inventory turnover ratio	23.24	15.57
Fixed assets turnover ratio	39.29	26.22
Turnover ratio of equity	118.70	79.20
Return on assets ratio	0.04000	0.02848
Return on equity ratio	1.83464	1.30631
Profit ratio of	0.01546	0.01649
Profit ratio of products	0.03538	0.02973
Integral coefficient of the threat of bankruptcy Altman (ZA)	3.65434	2.36784
The probability of bankruptcy by Altman	Dm	Dm
Model Sprinheyt	2.32745	1.64262
The probability of bankruptcy by Sprinheyt	Nb	Nb
ikelihood ratio for bankruptcy	17.88635	6.29072
The probability of bankruptcy by the coefficient. probability of bankruptcy	m	m
Universal dyskrym. function prediction. bankruptcy	1.02867	0.62770
The probability of bankruptcy for dyskrym. function	напб	напб
Factor Beaver	0.04114	0.02235
The probability of bankruptcy by Beaver	nsb	nsb
Cash-Flow Ratio	0.06364	0.03377
The probability of bankruptcy at a rate Cash-Flow	нсб	нсб
Model bankruptcy Martynenko	11.34390	8.59560
The probability of bankruptcy by Martynenko	N	n

As the table shows, the various risk factors bankruptcy give the opposite meaning. Therefore, the method used ekspertnyrh estimates.

Peer review of the financial condition of regional structures of wholesale and retail trade Dnepropetrovsk region was carried out by the panel in an amount of 12 people who are responsible staff of the Department of Civil Service to combat economic crime Krasnogvardiyskiy District Police Ukraine in Dnipropetrovsk region on the following scale:

12b. - Financially stable state, it is far from bankruptcy;

11b. - Financially stable state, far from bankruptcy;

10b. - Financially stable state, quite far from bankruptcy;

9b. - Financially very stable state, but is far from bankruptcy;

8b. - Financially very stable state, need a little note improvement;

7b. - Financially stable state, but not bankrupt, must be some measures to improve the situation;

6b. - Financially stable state, urgently need to carry out appropriate measures to improve the situation;

5b. - Financially stable state close to bankruptcy, the urgent need to conduct appropriate for such state measures for its improvement;

4b. - Bankruptcy, but it does have the opportunity to go urgently need to conduct appropriate for such state measures or rehabilitation;

3b. - Bankruptcy, but it has very little opportunity to go urgently need to conduct appropriate for such state measures or rehabilitation;

2b. - Bankruptcy, there is no way out of it, the decision on reorganization or liquidation of court cases;

1b. - Bankruptcy, there is no way out of it must be carried out only liquidation.

To simplify the model was developed following notation:

$$z_1 = x_1, \quad z_2 = x_2, \quad z_3 = x_4, \quad z_4 = x_5,$$
$$z_5 = x_4^2, \quad z_6 = x_5^2, \quad z_7 = x_4^3,$$
$$z_8 = x_1 x_4, \quad z_9 = x_1 x_5, \quad z_{10} = x_3 x_5, \quad z_{11} = x_4 x_5,$$
$$z_{12} = x_1 x_3 x_5, \quad z_{13} = x_1 x_4 x_5, \quad z_{14} = x_3 x_4 x_5,$$
$$z_{15} = \sin(x_4), \quad z_{16} = \sin(x_5).$$

Using the above considered designation was given nonlinear regression function to the linear form, that model is as follows [16]:

$$y = a_0 + \sum_{i=1}^{16} a_i z_i \tag{1}$$

Where, a_0, a_i - coefficients of nonlinear regression functions

z_i - variables model.

With the "regression" analysis package based on MS Excel calculated ratios of (3.12). The calculation results are shown in Table 3.5 and 3.6.

The final appearance of nonlinear regression model can be represented as follows:

$$\text{Rating} = 8,47 - \frac{0,2CRP + 77,25PE(C)}{VA} + 0,09\frac{CRP}{BF} - 6,39\frac{PE(C)}{CRP} +$$
$$+\frac{4,99(PE(C))^2 + 0,34CRP \cdot PE(C)}{VA^2} - 2,44\left(\frac{PE(C)}{CRP}\right)^2 + 13,7\left(\frac{PE(C)}{VA}\right)^3 +$$
$$+0,39\frac{C \cdot PE(C)}{3 \cdot CRP} + 0,54\frac{(PE(C))^2}{CRP \cdot VA} + 0,08\frac{C \cdot PE(C)}{VA \cdot 3} +$$
$$+1,23\frac{C \cdot (PE(C))^2}{CRP \cdot VA \cdot 3} + 80,67\sin\left(\frac{PE(C)}{VA}\right) + 5,47\sin\left(\frac{PE(C)}{CRP}\right),$$

where CRP - cost of product sales (F2 p.040) PE (C) - net profit (loss) (p.220 F2 or 225); BF - net sales (F2 p.035); VA - assets (F1 p.280); BB - accounts payable (F1 p.520 of 600); C - stocks (F1 p.100 140).

The model is adequate for setting $R^2 = 0.84$.

1.4. Optimization company receivables market conditions in Ukraine[37]

The transition to full cost accounting companies and self-financing mechanism causes of economic changes within the company and requires the development and implementation of adaptive management costs. Under adaptability should understand the system's ability to control costs of economic entity and samorehulyuvatysya samonastroyuvatysya to preserve the most important economic indicators within the effective operation of the business by changing the environment [38]. In the context of these

research objectives of such a system should have features forecasting and prediction. When it should be understood Adaptive software program output and sales, the proper level of actual cost, profit, Profitability, support sustainable production cycle in the wild or modify existing emergence of new economic relations, including and accounts receivable.

The contours of the cost management system will assign the cost structure for economic infrastructure, efficient organization of the production cycle proceeds to the company of raw materials to shipment of finished products. Adaptive management expenditure statement includes not only the cost structure, but predicting its variations influenced by factors external and internal environments, including and receivables expansion factual understanding of the production cycle, based on the realities of the market economy, the border shipment of finished products is to obtain financial resources, again influenced by the value of funds in receivables.

Analysis of recent publications on cost management companies, managing accounts receivable possible to determine not previously considered aspects of this issue.

On the one hand receivables is beneficial for the company in terms of turnover growth, because Ukrainian law products are considered realized since its shipment. In fact, the company providing trade credit remains for a certain period without adequate financial resources to replenish inventories, timely payment of wages, taxes, etc. Support rhythmic production. The resulting short-term bank loans with a value that does not affect the production cost of the goods, but the impact on operating costs. In addition, there is a risk of impairment of receivables amount of time, or even the risk of non-repayment of debt.

Today some scientists and entrepreneurs the opportunity to study and work on the development of specific provisions of individual enterprises on

credit policy, which essentially governs relations receivable [39]. In particular, the following provisions proposed introduction of a number of interest for each day of this debt, which is similar to the terms of a bank loan. But Ukrainian enterprises, especially giant enterprises of heavy industry, including coal, mining and metallurgy, engineering and so on., which at high levels of depreciation, almost no innovative implementations, just beginning to increase production rates after the crisis of the last decade and try to compete in domestic and foreign markets, did not agree to such right words not favorable conditions for buyers overpaid for goods. In addition, few develop "net" interest on receivables, it must adapt to the system overall performance of the enterprise as a factor of influence on its outcome. This "net" is more "profitable" tone. But charging huge amounts payable to the seller does not mean their receipt. And such "income" in practice rather turn to costs. Therefore adaptive model accounts receivable management should consider the latest in terms of cost and worn primarily predictive in nature for such key concepts as additional costs and lost income, depending on body receivables and interest related to its service. This research will be based in future optimization of the total amount of receivables for the company.

Thus improving the management of enterprise production costs influenced receivables study the real conditions of payments with deferred payments for goods shipped, comparison of revenues and expenses from providing commercial credit aims and objectives of this work.

Consider now the possibility of additional charges for providing the buyer with further payments in the form of a simple reward for service and penalty charges for exceeding the contractual maturities of debt. Based on the fact that in Ukraine legislative field conditions and the process of settlement of receivables not directly regulated, depending on the content of the agreement between economic entities. There does not directly

regulate the procedures and mechanisms of fines and penalties from the buyer to the seller in case of non repayment in due time. No mention of such action and the laws of Ukraine "On Profit Tax" [40] and "On Value Added Tax" [41], where the explanation and interpretation of relations on receivables devoted respectively paragraphs 12 and 4. Only the law of Ukraine " on liability for failure to performance of financial obligations "[42] of 22.11.96 as amended on 10.01.2002 in art. 4 states that the size of the penalty is calculated on the amount overdue payment and can not exceed double discount rate of the National Bank of Ukraine effective during the period for which the penalty is paid. But the authors suggest only the opinion that the Law "On the liability for failure to perform monetary obligations" can spread and accounts receivable.

Using actual data, analyze the possibility of additional revenues or loss of company receivables. Conventionally, there are two situations: receivables within the period of the agreement between the buyer and the supplier; receivables exceed the terms of repayment specified in the agreement or even unauthorized. Whatever the situation, the fact of receiving money over time by itself disrupts the normal production process and enterprise daily need working capital, including bank loans and possible fines, penalties and related credit interest rates. Here are a priori data taken from commercial banks Dnipropetrovsk region and their rates by providing short-term loans to corporate customers (technical credits, credit lines, overdrafts, loans for working capital) as of 8/1/06 p. In comparison with the NBU discount rate (see Table. 1).

As noted above, in the first situation, the existence of receivables within the term of the agreement, the legislation Ukraine provided additional funds mandatory penalty supplier with customers. Each company determines in its sole discretion determines whether such a fee for each day of delay of payment in the form of additional interest. But

characteristic is that in real terms the fast running economy of Ukraine, hardly an enterprise that is trying to attract customers and compete with competitors creating favorable conditions set rate for their trade credit is higher than bank interest.

Table 1

The cost of short-term loans to commercial banks Dnipropetrovsk region compared to the NBU discount rate on 08.01.2006 was.

Name of bank	1-3 дні	4-7 дні	8-15 днів	16-30 днів	31-90 днів	91-180 днів	181-365 днів	>365 днів
Privatbank% per annum%	12	14	18	20	21	22	23	24
per day	0,032	0,038	0,049	0,054	0,057	0,06	0,063	0,065
Aval% annual avg. %	23-25	23-25	23-25	23-25	23-25	23-25	23-25	23-25
Per day	0,065	0,065	0,065	0,065	0,065	0,065	0,065	0,065
KredytDnipro% annual avg.%	25-30	25-30	25-30	25-30	25-30	25-30	25-30	32
Per day	0,075	0,075	0,075	0,075	0,075	0,075	0,075	0,087
Discount rate NBU	9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5
% Per day	0,026	0,026	0,026	0,026	0,026	0,026	0,026	0,026

And yet alone will certainly pay is a percentage of the bank for the use of money that needed too, but did not come from the debtor. In this case, assuming that the base interest calculation, that amount necessary loan and the amount of the loan, the same, in theory the company could benefit in excess of its rate of banking or have no benefits or losses if rates

are equal to one another, but in fact the company will require additional financial resources to cover the costs of use of banking services in the difference between the interest rate

$$\Delta O_{oc} = C \cdot t \cdot \Delta i, \quad (1)$$

where ΔO_{oc} - additional requirement seller in cash resources (thousand); C - operating expenses (thousand / day); t - term receivables (days); Δi - the difference between the percentage of banks for loan and interest receivables for the company (share units).

Consider the second case, in which the receivables exceed the term specified in the contract or even is unexpected for the seller. According to the above, under the law of the maximum amount of penalties for late returned cash equal to double the NBU discount rate at the time of the existence of the debt. Since there is some interest in considering the option with the lowest cost to the enterprise of receivables, TJ all natural economic goal of any of economic process, especially the process of creating a new product, a new value is minimize costs to maximize profits, for further calculations and comparison of paid interest on the loan seller and received fines or penalties to the buyer, take spectrum proposed Privatbank percent (Table 1), compared with other banks are lowest. These calculations are presented below (Table. 2; Figure 1). Banking was passed in the year 365 days.

In the case of deferred debt for goods shipped by the seller, assuming equivalence calculation base, for the last some days this duty brings a revenue of difference between the fine and bank credit that is calculated in Table 2. The dynamics of such income has descending character. Total income for this period of time equal to the area graph in Figure 1, where the percentage of fine curve curve than the percentage of the bank. The point of intersection characterizes the position of balance, lack of income and expenses at the same time. This rate equal, in this case 0,052% per day

of the outstanding amount and term income is stopped for 15 days. Because the costs of overdue receivables and fines for it in the actual conditions of this example can be predicted after 15 days deferred payment, which will have a tendency to increase.

In this regard, it must be emphasized again that Table 2 illustrates only the period of time when the buyer has delayed agreement on deferred payment of goods shipped or had no right to delay and enterprise-seller does not charge interest on a daily given the amount of trade credit, but in this case has the right to demand fines and penalties. Under such conditions result from receivables can be represented by the following dependence

Table 2

The calculation of the ratio of interest paid and received by the company from receivables

Indexes	1-3 day	4-7 day	8-15 day	16-30 day	31-90 day	91-180 day	181-365 day	>365 day
Privatbank% per annum% per day	12 0,032	14 0,038	18 0,049	20 0,054	21 0,057	22 0,06	23 0,063	24 0,065
Discount rate% NBU % Per day	9,5 0,026	9,5 0,026	9,5 0,026	9,5 0,026	9,5 0,026	9,5 0,026	9,5 0,026	9,5 0,026
he percentage of fines from the debtor to the seller:% annual Per day	19 0,052	19 0,052	19 0,052	19 0,052	19 0,052	19 0,052	19 0,052	19 0,052
Income / expenses seller % Per day	0,02	0,014	0,003	-0,002	-0,005	-0,008	-0,011	-0,013

$$\pm \Delta O_{oc} = \sum_{n=1}^{m} (C \cdot t_m \cdot \Delta i_m), \qquad (2)$$

where $\pm \Delta O_{oc}$ – surplus (requirement) in working capital (thousand); C – day operating expenses (thousand); t_m – m-th period arrears of some bank interest rate (days); Δi_m – the difference between the percentage of fines and bank interest in m-th period (share units); - The number of periods changes in bank interest (units).

Depending on what sign shall Δi_m, expression in parentheses identified as revenue or expenditure in the total equation.

Based on actual values of interest rates for a number of days (tabl.1-2) will hold an approximation of these data, which will determine the theoretical dependence in the equation, the interest rate of the time period. During the time period will take time exceeded the contractual deadline for payment for shipped goods

$$y = a \cdot \ln(\Delta t) + b = 0{,}0045 \cdot \ln(\Delta t) + 0{,}0377, \quad (3)$$

$$z = a_1 \cdot \ln(\Delta t) + b_1 = 10^{-15} \cdot \ln(\Delta t) + 0{,}052, \quad (4)$$

where Δt - the percentage of a bank and a fine day (percentage units); a, a_1, b, b_1 - natural numbers depend on actual data rows.

Then the difference is (3-4) to (1) - (2) equal to the difference between z and y. For example, if there are receivables under the agreement, then it is not levied fines and penalties, so for some m-tion period $z = 0$, the equation becomes negative value that is actually costs $z - y = 0$.

Obviously, the break-even point by 15 percent in the coming days deferred debt, and theoretically (trend) - at 23 days. Indeed, if solved the equation, the value will become 23.

However, when solving the inverse equation, with 15 days deferred interest bank day is 0.049, which corresponds to reality. In this regard, TJ in the calculation of the principal is the correct definition is the difference percent for given days delay, and the initial amount Interest not match in practice (statutory reserves, which earn interest at the bank is not the sum

of receivables for which there are fine), in which case the break-even point debt is not the point of intersection curves percent and curves income (expenses) in these percentages specified permissible difference.

The analysis of a case of receivables, the calculation of income or expense of a serious and economically feasible to think and operate with no delay days and inventory turns in the said postponement or postponement rules in stocks. In other words, how many times can result in stocks during the period for which there is no agreed or agreed debt. This is based calculation result cumulative cost of it. For example, the daily operating cost is 2000 USD. Rate stocks - 3 days. Delayed payment is 10 days. During this period, the company will need 3.3 times (10: 3) to replenish stocks in the absence of other sources of funding at the expense of bank credit. Currently, the total cost, taking into account changes in the growth rate of bank term loans, will be:

$$(2000UAH \cdot 3day) \cdot 10day \cdot ((0,0045 \cdot \ln(10) + 0.0377)/100) +$$
$$(2000UAH \cdot 3day) \cdot 7day \cdot ((0,0045 \cdot \ln(7) + 0.0377)/100) +$$
$$(2000UAH \cdot 3day) \cdot 4day \cdot ((0,0045 \cdot \ln(4) + 0.0377)/100) +$$
$$(2000UAH3day) \cdot 1day \cdot ((0,0045 \cdot \ln(1) + 0.0377)/100) = 61,15UAH$$

Expressions dependent gain or loss on receivables ($\pm \Delta O_{oc}$) of the daily operating expenses (C), inventory rules (t), amounts receivable (DZ) of deferment (Δt)

$$O'_{oc} = C \cdot t + \Delta O_{oc}, \tag{5}$$

$$\Delta O_{oc} = C \cdot t^2 \sum_{j=1}^{k} ((j + \frac{\Delta t}{t} - k) \cdot (a \cdot \ln(t \cdot (j + \frac{\Delta t}{t} - k)) + b)) + \\ + (C \cdot t^2 \cdot (\frac{\Delta t}{t} - k) \cdot (a \cdot \ln(t \cdot (\frac{\Delta t}{t} - k)) + b)), \tag{6}$$

$$Ш = Д3 \cdot \Delta t \cdot z, \tag{7}$$

$$\pm \Delta O_{oc} = DZ \cdot \Delta t \cdot (a_1 \cdot \ln(\Delta t) + b_1) - \\ - C \cdot t^2 \sum_{j=1}^{k} ((j + \frac{\Delta t}{t} - k) \cdot (a \cdot \ln(t \cdot (j + \frac{\Delta t}{t} - k)) + b)) - , \tag{8}$$
$$- (C \cdot t^2 \cdot (\frac{\Delta t}{t} - k) \cdot (a \cdot \ln(t \cdot (\frac{\Delta t}{t} - k)) + b))$$

where O'_{oc} – given ratio of working capital in stocks considering receivables (thousand); ΔO_{oc} – the amount on loans (thousand); Pn - the amount of fines received (thousand); j – component amounts serial number which corresponds to a whole number of time unit t fit in Δt, included in this component; k – whole, rounded down from $\Delta t / t$. For example, if $\Delta t / t$ =3,3 then k =3.

So where calculations from the bottom up, starting with the lines where the whole is once t in Δt. Last strochtsi in each other. If, for example, the delay is 10 days, and the rate of stocks of 20 days, their ratio equal to 0.5, ie 10 days no complete turnover. Then j and k equal to 0, and a member of (8) marked "amount" is also zero. Cases of netsilymy values specified ratio reflects the third member of the equation (8). Under such conditions, it takes the form:

$$\pm\Delta O_{oc} = DZ \cdot \Delta t \cdot (a_1 \cdot \ln(\Delta t) + b_1) - \\ -(C \cdot t^2 \cdot (\frac{\Delta t}{t} - k) \cdot (a \cdot \ln(t \cdot (\frac{\Delta t}{t} - k)) + b)) \quad , \qquad (9)$$

Functional (8) in the parameters C and t const', based on the economic essence of the situation, some like dependence on product options x_1 and x_2 in accordance DZ and Δt, which, in turn, for the company in this situation is variable

$$y = x_1 \cdot x_2, \qquad (10)$$

$$\pm\Delta O_{oc} = DZ \cdot \Delta t. \qquad (11)$$

Mathematical analysis of this relationship leads to the conclusion that it is not defined curve at the point $\pm\Delta O_{oc} = 0$, so while the search for such values is both parameters DZ and Δt, to function $\pm\Delta O_{oc}$ alue equal to zero is not possible. Selection of the values of these parameters for zero function should only lead by setting a constant value of one.

Also the number of experiments have shown that the search for solutions begins with the negative value of the objective function of

income (expenses), and the time delay which is more important, and the amount of debt which is less. Thus, increasing the value of productive functions of negative value to a positive amount of debt increases, but reduced his term. This enables the primary justification for the assertion that the optimal value of receivables at which income (expense) are zero, is minimum, that gives smaller amount costs; and the optimum term debt under the same conditions is the maximum, that gives greater delay costs.

With the economic content in the context of research work Mathematical opinion is interpreted as follows: for enterprises with desired operating expenses and rate reserves, for each transaction on accounts receivable or situation of unplanned occurrence, there is optimum in terms of income (expenses) from it, which can be presented in a certain period of time for the amount in question or in a certain amount for the term agreed. Optimal parameters are searched for zero, limit income (expenses), across which any result changes its sign to the opposite: fees are costs and expenses income. In addition, the value of the debt is minimal, and the term debt - maximum.

Let the company to maintain stable operation of daily need 9000 UAH., And the rate of inventory is 10 days. Buyer fails to pay for shipped goods worth 50 000 UAH., Term debt is already 10 days. Using search options in the mathematical editor MathCad find answers to the question: what result the company has in the circumstances; a minimum amount may give the company a loan for 10 days; to which the maximum period may be a debt in the amount of 50 000 USD. (Table 3). The objective function of income or expenses should strive settings change to zero.

These results show that in terms of the example of the said receivables company pays the bank 432 UAH. And collect fines 260 UAH. The

difference in size will cost 172 USD. In a period of 10 days, the company can provide the minimum debt amount 83 183 UAH., Or to not have expenses Ana income. In the case of debt 50 000 UAH., The company is generally not possible to consider this option, because even one day delay in payment will cost 7.93 UAH.

Stating The methodology can be applied in receivables within the agreement. Then be somewhat different interest rates because there will be penalties, but only the Bank Rate and the interest of the company, if it is as part of its monetary policy. And in formulating economic situation this example instead of "buyer fails to pay for shipped goods worth 150 000 UAH., Term debt already is 10 days," would "company is considering an option agreement with deferred payment in the amount of 150 000 UAH., For a period of 10 days .

*T*able 3

Calculation of income (expenses) of receivables

Marking	The formula	Results with	Optimum amounts for the period	Optimum time limit for the amount
% bank unit	formula 3	0,000481	0,000481	0,000377
% penalty, unit.	formula 4	0,00052	0,00052	0,00052
% bank, UAH	formula 6	432,5547	432,5547	33,93
% penalty, UAH	formula 7	260	432,5547	26
Δt , day.	by coditions	10	10**	1*
DZ, UAH	by coditions	50000	83183,6*	50000**
C, UAH	given	9000	9000	9000
t , day	given	10	10	10
$\pm \Delta O_{oc}$	formula 8	-172,5547	1E-06	-7,93

* - Optimized parameters ** - set parameters that are variable for the enterprise.

Based on the studies generated adaptive management model income (expenses) from receivables, which is projected character and offers a full range of revenue-cost space values change term debt and bodies under existing regulations inventories. This model also allows you to make a decision on granting or refusal of the buyer to a certain amount receivable for a fixed term under certain operating costs, normal stocks and interest rates, and optimal values calculated in Table 3, the forecast models are partial cases.

Assume the amount receivable (RS) and normal working capital (t) for the main indexes. Zprohnozuyemo the income and expenses depending on how the relationship will change term debt (a) to normal working capital and the ratio of the daily operating expenses (C) to total receivables. Make vzayemovyraz: operating costs (C) equal to a fraction of the amount receivable () and delay days () - a fraction of normal working capital in days (). On the basis of (6) - (8) we get:

$$\begin{aligned} \pm\Delta O_{oc} &= DZ \cdot t \cdot d_t \cdot (a_1 \cdot \ln(t \cdot d_t) + b_1) - \\ &- DZ \cdot d_c \cdot t^2 \cdot \sum_{j=1}^{k} (j + d_t - k)) \cdot (a \cdot \ln(t \cdot (j + d_t - k)) + b) - \\ &- DZ \cdot d_c \cdot t^2 \cdot (d_t - k) \cdot (a \cdot \ln(t \cdot (d_t - k)) + b) \end{aligned} \quad , (12)$$

The program Microsoft Excel build a matrix of revenues and expenses on receivables with constant performance standards reserves and daily operating costs, placing in columns range of variation in the proportion of days of delay in normal working capital, in other words a range of changes in the number of revolutions of stocks in the period of deferment, but in terms of - range of daily changes in the share of operating expenses in the total amount of debt that is due to the variation of the amount of debt (Table 4). Each cell of the matrix is calculated according to the formula 12. Conditions of payment: operating expenses - 7000 UAH. / Day, the rate of reserves - 4 days.

If operating costs make up 10% of the debt that automatically equal to 70 000 UAH., Then the delay payments for 20 days (500% of normal), which is 5 turns, the company will lose 102 USD. additionally. If the share of operating expenses to increase to 20%, and the meaning is actually a reduction of debt 35 000 UAH., The most thosesame 20 days deferred bring already 466 UAH. costs. Conversely, debt provision 140 000 USD. 60 days (1500% of normal) will cost in 2894 USD., and the loan is 30 days (800% of normal) - about 842 USD. income.

The research based on analysis of the legal framework of Ukraine on issues of receivables, the use of evidence-economic practices, and methods of economic and mathematical analysis have allowed a closer look receivables in terms of opportunities for each case of additional income or expenses. Comparison of amounts of financial resources necessary to pay the seller for credit the bank in case of delayed repayment of debt and the amount that the legislation may recover from the defaulter as penalties provides information on effective value gain or loss. Based on this matrix based speakers income (expenses) in the space changes as debt and deferred, depending on their relationship with constant impacts, operating expenses and inventory rules accordingly.

Mathematical analysis tool income (expenses) of the amount and term accounts receivable allowed to conclude that balance each individual situation when income (expense) equal to zero, there is an optimum amount for a given period of delay and the optimal time for a given amount of debt, and the optimal the amount is minimal, which gives smaller cost, and the best time is fully upheld, above which also means getting costs for the company.

Table 4

Expected matrix income (expenses) receivable from a given norm stock

Receivables %	Turn / Day / UAH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76
1%	700000	1407	2757	4049	5280	6450	7556	8599	9578	10491	11339	12121	12836	13484	14065	14578	15023	15400	15708	15947
2%	350000	679	1301	1865	2368	2810	3188	3503	3754	3939	4059	4113	4100	4020	3873	3658	3375	3024	2604	2115
3%	233333	436	816	1137	1398	1596	1732	1804	1812	1755	1632	1443	1188	865	476	18	-508	-1102	-1764	-2496
4%	175000	315	573	773	912	990	1004	955	842	663	419	109	-268	-712	-1223	-1802	-2449	-3164	-3948	-4801
5%	140000	242	428	555	621	626	567	446	259	8	-309	-692	-1142	-1658	-2242	-2894	-3614	-4402	-5259	-6185
6%	116667	193	331	409	427	383	276	106	-129	-429	-794	-1226	-1724	-2289	-2922	-3622	-4390	-5227	-6132	-7107
7%	100000	159	261	305	288	210	68	-137	-406	-741	-1141	-1607	-2140	-2740	-3407	-4142	-4945	-5816	-6756	-7765
8%	87500	133	209	227	184	80	-88	-319	-614	-975	-1401	-1893	-2452	-3078	-3771	-4532	-5361	-6258	-7224	-8259
9%	77778	113	169	166	103	-21	-209	-460	-776	-1157	-1603	-2116	-2695	-3341	-4054	-4835	-5685	-6602	-7588	-8644
10%	70000	96	137	118	39	-102	-306	-574	-906	-1303	-1765	-2294	-2889	-3551	-4281	-5078	-5943	-6877	-7880	-8951
20%	35000	4	9	100	252	466	-743	-1083	-1488	-1958	-2493	-3095	-3763	-4498	-5300	-6170	-7108	-8115	-9190	-10334
30%	23333	1	58	173	350	588	-889	-1253	-1682	-2176	-2736	-3361	-4054	-4813	-5640	-6534	-7496	-8527	-9627	-10795
40%	17500	13	82	210	398	648	-961	-1338	-1779	-2285	-2857	-3495	-4199	-4971	-5810	-6716	-7691	-8734	-9845	-11026
50%	14000	20	96	232	427	685	-1005	-1389	-1837	-2351	-2930	-3575	-4287	-5065	-5911	-6825	-7807	-8857	-9976	-11164
60%	11667	-25	-106	-246	-447	-709	-1034	-1423	-1876	-2395	-2978	-3628	-4345	-5129	-5979	-6898	-7885	-8940	-10064	-11256
70%	10000	-28	-113	-256	-460	-726	-1055	-1447	-1904	-2426	-3013	-3667	-4387	-5174	-6028	-6950	-7940	-8999	-10126	-11322
80%	8750	-31	-118	-264	-471	-739	-1071	-1465	-1925	-2449	-3039	-3695	-4418	-5207	-6064	-6989	-7982	-9043	-10173	-11372
90%	7778	-33	-122	-270	-479	-749	-1083	-1480	-1941	-2467	-3059	-3717	-4442	-5234	-6093	-7019	-8014	-9077	-10209	-11410

1.5. Development of economic and mathematical model of compensation receivables periodic increment production [42]

The economic environment of the company, subject to the regime wherevse conserve resources and achieve the highest performance, increasingly requires more precise data on the settlement predict future economic situations and decision making. Specifically in terms of trade credit between enterprises partner becomes necessary management decisions in terms of compensation receivables. Along with common tools refinancing of debt, such as factoring, bill discounting loans previously been proposed to expand production and to obtain additional income for self-biased "repay" the debt from domestic reserves. Investigated the issue of finding a specific number of periods through which alone the company will return the value of receivables increasing each period according to the law change time value of money, the profits derived from the increase in production over the same number of periods. In particular, compensation considered debt each period profit or share, then on balance there were increasing debt. It is a process of periodic increase or decrease the amount - such as depreciation, collection of receivables due allowance for doubtful loans - usually presented in tabular form with numbered periods and initial estimates, final value and payment. Analytical dependence of transcendental process forward and has an unknown number of members amounts. Therefore, finding the number of periods by solving the optimization problem as analytical equations for finding the number of periods, or any other factor model, through which will put the result - repayment savings - means of calculation Excel spreadsheet was not possible.

Analysis of available studies found first, no complicated techniques to transfer functional dependencies, which marked the economic processes

related to periodization payments in analytical form necessary to solve optimization problems by finding factors specific values of these processes. Secondly, the author's opinion, there is no uniform agreement on the numbering of payment periods and not enough numbering periods the influence on the final result of calculation. In particular, labor Koptevo NV, the model proposed definition of the term loan and the interest rate, but well-known sense of the future value of the loan. The proposed study future value of receivables is not known because it buwherenaroschuvatys until it will match the amount of compensation formed on profits, and this extension cost of debt because of an unknown number of periods.

Therefore, the aim of the paper is finding algorithm Formula analytical look depends repayment period of receivables company the size of the debt, interest payments to pay off, and more.

Let the company exists or there receivables, for which the owner wants warning calculate Compensation own. The debt is repaid each period, and the balance being increased by additional costs, such as inflation rates. Increasing debt period equal to the period of repayment, and the company is operating cycles, after which it profits. Payments to maturity consist of a share of approximately constant level of income during the period. Problem: find the number of periods by which the amount owed ziywherena zero at its periodic settlement and at the same time increasing the residual amount, if we know the initial cost of debt rate increasing, recurring income and its share of the settlement.

Table 1 at the beginning of the period the debt is zero I. During this period, it increases the cost to the $DZ \cdot (1+E)$. However, during this period, the company makes a profit *Gor* and sends its compensation debt share. Earnings per maturity period is zero $Gor \cdot i$. At the beginning of the first period of the debt, accrued on zero period, reduced by the amount equal to the share of profits DZ_1. During the first period DZ_1 again increasing their

value to $DZ_1 \cdot (1+E)$, and to pay off again formed part of the profits in a constant amount $Gor \cdot i$. Accrued cost of debt for the first time reduced the share of profits and the value of the debt at the beginning of the second period, DZ_2. Similarly, the calculation of initial cost of debt for T periods.

Table 1

Period number	Cost *DZ* at beginning of period	Cost *DZ* at end of period	Gain on redemption
0	DZ	$DZ \cdot (1+E)$	$Gor \cdot i$
1	$DZ_1 = DZ \cdot (1+E) - Gor \cdot i$	$DZ_1 \cdot (1+E)$	$Gor \cdot i$
2	$DZ_2 = DZ_1 \cdot (1+E) - Gor \cdot i$	$DZ_2 \cdot (1+E)$	$Gor \cdot i$
3	$DZ_3 = DZ_2 \cdot (1+E) - Gor \cdot i$	$DZ_3 \cdot (1+E)$	$Gor \cdot i$
T	$DZ_t = DZ_{t-1} \cdot (1+E) - Gor \cdot i$	$DZ_4 \cdot (1+E)$	$Gor \cdot i$

Numbering repayment period can begin with 0 $(0,1,2,...,t)$ (Table.1), or from 1 $(1,2,3,...,t)$ (Table 2). Then the identical content of the economic process are its various designations. In Table 1 after passing through three periods - zero, first, second - actually the beginning of the fourth period marked as the beginning of the third, and the actual cost of debt at the beginning of the fourth period designated as DZ_3. Table. 2 after passing through three periods - the first, second, third - actually the fourth period marked the fourth, and the actual cost of debt at the beginning of the fourth period designated as DZ_4.

Table 2

Period number	Cost *DZ* at beginning of period	Cost *DZ* at end of period	Gain on redemption
1	DZ	$ДЗ \cdot (1+E)$	$П \cdot i$
2	$DZ_1 = DZ \cdot (1+E) - Gor \cdot i$	$DZ_1 \cdot (1+E)$	$Gor \cdot i$
3	$DZ_2 = DZ_1 \cdot (1+E) - Gor \cdot i$	$DZ_2 \cdot (1+E)$	$Gor \cdot i$
4	$DZ_3 = DZ_2 \cdot (1+E) - Gor \cdot i$	$DZ_3 \cdot (1+E)$	$Gor \cdot i$
T	$DZ_t = DZ_{t-1} \cdot (1+E) - Gor \cdot i$	$DZ_4 \cdot (1+E)$	$Gor \cdot i$

At first glance this difference does not matter. After selecting the numbering option periods should be clearly oriented in his notation. But as

it turned out the study to calculate the target result, finding the number of periods through which initial value *T*-th period turn zero in its periodic repayment and increasing, the difference in numbering periods is crucial.

Formulate target results in general terms, that is, accounts receivable should turn to zero at the end of the period of repayment:

$$DZ_T = 0 \qquad (1)$$

We write the initial value of debt at each period of repayment and increasing numbering options for both periods. Let the initial receivables - DZ, earnings per share redemption -, the rate of increase of debt - E, (Table 3), creating a table of initial series of general form.

Table 3

Period number		The cost of debt at beginning of period
0	1	$DZ \cdot (1+E)^0$
1	2	$DZ \cdot (1+E)^1 - Gor \cdot i \cdot (1+E)^0$
2	3	$DZ \cdot (1+E)^2 - Gor \cdot i \cdot (1+E)^1 - Gor \cdot i \cdot (1+E)^0$
3	4	$DZ \cdot (1+E)^3 - Gor \cdot i \cdot (1+E)^2 - Gor \cdot i \cdot (1+E)^1 - Gor \cdot i \cdot (1+E)^0$

Analytical expression receivables at the beginning of the first T-period in accordance targeted results (1) for periods numbering options $0(0,1,2,...,t)$ and from1 $(1,2,3,...,t)$ in general is under (2), (3).

$$DZ_t(0,1,2...,t) = DZ \cdot (1+E)^T - \sum_{t=1}^{T} (Gor \cdot i \cdot (1+E)^{t-1}) = 0; \qquad (2)$$

$$DZ_t(1,2,3,...,t) = DZ \cdot (1+E)^{T-1} - \sum_{t=1}^{T-1} (Gor \cdot i \cdot (1+E)^{t-2}) = 0, \qquad (3)$$

where $ДЗ_t(0,1,2...,t)$, $ДЗ_t(1,2,3,...,t)$ – receivables at the beginning of the *t*-th period in accordance with the numbering periods of zero and one (UAH) *T* - total known number of periods; *t*- period.

Due to the fact that in general, the number of periods - the value is unknown, calculate it from (2, 3) in an analytical form is not possible.

Solving this problem, we note that even when the total partition T into separate discrete periods sought a full term T can be any fractional number. Then move the sign $\sum$ in (2), (3) the integral sign in (4), (5), replacing the unknown parameter value. Note that the upper limit of the amount in (2), (3) always lags by one of the actual number interval. Therefore, the upper limit of the integral in (4), (5) must always increase by one.

$$\sum_{t=1}^{T}(Gor\cdot i\cdot(1+E)^{t-1})\to\int_{1}^{T+1}Gor\cdot i\cdot(1+E)^{x-1}dx\to\frac{Gor\cdot i\cdot((1+E)^{T}-1)}{\ln(1+E)}; \quad (4)$$

$$\sum_{t=1}^{T-1}(Gor\cdot i\cdot(1+E)^{t-2})\to\int_{1}^{T}Gor\cdot i\cdot(1+E)^{x-2}dx\to\frac{Gor\cdot i\cdot((1+E)^{T}-(1+E))}{(1+E)^{2}\cdot\ln(1+E)} \quad (5)$$

Then after integration (2), (3) take the form accordingly (6), (7):

$$DZ_{t}(0,1,2...,t)=DZ\cdot(1+E)^{T}-\frac{Gor\cdot i\cdot((1+E)^{T}-1)}{\ln(1+E)}; \quad (6)$$

$$DZ_{t}(1,2,3,...,t)=DZ\cdot(1+E)^{T-1}-\frac{Gor\cdot i\cdot((1+E)^{T}-(1+E))}{(1+E)^{2}\cdot\ln(1+E)} \quad (7)$$

Check the calculations by (6), (7) in the numerical example (Table 4). Set parameter: DZ = 32 thousand UAH .; E = 0,017; T = 3 periods; Gor = 9,1 thousand hryvnas .; i = 30%.

Table 4

Period number		Cost *DZ* at beginning of period	Cost *DZ* at end of period	Gain on redemption
0	1	32 000	32 544	2 748,19
1	2	29 795,81	30 302,33	2 748,19
2	3	27 554,14	28 022,56	2 748,19
3	4	25 274,37	-	-

By (6) at the beginning of the third period we get the value of receivables 25 203 UAH. By (7) at the beginning of the third period on a scale numbering periods of one to t, substituting in number three periods,

we get 27 600 UAH., And at the beginning of the fourth period that comes up to the beginning of the third on the scale numbering from 0 to t, substituting in number 25 get four periods 344 UAH. As you can see, the results for the two different formulas from accurate.

The first conclusion is the need matching numbering periods could lead to calculations regarding a method of marking periods. Let's choose numbered, starting from 0 to t. Then (6) is in its form and in (7) equal to T ($T + 1$). Substitution (7) T on ($T + 1$):

$$DZ_t(1,2,3,...,t) = DZ \cdot (1+E)^T - \frac{Gor \cdot i \cdot ((1+E)^{T+1} - (1+E))}{(1+E)^2 \cdot \ln(1+E)} \quad (8)$$

At the beginning of the third period when numbering from 0 to t, (6) have a debt of 25 203 UAH, and the (8) - 25 344 UAH. For tabular calculations (Table 4) cost of debt at the beginning of the third period - 25 274 UAH.

The second conclusion on the basis of numerical experiments is that the value obtained by (6) is always less than the real result and the value obtained by (8) is always greater than the real result. Thus the difference between (6) and between actual results and (8) and the real result is not the same and under (-71) and (70). One might consider this difference is almost the same and find her analytical dependence, to avoid the addition of two equations in the way of numbering periods. But calculations show that in other economic situations of debt other options, such as full income, or income increments at periodic increasing the production value of this difference is not a constant. The exact same value repayment period corresponding to the arithmetic mean of the values obtained (6) and (8).

We write the second conclusion mathematically:

$$DZ_t(0,1,2...,t) < DZ; \quad (9)$$

$$DZ_t(1,2,3,...,t) > DZ_t; \quad (10)$$

$$DZ_t = \frac{DZ_t(0,1,2,...,t) + DZ_t(1,2,3,...,t)}{2}; \tag{11}$$

$$DZ_t = \frac{DZ \cdot (1+E)^T - \frac{Gor \cdot i \cdot ((1+E)^T - 1)}{\ln(1+E)}}{2} + \\ + \frac{DZ \cdot (1+E)^T - \frac{Gor \cdot i \cdot ((1+E)^{T+1} - (1+E))}{(1+E)^2 \cdot \ln(1+E)}}{2} \tag{12}$$

The dependence of the arithmetic mean (12) has a rather complicated shape, so simplifying the mathematical transformations (12) is transformed into (13):

$$DZ_t = DZ \cdot (1+E)^T - \frac{Gor \cdot i \cdot [(1+E)^T - 1]}{2\ln(1+E)} \cdot \frac{E}{(1+E)} \tag{13}$$

Substituting in (13) and set numerical parameters of any value, we obtain the exact values of the cost of debt early periods numbered 0 to t according to Table 4.

For finding the value of *T* use (13) as the functional optimization problem. Define the absolute value (12) or (13) as an objective function that seeks to scratch, variable parameter T, only limited value greater than zero, the option "Solve" computer program Excel. We find *T* at a rate of 13.08 periods.

So during the research was an analytic form for calculating the maturity of receivables extra profit enterprise

This includes economic situations being relatively whererozrahunky period as the calculation of loan amortization, collection of receivables and algebraic expression a summation. Using the integration components in summation and the inclusion of the expression to the starting dependence creates a function that allows results are not exact, but close to reality. However, he more or less on the actual outcome depends on the way the numbering periods from 0 to 1 or *t* to *t*+1 and denote the components of a

certain period, for example DZ_t or DZ_{t+1}, which is essentially the same, but for different symbols. Studies have shown that accurate result gives the arithmetic mean of dependency, designed for both options numbering periods. The resulting algorithm greatly facilitates the prediction factors included in economic models, where there is flow periods and payments.

1.6. Оптимальний перерозподіл виробничих обов'язків співробітників обслуговуючого підприємства [43]

Socially advanced economies, scope of services in total trade turnover steadily increases. In these conditions, businesses that provide services to try to get closer to the location of customers. Therefore, such companies are going through a very acute problem related to lack of manpower, but the company can not afford to hire new employees because of negligible value services compared with the payroll and the cost of travel to the customer.

We show an example PE "Technocentre Lighthouse" that distributes the software "STATEMENT ++" and "1C Accounting" that the only possible solution to this problem was the need to minimize the time to complete tasks associated not only with the installation and updating of software, but with decreasing costs for enterprises moving specialists from one client to another. Thus increase profits. Obviously, in such conditions Dnipropetrovsk task is to solve the transport problem.

For its solution the whole territory of the city was divided into sectors.

Problem includes the following symbols: N - number of sectors; C_{ij}, (i, j = 1..N) - cost matrix, where C_{ij} - the cost of switching from the i-th sector j-th; D_i - matrix number of specialists in the i-th sector; P_j - matrix number of firms in the j-th sector; X_{ij} - matrix junctions with components

that can have the following values: $X_{ij} = 1$ if the i-th specialist moves from the sector j-th, $X_{ij} = 0$ if does not move; i, j = 1..N and $i \neq j$.

Table 1

Time spent on travel between sectors, min

Sectors	Л1	Л2	Л3	Л4	Л5	П1	П2	П3	П4	П5	П6	П7	П8	Ц
Л1	0	20	30	40	25	60	90	50	60	50	45	80	45	27
Л2	20	0	35	45	35	65	80	55	65	55	50	85	50	32
Л3	30	35	0	30	35	50	80	40	50	40	35	70	35	17
Л4	40	45	30	0	65	80	110	70	80	70	65	100	65	40
Л5	25	35	35	65	0	30	40	25	35	65	60	90	50	40
П1	60	65	50	80	30	0	20	30	40	50	60	80	37	50
П2	90	80	80	110	40	20	0	27	45	55	65	90	75	45
П3	50	55	40	70	25	30	27	0	20	30	45	60	45	15
П4	60	65	50	80	35	40	45	20	0	15	30	70	40	25
П5	50	55	40	70	65	50	55	30	15	0	15	55	25	25
П6	45	50	35	65	60	60	65	45	30	15	0	30	25	25
П7	80	85	70	100	90	80	90	60	70	55	30	0	20	35
П8	45	50	35	65	50	37	75	45	40	25	25	20	0	10
Ц	27	32	17	40	40	50	45	15	25	25	25	35	10	0

Table 2

Time spent on travel between companies within the same sector, min

Sectors	П1	П2	П3	П4	П5	П6	П7	П8	П9	П10	П11	П12	П13	П14
П1	0	5	10	7	3	8	10	5	6	15	20	5	6	1
П2	5	0	10	5	6	8	15	20	5	6	2	7	9	5
П3	10	10	0	20	5	3	6	4	8	10	15	4	6	8
П4	7	5	20	0	5	2	3	8	4	5	1	6	4	15
П5	3	6	5	5	0	7	5	6	2	5	4	9	6	10

Criterion minimize transportation costs

$$F(X) = \sum_{i=1}^{N} \sum_{j=1}^{N} C_{ij} \cdot X_{ij} \cdot D_i \cdot P_j \rightarrow \min . \quad (1)$$

Limitation:

$$\sum_{i=1}^{N} X_{ij} \cdot 10 \leq P_j , \; i = 1..N, \quad (2)$$

$$\sum_{j=1}^{N} X_{ij} = D_i , \; j = 1..N, \quad (3)$$

$$X_{ij} = 0 \text{ or } 1 . \quad (4)$$

Condition (3) means that specialists from each sector go only once; condition (2) - Specialists moved only in those sectors where firms than or equal to 10; condition (4) - matrix of transitions is 0 or 1.

Table 3

The original plan of moving experts at the beginning of the day

Start sector	Secto rd	Finish sector													
		Л1	Л2	Л3	Л4	Л5	П1	П2	П3	П4	П5	П6	П7	П8	Ц
	Л1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Л2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Л3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Л4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Л5	0	0	0	0	1	0	0	1	0	0	0	0	0	0
	П1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	П2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	П3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	П4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	П5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	П6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	П7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	П8	0	0	0	0	0	0	0	0	0	0	0	0	1	1

Table 4

The interim plan professionals moving in the middle of the day

The company, which will start	Firms	The company, which will move													
		Л1	Л2	Л3	Л4	Л5	П1	П2	П3	П4	П5	П6	П7	П8	Ц
	П1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	П2	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	П3	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	П4	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	П5	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	П6	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	П7	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	П8	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	П9	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	П10	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	П11	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	П12	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	П13	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	П14	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The input data for the calculation are:

- Data on payment for services;

- Information on experts located at the time of launch, in the desired sector;

- Matrix of distances between the sectors in minutes (Table. 1);

- Matrix of distances between enterprises in minutes (Table. 2).

When trying to solve the problem of the use of the "Search solution" MS Excel in this formulation proved that Newton's method [44] does not allow to find a solution. Therefore, to solve the problem of optimization method was applied gradients [45], which refers to methods of unconditional optimization. Like Newton's method, the method of gradients has a high rate of convergence, but uses only the first derivative of the objective function. Method gradients, in fact, is exhaustive solutions, which is optimized by the fact that the sorting options on certain grounds cut off not optimal set of enumeration. Since the number of vertices from level to level factorial increases in progression, the cut-off tops upper levels significantly reduces the total number of variants disguised.

This problem is solved within a day MxN times, where M - the number of customers who have submitted an order for maintenance; N - number of employees.

Results solve the problem presented in Table. 3-4.

After the experimental operation of the proposed method over a period of financial analysis was performed [5, 8] enterprise. They removed the lines that have zero value.

After comparing financial analysis for application optimization problem and after application were obtained the following results:

- Increase profits by 15%;

- Reducing costs;

- A significant reduction of the probability of bankruptcy.

1.7. Optimal redistribution of rent objects [46]

As you know, in the transition to a market economy established many forms of real estate ownership: own, state, municipal. Real Estate is part of the market turnover due to the emergence of such transactions as buying and selling, inheritance, entrusted reduction, rent and others.

Rental involves the transfer of capital goods (assets) for temporary use and possession. Mandatory condition for the implementation of lease relations is the presence of two economic entities - landlord and tenant relationships between them up on the same property.

Sometimes some companies question the effective rental property. As thus increase the profit? How to distribute the items among rental customers? How to meet the needs of customers? These and other issues pose a number of problems for landlords.

Often companies with similar type of activity is leasing process so that the tenant did not pass exactly the room that he needed, and more. Most often offer space larger area because there is no other. With this distribution facilities under lease may be a situation where the next customer in need of some area, and that area which is at par, missing. That is why there is a situation of non-lease areas as a result of the loss of unused space and reduce profits.

Show address this problem as an optimal redistribution of real estate among customers of WFP "GEOS" to minimize losses from unused areas to maximize profits.

The first step to achieve the goal of clear buwherevstanovlennya customer needs. What facilities need? What is the area? At what price? Wherepotribno be placed?

The second step buwhere clear redistribution of rent objects among customers so that each took desired area. So perhaps the same

apartment buwherezaymaty several customers. As a result the whole area buwherevykorystovuvatysya without a trace and the company reaps maximum profits from their rental facilities.

Thus, the optimal reallocation of real estate will enable clients to maximize profit and usually increase profitability.

The target function buwhereminimizatsiya our estimates of losses from unused areas to help increase profits.

First, create a database of apartments that rent company. Base buwherematy data such as the name of the object of the lease; Rental property area, measured in square meters and we denote by Pi; price per square meter facility lease, measured in Euro and we denote by C_i; Number of denoted by N.

Now create a database of existing customers, which have the following information: personal data tenants; the business name of the tenant; that this area requires client, measured by square meters and which is denoted by PP_j; number of customers, which is denoted by C.

Then create a matrix distribution facilities lease of existing customers. This matrix is designated as G_{ij}. Its elements can take the value 0 or 1. This matrix should be of size N x K.

You must create another matrix, the matrix of residual space. It shows the balance area of the j-th space after it takes the i-th client. It will also ZP_{ij} matrix size N to K, which describes the system of equations.

$$ZP_{ij} = \begin{cases} P_i - PP_j, P_i > = PP_j \\ DVC, P_i < = PP_j, \end{cases}$$

Where DVC – the highest value P_i; P_i - the price per square meter of space; PP_j - needed area, which ordered the j-th client.

Then form the functionality that will target function for finding solutions matrix distribution facilities. This functionality buwhereopysuvatysya the formula that requires minimizing the unoccupied area

$$\sum_{i=1}^{N}\sum_{j=1}^{K} Ci * Gij * ZPij \rightarrow \min , \qquad (2)$$

Where C_i – price per square meter and the second room.

The objective function will have the following restrictions.

$$\sum_{i=1}^{N}\sum_{j=1}^{K} Gij = K ; \qquad (3)$$

$$\sum_{j=1}^{K} Gij * PPj <= Pi . \qquad (4)$$

Using the "Search for solutions" MS Excel find optimal distribution of objects among customers of WFP "GEOS" method of integer programming.

Example Calculation results are presented in the following table. The introduction of this technique, allow the company to reduce the amount of free space by 13% and profits - by 4%.

An example of solving the optimization problem of rent premises for rent objects 9 and 20 clients

Clients Number	G_{ij}								
1	1	2	3	4	5	6	7	8	9
2	1	0	0	0	0	0	0	0	0
3	0	0	1	0	0	0	0	0	0
4	0	0	0	1	1	0	0	0	0
5	0	0	0	0	0	1	0	0	0
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
8	0	0	1	0	1	0	0	0	1
9	0	0	0	1	0	0	0	0	0

Clients Number	G_{ij}								
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	1	1	1	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	0	1	1	0	1	1
14	0	0	1	0	0	0	0	0	0
15	0	0	1	0	0	0	0	0	0
16	0	0	0	1	1	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0
19	0	0	0	0	1	0	0	0	0
20	0	0	0	0	1	0	0	0	0

1.8. Economic-mathematical forecasting models calculate the optimal grain crops [47]

Agriculture is one of the most important sectors, both in agriculture and in the whole economy. A distinctive feature of agricultural production is seasonal production processes. Productivity - output indicators of efficiency of agriculture. The proper planning and forecasting of yields and optimal agricultural crops depends income agribusinesses. Requires constant analysis of factors affecting crop yields. The calculation of optimal acreage crops traditionally [23] performed linear problems with linear constraints:

$$\begin{cases} D = \sum_{ш=1}^{m} Ts_i X_i \rightarrow \max \\ \sum_{i=1}^{n} X \le S_{\max}, \ 0 \le X_i \end{cases} \quad (1)$$

Where D- total revenue, Ts_i - the price and the second type of crops, X - crop area and the second type of crops, S_{max} - the total area planned for crops, n - number of types of crops.

And the problem statement does not account for possible changes in prices, yields and other factors, so it is almost impossible to apply the optimal planning of crops.

So, first to forecast the possible yields and prices on them, and find the best plan for crops.

To create nonlinear models used method for constructing nonlinear empirical relationships [2]

Earlier optimal planning of crops conducted without prediction of future yields and prices. And these factors depend on the forecast temperature. In combination, these factors were not considered.

To solve the optimization problem crops proposed plan as a model system (2) - (5), which is finding the optimal solution at time t

$$\sum_{i=1}^{N}(Ts_{ti} - B_{ti})z_{ti} \to max \ , \qquad (2)$$

Where the forecast prices and costs of production is a

$$Ts_{ti} = \sum_{j=1}^{M}\left[A_{ji}^{p}t_{M-j}^{B_{ji}^{p}} + C_{ji}^{u}(1-e^{D_{ji}^{p}t_{M-j}})Sin(E_{ji}^{p}t_{M-j}^{F_{ji}^{p}} + G_{ji}^{p})\right] + H_{i}^{p} \ , \qquad (3)$$

$$B_{ti} = \sum_{j=1}^{K}\left[A_{ji}^{b}t_{K-j}^{B_{ji}^{b}} + C_{ji}^{b}(1-e^{D_{ji}^{b}t_{K-j}})Sin(E_{ji}^{b}t_{K-j}^{F_{ji}^{b}} + G_{ji}^{b})\right] + H_{j}^{b} \ , \qquad (4)$$

and the size of the sale is limited to the top

$$z_{ti} \le \sum_{j=1}^{L}\left[A_{ji}^{z}t_{L-j}^{B_{ji}^{z}} + C_{ji}^{z}(1-e^{D_{ji}^{z}t_{L-j}})Sin(E_{ji}^{z}t_{L-j}^{F_{ji}^{z}} + G_{ji}^{z})\right] + H_{j}^{z}, \qquad (5)$$

moreover $z_{ti} \ge 0$.

Here Ts_i - the price and the first product in time t; B_{ti} - the cost of production, storage and sale of goods and the second in time t; z_{ti} - consumption and the first product in time t; N - number of types of goods; M, K, L - number of previous values in accordance with the prices, costs and consumption goods. To achieve approximation accuracy above 80% of their value enough to take a 2-5; A ... H - factors models, which means overall index, respectively p - price; b - costs; z - consumption.

If the time is uneven for each parameter (Par_{ti}) - prices, costs or consumption, - better use autoregressive model type

$$Par_{ti} = \sum_{j=1}^{K}\left[A_{ji}^{n} Par_{t-j}^{\ B_{ji}^{n}} + C_{ji}^{n}(1-e^{D_{ji}^{n} Par_{t-j}})Sin(E_{ji}^{n} Par_{t-j}^{\ F_{ji}^{n}} + G_{ji}^{n})\right] + H_{j}^{n} \quad . \qquad (6)$$

Optimal estimation of sale at the time t calculated by model built on previous values of prices, costs and consumption. Once found the optimal solution, the next stage of optimization requires re finding factors predictive models (3) - (5) models for real values of prices and sales costs.

Using this model received the best plan to sell dairy products, products of granite quarries, supplying machine tools in the enterprise and made calculation of optimal acreage crops. [3-5]

The proposed resolution of the problem was applied to calculate the optimal plan crops agricultural company "Garant-Ahro4" in 2008. For this collected data changes annual and seasonal temperature data on the yield of grain crops in years, data on prices for these types of crops in years.

Based on these data the hypothesis was put forward impact of seasonal and annual average temperatures on yield and prices (cost - stable). To predict temperatures in 2008 from the previous year temperature used autoregressive model type (6). Approximation accuracy is 100%. To determine the temperature dependence of the yield of previous and current periods for the four previous years were used models with nonlinear effects like: yield dependence on temperature squared, the logarithm of the temperature of the unit divided by the temperature. Then conducted a correlation analysis of the effects of rejection with low value. To predict the prices were used value yields the last two years and used nonlinear model of effects: productivity squared, the logarithm of productivity, unit divided by the yield. Once again performed a correlation analysis of the effects of rejection with low value. After the rejection is not significant effects calculation method of regression analysis model was derived coefficients of equations and inequalities sowing plan for 2008.

Autoregressive predictive model (6) allows an error of 20% predict seasonal and annual average temperatures provided the use of data from previous years in its construction. Nonlinear regression models to predict the yield of grain crops on condition known temperature values for the previous four years of error of 2.35%. Nonlinear models forecast prices for cereals enable error of 19.66% price forecast for the current period on condition known values yields the previous year. Model optimization of grain crops (8) - (9) allowed agricultural farm income forecast error 6.39%.

Perspectives of the direction of research is to determine the possibility of prediction is not for one year, and for several years to come.

Загальна математична модель прогнозування доходу:

$$\begin{cases} \sum_{i=1}^{n} X_i Ц_i B_i \rightarrow \max \\ \sum_{i=1}^{n} X_i \le S_{\max} \\ X_i \ge X_{m.o.} \\ X_i \ge 0 \\ Ц_i = f(B, B_{t-1}) \\ B_i = f(T, T_{t-1}, T_{t-2}, T_{t-3}, T_{t-4}) \\ T = f(T, T_{t-1}, T_{t-2}, T_{t-3}, T_{t-4}, T_{t-5}, T_{t-6}, T_{t-7}, T_{t-8}) \end{cases} \quad (7)$$

Where X_i - sown area and the first type of crop;

Ts_i - and the price of the first type of crop;

B_i - yield and the second type of crop;

X_i - sown area and the second type of crops with the technological limitations;

S_{max} - the maximum area under cultivation, which is 2417,47ha.

Technological limitations for 2008:

area for planting winter wheat - $So.p$ = 686,23ha;

area for planting winter barley - $So.ya$ = 124,03ha;

area for sowing barley - *Sya* = 402,9ha;

area for planting corn - *Sk* = 259,65ha;

area for planting peas - *Sh* = 62,62ha;

area for planting sunflower - *Ss* = 822,04ha.

Model calculation of optimal acreage in 2008:

The objective function:

$$X_{о.п}Ц_{о.п}B_{о.п} + X_{о.я}Ц_{о.я}B_{о.я} + X_{я}Ц_{я}B_{я} + X_{к}Ц_{к}B_{к} + X_{г}Ц_{г}B_{г} +$$
$$+ X_{с}Ц_{с}B_{с} + X_{ц.б}Ц_{ц.б}B_{ц.б} + X_{соя}Ц_{соя}B_{соя} \rightarrow max \quad (8)$$

Limitation:

$$X_{о.п} + X_{о.я} + X_{я} + X_{г} + X_{к} + X_{с} + X_{ц.б} + X_{соя} \leq S_{max} \quad (9)$$

$$X_i \geq 0$$

Depending revealed:

$Ц_{п} = 0{,}0007B_{о.п\,t\text{-}1}^{\,2} + 0{,}009B_{о.я}^{\,2} - 0{,}0028B_{к\,t\text{-}1}^{\,2} + 57{,}39;$

$Ц_{к} = 0{,}014B_{о.я}^{\,2} - 0{,}025B_{я}^{\,2} + 0{,}003B_{ц.б}^{\,2} - 38{,}49;$

$Ц_{я} = 0{,}02B_{о.п}^{\,2} + 0{,}28B_{о.я\,t\text{-}1}^{\,2} - 0{,}012B_{к\,t\text{-}1}^{\,2} - 110{,}2;$

$Ц_{г} = -0{,}003B_{о.п}^{\,2} + 0{,}31B_{о.я\,t\text{-}1}^{\,2} - 0{,}05B_{к\,t\text{-}1}^{\,2} - 52{,}79;$

$Ц_{с} = 0{,}0016B_{о.п}^{\,2} - 0{,}05B_{к\,t\text{-}1}^{\,2} + 0{,}75B_{соя}^{\,2} + 118;$

$Ц_{соя} = 0{,}06B_{о.п}^{\,2} + 0{,}32B_{о.я\,t\text{-}1}^{\,2} - 0{,}71B_{с}^{\,2} - 14{,}81;$

$Ц_{ц.б} = -0{,}0005B_{о.я}^{\,2} - 0{,}0013B_{к\,t\text{-}1}^{\,2} - 0{,}0012B_{г\,t\text{-}1}^{\,2} + 18{,}6;$

$B_{о.п} = 0{,}25T_{в\,t\text{-}4}^{\,2} + 0{,}0016T_{в}^{\,2} - 0{,}597T_{з\,t\text{-}1}^{\,2} + 5{,}69;$

$B_{о.я} = 0{,}18T_{ср\,t\text{-}1}^{\,2} + 0{,}02T_{л\,t\text{-}1}^{\,2} - 0{,}03T_{о}^{\,2} + 2{,}11;$

$B_{к} = 0{,}06T_{л\,t\text{-}3}^{\,2} - 0{,}32T_{о\,t\text{-}2}^{\,2} - 0{,}04T_{о\,t\text{-}4}^{\,2} + 26{,}88;$

$B_{я} = -0{,}86T_{ср\,t\text{-}1}^{\,2} - 2{,}77T_{з\,t\text{-}4}^{\,2} + 0{,}51T_{в\,t\text{-}1}^{\,2} + 73{,}12;$

$B_{г} = -0{,}16T_{з} - 0{,}59T_{з\,t\text{-}1}^{\,2} - 0{,}36T_{з\,t\text{-}4}^{\,2} + 19{,}84;$

$B_{с} = 0{,}08T_{ср\,t\text{-}4}^{\,2} + 0{,}098T_{з}^{\,2} - 0{,}05T_{в\,t\text{-}4}^{\,2} + 8{,}88;$

$B_{б} = 20{,}82T_{з} + 1{,}16T_{ср\,t\text{-}1}^{\,2} + 5{,}0045T_{з}^{\,2} + 75{,}63;$

$B_{соя} = 0{,}05T_{ср\,t\text{-}3}^{\,2} - 0{,}03T_{з}^{\,2} - 0{,}04T_{в\,t\text{-}4}^{\,2} + 5{,}1;$

$T_{л} = 0{,}2T_{л\,t\text{-}1}^{\,0{,}95} - 1{,}7(1 - e^{0{,}05\,T_{л\,t\text{-}1}})\mathrm{Sin}(-2{,}02T_{л\,t\text{-}1}^{\,0{,}57} - 10{,}9) + 16{,}8;$

$$T_в = -0,3\ T_{в\,t-1}^{\ 1,02} - 0,76(1 - e^{-0,9\ Tв\,t-1})\mathrm{Sin}(-4,94T_{в\,t-1}^{\ 0,43} - 4,86) -$$
$$- 0,3\ T_{в\,t-1}^{\ 1,02} - 1,99(1 - e^{-0,5\ Tв\,t-1})\mathrm{Sin}\ (-0,26\ T_{в\,t-1}^{\ 1,34} - 0,8) + 16,8;$$
$$T_о = -0,56\ T_{о\,t-1}^{\ 0,8} - 0,024(1 - e^{0,22\ To\,t-1})\mathrm{Sin}(-1,1T_{о\,t-1}^{\ 1,3} + 0,6) -$$
$$- 0,56T_{о\,t-1}^{\ 0,8} - 1,3(1 - e^{0,12\ To\,t-1})\mathrm{Sin}(-0,13T_{о\,t-1}^{\ 1,4} + 0,42) + 17,1;$$
$$T_р = -0,4T_{р\,t-1}^{\ 0,94} - 0,3(1 - e^{-0,025\ Tр\,t-1})\mathrm{Sin}(-2,2T_{р\,t-1}^{\ 1,0001} - 0,14) -$$
$$-2,94(1 - e^{-0,6\ Tр\,t-1})\mathrm{Sin}(-0,47T_{р\,t-1}^{\ 1,0096} - 1,4\ ) + 13,5;$$
$$T_з = T_{з\,t-1}\ (1 - e^{0,008\ Tз\,t-1})\mathrm{Sin}T_{з\,t-1} - 16,8.$$

Where $B_{о.п\ t-1}$ – the yield of winter wheat last year; $B_{о.я}$ – winter barley yields this year; $B_{к\ t-1}$ – the yield of corn last year; $B_я$ – barley yields this year; $B_{ц.б}$ – yield sugar beets this year; $B_{о.п}$ – yield of winter wheat this year; $B_{о.я\ t-1}$ – the yield of winter barley previous year; $B_{соя}$ – soybean yields this year; $B_с$ – the yield of sunflower this year; $B_{г\ t-1}$ – pea yields of the previous year; $T_{в\ t-4}$ – the average temperature of the spring 4 years ago; $T_в$ – the average temperature in spring of this year; $T_{з\ t-1}$ – the average temperature in winter of the previous year; $T_{ср\ t-1}$ – the average temperature of the previous year; $T_{л\ t-1}$ – the average temperature in summer last year; $T_о$ – the average temperature in the autumn of this year; $T_{л\ t-3}$ – the average temperature in summer 3 years ago; $T_{о\ t-4}$ – the average temperature in autumn 4 years ago; $T_{з\ t-4}$ – the average winter temperature 4 years ago; $T_{ср\ t-4}$ – the average temperature is 4 years ago; $T_{о\ t-1}$ – the average temperature in autumn last year.

It received optimal computation of income for 2008. in an amount of 4,269,111 USD. After sowing areas laid out real income compared with the projected totaled 4,012,746 UAH. Error revenue forecast is 6.39%.

1.9. Estimates terms of liquidity products to ensure repayment of loans by agricultural enterprises [48]

Shelf life of agricultural products objectified chayutsya tables set up on the basis of statistical studies. But in modern conditions have convenient mathematical quantitative relationships to more accurately calculate shelf life. So put the goal of restoring liquidity analysis depending on the shelf life of agricultural products for example meat and potato and vegetable production areas.

Consider the dependence of the shelf life of meat on the temperature (Fig. 1), built according to [49] as

$$T = \begin{cases} A \text{ for } t \le t_{\min} \\ B \cdot e^{-Ct} \text{ for } t > t_{\min} \end{cases}, \quad (1)$$

Where T – the shelf life of meat products, t - temperature storage, t_{min} - the lowest temperature storage, *A, B, C* - coefficients modeled estimates.

Obviously, A is the higher value of the term deposit. Factors *B* and *C* can be found by the least squares method according to [50]. It is necessary to solve the optimization problem with variables B and C and objective function

$$\sum_{i=1}^{N} \frac{(T_{ri} - T_{fi})^2}{T_{fi}} \to \min, \quad (2)$$

Where N – statistical sampling size (in our case $N = 4$) for temperature $t_1 = -10$ ºC, $t_2 = -18$ ºC, $t_3 = -25$ ºC, $t_4 = -32$ ºC, $T_{ri} = B \cdot e^{-Ct_i}$ – calculated and T_{fi} – actual shelf life of products, $i = 1..4$.

Results of calculations in Excel spreadsheets environment presented in Table. 1. There given confidence probability approximation as the criterion Pearson.

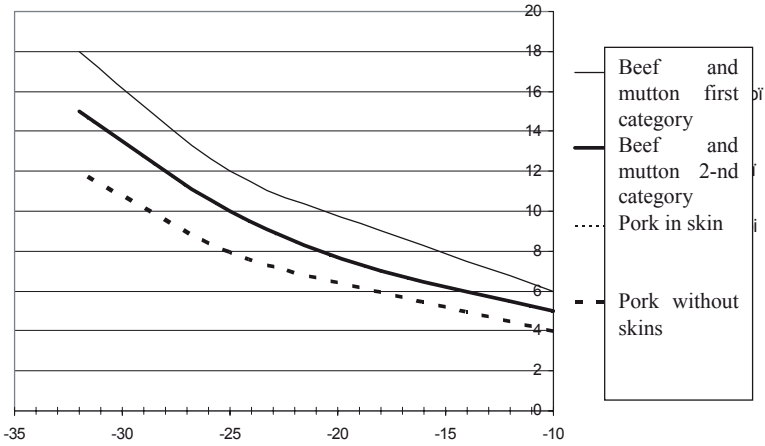


Fig. 1. Dependence shelf life of meat temperature

Table 1

Numerical coefficients model assessment (1)

Type of product	A	B	C	Confidence probability
Beef and mutton first category	18	3,54	0,0505	0,993
Beef and mutton second category	15	2,77	0,0524	0,997
Pork in skin	15	2,77	0,0524	0,997
Pork without skins	12	2,36	0,0504	0,998
Chickens, turkeys, guinea fowl	12	3,55	0,0388	0,987
Chicken egg breeds, Chicken Broilers	11	2,61	0,0449	1,000
Geese, ducks	11	2,07	0,0515	0,983

Next determine which model estimates can be described by the shelf life of vegetables. For this we use data from [51] about the weight loss for months. To determine the absolute value of weight loss relative to the initial production laid down for storage, apply the formula

$$B_M = \prod_{M=1}^{M} (100\% - B_T), \qquad (3)$$

Where B_M – absolute loss products in mass% in the month M, B_T - relative loss products in mass% in the previous month T.

Some images stored particle production by month in artificial cooling is shown in Fig. 2. Check the quality of the data approximating Model Evaluation form (1), using the method of least squares and giving months following numbers: 1 - September 2 - October 3 - November 4 - December 5 - January 6 - February 7 - March 8 - April 9 - May 10 - June 11 - July 12 - August.

The results of calculations of the coefficients A, B, C are summarized in Table. 2. And the confidence probability Pearson criterion for all models was not less than 0.99.

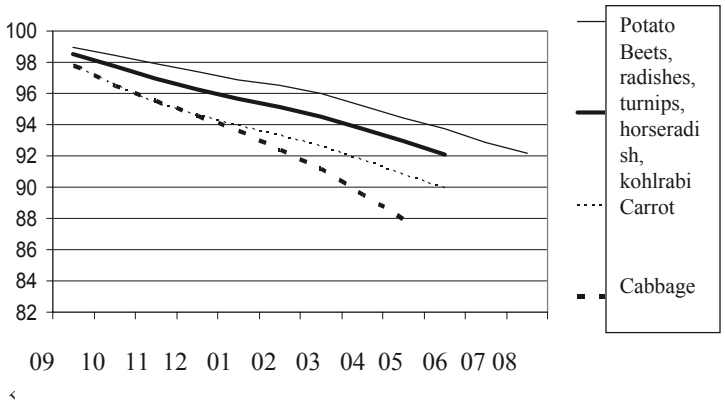


Fig. 2. Dependence of residual potato and vegetable storage with cooling

Let us find out the reason that the shelf life of agricultural products is described by an exponential law. For this we consider data from [52] wherenavedeno content of microorganisms in meat. Construct graphs of the number of mikro¬orhanizmiv shelf life (Fig. 3).

Table 2

Calculations coefficients model estimates for potatoes and vegetables

Product	Storage method	A	B	C
Potato	1	100	99,90	0,0064
	2	100	100,43	0,0095
	3	100	98,87	0,0057
Beets, radishes, turnips, horseradish, kohlrabi, parsnips	1	100	99,16	0,0072
	2	100	99,16	0,0080
Carrot	3	100	99,07	0,0067
	1	100	98,28	0,0088
	2	100	98,28	0,0111
Cabbage late ripening	1	100	99,21	0,0127
	2	100	98,07	0,0128
	3	100	97,83	0,0102
Onion onions	1	100	100,28	0,0073
	2	100	98,85	0,0082

As can be seen from the graphs, these curves can be described dependence appearance

$$K = D \cdot (1 - e^{-ET}), \quad (4)$$

Where D i E – model parameters, T - term storage of the initial (zero) to the maximum permissible since the shelf life.

It is believed that at the beginning of storage at $T = 0$ microorganisms K = 0. Approximation formula (4) provided for the confidence probability criterion Pearson at 0.7.

Based on research the following conclusions:

1. To ensure the timely repayment of loans and timely payment of interest accrued from cash receipts from sales of agricultural pidpry¬yemstv need to use more accurate analytical evaluation terms of liquidity of the product according to the methods of storage.

2. The terms storage of livestock and crop adequately describes the exponential model estimates, as evidenced by the satisfactory level of confidence as the criterion of Pearson approximation.

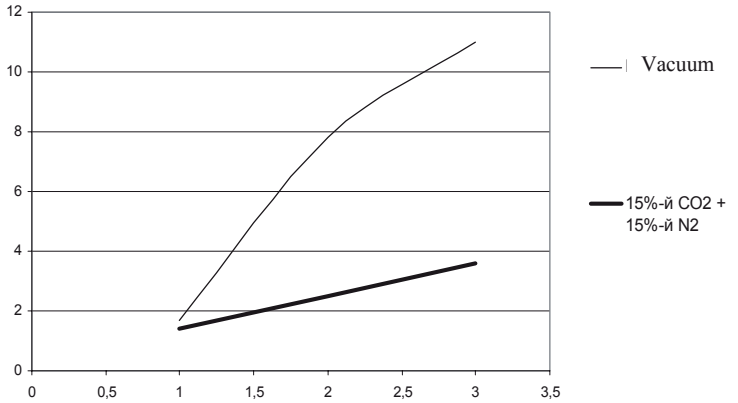


Fig. 3. Dependence number of microorganisms (h106) the timing of storage (in weeks)

1.10. Forecasting in exports of seamless pipes [53]

Using as a data demand, export volumes of Ukrainian enterprises of the product in the previous month (August 2003 to July 2009), enough to build an accurate predictive model.

Preliminary analysis of schedule export volumes can detect a clear seasonal pattern: the fall of the volume of exports in the winter months. This situation is caused primarily stop some construction projects due to weather conditions. However, in addition there are other seasonal dependence, identification and consideration which is a scientific interest. Fig. 1 shows the statistics of exports of seamless pipes.

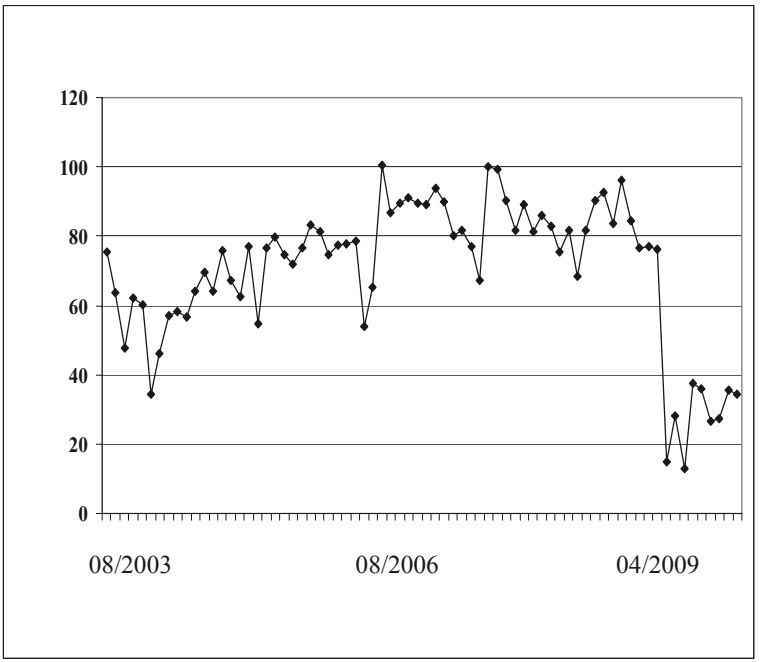


Fig.1. Exports of seamless pipes.

Analysis of correlation between current values of exports of pipes and its previous columns periods behind the current 1, 2, 3 and 4 (1-6 steps as in the table) steps (Table 1.), Demonstrated that conn relationship between the values of oil prices (as well as the price of gas) and the volume of export values weaker than the relationship between the value of exports and export values of several periods ago. On this basis, put forward a hypothesis about the possibility of building autoregression model type (1) [2]

$$Y_t = \sum_{j=1}^{T}\left[A_j {Y_{t-j}}^{B_j} + C_j(1-e^{D_j Y_{t-j}})Sin(E_j {Y_{t-j}}^{F_j} + G_j)\right] + L \ , \qquad (1)$$

where T - the number recorded the previous values ($T = 5$); Y_t - value exports in period t; Y_{t-j} - export values $_j$-back period; A - L - constant.

Table 1

Correlation of the current and previous values of exports of seamless pipes

	Y_t	Ціна на нафту, долл. за бар.	Y_t	Ціна на газ, долл. за тис. куб. фут.	Y_t
Y_t	1,000	У період *t*	0,511	У період *t*	0,367
Y_{t-1}	0,711	У період *t-1*	0,556	У період *t-1*	0,438
Y_{t-2}	0,603	У період *t-2*	0,522	У період *t-2*	0,495
Y_{t-3}	0,562	У період *t-3*	0,476	У період *t-3*	0,493
Y_{t-4}	0,493	У період *t-4*	0,402	У період *t-4*	0,458
Y_{t-5}	0,389	У період *t-5*	0,314	У період *t-5*	0,418
Y_{t-6}	0,344	У період *t-6*	0,258	У період *t-6*	0,375

In case the prediction model built on the basis of value only to the previous period (2), it is necessary to determine the K - model number of terms (1). To determine the K appropriate to use spectral analysis. Spectral analysis was performed using application package STATISTICA. In periodohrami (Figure 2) revealed five peaks that represent 5 specific frequency (0.0138, 0.083, 0.16, 0.292, 0.38), hence K = 5.

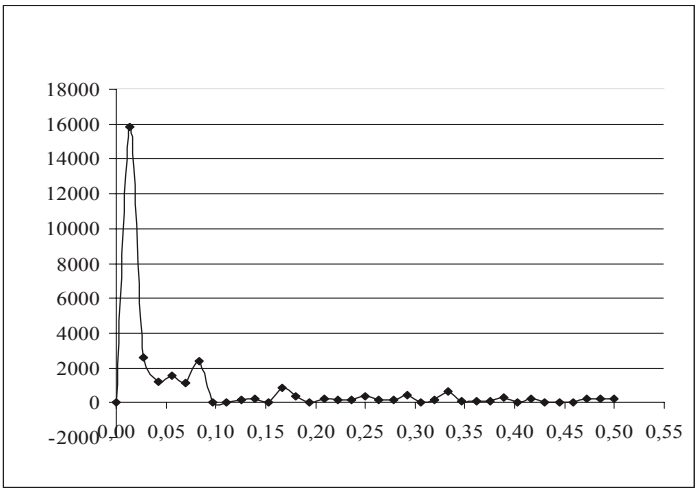


Fig. 2. Periodohrama process seamless pipe exports in frequency

Constants A - L model (1) were determined by least squares using Excel, namely the tool "Search solution". Objective function in this case will be the sum of squared errors (regression residues):

$$S = \sum_{t=1}^{N} \left(Y_t^F - Y_t^R \right) \to \min , \tag{2}$$

Where N – the size of the statistical sample, $Y^F{}_t$ – the actual value of the variable in the t-th period; $Y^R{}_t$ – designed for the model (1) the value of the variable in the t-th period.

However, using data from the volume of exports of seamless pipes directly in the model (1) is very problematic since the function sine region - [-1, 1] and the average of the volume of exports for 6 years is 70.16 thousand metrical tonn

In view of the above, it is advisable to build a model input data which is to transform the initial data. Therefore, the model (1) was applied with effects: the square root of the volume of exports:

$$Y_t \to \sqrt{Y_t} , \tag{3}$$

logarithm of the volume of exports

$$Y_t \to \lg(Y_t) , \tag{4}$$

the natural logarithm of the volume of exports

$$Y_t \to \ln(Y_t) , \tag{5}$$

the volume of exports divided by 100:

$$Y_t \to \frac{Y_t}{100} , \tag{6}$$

and the rise in export volume degree, determined by finding a solution:

$$Y_t \to Y_t^Q . \tag{7}$$

Determine on which the transformation is most accurate model is only possible by building these models, picking them coefficients, and determining which of the models has the lowest error (Table. 2). To

determine the average forecast error, we will compare the calculated forecast data values that are not taken into account when constructing forecast - export volumes for August-October 2009.

Taking the main criterion for choosing a model error of the lowest forecast, choose the model of the effect of the form (5):

$$Y_t = \sum_{j=1}^{K} \left[A_j (\ln Y_{t-1})^{B_j} + C_j (1 - e^{D_j (\ln Y_{t-1})}) Sin(E_j (\ln Y_{t-1})^{F_j} + G_j) \right] + L \qquad (8)$$

Table 2.

Comparative analysis of models

Type of conversion Input	The average error Approximation	The average error forecast
Models built on depends only on the previous value		
Division 100	20,6%	18,14%
Logarithm	18,88%	11,99%
Natural logarithm	18,89%	7,38%
Square root	20,5%	17,63%
The degree, which selects Solver (-0,286)	18,8%	10,39%
Models built on 5 based on previous values		
Division 100	24,18%	12,36%
Logarithm	19,49%	10,84%
Natural logarithm	20,67%	19,17%
Square root	20,06%	9,93%
The degree, which selects Solver (-0,35; -0,37; -0,06;-0,11;0,02)	20,43%	20,56%

Substituting in the model (8) calculated constants A - L, get a model:

$$Y_t = 46,15(\ln Y_{t-1})^{-3,73} + 10082(\ln Y_{t-1})^{-50,1} + 23774(\ln Y_{t-1})^{-5,76} - \\ - 2743(\ln Y_{t-1})^{-5,03} + 379,4(\ln Y_{t-1})^{0,374} - 584,21 \qquad (9)$$

Let us give these:

$$Y_t = 46,15\ (\ln Y_{t-1})^{0,374}[(\ln Y_{t-1})^{-4,07} + 218,46(\ln Y_{t-1})^{-50,474} + \\ + 515,15(\ln Y_{t-1})^{-6,134} - 59,44(\ln Y_{t-1})^{-5,404} + 8,22] - 584,21 \qquad (10)$$

The lack of a model (9) - (10) trigonometric and exponential dependency because the ratios of these relationships, finding a solution calculated zero. Using the model (10), build a forecast volume of exports of seamless pipes for several months (see. Table. 3).

Table 3.

Forecast exports of seamless pipes

The forecast period	Projected export demand, tons
November 2009	43,495
December 2009	47,232
January 2010	51,297
February 2010	55,438
March 2010	59,378
April 2010	62,891
May 2010	65,846
June 2010	68,213
July 2010	70,035
August 2010	71,397
September 2010	72,393
October 2010	73,108

Based on research the following conclusions:

1) The most accurate prediction for the quality was logarithmic model.

2) The most effective model is constructed on the basis of previous values export pipes.

3) Practical application of predictive models allow commercial and intermediary enterprises optimize inventory production, which in turn allows you to:

- Reduce the cost of renting warehouse;
- To optimize the loading of vehicles;
- To increase net income and net cash flow of the company;
- Increase inventory turnover, etc.

1.11. V-stochastic model of business management with a high level of natural risk [54]

Economy mining industry develops in a continuous risk arising from a significant number of factors whose impact is not fully defined. Among them, first of all, you need the following groups:

1. Restructuring of the economy with its reorientation on the consumption of the population, not the other industries;

2. Sudden changes in climate and other natural conditions. Geological conditions affecting the extraction of minerals closed method, climate - with outdoor mining method;

3. Cutting and, in part, changing uncertain political and economic conditions (laws), caused not only a struggle of different groups within the country, but world politics and pressure on the economy. In particular, the permanent antidumping processes that take place in the West in order to curb the supply of mining and metallurgical complex.

In such circumstances, management companies should conduct this type given the likelihood of different situations, partly unfavorable nature which impede the normal operation of the company.

Solving problems of this type carried out by methods of stochastic programming that is written in one of the following forms:

find $\min M_{\omega}\{f(X, \omega)\} = F(X)$

with conditions $M_{\omega}\{g(X, \omega)\} = G_i(X), i=1,\dots m, \mathbf{X} \in X$;

find $\min P\{f(X, \omega)\} \geq \alpha$

with conditions $P\{g(X, \omega) \leq 0\} \geq p_i, i=1,\dots m$,

where X – solution; $\mathbf{X}$ – space solutions, which depends on the environment ω; M_{ω}– Operation expectation; a and p_i – some material

numbers; P – probably; $f(\mathbf{X})$ – function goal; $g(\mathbf{X})$ – function limitations; $F(\mathbf{X})$ – features set goals; $G(\mathbf{X})$ – set function limitations.

Depending on the functional tasks of stochastic programming distributed on:

- ✓ M model in which functionality is the expectation of the objective function $M(C^TX)$;
- ✓ - *V*-model, which is the functional variance objective function $M(C^TX - \hat{C}^TX)$);
- ✓ *P*-model, in which the functionality is likely $P\{C^TX \geq C^TX_0 = k\}$. In the latter group include models and objectives, which should minimize the threshold k, which may not be exceeded with a given probability α: $P\{C^TX \leq k\} = \alpha$

Here C^T. – coefficient matrix functions f.

If we consider the problem of those whose decisions have found [4-6], we can see that authors pay attention, first of all, M-R models and models. For the first sought the maximum average profit of the enterprise with high natural risk for second - at least the probability of loss from adverse factors. This kind of problem is outdated economic situation of mining companies, especially those wherenemaye recycling because most of them are loss-making or non-profit enterprises. Obviously, for such companies formulation of the problem must meet the basic provisions of the theory of risk management [2, 6] - namely try to minimize the risk of possible losses in case of unfavorable natural state ω. Thus, functionality must be V-model, which minimize possible losses from the onset risk situation, with limitations, which should include the requirement nonnegative income of the company for the planning period.

Define parameters V-model: c_j - the cost of production of 1 ton of raw material *j*-th production sites ($1 \leq j \leq M$): M- the number of manufacturing sites;

s_t - income from the sale of 1 ton of raw materials in the t-th step of the calculation; E_{ji} - discount rate for the t-th step calculation for j-th production area (in this setting include the negative factors that can change predict inflation, the need for unscheduled repairs, change the percentage of useful product in the rock, etc.); $f_i(t)$ – distribution law of probabilities of occurrence of each of the N unfavorable ($1 \leq i \leq N$); z_i - the amount of damages, the occurrence of adverse factors; x_{jt} - the amount of raw material extraction j-th production plot for the t-th step of the calculation.

Then, the average size of the expected losses from the occurrence of adverse factors

$$Z_{av} = \frac{1}{T} \sum_{j=1}^{M} \sum_{i=1}^{N} z_{ji} \int_0^T t f_i(t) dt$$

Find the index of expected losses in the project

$$I_L = \frac{z_{av}}{\sum_{j=1}^{M} \sum_{i=1}^{N} z_{ji}}, \qquad (I_L \leq 1)$$

To calculate the profit from sales at the end horizon (T) use clean modern setting income (NPV) [7, 8]. For this current discount rate at each step of the calculation (E_{jt}) should be increased by the amount $1/I_L$

$$NPV = \sum_{j=1}^{M} \sum_{t=0}^{T} \frac{(s_j - c_j) x_{jt}}{(1 + \frac{E_t}{I_{оз}})^t}, \qquad (1)$$

The average amount of income we find the following

$$M(NPV) = \sum_{j=1}^{M} \sum_{t=0}^{T} \left[\frac{\left((s_j - c_j) x_{jt} - \frac{1}{T} \sum_{i=1}^{N} z_{ji} \int_t^{t+1} t f_i(t) dt \right)}{(1 + \frac{E_t}{I_{оз}})^t} \right]. \qquad (2)$$

Then, according to the theory of risk management option, which reflect the risk of production activity will be standard deviation of earnings

$$\sigma(NPV) = \sqrt{\sum_{j=1}^{M}\sum_{t=0}^{T}\left[\begin{array}{l}(s_j - c_j)x_{jt} - \\ -\frac{1}{T}\sum_{i=1}^{N} z_{ji}\int_{t}^{t+1} tf_i(t)dt - \\ -M(NPV)\end{array}\right]^2}. \qquad (3)$$

Now we can make *V*-model of business management with a high level of natural risks

$$\sigma(NPV) \rightarrow \min, \qquad M(NPV) \geq 0, \qquad x_{jt} \geq 0, \qquad (4)$$

where $\sigma(NPV)$ фтв $M(NPV)$ determined by (1) - (2). As an alternative, these equations can make M-model appearance

$$M(NPV) \rightarrow \max, \qquad \sigma(NPV) = 0, \qquad x_{jt} \geq 0. \qquad (5)$$

Comparison of models (4) and (5) was conducted by the method of stochastic modeling [9] under which applies a random number generator which sets the random values of all parameters. The calculations are carried out repeatedly and sweated conclusion on the statistical reliability of the results. The calculation parameters are shown in Table. 1. To preserve the generality of the results of calculation, all ratios were set in the same range. Number of manufacturing sites - 3.

Table 1

Parameter	Range existence	Distribution law
Income from the sale of 1 ton of raw materials in the *t*-th step of the calculation	0,5-1,0	Even
The cost of production of 1 ton of raw material *j*-th production plot	0,4-0,7	Even

Parameter	Range existence	Distribution law
The rate of discount for the *t*-th step calculation for *j*-th production area	0,03-0,2	Even
The size of losses upon the occurrence of adverse factors	0,5-5,0	Even
Law probability distribution of occurrence of each of the N adverse factors (parameters of the distribution were replaced by uniform law)	m_t= 0,001-0,2; σ_t = 0,01-0,1.	$f(t) = \frac{1}{\sigma_t \sqrt{2\pi}} e^{\frac{(t-m_t)^2}{2\sigma_t^2}}$
Step calculation for horizon 1.	0,1	-

Calculations were performed with the use of spreadsheets Excel. With RANDBETWEEN and NORMALIZE generated 50 sets of values that were used to solve the problems of optimum form (4) and (5) SEARCH function solutions. On the basis of the results determined by the average of all 50 settlements medium-sized profits from the formula (2) and standard deviation of profit by the formula (3). Rows of values $\sigma(NPV)$ and $M(NPV)$ for all calculations have been used to test the hypothesis of statistical difference between these samples by the criterion of Pearson with confidence probability 0.8. For this bull Pearson function used in Excel'i.

The results were calculations:

 V- model for the average profit was 0.2 and the average risk - 0.04;

 M model for the average income was 0.12 and the average risk - 0.14.

Tabular Pearson criterion value was 23.4 and calculated from experimental data - 18.2. So canceling V- models of M models statistically significant and the first better than the second 30% and profitability by 70% on risk.

So: 1. The original *V&M*-model and model business management with a high level of natural risks.

2. The efficiency of *V*-model as compared to *M*-model for businesses of the same type.

1.12. Defining permanent break-even point for production multifood

Break-even point - an important indicator of the company. It shows that the volume of production required to produce and implement income of the company amounted to total costs, that company did not receive profits, but do not incur losses.

Break-even point expressed in two forms: commodity and money. For odnoproduktovoho production break-even point is given by:

$$T_G = \frac{\text{Fixed costs}}{\text{Price} - \text{Variable costs}}$$

$$T_{M.} = T_G * Price$$

where, T_G – one product production break-even point in the commodity terms; T_M – break-even point one product output in monetary terms.

The work Schehorsky A.Y [1] to calculate the break-even point production multifood proposed formula:

$$X^i_{bvk} = \frac{\mu^i_{vk} \overline{\overline{Z}}}{\sum_{i=1}^{mv} \sum_{j=1}^{n} \mu^i_{vj} b^i_{vj} + \sum_{i=1}^{mv} \sum_{j=1}^{n} \mu^i_{zj} b^i_{zj}}$$

where, $b^i_{vj} = (1 - p^i_{vj} + h^i_{vj})(1-a) * \overline{C}^i_{vj} - \overline{U}_j (1 - q^i_{vj})(1 - (p^i_{vj} - h^i_{vj})(1-r))$,

μ^i_{vk} – the proportion of *j*-th type of product in total production on the i-th domestic and foreign markets, respectively; Z – fixed costs; p^i_{vj} – the probability of loss of demand; h^i_{vj} – the likelihood of increased demand;

$\overline{C}_{vj}^{i}$ – the expected price level; $\overline{U}_j$ - variable costs per unit of output; r – indicator.

The proposed method requires a large number of calculations, which include factors such value that you want to predict. In addition, it is intended for export-oriented industries that require advanced planning.

To build a model hospital multifood production break-even point has been hypothesized that the fixed costs for each product in proportion to income for each product. In addition, it is assumed that price and variable costs per unit of each product are known.

Then heading break-even point for each product can be defined as

$$T_{G.i} = \frac{\frac{D_i}{D_T} * FC}{P_i - VC_i}, \quad (1)$$

де, T_{Gi} - break-even point of the i-th product; D_i - the i-th income product; D_T - total income from sales; P_i , VC_i - pursuant Price / Variable costs and th type of product; i- the type of product (1> i> n); n - number of products.

This formula includes still quite understandable and accessible characteristics of the company, of which requires quite a large settlement. Therefore, it can often be used in various fields multifood production.

To find cash equivalent received enough breakeven point multiply it by the price of the product

$$T_{Mi} = T_{Gi} * P_i, \quad (2)$$

where, T_{Mi} – break-even point i-the first product in terms of money; T_{Gi} – break-even point i-th product in the commodity terms; P_i – price i-th product.

Total break-even point for such an enterprise can be expressed only in monetary terms as follows:

$$T_T = \sum_{i=1}^{n} T_{Gi} = \frac{FC}{D_{T.}} \sum_{i=1}^{n} \frac{D_i}{P_i - VC_i}. \quad (3)$$

where, T_T - overall break-even point in monetary terms; T_{Gi} – break-even point *i*-th product in the commodity terms; FC – fixed costs; T_{Gi} - break-even point of the i-th product; D_i - the *i*-th income product; D_T - total income from sales; P_i , VC_i - pursuant Price / Variable costs and th type of product; *i*- the type of product (1> *i*> *n*); *n* - number of products.

We use the data obtained formulas for operation of business of "Feedback", which specializes in the production and sale of four main products: pig iron, foundry pig iron, wire rod and rolling. Taking the data for the activities of the enterprise 6 periods presented in the Table. 1, determine the break-even point for each product.

The results of calculations made for each period for all products presented in Fig. 1.

Table 1

These production activities of "review" of fixed costs 124794,95hrn

Product	Price, UAH / Ton	Variable costs, UAH/ Ton	Sales volumes (tons)	Revenues	Profit
Pig iron	2732,30	795,16	11,10	30328,53	-103292,70
	2742,61	801,12	10,50	28797,41	20385,65
	2770,12	808,42	11,00	30471,32	21578,70
	2815,34	814,34	12,00	33784,08	24012,00
	2869,72	820,72	11,20	32140,86	22948,80
	2900,00	826,45	11,90	34510,00	24675,25
Foundry	3390,12	1012,22	9,40	31867,13	22352,26
	3392,41	1015,15	9,00	30531,69	21395,34
	3423,44	1022,60	7,50	25675,80	18006,30
	3446,22	1020,40	8,10	27914,38	19649,14

Product	Price, UAH / Ton	Variable costs, UAH/ Ton	Sales volumes (tons)	Revenues	Profit
	3477,30	1023,50	8,80	30600,24	21593,44
	3482,13	1021,12	9,50	33080,24	23379,60
Wire	6602,94	2547,43	6,50	42919,11	26360,82
	6645,15	2580,24	5,10	33890,27	20731,04
	6640,32	2577,43	5,30	35193,70	21533,32
	6638,23	2573,28	5,60	37174,09	22763,72
	6637,12	2571,26	6,20	41150,14	25208,33
	6635,54	2570,23	6,40	42467,46	26017,98
Rolling	5215,34	2013,55	20,20	105349,8	64676,16
	5219,43	2016,74	20,00	104388,6	64053,80
	5226,86	2034,40	18,45	96435,57	58900,89
	5224,79	2030,10	18,80	98226,05	60060,17
	5236,89	2041,22	17,90	93740,33	57202,49
	5230,44	2039,47	19,50	101993,5	62223,92

Analysis of the graphs shows that iron and cast iron foundry with feedback. The correlation coefficient between the two products, which is -0.877 confirms this conclusion. The value of the correlation coefficient indicates a strong connection between them, so these complementary products.

Almost constant value break-even point for wire rod and a sharp drop for hire, says that demand for the latter type of product for the period subjected to analysis, significantly decreased.

Break-even point for the entire enterprise, defined by (3) for all periods was zero.

It was further determined reserves stability for each product as

$$SS_i = D_i - T_{Mi} \qquad (4)$$

where, SS_i – stock sustainability *i*-th type of product, D_i – income *i*-th product; $T_{ep.i}$ – the equivalent break-even point *i*-th product.

The calculation results are presented in Fig. 3

When the safety factor graph crosses the axis t = 0, which means that this type of production is unprofitable for the company. Analysis of the results shows that only iron and cast iron foundry were beneficial to production, but two other products: Rod and rent - loss for the period from 2 to 5.

For comparison, the figures obtained from other operating performance of the company, prrovedemo calculation results are presented in Table. 2.

Table 2

Operating performance of the enterprise

Indicator	Value
Gross profit ratio	0
Ratio of net profit	0
Analysis of operating expenses	1
Ratio of profit before interest and taxes	0
Factor income after interest and taxes	0

Looking at the table, to make clear the economic conclusions virtually impossible because the company is not clear what to do in this situation. It is not clear why the company is spending all the profits to update vyrobhnytstva, and still is not bankrupt. Operating performance make it impossible to reliably rozidilyty products that do not zaberzpechuyut profitable business enterprise. And using the results obtained by calculating the break-even point, you can choose the way in which the company buwhereyty further depending on their goals, whether buwherezbilshennya

profit and increased investor interest if further work in the break-even position, increasing in proportion as profit and loss.

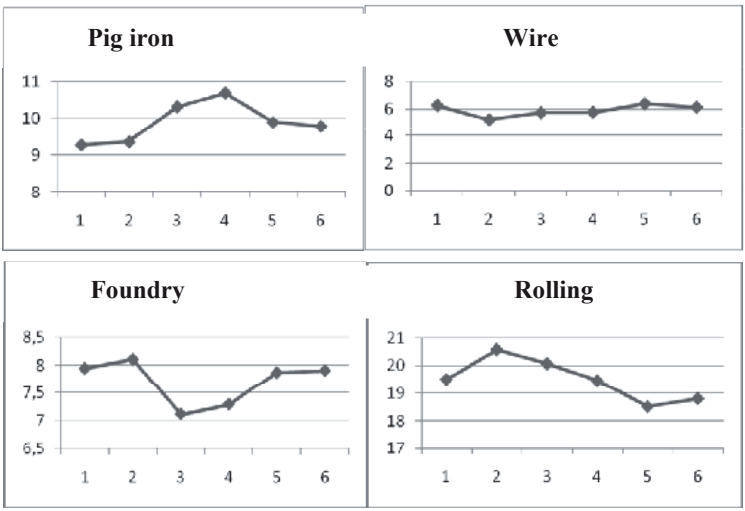


Fig. 1. Calculation of changes in break-even point in time for multifood production (1) - (2) in ths. Tons

Based on the calculations the following conclusions:

1. The method allows to find a break-even point for each type of product.

2. For the selected enterprises is obvious that trying to run with zero income to reduce payments to the budget.

3. Existing operating performance of the company do not allow to separate the types of products that prevent the enterprise profitable.

4. The aim of further research be determining applicability of the developed method for the analysis of concealment of taxes.

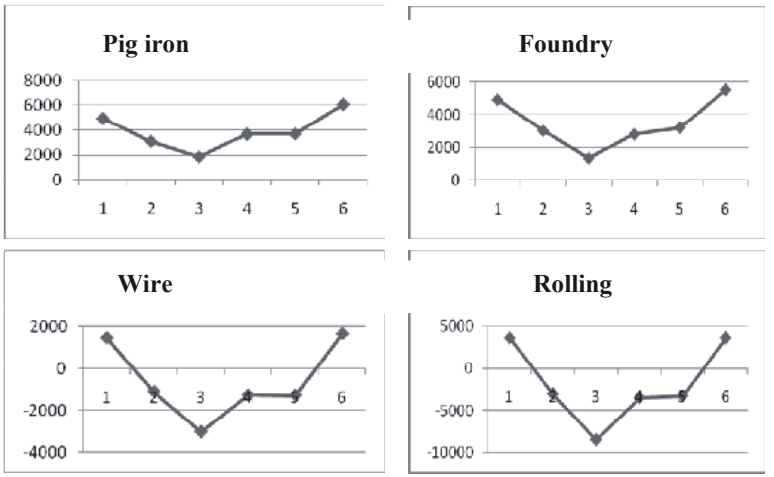


Fig. 2. Determination of safety factor in UAH for (4) for each product

1.13. A portfolio of orders engineering enterprise in order to reduce the risk of loss of profit [57]

The portfolio of orders of machine-building enterprise is uncertain in advance facilities for making you want to always keep account not only income from advance receipts and payments on completion of work. It should take into account the ongoing cost of acquisition and storage costs, which vary in the opposite direction.

It should be monthly or annually calculate the average volume of orders. Of particular importance is the selection of small orders, since their number might affect inability to fulfill orders more volume.

A separate problem are cases when the company received orders from several clients at once, and do not allow production capacity to accept all orders immediately.

Thus, the problem of the portfolio of orders for machine-building enterprises subject to the limitations in manufacturing capacity is not considered. A solution of this problem will reduce the risk of a shortfall in revenue.

Data were taken in 2014 by engineering company OOO "Dnipromashkomplekt" that produces custom metal. Sample size - 100 orders. The numerical values of the financial indicators were taken in terms of hryvnia.

Analysis of data on orders made now by means of mathematical statistics using some features spreadsheet Microsoft Excel.

Cluster analysis was performed in the program for statistical monitoring STATISTICA 12. To determine the extent of the metric distances used Euclid, Chebyshev quarters. Mahalanobis [58].

Correlation analysis of the impact of economic factors on earnings showed that the most influential are the following (in Kazan with their symbols): x_1 - customer number; x_2 - term production orders; x_3 - cost of materials; x_4 - the bulk of wages; x_5 - overhead costs; x_6 - the cost of maintenance and operation of equipment; x_7 - administrative costs; x_8 - distribution costs.

The next step was breaking all orders into groups (clusters).

It was chosen minimum and maximum number of clusters 4 and 8 respectively.

The system is offered 6 clusters as the best option, so the range for the number of clusters was selected correctly. Error clustering of 12.4% for Chebyshev metric distances. For this type klasteryzatsiyiyi size of less than 20% error is acceptable. Other metric distances given greater error. Result partition are shown in Table 1

Table 1

The list of orders each cluster

Number Cluster	Number order
1	1;2;3
2	7;15;17;20
3	32;33;34;35;36;37;38;39;40;41;42;43;44;45;46;47;48;49;50; 51;52;53;54;55;56;57;58;59;60;61;62;63;81
4	64;65;66;67;68;82;83;84;85;86;87;88;89;90; 91;92;93;94;95;96;97;98;99;100
5	4;5;8;9;10;11;12;13;14;16;18;19;21;22;23;24;25;26;27;28; 29;30;31;69;70;71;72;73;74;75;76;77;78;79;80
6	6

Obtained divided into clusters and grouped data was used to create separate functions.

To build a separate linear functions used the following algorithm:

1) created additional column variable, which was named a distinctive cluster (Y *);
2) the calculation of linear regression for the i-th cluster value *Y** was awarded the 1000 number only for the data of the cluster;
3) other cluster *Y** = 0;
4) then built linear regression *Y** depending on the input factors;
5) Repeat the previous procedure for all clusters, thus receiving 5 dependencies. For the sixth cluster dependence is not built, because it has got only one order;
6) quality control division clusters for these functions implemented on the table the calculated values of *Y**. If the respective cluster

value exceeds the value of *Y** for the other clusters, the function is acceptable (Table. 2).

Table 2

Confirmation of admissibility resolution linear functions for each cluster

Number Cluster	Number order	Y* to cluster №1	Y* to cluster №2	Y* to cluster №3	Y* to cluster №4	Y* to cluster №5
1	3	890,395	-53,2401	282,886	-147,406	-10,8396
2	20	139,4859	880,2594	68,96827	34,76883	-106,417
3	58	180,68	165,833	506,0179	444,4269	-277,389
4	90	60,85858	70,00354	308,1937	745,0481	-321,149
5	19	-132,905	49,78457	329,6397	-126,913	864,6362

This linear equation look like separate functions for each cluster. To reduce the volume formulas given only 3-4 significant digits coefficients.

$$Y_1^* = -149{,}56 - 7{,}09x_1 + 8{,}56x_2 - 0{,}001077x_3 + 0{,}0678x_4 + 0{,}035x_5 + 0{,}029x_6 + 0{,}1074x_7 - 0{,}313x_8; \quad (1)$$

$$Y_2^* = 95{,}523 - 1{,}137x_1 - 4{,}69x_2 + 0{,}00252x_3 + 0{,}0484x_4 + 0{,}0394x_5 + 0{,}094x_6 + 0{,}00888x_7 - 0{,}2997x_8; \quad (2)$$

$$Y_3^* = -47{,}52 + 23{,}9x_1 + 7{,}869x_2 - 0{,}0005635x_3 - 0{,}05689x_4 + 0{,}2112x_5 - 0{,}2197x_6 + 0{,}0844x_7 - 0{,}08234x_8; \quad (3)$$

$$Y_4^* = -348{,}6 + 77{,}97x_1 - 0{,}713x_2 + 0{,}0004503x_3 + 0{,}02874x_4 - 0{,}1732x_5 + 0{,}2762x_6 + -0{,}1238x_7 - 0{,}003074x_8; \quad (4)$$

$$Y_5^* = 1434{,}9 - 94{,}132x_1 - 10{,}24x_2 - 0{,}0012593x_3 - 0{,}07967x_4 - 0{,}1225x_5 - 0{,}1637x_6 - 0{,}07752x_7 + 0{,}672x_8; \quad (5)$$

For each cluster separately constructed linear regression dependence 8 variables listed above on income has been marked as *Y*. received five regression models are acceptable, as Quality of approximation R^2 for each of them close to the unit, and the standard error is relatively little. Thus, the function depending profit for each cluster.

For the construction of specific daily load enterprise follows the same statistically significant performance impact on profits. This figure was

determined by the fact that the company operated analyzed the entire year, which was 251 working hours, with no downtime, with a full load

$$Dlse = \frac{1}{251}\sum_{i=1}^{100}\frac{\sum_{j=3}^{6} x_{ij}}{x_{2j}}. \qquad (6)$$

According to estimates for 2014, the figure was

$$\mathrm{Dlse}_{2014} = 2956{,}17 \text{ UAH. / Day.}$$

Then the problem of optimal portfolio formation engineering enterprise orders can be placed as follows: To ensure maximum performance gain for new orders, provided that the daily load is calculated buwhereperevyschuvaty 2014.

These requirements of economic and mathematical model will look like (7). It presents the following symbols, including those that have been submitted: Z_l - the array that takes the value 0 (if the order is not accepted) or 1 (if the order is accepted), ($1 \le l \le KZ$), KZ - number orders, DlseO - current unit load to the plant by the old order, $Dlse_O$ - exceeding the level of inflation this year over inflation in 2014.

$$\text{Profit} = \sum_{l=1}^{K_Z} Z_l Y_l \to \max$$

When restrictions:

$$Y_l = Y_1 = -1950{,}1 + x_1 + x_2 + 0{,}08056x_3 + 0{,}7651x_4 + x_5 + x_6 + x_7 + x_8, \text{ якщо } Y_1^* > Y_2^* \& Y_3^* \& Y_4^* \& Y_5^*$$

$$Y_l = Y_2 = -1359{,}9 + x_1 + x_2 - 0{,}0689x_3 + 1{,}089x_4 + x_5 + x_6 + 3{,}1083x_7 + x_8, \text{ якщо } Y_2^* > Y_1^* \& Y_3^* \& Y_4^* \& Y_5^*;$$

$$Y_l = Y_3 = 955{,}99 - 42{,}94x_1 - 20{,}364x_2 + 0{,}0704x_3 + 0{,}3722x_4 + 1{,}695x_5 - 7{,}8876x_6 + 1{,}9124x_7 + 1{,}0518x_8, \quad \text{якщо } Y_3^* > Y_1^* \& Y_2^* \& Y_4^* \& Y_5^*;$$

$$Y_l = Y_4 = -157{,}937 + 34{,}48x_1 - 16{,}898x_2 - 0{,}014864x_3 - 0{,}4024x_4 + 1{,}6952x_5 + 0{,}8123x_6 + 2{,}903x_7 + 1{,}912x_8, \quad \text{якщо } Y_4^* > Y_1^* \& Y_2^* \& Y_3^* \& Y_5^*$$

$$Y_l = Y_5 = 546{,}9 - 15{,}173x_1 - 25{,}74x_2 + 0{,}0802x_3 + 0{,}4141x_4 + 1{,}922x_5 - 2{,}3403x_6 + 1{,}35535x_7 - 1{,}5054x_8,$$

якщо $Y_5^* > Y_1^* \& Y_2^* \& Y_3^* \& Y_4^*$;

$$\sum_{l=1}^{K_Z} \frac{\sum_{j=3}^{6} x_{il}}{x_{2l}} \le Dlse_{2014} - Dlse_O Ov_l ;$$

$Z_l \in [0,1]$.

The economic and mathematical model of optimization of the portfolio of orders immediately meet two criteria: maximize profit and minimize loss of profit because it provides yaknayschilnishe filling every working day.

It proved convenient to create separate clusters, which determined depending on profits from production costs. This approach provided the use of linear regression in the version piecewise linear approximation, which greatly improves the quality of forecasting profits.

Checking developed technique shown in example (Table. 3), which shows that of the 14 orders, only 5 were selected.

Table 3

Results calculate the optimal plan orders (7)

Name of the customer	LLC «MANGANESE»	Ltd. "Incorporation"	Ltd. "Invariant"	Ltd. "KSM PROTEC»	Ltd. "Metcom Invest"	BP (private) "DEMZ"	Ltd. "SPYETSVAHON"	Tripoli TPP	Ltd. and HC II "MAM"	PJSC "external economic	LLC "GRAND greetings"	LLT «Daniele»	LLT «Snamprogetti»	ТОВ «АЛЬТКОМ»
Z_l	0	0	1	0	1	1	0	0	0	1	0	0	0	1

The simplicity of the algorithm allowed to develop a program in C ++ that performs all calculations automatically, which enabled increasing the overall effectiveness of the company by 3%.

Designed criterion daily downloading allowed the company to unify methods of forming optimal portfolio engineering company.

Using clustering ensured obtain piecewise linear dependence of profit on cost with high quality approximation.

The developed algorithm software automates all calculations, reduces the likelihood of errors, speeds up decision-making process for choosing the most profitable orders for the company. This technique can be applied to companies that have production, but the service is carried out as designed Dsle criteria can be considered universal because it is expressed in monetary units and does not include the technological parameters of production.

1.14. Optimize the allocation of funds for replacement of fixed assets to improve efficiency

Total funds available metallurgical enterprises is always limited and under significant physical and psychological wear and tear of fixed assets in the steel industry is much less than the demand for them. This creates the need for research on the optimal management of available funds.

This study aimed at improving methodological approaches to optimal allocation of funds for capital renewals steel plant using the method of nonlinear dynamic programming in order to increase its effectiveness.

The scarcity of funds and the urgent need to upgrade fixed assets steel companies need optimum distribution first. Criteria for optimality in this case may be or the increase in profit (maximization problem) or reduce operating costs (minimization problem). It is believed that in the marketplace only possible optimality criterion is total future economic

benefits. Wherepid future economic benefits meant potential growth now receiving income from further use updated property assets.

Note in replacement of fixed assets should understand the economic category, which reflects the main purpose of which increase future economic benefits from the use of assets and carried out in the direction of revamping, expansion, new construction, reconstruction and repair of elements of modernization. This approach to determining the substantive content of the update fixed assets and justifies its use only to the active part of the production assets and the elimination of obsolescence, and improve the technical level, and increase the efficiency of fixed assets.

To optimize decisions on prioritizing areas of new capital assets, depending on the maximum level of future economic benefits were developed following matymatychnu economic model.

We introduce the notation: VO_l - update costs; HP_l - cash flow (future economic benefits and the cost of the upgrade); l - the type of machinery, equipment, vehicles, $l = [1, M]$; M - number of types of machines, equipment and vehicles; t - during the upgrade $t = [1, T]$; T - time horizon; S - the amount of money you have to invest in upgrading the 1st stage.

We assume that the amount VO_l and HP_l permanent for the entire period of calculation.

Since it is necessary to optimize the cost of replacement of fixed assets, ie the active part of the production assets, the tax and accounting, they constitute the fourth and fifth groups. Which Tax Code of Ukraine established minimum acceptable useful lives - five years, and what buwheredorivnyuvaty horizon ($T = 5$ years).

Suppose that all the profits from the replacement of fixed assets investment in the renewal iwherena l other types of assets in the next year.

Introduce integer array $X_{ll} \subseteq [0; 1]$, for which a value of l at time t mean that in the year to do updates l-th unit.

Matrix implementation period of investment in the renewal of fixed assets l-type buwherematy form shown in Fig. 1.

Type of fixed assets (FA)	Period Update FA (t), year				
	1	2	3	4	5
1. …					
2. …					
…					
l ...					

Fig. 1. Matrix x_{tl} realization of investment in new capital assets

For array X_{tl} it is necessary to impose restrictions

$$\sum_{t=1}^{T} X_{tl} = 1. \qquad (1)$$

Output data to select the direction of renewal of fixed assets steel companies, such as the cost of updating the types of assets (VO_l) and cash flow from the renewal of fixed assets (HP_l) are given in the Table. 1.

Under these assumptions, the problem reduces to the problem of nonlinear dynamic programming because of the need to consider the fact that the economic effect of l-upgrade type of equipment can only be for next year. In addition, once spent updates no longer need to spend in the following periods. Summarizing the above, we proposed a methodological approach to choose the direction of new capital assets steel companies using the method of mathematical programming.

In our case applied method of dynamic programming as a factor in increasing the rate of the economic benefits of updating the help of irregularities compiled as the sum of cash flows for each year of calculation. Cash flows sixth year will consist only of income from renewal and will be functional, aspiring to the maximum.

Table 1. Baseline data for selecting the direction of renewal of fixed assets of JSC "Dnieper Metallurgical Plant them. FE Dzerzhinsky " thousand UAH.

Type of fixed assets (FA)	The cost of updating FA, VO_l	Cash flow from updating FA, HP_l
Sinter plant		
1. Construction of new modern sinter machine №1	87900	43950
2. Construction of new modern sinter machine №2	95640	47820
3. Ring cooler	20360	13573
4. Fasting units ore yard	11080	5276
5.Llayring stack units ore yard	25570	10654
Blast redistribution		
6. Reconstruction blast furnace (BF) №10	908000	363200
7. Construction of a new modern SE V 3000 m	3734330	1333689
8. Construction of a new modern SE V 1640 m	1865300	932650
9. Separate unit air (oxygen unit) AKAp-40 / 35	60954	32081
10. Vacuumizator with chemical heating	172090	101229
11. Compressor DO1800	19120	28680
12. Compressor DO1800	26780	40170
13. Nitrogen compressor DO390	40300	60450
14. Installation of pulverized coal	1215000	528260
15. Installation of desulphurization	89560	44780
16. The power unit	48660	25610
Steel melting redistribution		
17. Overhaul of modernization converter №2	52000	22608
18. The boiler cooling steel manufactured	24370	12826
19. Compensating filter plant	19560	7523
20. Building 7 Trout CCM №1	258300	99346
21. Reconstruction of varietal bloom caster №2	92100	43857
22. Reconstruction of varietal bloom caster №3	123000	58293
23. The transfer trolley caster	2700	1350
24. The steam generating plant	15880	9925
25. Construction of a new oxygen unit	35000	15909
Rolling redistribution		
26. The unit furnace steel processing «LF» №1,	94220	47110
27. The unit furnace steel processing «LF» №2,	203220	70075
28. New equipment beam state company "Siemens	202100	80840
29. The construction of the middle sort-reinforcing	1534500	639375
30. Reinforce construction of 200 state-wired	1340000	558330

So, mathematically depicted by years of inequalities *t*:

$$t = 1; \qquad S - \sum_{l=1}^{M} BO_l * x_{1l} \geq 0 . \tag{2}$$

$$t = 2;\ \sum_{l=1}^{M}\begin{cases} PHP_l, \text{ if } x_{1l} = 1; \\ 0, \text{ in ather case.} \end{cases} - \sum_{l}^{M}\begin{cases} VO_l, \text{ if } x_{1l} = 0; \\ 0, \text{ in ather case.} \end{cases} * x_{2l} \geq 0. \quad (3)$$

$$t = 3;\ \sum_{l=1}^{M}\begin{cases} HP_l, \text{ if } x_{1l} = 1 \text{ або } x_{2l} = 1; \\ 0, \text{ in ather case.} \end{cases} - \sum_{l}^{M}\begin{cases} VO_l, \text{ if } x_{1l} = 0 \text{ and } x_{2l} = 0; \\ 0, \text{ in ather case.} \end{cases} * x_{3l} \geq 0. \quad (4)$$

$$t = 4;\ \sum_{l=1}^{M}\begin{cases} HP_l, \text{ if } x_{1l} = 1 \text{ or } x_{2l} = 1 \text{ or } x_{3l} = 1; \\ 0, \text{ in ather case.} \end{cases} -$$

$$- \sum_{l=1}^{M}\begin{cases} VO_l, \text{ if } x_{1l} = 0 \text{ and } x_{2l} = 0 \text{ and } x_{3l} = 0; \\ 0, \text{ in ather case.} \end{cases} * x_{4l} \geq 0. \quad (5)$$

$$t = 5;\ \sum_{l=1}^{M}\begin{cases} HP_l, \text{ if } x_{1l} = 1 \text{ or } x_{2l} = 1 \text{ or } x_{3l} = 1 \text{ or } x_{4l} = 1; \\ 0, \text{ in ather case.} \end{cases} -$$

$$- \sum_{l=1}^{M}\begin{cases} VO_l, \text{ if } x_{1l} = 0 \text{ and } x_{2l} = 0 \text{ and } x_{3l} = 0 \text{ and } x_{4l} = 0; \\ 0, \text{ in ather case.} \end{cases} * x_{5l} \geq 0. \quad (6)$$

$$t = 6;\quad \sum_{l=1}^{M}\begin{cases} 4HP_l, \text{if } x_{1l} = 1; \\ \begin{cases} 3HP_l, \text{if } x_{2l} = 1; \\ \begin{cases} 2HP_l, \text{if } x_{3l} = 1; \\ \begin{cases} HP_l, \text{if } x_{4l} = 1; \\ 0, \text{ in ather case.} \end{cases}, \text{ in ather case.} \end{cases}, \text{ in ather case.} \end{cases}, \text{in ather case.} \end{cases} \to \max. \quad (7)$$

To solve this problem we used software package wxMaxima 12.04.0, which is freely available online. As an optimization algorithm was selected kvazinyutonivskyy algorithm restricted memory. Since this algorithm performs minimization, functionality was transformed into minimizatsiynyy by replacing characters in the equation reversed. Below is a listing of a piece of software for finding the optimal solution determine the date and type of equipment that buwhereonovlyuvatysya. For ease of viewing information operators and intermediate calculation results have been removed. The size of the initial investment amount intended to update the equipment was defined as $S = 2648000$ thousand. UAH.

The calculation results in a matrix of zeros and ones, are presented in Table. 2.

Table 2.

Program equipment reconstruction in the years since the calculation

Type of fixed assets	Value array X_{tl}				
	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$
Sinter plant					
1. Construction of new modern sinter machine №1	1	0	0	0	0
2. Construction of new modern sinter machine №2	1	0	0	0	0
3. Ring cooler	1	0	0	0	0
4. Fasting units ore yard	0	0	1	0	0
5.Llayring stack units ore yard	0	0	0	1	0
Blast redistribution					
6. Reconstruction blast furnace (BF) №10	0	0	0	1	0
7. Construction of a new modern SE V 3000 m	0	0	0	0	1
8. Construction of a new modern SE V 1640 m	1	0	0	0	0
9. Separate unit air (oxygen unit) AKAp-40 / 35	1	0	0	0	0
10. Vacuumizator with chemical heating	1	0	0	0	0
11. Compressor DO1800	1	0	0	0	0
12. Compressor DO1800	1	0	0	0	0
13. Nitrogen compressor DO390	1	0	0	0	0
14. Installation of pulverized coal	0	1	0	0	0
15. Installation of desulphurization	1	0	0	0	0
16. The power unit	1	0	0	0	0
Steel melting redistribution					
17. Overhaul of modernization converter №2	0	0	0	1	0
18. The boiler cooling steel manufactured	1	0	0	0	0
19. Compensating filter plant	0	0	0	1	0
20. Building 7 Trout CCM №1	0	0	1	0	0
21. Reconstruction of varietal bloom caster №2	0	1	0	0	0
22. Reconstruction of varietal bloom caster №3	0	1	0	0	0
23. The transfer trolley caster	1	0	0	0	0
24. The steam generating plant	0	0	1	0	0
25. Construction of a new oxygen unit	0	0	1	0	0
Rolling redistribution					
26. The unit furnace steel processing «LF» №1,	1	0	0	0	0
27. The unit furnace steel processing «LF» №2,	0	0	0	1	0
28. New equipment beam state company "Siemens	0	0	1	0	0
29. The construction of the middle sort-reinforcing	0	0	1	0	0
30. Reinforce construction of 200 state-wired	0	0	0	1	0

The table shows that over the specified time horizon optimal investment may be engaged only those types of equipment, which is in

front of the unit. Optimum calculation shows that in the case of funds from increased productivity due to equipment upgrade to update other types of equipment can be for 5 years to upgrade all the existing equipment at the plant.

Economic effect designed to determine the optimal plan directly impossible, since all funds received from increased production capacity went to equipment for reconstruction of the fifth year of payment. However, analysis of the planned measures now update of fixed assets for five years shows that at the same time with the same amount of initial investment, the company would be able to upgrade fixed assets totaling 132,584 thousand. UAH., And from using the model proposed above totaling 148,258 thousand. UAH. Thus, the economic effect of the introduction of scientific statements: 148,258 - 132,584 = 132,584 thousand. UAH., Or 32%.

Thus, the use of nonlinear dynamic programming models with limited resources for planning the enterprise with new capital assets is for managers greater information value, since using these models can choose the optimal operation of the replacement of fixed assets.

1.15. Economic-mathematical model of economic feasibility completeness extraction of coal reserves at mines with small residual [58]

A significant reduction in recent years, the volume of coal production in Ukraine is due ambitious, not in all cases sufficiently economically justified reduction of coal mining assets during the restructuring of the coal industry. Closed mines were not only very complicated mining and geological conditions, small mineral resources and low technical and economic indicators, but also those within the mining allotment remaining coal reserves are sufficient for a relatively long-term operation of mines.

On the issue of completeness of extraction of coal reserves are four interrelated aspects together: mining and geological, economic, environmental and social. Since Different combinations of these steps remove aspects of completeness stocks, there is a need to build a common scheme account of these aspects (factors). Preferred as such a scheme to build a mathematical model that will allow with sufficient completeness to consider these factors acting in different directions.

Development of EMM is dependent on the task and the initial conditions, which include: purpose of the study, criteria for choosing the best option billing period restrictions.

As the objective function (criterion) to select the most appropriate option extraction reserves passed the minimum cost per 1 ton of extracted reserves, taking into account the costs: the actual coal production, closing mines, power compensation, retiring loss of differential rent due to the incomplete removing mineral reserves. Different options are removing the completeness stocks.

The objective function

$$S_i \to \min, \qquad i = \overline{1, n} \tag{1}$$

where: S_i – he full amount of discounted cost of 1 ton of extracted reserves and for th variant thousand. UAH; *i* - index options remove stocks; *n* - number of options for removing reserves.

The costs of mining are divided into two parts: the costs are directly proportional to the number of stocks that are removed, regardless of the time that is mining (coal extraction in the ranks and transporting minerals underground and surface) and costs dependent Occasionally remove stocks (all other costs). Time remaining mine operation depends on the stocks that are removed, and the capacity of the mine.

The first part of the cost is defined by:

$$\alpha\, z_{pr} \cdot \kappa_{ui} = B_I, \tag{2}$$

where z_{pr} – industrial residual stocks mln. tons; κ_{ui} - Coefficient for the removal of industrial stocks and th option; α - Costs directly to coal extraction (cleaning work, transport, minerals), UAH/T; B_I – the total cost directly to coal, thous. UAH.

The second part of the costs is given by:

$$B_c \cdot \frac{z_{pr} \cdot \kappa_{ui}}{P} = B_{II}, \tag{3}$$

where B_c – annual fixed costs of the mine, th. UAH; P– capacity of the mine, ths. tons; - The total cost (the rest) in coal-dependent term extraction inventories thousand. UAH.

The total cost of mining and for th option in t-buwheredorivnyuvaty year, excluding the time factor:

$$B_T = \sum_{t=1}^{\tau} (\alpha\, z_{pr} \cdot \kappa_{ui} + B_c \cdot \frac{z_{pr} \kappa_{ui}}{P}), \quad i = \overline{1, n}, \ \tau \subset T, \tag{4}$$

where τ - The period during which stocks are removed, years;

T – ettlement period of years.

From equation (4) follows directly that the costs for mining operations do not depend on the completeness of extraction of reserves. If the costs according to their destination by munapryamu *j*-th option and remove stocks indicate the costs directly to mining per 1 ton (Q_{ij}) is:

$$Q_{i1} = \frac{\alpha\, z_{pr}\, \kappa_{ui} + \dfrac{B_c \cdot z_{pr} \kappa_{ui}}{P}}{z_{pr}\, \kappa_{ui}} = \alpha + \frac{B_c}{P} \tag{5}$$

The right side of equation (5) does not depend on the completeness of extraction of reserves, while the total cost Q_{i1} Depending on the completeness of extraction of reserves k_{ui}.

The cost of closing the mine is largely dependent on the social component - the creation of new jobs. The total cost of the closure of the mine depends on specific conditions and varies quite widely. These costs are distant in time as long as stocks held removal, ie the period of the mine, and the comparability of these costs should be brought to date using a discount factor which can be taken as 0.1.

Accordingly, the value of the mine closure costs (Q_{i2}) an be represented by the relation:

$$Q_{i2} = \sum_{t=\tau+1}^{T} \frac{P_{it}}{(1+E)^t}, \tag{6}$$

where P_{it} – the cost of closing the mine and extraction th option stocks in the t-th year, ths. UAH; E – discount factor.

Given that the cost of removing reserves scattered in time (depending on the completeness of extraction of reserves), they should also lead to the initial moment by discounting, and then the ratio (4) take the following form:

$$B_T = \sum_{t=1}^{\tau} \frac{\alpha\, z_{pr}\, \kappa_{ui} + B_{c0} \cdot \dfrac{z_{pr}\, \kappa_{ui}}{\Pi}}{(1+E)^t}, \tag{7}$$

where $B_{c\,0}$ – annual fixed costs of the mine at the initial moment, th. UAH.

Disposal of mine closure in case of power reduces the mine fund industry as a whole. Currently, the reserve capacity (relative to the volume of production) is a small (approximately 10%), so you need to predict the

time of mine closure costs for power compensation retiring. These costs (Q_{i3}), taking into account the time factor can be determined by the ratio:

$$Q_{i3} = \sum_{t=\tau}^{T} \frac{P\beta_{it}}{(1+E)^t}, \tag{8}$$

where β_{it} – - The cost per 1 ton capacity mine compensation fund is eliminated due to the closure of the mine and im option in the t-th year

In terms of operating mine mineral reserves remaining nevytyahnutymy can not be in any way used and represent a loss. However, stocks have some value, depending on their quality and geological conditions, although no cost and, therefore, prices. In this paper we accept that the value of mineral reserves determined by differential rent that would be received, albeit in a latent form when they are working out and therefore buwherevtrachena due to incomplete removal of stocks. These losses (Q_{i4}) may be determined by the relation:

$$Q_{i4} = \sum_{t=1}^{\tau} \frac{(1-k_{ui})\, z_{pr} d_{it}}{(1+E)^t}, \quad i = \overline{1,n}, \tag{9}$$

where d_{it} – differential rent and for th option na1 per ton of reserves in the *t*-th year

How to limit the construction of EMM taken by two factors: the number of elongated stocks should not be less than 30% and accounted for expenses (all terms) should not be more than doubled to exceed the industry average cost. [9]

The resulting ratio (4) - (9) can build a common EMM.

The objective function (1) becomes as follows:

$$S_i = \frac{1}{z_{ui}} \cdot \sum_{j=1}^{4} Q_{ij}, \qquad i = \overline{1,n} \tag{10}$$

where z_{ui} – tracted coal for industrial and th option mln. tons; j – code direct costs for working off coal reserves.

$$\sum_{j=1}^{4} Q_{ij} = Q_{i1} + Q_{i2} + Q_{i3} + Q_{i4} \tag{11}$$

$$Q_{i1} = \sum_{t=1}^{\tau} \frac{\alpha\ z_{pr} k_{ui} + B_{c\,0} \dfrac{z_{pr} k_{ui}}{M}}{(1+E)^t}, \qquad i = \overline{1,n} \tag{12}$$

$$Q_{i2} = \sum_{t=\tau}^{T} \frac{P_{it}}{(1+E)^t} \qquad i = \overline{1,n} \tag{13}$$

$$Q_{i3} = \sum_{t=\tau}^{T} \frac{M\beta_{it}}{(1+E)^t} \qquad i = \overline{1,n} \tag{14}$$

$$Q_{i4} = \sum_{t=1}^{\tau} \frac{(1-k_{ui})\, z_{pr} d_{it}}{(1+E)^t} \qquad i = \overline{1,n} \tag{15}$$

Обмеження:

$$k_{ui} \geq 0,3, \qquad i = \overline{1,n} \tag{16}$$

$$S_i \leq 2\overline{S}, \qquad i = \overline{1,n} \tag{17}$$

where $\overline{S}$ – limit (allowable) value recorded expenses thousand. UAH.

Three factors (cost of closing the mine, vybuvayuchoyi power compensation and loss of differential rent) are complete in the direction of maximum extraction reserves, because it removed the time of mine closure and compensation capacity of retiring. They are opposed to increase in the cost of coal, since most have to work out the remaining reserves in complex geological conditions. The ratio of these oppositely operating trends and determine reasonable completeness removing stocks.

o conclude we present the calculation economically expedient extraction completeness stocks according to the proposed EMM conditional on, but close to real values. Consider two options (i = 2): in the first version completeness removing stocks $\kappa_{u1} = 0,4$, second version

– $\kappa_{u2} = 0{,}8$. Initial data remaining stock z_{np}=6•10^6 т, Mine capacity of 400 ths. tons of mine closure costs – 100•10^6 грн., the cost of her power compensation retiring - 1000 грн./тThe average industry cost - 190 UAH. / T, costs directly related to production volume-IOM - 50 UAH. / T, the remaining costs of the mine – 60•10^6 UAH./year

Option 1: $\kappa_{u1} = 0{,}4$. Time working off inventories $t = 6 \cdot 10^6 \cdot 0{,}4 : 0{,}4 \cdot 10^3 = 6$ years. The average term to account for the time factor - 3 years, the discount factor *E* = 0.1.

$$Q_{11} = \left[50 \cdot 6 \cdot 10^6 \cdot 0{,}4 + \frac{60 \cdot 10^6 \cdot 0{,}4 \cdot 6 \cdot 10^6}{400 \cdot 10^3} \right] \frac{1}{1{,}1^3} = \frac{1}{1{,}331} \left[120 \cdot 10^6 + \frac{144 \cdot 10^9}{400} \right] =$$

$$= \frac{(120 + 360) 10^6}{1{,}331} = 361 \cdot 10^6 \text{ UAH}$$

$$Q_{12} = \frac{100 \cdot 10^6}{1{,}1^6} = \frac{100 \cdot 10^6}{1{,}771} = 56 \cdot 10^6 \text{ UAH}$$

$$Q_{13} = \frac{400 \cdot 10^3 \cdot 10^3}{1{,}1^6} = \frac{400 \cdot 10^6}{1{,}771} = 226 \cdot 10^6 \text{ UAH}$$

$$Q_{14} = 6 \cdot 10^6 \cdot 1 - 0{,}4) \cdot 15 = 54 \cdot 10^6 \text{ UAH}$$

The total cost of working off inventory: $S_1^1 = 696 \cdot 10^6$ UAH

or on 1 ton: $S_1 = \frac{696}{2{,}4} = 290$ UAH/T.

Option 2: *ku*$_2$ = 0.8. Initial data are the same, but the term extraction reserves - 12 years and the average period to account for the time factor *t* = 6.

$$Q_{21} = \left[50 \cdot 6 \cdot 10^6 \cdot 0{,}8 + \frac{60 \cdot 10^6 \cdot 0{,}8 \cdot 6 \cdot 10^6}{400 \cdot 10^3} \right] \frac{1}{1{,}1^6} = \frac{(240 + 720) 10^6}{1{,}771} = 542 \cdot 10^6 UAH$$

$$Q_{22} = \frac{100 \cdot 10^6}{1{,}1^{12}} = 100 \cdot 10^6 \cdot 0{,}3186 = 32 \cdot 10^6 UAH$$

$$Q_{23} = \frac{400 \cdot 10^3 \cdot 10^3}{1{,}1^{12}} = 400 \cdot 0{,}3186 = 127 \cdot 10^6 UAH$$

$$Q_{24} = 6 \cdot 10^6 \cdot (1 - 0,8) \cdot 15 = 18 \cdot 10^6 UAH$$

The total cost of working off inventories UAH.

or on 1 ton: $S_2 = \frac{715}{4,8} = 149$ UAH./T.

Therefore, the second option was much more effective than the first.

Due to nemozhlyvistiyu solve the optimization problem (10) - (16) having a variable factor is the period during which mined reserves (τ), because it is a sum parameter (12) - (16), to find an analytical relationship between the amount of discounted cost of 1 ton of recoverable reserves for the remaining *i*-th version (S_i) and (τ) as a continuous formula.

The target function must be a difference between the cost of mine closure and income (for mines planned for closure - loss) from the sale of coal products, which obtained when developing the remaining mineral reserves.

To solve this problem must obtain tabulated values of parameters outlined above for a certain period. As the main products are coal mines, get prices for the period when Ukraine hryvnia was introduced as the only form of payment.

This was taken the world's largest coal supply contracts, the average price in dollars for which was designed to cross-rate dollar-hryvnia at the time of sale

$$C(t) = \frac{\sum_{i=1}^{N_t} C_{it} W_{it} KK_{it}}{\sum_{i=1}^{N_t} W_{it} KK_{it}}, \qquad (18)$$

Where C_{it} - price of *i*-contract in the *t*-th year, W_{it} - accordingly, the amount of *i*-contract in the *t*-th year, KK_{it} - cross-rate dollar-hryvnia in the *t*-th year at the time of the *i*-th contract.

As a result of these calculations were obtained tab. 1

Table 1

The average price of coal over the years

Year, t	The average price of coal on the world market, UAH. / T, $C(t)$
1993	45,45
1994	32,32
1995	149,48
1996	184,83
1997	188,87
1998	347,44
1999	475,71
2000	550,45
2001	534,29
2002	539,34
2003	540,35
2004	289,44
2005	239,88
2006	248,18
2007	437,40
2008	1029,60
2009	719,10
2010	801,00
2011	800,93
2012	818,10

To describe the dependence of average coal prices smooth continuous function, we use the first linear approximation, because .. Table 3.1 shows that price increases almost continuously.

As a result of approximation of the following equation

$$C(t) = 38,078t - 75802, R^2 = 0.654. \quad (19)$$

As shown in the R^2 value is not very high quality. To increase the accuracy of forecasting used the method described in [1], whereperiodychni processes described proposed type of dependency

$$y = Ax^B + C(1 - e^{Dx})Sin(Ex^F + G) + H ,$$

Here A ... H - factors model. For that part of the value of coal prices, subject to confirmation, found value

$$\Delta C = C_t - C(t).$$

As a result of the applied [1] methods, nonlinear model was obtained as residue

$$\begin{aligned}\Delta C = {} & 0.0026t + 349,75[1 - EXP(-0,0002t)]Sin(1,558t^{0,9} + 3) + \\ & + 49,95[1 - EXP(-0,003t)]Sin(0,558t^{0,8} - 1,49) + 50.\end{aligned} \quad (20)$$

which is the sum of the linear model has increased the accuracy of approximation to the $R^2 = 0,88$.

Fig. 1 shows graphs of price changes from year to coal and curves that approximate it.

Substituting in (3.2) and (3.4) years 2013-2015 allowed to get estimates presented in Table. 2.

Table 2

Weather weighted average price of coal

Year, t	The average price of coal on the world market, UAH. / T, $C(t)$
2013	827,19
2014	902,40
2015	940,94

With the dependence of the form (20) for the price of coal, calculate table limits economic feasibility of extracting residual stocks of coal mines of different power (tab. 3).

The calculation of cumulative conducted to ensure that create dependency on these parameters, the closure of the mine. Moreover, the calculation of cost was discounted at the end of the 5th year.

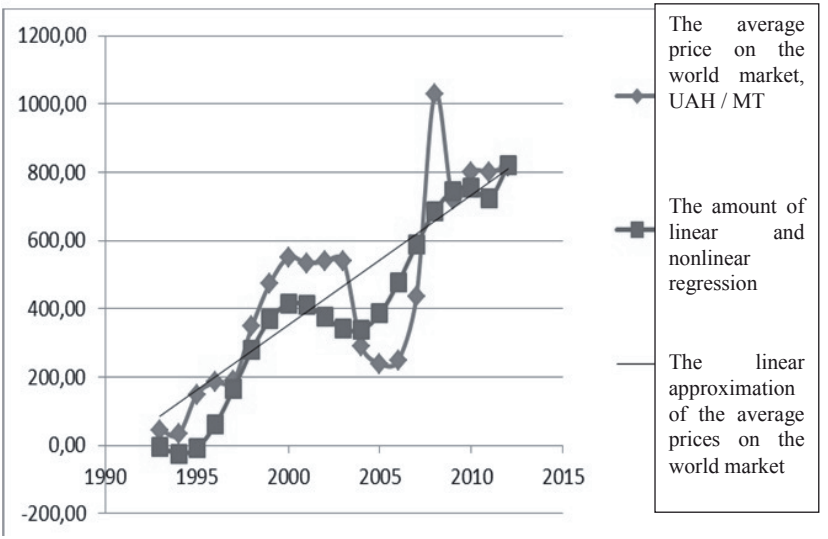


Fig. 1. Approximation changes in average coal prices the amount of linear and nonlinear regression

Table 3

Determining the economic feasibility limits removal of residual stocks

Power mine th. tons / year, P	Year calculation, t	The amount of cumulative production, tons, Q(t)	Costs of production Q_1(t) - a discount., Cumulative mln. UAH	The costs of closing mines Q_2 (t), mln.UAH / Year
300	1	150,3	619	0
300	2	339,3	1182	0
300	3	447,1	1694	29,37
300	4	541,2	2159	29,37
300	5	590,9	2582	29,37
600	1	537,0	652	0
600	2	944,0	1244	0
600	3	810,0	1783	37,77
600	4	780,0	2273	37,77
600	5	760,0	2718	37,77
900	1	809,0	909	0
900	2	1613,0	1735	0
900	3	1454,0	2486	42,37
900	4	1407,0	3169	42,37
900	5	1502,0	3790	42,37

Power mine th. tons / year, P	Year calculation, t	The amount of cumulative production, tons, Q(t)	Costs of production Q_1(t) - a discount., Cumulative mln. UAH	The costs of closing mines Q_2 (t), mln.UAH / Year
1200	1	1412,0	341	0
1200	2	2519,0	651	0
1200	3	2526,0	933	63,93
1200	4	2886,0	1189	63,93
1200	5	2935,0	1422	63,93

Provides project closure duration of work on mine closure is three years, so these costs are shared in equal installments on the last three years of operation of the mine

According to the method described in the introduction, was held first exposure calculation, the number and capacity of the mine (P) on the parameters indicated in the table. 3 as Q, Q_1 and Q_2. To do this, two columns P and t was formed with the following additional column transformations: P^2, P^3, t^2, t^3 and Pt.

Then was fulfilled correlation analysis of the impact of these effects on output factors Q, Q_1 and Q_2. To further calculation was elected those effects, the correlation coefficient exceeding 0.65. In Table. 4 shows an example of the correlation matrix for the triangular costs for mine closure. The calculation was performed subroutine "Correlation" spreadsheet Excel, running Windows 7.

Excluding the effects maloznachymi held Calculation of quasi-linear model subroutine "Regression" spreadsheet Excel, running Windows 7.

As a result of the application of methods create quasi-linear models [2], received the following relationship:

– Volume production

$$Q = 4948,8 - 21,34P + 0.034P^2 + 0.529Pt - 0.000017P^3, \qquad R^2 = 0.79. \tag{21}$$

– Costs of production

$$Q_1 = 1,2 + 784t - 30.27t^2 - 0.0016Pt + 0.729t^3, \quad R^2 = 0.78. \tag{22}$$

–- The cost of closing

$$Q_2 = 26,1 - 59,59t + 29.42t^2 + 0.00787Pt - 3.61t^3, \quad R^2 = 0.87. \tag{23}$$

Table 4

The triangular correlation matrix mine closure costs with the effects of the transformation capacity of the mine (P) and time of the mine (t)

	Power shaft, P, tons / year	Year calculation, t	P^2	t^2	Pt	P^3	t^3
Power shaft, P, tons / year	1						
Year calculation, t	0	1					
P^2	0,984374	0	1				
t^2	0	0,981105	0	1			
Pt	0,654653	0,690065	0,644424	0,6770	1		
P^3	0,951369	0	0,990532	0	0,623	1	
t^3	0	0,943117	0	0,98921	0,651	0	1
The costs of closing mines Q_2 (t), mln. / Year	0,310037	0,785210	0,320030	0,7276	0,811	0,322	0,658

As seen from the values of R^2, the quality is high enough approximation that allows us to formulate optimization criterion type

$$Q_1(t,P) + Q_2(t+3,P) - Q(t,P)\cdot C(t) \to \min, \quad 0 \le t \le 5. \tag{24}$$

he total content of this criterion is that the need to minimize the cost of production Q_2 by continued mining of coal and its implementation. Since the existing plans, the closure is made within 3 years, (3.8) for Q_2 to setting time added number 3.

Substituting (21) - (23) to (24), finally the optimization criterion that depends on the time and power shaft

$$\begin{aligned}
&1,2+784t-30.27t^2-0.0016Pt+0.729t^3+26,1-\\
&-59,59t+29.42t^2+0.00787P(t+3)-3.61(t+3)^3\\
&-\left[4948,8-21,34P+0.034P^2+0.529Pt-0.000017P^3\right]\cdot\\
&\cdot\left[\begin{array}{l}38,078t-75802+0.0026t+349,75[1-EXP(-0,0002t)]Sin(1,558t^{0,9}+3)+\\ \quad+49,95[1-EXP(-0,003t)]Sin(0,558t^{0,8}-1,49)+50\end{array}\right]\rightarrow\min
\end{aligned} \quad , \quad (25)$$

To calculate the optimal time to close the mine were asked capacity of 300 thousand tons / year. Then variables there was only time for closure. The solution to this problem was executed subroutine "Search solution" spreadsheet Excel, running Windows 7.

As restrictions were asked restrictions (3.8). As a result of calculation found that this optimal moment for the closing of the mine is t = 3.589 year or 3 years and 7 months.

Conclusions:

1. First established method for determining the optimal time to close the mine.

2. The efficiency of application and amount of linear regression models to approximate transcendental curve changes over time coal prices.

3. The efficiency of application of the establishment of quasi-linear models for Approximation of the cost of closure, production and volume production on time and power shaft.

Chapter 2. FINANCE

2.1. Research limits exist optimal solutions Markowitz for portfolio [68]

Nowadays the stock market offers more and more different types of securities. Thanks to telecommunications, securities trading has become an international phenomenon when, without leaving the office, you can manage your package of securities on stock exchanges all over the world. Each type has its securities yield, which varies with time, so the choice of the types of securities that should be included in their assets, is a problem.

This problem is solved by the most famous models of Markowitz portfolio securities for which can be found the optimal solution using linear programming methods [69-70] for:

- The maximum income for a given value of risk

$$\begin{cases} m_p = \sum_i x_i d_i \to \max \\ \sum_i \sum_j x_i x_j v_{ij} = r_p \\ \sum x_i = 1 \end{cases}, \qquad (1)$$

- Minimize the risk of a given value yields securities portfolio

$$\begin{cases} v_p = \sum_i \sum_j x_i x_j v_{ij} \to \min \\ \sum_i x_i d_i = m_p \\ \sum_i x_i = 1 \end{cases}, \qquad (2)$$

where x_i - share capital spent on the purchase of securities of i-type, d_i- average yield securities i-th species in percentage per currency, m_p - given the average yield of all portfolio securities, v_{ij} - covariance yield securities i-th and j-th species V_p - covariance entire securities portfolio, which

measured risk portfolio, r_p - given the average covariance of securities entire portfolio.

This model is used for calculation of efficiency of investment projects (see., Eg, [71-73]). But it is made without the use of a critical analysis of the possible scope of application of the model type (1) - (2).

In connection with the above, there are the following problems:

- ✓ Identify opportunities to use matrix of correlation coefficients [6] $r_{ij} = \frac{v_{ij}}{\sigma_i \sigma_j}$, (where σ_i – standard deviation of return of securities and of type) instead of the covariance matrix. The correlation coefficient is dimensionless and always varies [± 1], making it much easier to analyze the situation and determine the acceptable level of risk than covariance. This is especially true model (1) where you want to set a specific, pre-determined level of risk;
- ✓ Analysis of covariance matrix type - for which type of solution is possible if there is?
- ✓ Finally, is it possible to simplify the model (1) - (2) and bring them into a single model type

$$\begin{cases} \dfrac{\sum_i \sum_j x_i x_j r_{x_i x_j}}{\sum_i x_i d_i} \to \min \\ \sum_i x_i = 1 \\ x_i \geq 0 \end{cases}, \qquad (3)$$

To reflect on the problem of determining the acceptable level of risk for each portfolio. B (3) as the objective function is selected ratio, which average risk divided by the average yield of the portfolio. Obviously, this objective function should seek a minimum. We call this model "risk-revenue."

The decision of tasks performed using the function "Randbetween" "covariance," "Correlation" AND "Search solutions" spreadsheet EXCEL.

In the first phase of research conducted for solving the problem Markowitz for maximum profit and minimum risk, according to the models (1) and (2) using in the calculation of risk matrix covariance and correlation for identical initial data. This was generated random number with uniform yield initial values for the six types of securities. A sample of the data shown in Table. 1.

Table 1.

Generated random number generator yield securities

Number of observations yield changes	Stocks type 1	Stocks type 2	Stocks type 3	Stocks type 4	Stocks type 5	Stocks type 6
1	10,74	10,84	14,75	14,30	14,76	14,30
2	13,49	13,44	15,97	12,84	10,37	10,39
3	12,80	12,39	15,18	12,45	10,93	15,27
4	15,18	13,33	12,61	10,84	13,28	14,12
5	12,89	10,75	13,87	12,07	10,47	10,00
6	15,11	12,70	12,32	11,88	13,15	12,46

According to Table. 1 calculated covariance matrix (tab. 2) and correlation (Table. 3). Both matrices show only the lower triangle as they are diagonally symmetric.

Table 2

Covariance matrix calculated according to Table. 1

	Stocks type 1	Stocks type 2	Stocks type 3	Stocks type 4	Stocks type 5	Stocks type 6
Stocks type 1	2,2983					
Stocks type 2	1,2048	1,1737				
Stocks type 3	-1,2973	-0,1007	1,7542			
Stocks type 4	-1,4237	-0,5953	0,9063	1,1031		
Stocks type 5	-0,2984	-0,2963	-1,0046	0,3977	2,7612	
Stocks type 6	-0,4168	0,1388	-0,2628	0,1589	1,8416	3,9742

Table 2

The correlation matrix is calculated according to Table. 1

	Stocks type 1	Stocks type 2	Stocks type 3	Stocks type 4	Stocks type 5	Stocks type 6
Stocks type 1	1					
Stocks type 2	0,7335	1				
Stocks type 3	-0,6461	-0,0702	1			
Stocks type 4	-0,8941	-0,5232	0,6515	1		
Stocks type 5	-0,1184	-0,1646	-0,4564	0,2279	1	
Stocks type 6	-0,1379	0,0643	-0,0995	0,0759	0,5559	1

There were 9 settlements on both models (1) and (2). Results showed complete identity value when calculating return on portfolio risk covariance and correlation matrices. Cancellation values of average portfolio yield does not exceed 0.7%. Therefore, all further calculations were performed using the correlation matrix.

The next series of numerical experiments were conducted to determine the dependence of yield portfolio (1) the type of correlation matrix for each new calculation was asked matrix of correlation coefficients with the values that lie in different ranges: [-1, -0.8], [-0.8 ; -0.6] ... .. [- 0.1; +0.1] .... [0.6, 0.8], [+0.8, +1], in order to characterize the correlation matrix of a single number, the coefficient applied multiple correlation [75-76]. For example, three values y, x_1, x_2 and this factor is calculated as follows:

$$R_{yx_1x_2} = \sqrt{\frac{r_{yx_1}^2 + r_{yx_2}^2 - 2r_{yx_2}r_{yx_2}r_{x_1x_2}}{1 - r_{x_1x_2}^2}}, \qquad (4)$$

where r_{yx_1} - given the correlation coefficient between y and. This ratio varies in the range [0; 1] to solve the problem of this stage was held on 61 optimal calculation model (1). To distinguish R_{yx1x2} value for positive and

negative changes in the range matrix coefficients of correlation, he was given a minus sign for negative ranges. The results are presented in fig. 1.

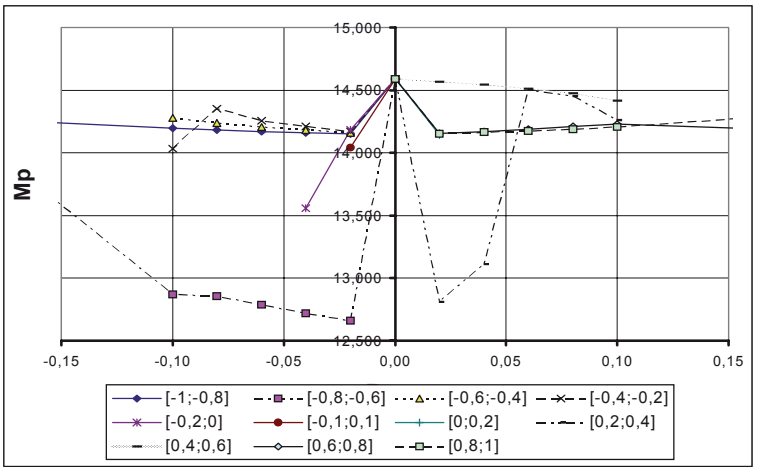


Fig. 1. Dependence portfolio yield (m_p) of multiple correlation coefficient (R_{xyz}) for different ranges of existence of cross-correlation coefficient values (in brackets)

As can be seen from the graph, the best solutions are found when the rate of multiple correlation is near zero. This does not contradict the theory classic risk management [77]. What is new is that for coefficients correlation located in the range [-0.8; -0.6] And [0.2; 0.4] danger, rejecting multiple correlation coefficient of zero more than 0.1, get a solution, 13% worse than when R_{YX1X2} zero.

The last stage of research devoted to checking the model (3). There were about 20 of optimum calculations for this model, and in all cases, the calculation of average out to zero riskiness of a portfolio of securities and got out only one, and in which the average yield was greatest. This result can be considered satisfactory, since the actual riskiness of a portfolio

consisting of only one type of shares proportional to the standard deviation of return on these shares [69, 77].

Therefore, the recommendations [78], the average riskiness of the portfolio was converted to the form

$$R_p = \sqrt{\sum_i x_i^2 v^2{}_i} + \sum_i \sum_j x_i x_j v_{ij} , \qquad (5)$$

where v_i – equal σ_i.

Then the "risk-revenue" model (3) has acquired the following form

$$\begin{cases} \dfrac{\sqrt{\sum_i x_i^2 v^2{}_i} + \sum_i \sum_j x_i x_j v_{x_i x_j}}{\sum_i x_i d_i} \to \min \\ \sum_i x_i = 1 \\ x_i \geq 0 \end{cases} , \qquad (6)$$

Under this model was conducted over 40 best calculations using random values yield distributed evenly according to the law. On the basis of the results was constructed graph in Fig. 2. Dependence of optimal yield of the portfolio risk is modified nonlinear. Changing risk from 0 to 0.5 there is a linear increase yield by 8%, from 0.5 to 1, - the rate of growth slowed to 3%. A further increase in risk does not cause significant changes in profitability.

Based on experiments, the following conclusions regarding the optimal model portfolio securities Markowitz:

1. Using correlation matrix gives identical results using matrix covariance.

2. The most effective is a portfolio that consists of low correlation securities.

3. "Risk-revenue" .model type (6) can be applied to the case where difficult to determine the acceptable level of risk or the return on the type of model (1) - (2).

4. The results for the optimal calculation model (6) should be taken in cases where the risk is modified less than 1.

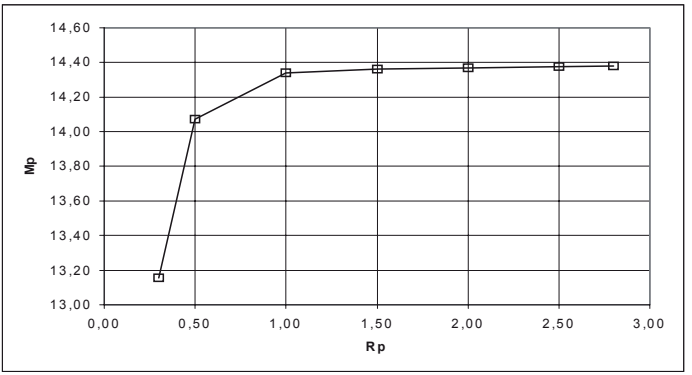


Fig. 2. Dependence of the yield of the securities portfolio (M_k) of the average risk (R_p) model (6)

2.2. The use of information technology to determine the optimal structure of banking services [79]

The limited sources of resource base and secure areas of capital investment requires banks to new approaches to financial intermediation to ensure compliance with the requirements of services market.

Prominent among them is strengthening market orientation processes of accumulation and use of funds by banks serving important factor in expanding financial capabilities of banking institutions for a successful competition. To improve the situation it is necessary to find an optimal solution that will raise funds in necessary for normal functioning of the bank's size, and place them with the highest yield, without going beyond the set margin and taking into account the views of customers. This will be possible if it developed a system of feedback from clients who are consumers of banking services, or can become them. Then, according to

the wishes of clients and the situation on the financial market may be finding the best loan and deposit rates and terms. According to modern scientific approaches to this problem can be solved by using mathematical methods.

To attract information for further work was selected single continuous survey method using questionnaires, which question desired level of rates on loans and deposits for various types of banking services. Questioning was conducted during two weeks among employees DF JSB "Factorial Bank", bank customers and citizens. All were interviewed 94 individuals. The results were recorded in a special table for further processing.

General population was divided by categories of respondents into three groups: 1) customers, 2) employees, 3) others. This was done to separate bank employees expectations of customers desires of the public. Given the desire of customers to maximize their profits and minimize their costs in exaggerated sizes, sample "Clients" was divided on the basis of logical decision making on active and passive operations of the bank. This was calculated the difference between the average interest on the loan desired and desirable average interest on deposits for each client. All zero and negative results are not taken into account as economically feasible. For each sample we calculated mean values, variance, standard deviation and error of the rates on different types of loans, deposits and terms for different types of credit, deposit.

The calculation results are summarized in Table. 1-5.

Table 1

Averages

Middle	Bids%				Terms			
	Auto	Mortgage	Consumer	Deposit	Auto	Mortgage	Consumer	Deposit
General	14,57	12,31	16,505	14,20	63,44	270,3	18,510	11,74
Employee	18,86	17,31	20,681	15,09	63,81	270	23,181	15,27
Customers	13,18	10,737	15,254	14,46	63,73	274,9	17,213	10,13
ustomers are	14,31	13,363	16,068	12,93	55,09	270	15	10,63

Middle	Bids%					Terms		
	Auto	Mortgage	Consumer	Deposit	Auto	Mortgage	Consumer	Deposit
significant for the bank								
Others	13,72	11,045	15,090	11,18	61,09	245,4	16,363	13,63

Table 2

Dispersions

Middle	Bids%					Terms		
	Auto	Mortgage	Consumer	Deposit	Auto	Mortgage	Consumer	Deposit
General	16,18	19,9	20,3225	9,8731	509,79	6977,3	138,31	55,869
Employee	4,790	9,65	8,41774	4,4675	663,58	8828,5	289,01	125,92
Customers	10,81	11,8	14,9551	7,1322	525,79	6095,4	83,370	21,349
'ustomers are significant for the bank	10,32	9,19	12,3879	6,7689	297,03	8142,8	57,428	18,623
Others	22,41	22,2	31,4909	25,363	185,89	8967,2	115,85	79,854

Table 3

Standard deviation

Middle	Bids%					Terms		
	Auto	Mortgage	Consumer	Deposit	Auto	Mortgage	Consumer	Deposit
General	4,0227	4,466	4,50835	3,1421	22,578	83,530	11,760	7,4745
Employee	2,1886	3,107	2,90133	2,1136	25,760	93,960	17,000	11,221
Customers	3,2889	3,439	3,86719	2,6706	22,930	78,073	9,1307	4,6205
'ustomers are significant for the bank	3,2128	3,032	3,51965	2,6017	17,234	90,237	7,5781	4,3154
Others	4,7347	4,714	5,61167	5,0362	13,634	94,695	10,763	8,9361

Table 4

Errors averages

Middle	Bids%					Terms		
	Auto	Mortgage	Consumer	Deposit	Auto	Mortgage	Consumer	Deposit
General	6,61	7,3460	7,41557	5,1683	37,138	137,39	19,344	12,294
Employee	3,59	5,1111	4,77227	3,4766	42,371	154,55	27,963	18,457

Customers	5,40	5,7574	6,36096	4,3927	37,716	128,41	15,018	7,6000
ustomers are significant for the bank	5,28	4,9876	5,78932	4,2794	28,348	148,42	12,464	7,0983
Others	7,78	7,7540	9,23038	8,2838	22,426	155,76	17,704	14,698

Table 5

The error variance

Middle	Bids%				Terms			
	Auto	Mortg age	Consu mer	Depos it	Auto	Mortg age	Consu mer	Depos it
General	2,488	3,0670	3,12539	1,5181	78,391	1072,8	21,2688	8,5910
Employee	1,589	3,2038	2,79306	1,4823	220,18	2929,3	95,8964	41,781
Customers	2,079	2,2743	2,87517	1,3711	101,08	1171,8	16,0281	4,1044
ustomers are significant for the bank	3,425	0,1386	0,18683	0,1020	4,4799	122,81	0,86614	0,2808
Others	11,11	11,021	15,6176	12,578	92,191	4447,2	57,4571	39,603

Using both paired t-test [80] means for sampling personnel and significant clients were installed with confidence probability of 0.95 that there is a statistically significant difference between the interest rates on the opinion of customers and employees. t-statistics for the various types of interest rates (car loans - 5.4835, loans for housing - 4.3099, consumer loans - 4.6289, deposits - 3.4814) compared with tabulated values of t Critical one-sided = 1.7207 and t critical bilateral = 2.0796 greatly exceeds them. Conversely, the opinions of customers and bank employees on the timing for different types of loans and deposit the same (car loans - 1.2748, housing loans - 0.00, consumer loans - 1.7672, deposits - 1.8585).

Formulated the hypothesis of consistency opinions bank employees and bank customers significant interest rate on loans, deposits and timing of these banking products. The test of this hypothesis could be done through formulas Pearson, Spearman [1] and Coefficient of rank concordance [81], but they often do not allow get the desired result in

the lack of consistency of objects on one of the small volume measurements and measurements together.

To solve this problem, proposed to use modified concordance rate [82]. Pairwise concordance coefficient calculation modified (2) loan and deposit rates, credit and deposit deadlines provided in a matrix in the table. 6-9.

Table 6

Matrix concordance coefficients (interest rates / clients of the bank)

Auto	Mortgage	Consumer	Deposit	
x	0,863	0,831	0,861	Auto
	x	0,777	0,886	Mortgage
		x	0,758	Consumer
			x	Deposit

Table 7

The matrix coefficients concordance (Interest rates/employees of the bank)

Auto	Mortgage	Consumer	Deposit	
x	0,825	0,810	0,657	Auto
	x	0,707	0,776	Mortgage
		x	0,600	Consumer
			x	Deposit

Table 8

The matrix coefficients concordance (Date / clients of the bank)

Auto	Mortgage	Consumer	Deposit	
x	0,336	0,554	0,521	Auto
	x	0,279	0,273	Mortgage
		x	0,785	Consumer

Table 9

The matrix coefficients concordance (Date / employees of the bank)

Auto	Mortgage	Consumer	Deposit	
x	0,363	0,643	0,574	Auto
	x	0,302	0,280	Mortgage
		x	0,792	Consumer

			x	Deposit

As the table harmonize interest rates concordance coefficient close to unity. That is the view of respondents agreed. But the rate of concordance terms less. This indicates non ordinary of opinion regarding the timing of both bank customers and to employees.

Analysis calculations showed that coordination between credit and deposit rates to customers slightly higher than employees. This points to a moderation in the minds of customers.

Also, respondents to the accompanying link was offered bank products such as personal account and plastic card. These products, with its low cost, bring implicit profit of the bank in the form of fees for services, cash, non-cash transfer of funds and as a recognition of the bank in the banking market, which is the important criterion for the introduction and approval of new products, and as a result, additional profit.

So, in terms of bank employees opening current accounts at the loan or deposit is a prerequisite. During that 86 percent of respondents expressed. 5 percent are undecided with the idea of mandatory open a current account, and 9 percent were in favor of opening a current account in the presence of additional conditions, such as flexible commission fees, better service and more. Regarding the issue of plastic cards, it polled 90 percent of workers voted for the provision of services on preferential terms.

On the other hand, only 59 percent of the total set of clients and 50 percent of bank customers significant in favor of mandatory open a current account with the loan or deposit. Accordingly, 16 per cent and 23 per cent refused to account. 13 per cent of the total set of customers and 14 percent important for bank customers have not decided on this issue, and

11 percent and 13 percent respectively offered other conditions under which they agreed to open a current account.

Some things look better with plastic cards. 70 percent of the total set of customers confirmed the desire to have a plastic card in support of basic banking products, significant figure for bank customers slightly lower, 59 percent. 15 and 18 percent abandoned this additional product, despite the favorable conditions of registration. 11 and 14 percent undecided opinion, and 3 percent of the total number of clients and customers significant 9 percent wanted to be booked for some changes in the conditions offered by the bank.

The thoughts of the relationship between interest rates on credit and types of fees are divided. Yes, most bank employees (68 percent versus 27 percent) believe that we should put more interest rate and take a one-time commission. This is understandable, since in this case the bank quickly earns money that partially cover the gap in liquidity active and passive operations. The opposite opinion with clients. In the total population

41 percent on a one-time fee and higher interest rate, as in this case, at the end of a long term loan total overpayment for credit costs less than 41 percent at a lower interest rate and monthly fee because they do not want to spend just a large sum of money, 13 percent undecided with this question, and 5 percent have chosen other options, mainly in formulating their thoughts around the length of the loan and its solvency.

In connection with these studies decided to further calculations using rates on credit and deposit operations and only in terms of questionnaires filled the clients that are important for the bank as potential consumers.

We hypothesized that maximize bank profits should reduce the terms of credit and reduce deposit rates simultaneously with the increase in interest rates and term deposits. That is the challenge of double optimization. Therefore, on the one hand, we have:

$$P_d + \frac{T_\kappa}{12} \cdot P_k \to \min, \qquad (1)$$

where R_d - interest rate on the deposit; Pk - the interest rate on the loan; T_k - term loan.

On the other hand

$$P_k + \frac{T_d}{12} \cdot P_d \to \max , \qquad (2)$$

where R_d - interest rate on the deposit; T_d - term deposit; P_k - the interest rate on the loan.

Obviously, partially from (3) divided by (4) and will be our functionality that should be made for a minimum

$$\frac{P_d + \frac{T_k}{12} \cdot P_k}{P_k + \frac{T_d}{12} \cdot P_d} \to \min , \qquad (3)$$

Set limits on this functionality.

1) all variables must be integral;

$$P_d , T_d , P_k , T_k > 0; \qquad (4)$$

2) the rate on the deposit must not exceed or equal to the rate on the loan

$$P_d < P_k ; \qquad (5)$$

3) the difference between credit and deposit rate should be equal to the minimum required level of margin that the bank set

$$P_k - P_d = M, \qquad (6)$$

where M - the minimum required margin of the bank;

4) rate on the loan is limited above and below the desired client calculated average error rate of ±

$$\overline{P}_{кк} - \varepsilon_{P_{KK}} < P_к < \overline{P}_{кк} + \varepsilon_{P_{KK}} , \qquad (7)$$

where $\overline{P}_{кк}$ – calculated on the basis of personal data desired average customer interest rate on the loan; $\varepsilon_{P_{KK}}$ – secondary error;

5) The rate for restricted deposits above and below the calculated desired average customer with maximum deviation of error rate

$$\overline{P}_{dk} - \varepsilon_{P_{dk}} < P_{\partial} < \overline{P}_{dk} + \varepsilon_{P_{dk}}, \qquad (8)$$

where $\overline{P}_{dk}$ – calculated on the basis of personal data desired average customer interest rate on the deposit; ε_{Pdk} – secondary error;

6) the term of the loan is limited above and below the calculated desired average customer, with a deviation of no more than his error term

$$\overline{T}_{\kappa\kappa} - \varepsilon_{T_{KK}} < T_{\kappa} < \overline{T}_{\kappa\kappa} + \varepsilon_{T_{KK}}, \qquad (9)$$

where $\overline{T}_{\kappa\kappa}$ – calculated on the basis of personal data the average desired loan term customers; $\varepsilon_{T_{KK}}$ – secondary error;

7) term deposit limited above and below the calculated desired average customer with maximum deviation of error rate:

$$\overline{T}_{dk} - \varepsilon_{T_{dk}} < T_{d} < \overline{T}_{dk} + \varepsilon_{T_{dk}}, \qquad (10)$$

where $\overline{T}_{dk}$ – calculated on the basis of personal data desired average customer deposit term; ε_{Tdk} – secondary error;

8) the deposit rate should be not less than the annual inflation rate

$$P_d > \text{annual inflation rate;} \qquad (11)$$

9) rate on the loan should not be less than the rate refinancing

$$P_k > \text{NBU refinancing rate,} \qquad (12)$$

Where NBU – National bank of Ukrain

After calculations using the tool "Search solution" MS Excel was found that the optimized first term lending and deposit services. This is logical, because the terms are no more restrictions than the wishes of customers that they expressed in their questionnaires. So, we can say that the bank will meet customers on credit terms only after the customers will place their free money for as long a period.

However, the timing optimization is performed and optimize interest rates. But there are additional to the wishes of customers, limitations in the form of refinancing the NBU, inflation in the current period and bank margins. So first maximized interest rates on deposits, and already from it delayed the interest rate on the loan to value margin. With increasing level of margin rate on the loan increased to maximum level, then begins a gradual decrease in deposit interest rates to the current level of inflation or the lowest desirable rate on the deposit.

Last point is not desirable in terms of customers, so the best option for raising funds while lack of resources is to establish a level margin at which the deposit rate - the maximum, but in this case, the client must agree to deposit at the maximum calculated dates and number of accompanying products bank.

As an example, we can cite the calculation optimize conditions between car loans and deposits. The calculation results are shown in Table. 10.

Table 10

Calculations car loan / deposit margin with different levels

Margin	0,5	1	1,5	2	2,5	3	3,5	4
credit %	17,711	18,211	18,711	19,211	19,60	19,60	19,60	19,60
% deposit	17,211	17,211	17,211	17,211	17,10	16,60	16,10	15,60
Credit period, months.	26,742	26,742	26,742	26,74	26,74	26,74	26,74	26,74
Term of deposit, months.	17,73	17,73	17,73	17,73	17,73	17,73	17,73	17,73

In this case, profit maximization is due to the rapid turnover of funds. The proposed method was adopted as an alternative method of determining the conditions of banking services in the Dnipropetrovsk branch of JSB "Factorial Bank".

The study was conducted using the method of questioning in two weeks in Dnipropetrovsk branch of JSB "Factorial Bank" Bank's customers, both existing and potential, bank employees and citizens.

The data were processed using advanced concordance coefficient and t-test for the secondary, which allowed them to establish consistency and statistical reliability.

After analyzing the results, it was decided to take into account the views important for bank customers.

The developed optimization model with constraints given calculated to determine the optimal conditions for a given margin, taking into account the views of customers. This method was introduced as an alternative to the DB of AB "Factorial Bank", which made it possible to increase the financial result of six percent.

2.3. One of the ways to diversify temporarily free capital enterprise[83]

In a modern market economy in the cycle and capital turnover create temporarily free funds that can not at any time be used as capital.

The appearance of temporarily free funds contradicts the very essence of capital (because the capital - a cost that brings additional value). Therefore, in such circumstances objectively created the need for concentration of temporarily free money and channeling them into circulation in order to ensure their growth.

One way to control temporarily free funds is their investment in short-term investment projects. One of these projects can be currency trading because there are many currency exchanges, where you can trade currencies directly from your own PC. That game in the currency markets is a means of enrichment and accumulation of their temporarily free cash funds.

In the currency market Forex - one of the world famous currency markets - only traded major currencies, namely the US dollar, euro, British pound, Swiss franc, Japanese yen.

But there are currency exchanges, where the game is not only hard but also soft currencies. Curiosity these trades is as follows: soft currency have higher margins, and profits that the game can be more, because the rate of soft currency more unstable over time than a currency exchange firm [84].

So, if soft identify the most profitable currency against one of the hard currencies - US dollar, then you can develop a mathematical model of optimal portfolio of soft currencies, which will make the temporarily free funds.

The initial data values of currencies against the hryvnia was obtained from the official electronic resorce National Bank of Ukraine [85]. In developing economic and mathematical models have been considered and applied information provided period. After a detailed analysis of the data was done sampled and discarded those currencies that have either ceased to exist or have not been mentioned enough for further calculations (such as those reflected only the average exchange rate for the year, without information on how to change its course per month). In order to obtain more accurate calculation output table is divided into two separate tables: the first table contains information on changes in exchange rates by month, and the second - the average exchange rate over the years.

Based on the fact that the national currency of Ukraine - UAH, not a hard currency for further calculations all rates have been listed so as to obtain a table of currency quotes, the value of one currency for each currency against the US dollar one

$$c_j = \frac{\text{100-currencies of } i\text{-th exchange}}{100\,USD},\ i \in [1,18],\ , \qquad (1)$$

where c_{it} - value and the second currency after currency quotes at time t. Then each observation period was defined margin (or yield) for each currency and currency-th follows

$$d_i = c_{it} - c_{it-1}, i \in [1,18], t \in [1,182], \quad (2)$$

where d_i - yield and the second currency, c_{it} - value and the second currency in the t-th period (or profit), c_{it-1} - value and the second currency in the previous (t-1) period (or cost).

Having information about the margin of each currency, calculated the optimal composition of the portfolio currency through which its owner - the investor will receive the maximum profit. To calculate portfolio risk-used revenue model from [79]

The advantage of this model is no need for data availability or for the exchange of risk portfolio, or for yield and the possibility of using it as risky, and with the risk-free securities. That can calculate the potential profit from the possession and use of a currency portfolio only having data on the profitability of its components (currencies and th species) or on the portfolio as a whole and thanks to which the calculated correlation points required to calculate the total return of the portfolio.

Based on the above developments we propose a method of constructing portfolio optimization currencies, thanks to the game which the company will receive the maximum profit.

The results of calculation of the optimal portfolio of currencies during the period are presented in the following table

he composition of the optimal portfolio of currencies

Currency Portfolio	Yield, d_i	The proportion invested in equity portfolio, x_i	
		in relative terms	percentage, %
100 Australian Dollar	0,0018	0,0772	7,72
100 Pound Sterling	0,0018	0,0772	7,72
100 Danish Krone	0,0002	0,0771	7,71
100 EUR	0,0016	0,0772	7,72

Currency Portfolio	Yield, d_i	The proportion invested in equity portfolio, x_i	
		in relative terms	percentage, %
100 Iceland Krona	*-0,0001*	*0,0000*	*0,00*
100 Kazakh tenge	*-0,0000*	*0,0000*	*0,00*
100 Canadian dollars	0,0020	0,0772	7,72
100 LVL	0,0025	0,0772	7,72
100 Lithuanian Litas	0,0011	0,0772	7,72
100 Moldovan leu	*-0,0007*	*0,0000*	*0,00*
100 Norwegian Krone	0,0003	0,0771	7,71
100 Russian rubles	-0,0009	0,0000	0,00
100 SDR	0,0012	0,0772	7,72
100 Turkmen Manat	0,0000	0,0754	7,54
100 Uzbek sum	-0,0001	0,0000	0,00
100 Swedish Krona	0,0003	0,0771	7,71
100 CHF	0,0017	0,0772	7,72
100 Japanese Yen	0,0000	0,0755	7,55
Портфель в цілому	0,0011	1,00	100%
Ризикованість портфеля			8,2855

The table shows that the composition of the optimal portfolio consists of the following currencies with relatively equal proportions:

- Australian Dollar - 7.72% of the total invested amount of money
- Pound Sterling - 7.72%
- Danish Krone - 7,71%
- EUR - 7.72%
- Canadian dollars - 7.72%
- LVL - 7.72%
- Lithuanian Litas - 7.72%
- Norwegian Krone - 7,71%
- SDR - 7.72%
- Turkmen Manat - 7,54%
- Swedish Krona - 7,71%
- CHF - 7.72%
- Japanese Yen - 7,55%.

Icelandic krona, Kazakh tenge, Moldovan leu, Russian ruble Uzbek sums are not included in the optimal portfolio because they have negative returns, and because it is not profitable to invest their own money.

The yield of the optimal portfolio is 0.0011 or 0.11% at risk (minimum) 8.2855. The highest yield for the period are LVL: 0.0025 or 0.25%, whose share is 0.0775 or 7.75% of the total invested amount of money because they are the most profitable to invest.

Unfavorable foreign exchange currency investments are as follows (with a negative yield):

- Iceland Krona (-0.0001 or -0.01%),
- Kazakh tenge (-0.00% or -0.0000)
- Moldovan leu (-0.0007 or -0.07%),
- Russian rubles (-0.0009 or -0.09%),
- Uzbek sum (-0.0001 or -0.01%).

Conclusions:

1. With the diversification now temporarily free capital to the best investment currency is LVL. Their yield for the period is 0.25%. The least profitable investment currency is Russian rubles, their yield is -0.09%.

2. In diversifying now temporarily free capital in an optimal portfolio of currencies, the composition of which is designed by us in the article, it will get a profit of 0.11% of the invested amount of money at risk 8.2855.

3. The calculations can be concluded that the risk-revenue model can be applied in practice.

2.4. Determining the probability of loan default by persons who have no credit history [86]

Over 2013 individuals' deposits in accounts at banks increased by 70 billion USD. or by 19%. It is reported by the National Bank of Ukraine. As noted in the financial institution, increase contributions by public took place deposits in national currency the level of dollarization of deposits of physical persons decreased from 50.8% at the beginning of the year to 42.5%. Thus the share of long-term deposits increased compared to last year. According to the bank, the funds of individuals and entities on the whole of the year increased by 96 billion USD, or 16.4% [87].

The inflow of deposits makes banks look for new forms of attracting customers wishing to take credit. This growing number of small customers.

To process information, the volume of which is growing, banks have resorted to scoring - automation of calculation of the risk of loan default. But calculations should be simple and require a small amount of data, because customers that have no credit history, by definition, can not provide the required amount of information.

Analysis of recent research and publications. In recent years, scoring for calculating the rating of borrowers and credit risk management has spread logistic regression.

Logistic regression - a kind of multiple regression, the general purpose of which is to analyze the connection between several independent variables (also called regressors or predictors) and the dependent variable. Binary logistic regression, as the name implies, is used in cases where the dependent variable is binary (that can take only two values). In other words, using logistic regression can estimate the probability that the event occurs for a particular subject (repayment / default etc.).

The method is to construct a regression equation [88, 89] type

$$y = a_0 + \sum_{i=1}^{n} a_i x_i ,$$

where a_0, a_i ... ... a_n - factors model x_i - model inputs, ie, the data banks collect about their customers in the loan and its repayment together with interest.

But the Smooth determine probability value in the range [0; 1] is not possible because of the binary outcome - the loan back or not, a so-called logit transformation as

$$P = \frac{1}{1 + e^{-y}} ,$$

where P - the probability that the event will happen interesting; e - base of natural logarithms 2.71 ...; y - standard regression equation.

The result of this transformation are the chances that smoothly varies in the range [0; 1].

Despite the simplicity of the task, logit transformation can not be regarded as allowing full automation of payments. For him to enter the data and determine which of them are characterized by the return of the loan, and that - no. The operator must follow the process of "learning" model, defining the types of errors [90]

• TP (True Positives) - correctly classified positive examples (the so-called true positive cases);

• TN (True Negatives) - correctly classified negative examples (true negative cases);

• FN (False Negatives) - positive examples classified as negative (type I error). This so-called "false pass" - when we are interested in error is not detected (false negative examples);

• FP (False Positives) - negative examples classified as positive (type II error); This false identification, because the absence of mistake makes a decision about his presence (false positive cases).

Further analyzes, which often do not operate absolute terms and relative - shares (rates), expressed as a percentage:

The proportion of truly positive examples (True Positives Rate):

$$TPR = \frac{TP}{TP + FN}$$

: The proportion of false positive examples (False Positives Rate)

$$FPR = \frac{FP}{TN + FP}$$

We introduce two definitions: the sensitivity and specificity of the model. They defined objective value untempered binary classifier.

Sensitivity (Sensitivity) - is the proportion of true positive cases

$$Se = TPR = \frac{TP}{TN + FP}$$

Specificity (Specificity) - proportion of truly negative cases which were correctly identified model:

$$Sp = \frac{TN}{TN + FP}$$

Note that the FPR = 100 - Sp.

A graph of $Se = F(FPR)$, called *ROC*-curve (Receiver Operator Characteristic) and to determine the quality of the model. The area under the curve called *AUC* (Area Under Curve) and the closer its value to one considered the more accurate the resulting model the probability of default. In Table. 1 example of the values of *AUC*, designated experts [91].

Even in a simplified form, it is clear that the above definition of default method is empirical, not given statistical reliability of the results. It is also clear that the resulting model can be used to calculate the probability

of loan default for people who have no credit history. She initially created to determine default individuals who have already received credit.

The most popular indicators that are collected by banks for their customers, are presented in Table. 2. At the bottom of the table. 2 presents symbols that will be used later presentation material.

Table 1

Expert AUC values scale

Interval AUC	Quality model
0.9-1.0	Wonderful
0.8-0.9	Very good
0.7-0.8	Good
0.6-0.7	Mediocre
0.5-0.6	Unsatisfactory

Analysis of the table shows that the client does not have the credit history of the above parameters can only be such as age (X_3) income per month (X_5) and the number of dependents in the family (X_{10}). They can still attach the ratio of monthly payments the borrower (housing, child support, etc.). For his monthly earnings (X_4) because it can be calculated when determining the amount of the loan.

All other indicators relating to customers who have a credit history.

Pull out the hypothesis that all customers as those who have a credit history, and those that do not have it, a homogeneous group of borrowers.

Then, having determined the probability of loan default to borrowers with a certain credit history, you can distribute these findings for the group, whose credit history is not known.

Obviously, such a distribution can be made only on the basis of indicators that can be collected for the issuance of credit - namely, X_2, X_4, X_5 and X_{10}.

Table 2

The list of indicators that determine the reliability of the client [6]

Characteristic	Numerical values of	Symbol rate
The ratio of debt on credit cards and lines of credit (excluding mortgages and auto loans) to total credit limits.	Interest	X_1
Age borrower	Whole	X_2
Number of late payments within 30-59 days over the last 2 years	Whole	X_3
The ratio of the borrower's monthly payments (housing, child support, etc.). For his monthly earnings	Interest	X_4
The monthly income of the borrower	Material	X_5
Number of active loans (car, mortgage) and co-payments of credit cards.	Whole	X_6
The number of cases where the borrower has delayed payment more than 90 days.	Whole	X_7
Number of mortgage loans and real estate.	Whole	X_8
The number of cases where the borrower has delayed the payment within 60-89 days over the last 2 years	Whole	X_9
Number of dependents in the family (children, parents, spouse, etc.)	whole	X_{10}

So the next phase of the study should be:

1. Develop a simple formula to determine the probability of loan default for customers with known credit history.

2. The calculation of the probability of loan default by this formula for customers with known credit history.

3. Construction of analytical dependence species

$$P = F(X_2, X_4, X_5, X_{10}), \quad (1)$$

where P - the calculated probability of loan default.

1. Check the accuracy of forecasting formula (1) on the data that were not used in calculating the coefficients.

2. Defining acceptable for the Bank calculated the probability for customers who have no credit history.

Stage 1. Analysis of indicators that can be defined only for customers who have a credit history shows that they can be divided into two groups:

1. Quantitative it - the number of late payments within 30-59 days over the last 2 years (X_3), the number of active loans (car, mortgage) and co- payments credit card (X_6), the number of cases where the borrower has delayed payment more than 90 days (X_7), the number of mortgage loans and real estate loans (X_8) and the number of cases where the borrower has delayed the payment within 60-89 days over the last 2 years (X_9).

2. Relative it - the ratio of debt on credit cards and lines of credit (excluding mortgages and auto loans) to total credit limits (X_1).

Each of these groups allows you to calculate the probability of loan default by the numerical values of these parameters.

For the first group the probability of loan default may be calculated similar calculations for insurance [7], where the probability of the insured event is defined as

$$P\,A(\,) = K_b / K_d, \qquad (2)$$

where K_b - the amount of payments for a given period (usually a year), K_d - the number of contracts concluded in a given year.

In our case analogous parameter K_d is the sum of all quantitative factors $X_6 + X_8 + X_3 + X_7 + X_9$.

Analogue K_b parameter is the number of late payments within 30-59 days over the last 2 years (X_3), the number of cases where the borrower has delayed payment more than 90 days (X_7) and the number of cases where the borrower has delayed the payment within 60-89 day for the last 2 years (X_9). The reason for this choice is the logical conclusion that since the client has made a delay or failure to return any payments it can and they do not return. This principle of minimizing risk.

Then, the likelihood that the customer does not return the loan in quantitative terms can be found from the expression

$$P_1 = \frac{X_3 + X_7 + X_9}{X_6 + X_8 + X_3 + X_7 + X_9}. \tag{3}$$

The second group of indicators - quantitative represented by one parameter - the ratio of debt on credit cards and lines of credit (excluding mortgages and auto loans) to total credit limits (X1).

Obviously, the higher is the score, the higher the probability of loan default, so

$$P_2 = X_1. \tag{4}$$

Then, the probability of loan default rates for both will be the likelihood of any of these events - quantitative or relative.

$$P = (P_1 \text{ or } P_2). \tag{5}$$

These events are independent of each other, since the emergence of one of them does not affect the appearance of the other. Probability theory known formula to determine the likelihood of any independent events [8]

$$P(A_1 \text{ або } A_2, \ldots, \text{ або } A_n) = 1 - \prod_{i=1}^{n} (1 - p(A_i)), \tag{6}$$

where A_i – independent event, $p(A_i)$ – the probability of its occurrence, $1 \le i \le n$.

Substituting formula (3), (4) to (6), finally get that loan default probability for Pd-known client credit history can be found from the expression

$$P_d = \left[1 - \left(1 - \frac{X_3 + X_7 + X_9}{X_6 + X_8 + X_3 + X_7 + X_9} \right) (1 - X_1) \right]. \tag{7}$$

Step 2: Calculate the probability of loan default for customers with known credit history performed by numerical data [9].

Step 3. To build analytical dependence of the form (1) was calculated (subroutine "Correlation" spreadsheet Excel) correlation matrix presented in Table. 4.

Table 4

Correlation matrix

	P_d	X_2	X_5	X_{10}	X_1
P_d	1				
X_2	0,262	1			
X_5	0,287	0,218	1		
X_{10}	-0,063	-0,112	0,121	1	
X_1	0,104	0,0409	0,06	-0,017	1

Since it is clear that the least impact on the estimated probability of loan default is the number of dependents (X10) = -0.063. The biggest impact - income per month (H5) = 0.287.

In general, the relatively small correlation coefficient for all indicators show that the result should not be approximated by a linear dependence. Need to pick up a log linear, which provides high quality approximation.

To this end, the table initial parameters were added Hi2 type nonlinear effects and HiHj. Separately, the effect was created X5 / (X10 + 1), which determines the average income per family member. Re-calculation of the correlation matrix along with the non-linear effects. options presented in the Table. 5.

Table 5

Fragment correlation matrix for linear and nonlinear effects

	X_2	X_5	X_{10}	X_1	$X5$ /(X10 +1)	
P_d	0,26	0,29	-0,06	0,1	0,26	
	X_{12}	X_{52}	X_{102}	X_{12}	$X_2 X_5$	$X_2 X_{10}$
P_d	0,26	0,22	-0,06	0,08	0,32	-0,02
	$X_2 X_1$	$X_5 X_{10}$	$X_5 X_1$	$X_{10} X_1$		
P_d	0,14	0,09	0,18	0,04		

The table presented in fragments that we mainly interested Pd correlation with other factors, both linear and non-linear, ie, the first column of the matrix. Analysis of the correlation matrix showed that not all effects have a significant impact on the estimated value of the probability of loan default. It was therefore decided to include in the model only those effects, the value of the correlation coefficient with the probability of loan default than 0.2. They were: X_2, X_5, $\frac{X_5}{X_{10}+1}$, X_2^2, X_5^2 та X_2X_5.

Thus was formed the new data table that included only the selected effects. This table was used to calculate the coefficient regression model subroutine "Regression" spreadsheet Excel. This routine finds the coefficients of the predictors using least squares method when minimizing the sum of squared deviations of the actual values of criterion variables of their evaluations (mean value of criteria variable calculated by the equation Assisted created).

As a result of the calculation was obtained dependent species

$$P_d = 0.33985 - 1,4 \cdot 10^{-7} X_2 - 2,6 \cdot 10^{-7} X_5 + \frac{1,2 \cdot 10^{-7} X_5}{X_{10}+1} + 0,71498 X_5^2 - 5,9 \cdot 10^{-9} X_2 X_5. \quad (8)$$

Accuracy approximation regression depending described parameter R2 and is R2 = 0.98335, which indicates the high quality of the resulting model dependence of the probability of loan default on the age of the borrower, income per month, number of dependents and the ratio of debt on credit cards and credit lines (excluding mortgages and car in credit) to total credit limits.

Step 4. Check forecasting properties dependence (8) carried out on another sample is also taken from [95]. First, the formula (7) determined the probability of loan default individuals with credit history.

The calculation was carried out by determining the average error formula

$$\Delta_{cp} = \frac{1}{N}\sum_{i=1}^{N}\left|P_{di} - P_{dsi}\right| / P_{di},$$

where N - sample size, which was carried forecasting skills test formula, P_{di} - current value calculated by (8) the likelihood of loan default.

For 123 points higher than the average error is, 8.45%.

Calculation quality forecasting Pearson criterion suggests that 73% trust probability model is adequate.

Step 5. Logical be accepted estimates of the probability of loan default for a client that does not have a credit history, level of loan default statistics for a particular bank.

$$P_н = \frac{K_н S_н}{KS}, \tag{9}$$

where the P_H - the probability of loan default individual bank calculated the actual performance of the Bank, K - the total amount of loans, S - the total amount of loans, K_N - the total amount of bad loans on time, S_H - the total amount of bad loans on time.

In case designed for (8) the probability of less than or equal P_H, it is hoped that the customer is likely, with probability $P_P = 1 - P_H$, return credit.

If the bank still decides to grant the loan in terms of the excess Pd pH, it is necessary to determine the extent of risk that decision.

To determine the extent to expert use spreadsheet risk premium in the calculation of the investment project [96]. In Table. 7 shows a modification to the table of Pd excess of pH, the definition of risk. The results of research can be summarized in the following paragraphs:

1. Statistical research on bank customers who have a credit history, you can distribute and those who do not have.

2. Developed formula (7) to determine the risk of loan default for people who have a credit history.

3. Calculated by (7) to determine the probability of the risk of loan default for people who have no credit history, but the age of the borrower's income for the month, the number of dependents and the ratio of debt on credit cards and lines of credit (excluding mortgages and auto loans) to total credit limits.

4. The developed formula for determining the probability of loan default to a particular bank for its failure to return statistics.

5. defined as risk when the calculated probability of loan default than statistical probability for a particular bank.

6. As for the likelihood of default data was taken from an educational website, it is necessary to verify the algorithm on real data bank.

Table 7

Scale exceeding P_H of P_d

The risk level	Excess P_H
Extralow risk	0,03
Low risk	0,06
Risk of concern	0,05
Anxious risk	0,08
Critical risk	0,10
High risk	0,15
Extremely high risk	0,20

2.5. Determination of the sale of bank assets on incomplete information

In the event that you need to know the distribution of sales over a certain time horizon (T), for each of its stages t ($1 \leq t \leq T$), and accurate data on the dynamics of sales there than the total amount of sales (S_p) and qualitative characteristics of the speakers invited to the following algorithm.

Since most of the time schedule change in sales is one extreme, and shifted relative to the middle of the horizon in one direction or another, it is advisable to use formula lognormal density distribution law for establishing the connection between time and sales. Fig. 1 shows the curve options $X \sim \mathrm{LogN}(\mu, \sigma^2)$. [97]

It should be noted that these charts have a different appearance depending only on the dimension σ, but dimension μ always equal zero

Schedule for σ = 1, recalls the dynamics of sales, more active in the early horizon, and for σ = 0,25 – at the end. For the first case, the characteristic is almost complete decay curve to zero when x> 3, and the second - if x> 2.

Then change the time sales of bank assets can be described addiction

$$S_t = \frac{ABExp\left(\left(\frac{Lnt}{B\sigma}\right)^2 / 2\right)}{t\sigma\sqrt{2\pi}}, \qquad (1)$$

And where A - coefficient scale sales in B - time scale factor.

Equation (1) is transcendental because definition of coefficients A, B and σ can be conducted only by solving an optimization problem as follows:

1. Determine the time horizon, the total amount of sales and sales type dynamics - at the beginning or at the end of the horizon.

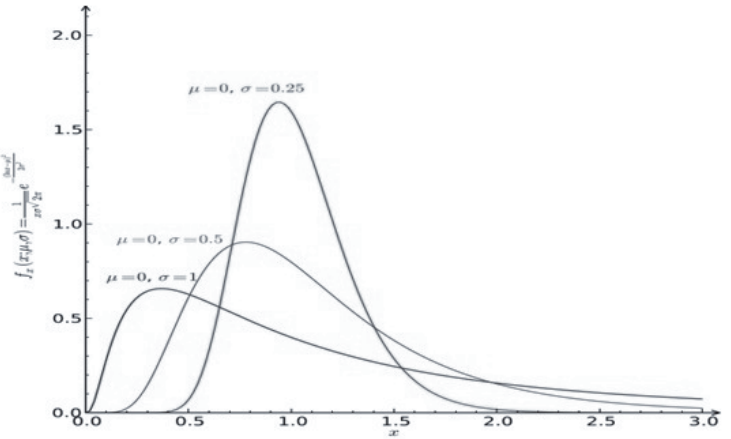


Fig. 1 - Charts lognormal distribution curve density depending on factors σ and μ

2. We expect initial coefficients:

$$A = \frac{S_P}{T}; \tag{2}$$

$$B = \frac{T}{k}, \tag{3}$$

where $k = 3$ if sales are more intense in the first part of the horizon, $k = 2$ - if the second;

$$\sigma = 1. \tag{4}$$

3. For the initial values of coefficients, forward sales amount for each point in time according to (1)

$$S_\Sigma = \sum_{t=1}^{T} S(t). \tag{5}$$

4. Asking moment in which sales were the highest t_M ($1 \le t_M \le T$) and form a system of logical relations, indicating that the value of sales at the point tM is more than two points of sales before and two after the date t_M.

$$S(t_{M-2}) < S(t_{M-1}) < S(t_M) > S(t_{M+1}) > S(t_{M+2}), \quad (6)$$

5. If for some points in time know the exact value of sales, forming an array of these values in a table with values pairs

$$t_i \text{ and } S(t_i) \quad (7)$$

6. Then, in finding unknown coefficients A, B and □ formulate the optimization problem of the objective function

$$S_\Sigma \to S_P, \quad (8)$$

under constraints (6), (7) and

$$A, B \geq 0, \ 0{,}2 \geq \sigma \geq 1{,}5. \quad (9)$$

7. Assign variables A, B and σ.

Then, after solving the problem will be found and the amount of sales for each point in time. Where the horizon starts from the beginning of the fiscal year, you need to assign the first stage of calculating the number 1 and so on. And not to get confused, values in the table next to the number of stages, put a real date.

Example.

It is known that the total sales of bank assets is Sp = 100 conventional units, time horizon T = 12, and the highest level of sales accounted for by the third stage. Thus, the first phase of sales almost was not.

Then:

- Initial coefficients $A = 100/12 = 8{,}33$; $B = 12/3 = 4$;

– limitation $S(t_1) < S(t_2) < S(t_3) > S(t_4) > S(t_5)$;

– with $t = 1$, $S(t) = 0$.

In Table. 1 shows an example of calculating these data using the tool "Search solution" Excel spreadsheets by OPG solving nonlinear problems.

As you can see, the amount is almost exactly matches a given, but for the first quarter of zero sales condition is not fulfilled. But the estimated

sales value of less than 1%, so in conditions of considerable uncertainty can assume that the solution is quite acceptable.

Table 1

Example of the proposed method

Quarter number	Function lognormal law
1	0,946055353
2	11,34131074
3	19,89654076
4	19,89654099
5	15,84051689
6	11,34131122
7	7,707727516
8	5,108101768
9	3,349295841
10	2,190582934
11	1,435960888
12	0,946055445
S_{Σ} =	100,0000003

The coefficients which provide a specified schedule of sales (Fig. 2)σ = 0,5; A = 22,93623; B = 4,44799456.

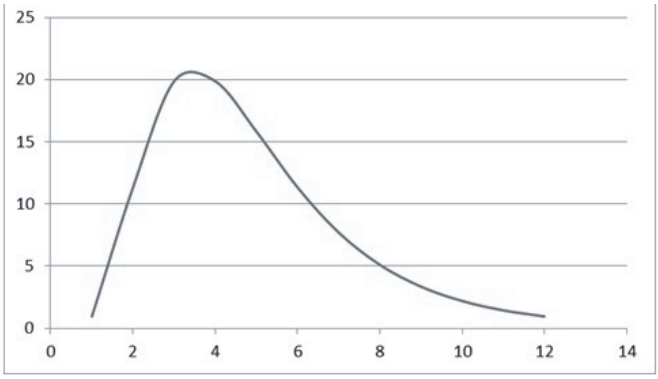


Fig. 2 - Schedule of sales of bank assets, built on the table. 2

2.6. Calculation of net adjustment of tariff rates is in riskfree insurance [98]

In theory insurance "risk-free" is called various forms of life insurance and rental accumulation [99].

Employees of the Center of American Studies astrological assembled and then painted on zodiac sign dates of birth and death, more than 60 thousand people from different countries. Information researchers drawn from encyclopedias, library forms, religious books and even tombstones. Group sociologists from several American universities have checked the data again. The results were identical to previous findings [100]. In Table. 1 shows the results of determination statistically significant calculating the average age of persons whose birthdays fall on a pre-determined date range. Large statistical material means that the variance for each group is close to zero, which is confidence in the results, and thus enables the specification of tariff net rates at the conclusion of insurance contracts or accumulation.

Table 1

The average lifespan for signs of the zodiac

Zodiac	Middle age		Zodiac	Middle age	
	Man	Women		Man	Women
Capricorn	77,5	80	Cancer	68	73
Aquarius	71,5	71,6	Lion	74	74,5
Pisces	71	75	Virgo	76,5	80,5
Aries	79	78	Libra	73	77
Taurus	81,5	79,5	Scorpio	62	63,5
Gemini	78	85	Sagittarius	68,5	72,5

To solve the problem of tariff adjustment coefficients net rates depending on the date of birth of the person who signed the contract of insurance. the authors use the method of calculating mortality tables [101] on statistical census Ukraine [102].

According to these data, designed to root table 100,000 in Excel spreadsheet graphs changes the probability of survival and mortality for all ages (Fig. 1-2). As the statistics cited for ages four years to build these graphs was taken midpoint of each age group.

For these charts were used definition of polynomial trend line of the degree, which provided 100% accurate approximation. Equation (1) established for the probability of survival, and (2) - for the probability of dying.

$$p_x = -8 \cdot 10^{-8} x^4 + 6 \cdot 10^{-6} x^3 - \\ -0,0002x^2 + 0,0022x + 0,9793, \quad (1)$$

where p_x - probability of survival, x - age in years.

$$q_x = 2 \cdot 10^{-10} x^6 - 4 \cdot 10^{-8} x^5 + 3 \cdot 10^{-6} x^4 - \\ -9 \cdot 10^{-5} x^3 + 0,0016x^2 - 0,0128x + 0,0358, \quad (2)$$

where p_x - probability of survival, x - age in years.

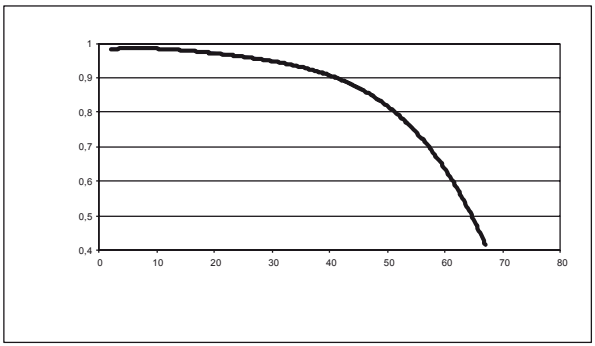


Fig. 1. Graph of the probability of survival from age persons

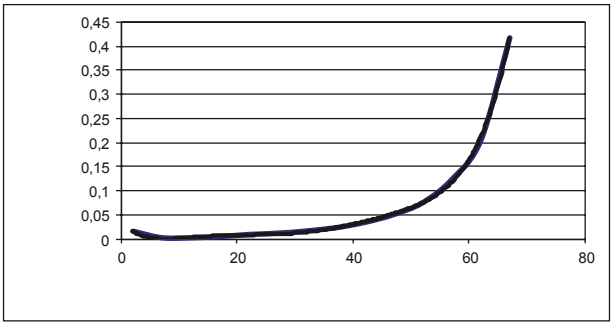


Fig. 2. Graph of the probability of dying of old people

Since the calculation of net rates sometimes convenient to use the number of those who survived and those who died relative to the top of the table, it was made a similar approximation for these parameters

$$l_x = -0,079x^4 + 0,628x^3 - \\ -22,683x^2 + 222,74x + 97933 \quad , \qquad (3)$$

where l_x - the number of those surviving relative root table in 100,000's, x - age in years;

$$d_x = 8 \cdot 10^{-6} x^6 - 0,0017x^5 + 0,1462x^4 - \\ -6,3253x^3 + 141,93x^2 - 1439,8x + 5442,1 \text{'} \qquad (4)$$

where d_x - the number of those who did not survive, relatively root table in 100,000's, x - age in years.

With this approximation data which allow calculation of net actuarial rates for all types of insurance, show how they need to be adjusted, given the date of birth of the insured person.

Determine the average age for articles on the table. 1. The average age for men from these data is m_{xm} = 73.375 for women - m_{xw} = 75.84166667.

Calculation of adjustment should be conducted in view of the fact that when the average age of the person more than the average age, the rate has reduced net rate, if less - increased.

However, when determining the adjustment must take into account the fact that in Ukraine in 2000 according to census the average life expectancy was 73.7 years, men - 64.5 years [102]. So you need to enter an amendment to the difference in the form of

$$k_P = \frac{m_Z}{m_U}, \tag{5}$$

where k_P - correction factor, m_Z – of medium age for Table 1, m_U - the average age Ukrainian.

Then the adjustment factor net rates will look

$$k_i = k_P \frac{m_Z}{m_i} = \frac{m_Z}{m_U}\frac{m_Z}{m_i} = \frac{m_Z^2}{m_U m_i}, \tag{6}$$

де m_i – age on the table. 1 for the i-th birth date range.

According to the formula (6) were calculated adjusting for all factors specific dates of birth for each sex. The calculation results are provided in Table. 3.

Table 3

Factors net adjustment of tariff rates without risk insurance

Dates of birth	The coefficient of adjustment of tariff net rate (k_i)	
	Man	Women
(December 22 - January 19)	1,07704739	0,975569607
(January 20 - February 18)	1,16742899	1,090021907
(19 February - 20 March)	1,17565032	1,040607581
(March 21 - April 19)	1,05659712	1,000584212
(April 20 - May 20)	1,02418617	0,981705265
(May 21 - June 20)	1,07014324	0,91818316

Dates of birth	The coefficient of adjustment of tariff net rate (k_i)	
	Man	Women
(June 21 - July 22)	1,22751724	1,069117378
(July 23 - August 22)	1,12798882	1,047591524
(August 23 - September 22)	1,09112644	0,969510168
(September 23 - October 22)	1,14344072	1,013578812
(Oct. 23 - Nov. 21).	1,34630923	1,229064072
(Nov. 22. - 21 December)	1,21855726	1,076490601

For example, define the expected (actuarial) the present value of a single amount for insurance on survival for 5 years for a man aged 40 years, leaving the annual rate of return of 10%, a birthday is February 18.

Calculation of conduct by the formula given in [103]

$$A_{x\frac{1}{n}} = v^n p_x, \tag{7}$$

where $A_{x\frac{1}{n}}$ –expectations actuarial the present value of a single amount $v = \frac{1}{(1+N_P)}$ – annual discount factor, p_x - the probability of survival to age x, n - duration of the insurance contract, state of emergency, N_P - the rate of return.

Then, with (1) we have that

$$A_{40\frac{1}{5}} = \left(\frac{1}{(1+0,1)}\right)^5 (-8\cdot 10^{-8}\cdot 40^4 + 6\cdot 10^{-6}\cdot 40^3 -$$
$$-0,0002\cdot 40^2 + 0,0022\cdot 40 + 0,9793) = 0,5759$$

After applying correction coefficient selected from the table. 3 for the range (January 20 - February 18), which is for men k_i = 1.16742899 finally have that $A_{40\frac{1}{5}}$ = 0,672322355.

As a result of research can come to the following conclusions:

1. Analytical results depending on the timing of life developed by census Ukraine.

2. The method of actuarial adjustment for the date of birth of the person who enters into a contract of insurance.

3. Adjustment payments increased net rate, which reduces the risk of the insurance company.

Chapter 3. MANAGEMENT PERSONNEL

3.1. Corporate utility function [104]

The general trend of economic development is the corporatization of production [106]. The first reason for this phenomenon is to try to large enterprises expand the scope of influence by absorbing small businesses, the second - the desire of small businesses to get a stable income, which is possible only if small business is part of a large corporation.

Another aspect of this phenomenon is the displacement of small businesses with large market for goods and services due to lower prices and better quality products [109]. The third aspect - a monopolistic influence of large enterprises to the general policy in the region or in the whole country.

In connection with the trends outlined above, the problem of corporate decision-making, primarily by looking at some of the investment project. Moreover, the concept of the project can always bring any economic situation, which may lead to changes in the financial performance of the corporation (accidents, exclusion of tax benefits, global change trends in the consumer market, etc.).

Decision-making in this case made by management consulting corporation with its units, followed by the decision-making at the general meeting management [106] with the subsequent decisions of this decision the head of the corporation (a person who makes decisions - ESD).

This mechanism is quite cumbersome decision-making in order to make a decision in a short period of time. In addition, the decision may affect the emotional factors that make it impossible to make informed decisions. Obviously, the procedure requires the adoption of enterprise solutions based on numerical characteristics of individuals who prepare decisions for approval.

J.O.Morhenshtern Neumann and developed a procedure for constructing individual utility function for the individual. The procedure is as follows: ESD answers some questions, while exercising their individual preferences, taking into account its relationship to risk. The value impairment is two steps [105, 109]

Step 1 are assigned arbitrary values of utility gain for the worst and the best way, and the first value (worse output) is associated with a smaller number. Utility output is not determined uniquely, but up to a monotonic transformation.

Step 2: The person is offered a choice: get some guaranteed cash sum of m, located between the best and worst values of S and s, or participate in a game that is obtained from the probability p – S the largest amount of money and with probability (1 - p) – the lowest amount s. This chance to change (raise or lower) until the ESD will become indifferent with regard to the choice between a guaranteed amount and game. Let the stated value equal probability p_0. Then usefulness guaranteed amount is defined as the mean value (expectation) utility lowest and highest amounts

$$U(m) = p_0U(S) + (1-p_0)U(s).$$

So, in general, the graph of individual utility is based on three points and can be of three types. But for a group of people, this curve has a wavy character [105] as an individual curve usefulness depends on the size of their wealth individuals, and these fortunes for different people may differ in some times - one person can take the risk the sum of one million USD and the other did not earn such amount and for a lifetime.

To create a corporate utility function we propose the following procedure:

1. 1. Determine the number of hierarchical levels Corporation - K;

2. Each level is determined by the maximum amount which can poryadkuvaty person and second ($1 \le i \le K$) level of the hierarchy - S_i ($0 \le Si\text{-}1 \le S_i$);

3. Each such amount is associated with its own usefulness as a number, which is the result of a linear transformation amount (for example, 10 thousand. UAH. - 1 to 1 mln. UAH. - 100);

4. To determine the utility function and level of the hierarchy going all employees of the corporation hierarchy level and they are invited to make a collective decision on steps 1 and 2. Moreover, as the amount taken s largest amount of lower-level hierarchy of S_i-1 and the amount S - the largest of this level Si. For the first level of the hierarchy accepted the sum s = (0,1-0,5) S_i;

5. Having three pairs utility and the appropriate amount of each hierarchical level corporations, bring them to the table, the value of which sort ascending amounts;

6. By means of regression analysis [6] find coefficients ai depending on the amount of utility type $U_{A1} = \sum_{i=0}^{K-1} a_i s^i$.

7. Index a1 means that the first phase approximation;

8. For each value of the sum of the initial data table, calculate the value UA1pi create a new string value = $U_{Ф2}=U_{Ф1}- U_{A1p};$; where U_{F1} - actual utility value from the table;

9. Create another column of the table to calculate the tool type $U_{a2} = A\text{Sin}(Bs + C) + D\text{Sin}(Es + G)$, where A-G - coefficients, initial values are selected recommendations [4];

10. For all values of the argument and arbitrary values of constants calculated value U_{F2};

11. For each function find (U_{A2} - U_{F2}) 2 and decide the optimal methods of nonlinear programming problem [6] with a functional type

$\sum_{j=1}^{N} (U_{A2j} - U_{F2j})^2 \to 0$, and parameters that change are constants *A* - *H*. Here *N* - sample size, which is always 3*K*;

12. Through the proposed algorithm, we get the kind of corporate function impairment

$$U_A = \sum_{i=0}^{K-1} a_i s^i + A\sin(Bs + C) + D\sin(Es + G), \quad (1)$$

which can be used in making corporate decisions follows.

Let corporation before there was a financial problem, which in general is always possible to formulate a table in which each possible solution to this problem, which is characterized by a certain amount sj ask dependent probability of exit p_j ($1 \le j \le M$), where *M* - number possible exits financial problems.

We find the average expected yield financial problems as

$$S_{OVP} = \sum_{j=1}^{M} s_j p_j \quad (2)$$

We find also the average expected utility of financial problems as

$$U_{OVP} = \sum_{j=1}^{M} U_A(s_j) p_j \quad (3)$$

and the average utility output as expected

$$U_A(S_{OBII}). \quad (4)$$

If the problem is financial investment project, this project was adopted in the case when

$$U_{OVP} \le U_A(S_{OVP}). \quad (5)$$

If this is likely to lose some money, the amount of which should insure the corporation in the event of financial problems is found

$$S_{STR} = S_{OVP} - S[U_{OVP}] \quad (6)$$

where $S[U_{OVP}]$ – The amount which corresponds to the expected average utility financial problems. It can be found graphically or by solving the problem of optimal method of nonlinear programming type

$$U_A(s) - U_{OVP} \rightarrow \min, \qquad (S_1 \leq s \leq S_K). \qquad (7)$$

Consider the results of determination of utility function for corporate corporation that has 5 hierarchical levels. For the employees of this corporation had conducted the procedure on p.1-10, which allowed to obtain the following approximation corporate utility function for conditional values amounts

$$U_A(s)=0{,}001089 \cdot s^2 - 0.00861 \cdot s + 0.388862 - 1.3054 \cdot \mathrm{Cos}(1.1115 \cdot s+$$
$$+0.7319) + +0.4465 \cdot \mathrm{Sin}(0.566 \cdot s+3.614).$$

Fig. 1 shows a graphic representation of the procedure for the formation of polynomial approximation item 6 and Fig. 2 - occasionally - in section 8.

Each object management - a system consisting of interconnected elements. In addition, each system is also the element of a higher level. Hierarchy of leads uphill to a holding corporations and down to a small organization which is part of the holding.

There is a problem of corporate decision-making. Decision-making in this case made by management consulting corporation with its units, followed by the decision-making at the general meeting of the leadership of the subsequent decisions of this decision the head of the corporation (a person who makes decisions - ESD).

This mechanism is quite cumbersome decision-making in order to make a decision in a short period of time. In addition, the decision may affect the emotional factors that make it impossible to make informed decisions. The effectiveness of the adoption of certain decisions must be confirmed, since it is not possible for a long time and effectively, guided only by their experience and intuition. Therefore, we need corporate

decision-making process based on numerical characteristics of individuals who prepare decisions for approval.

This method was used to calculate corporate utility function LLC "Promyediya"

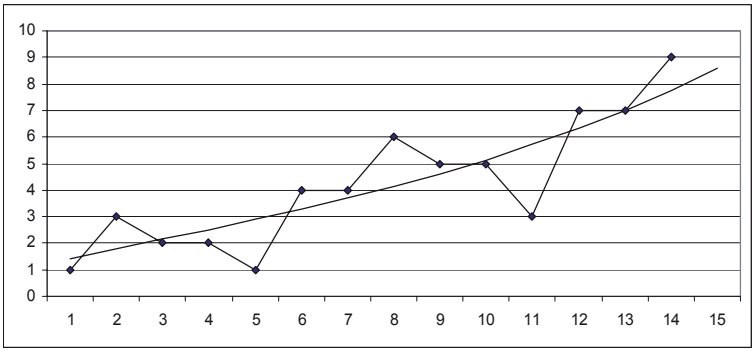


Fig. 1. Measured schedule of corporate utility function (♦) and its polynomial approximation degree is (-)

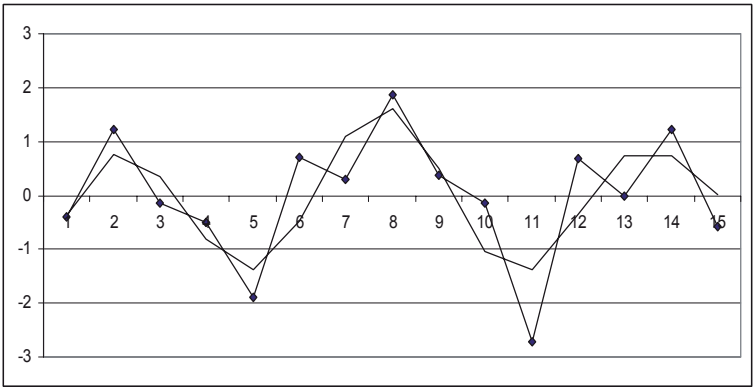
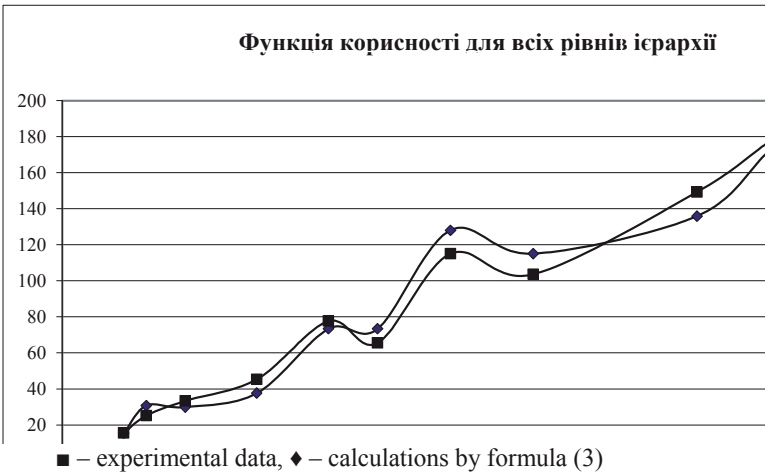


Fig. 2. Periodic component of corporate utility function (♦) and its approximation (--)

For employees at various levels of the hierarchy was established following the financial value of the game:

Levels	Staff	W Outputs
1	Workers plant printing and delivery	s = 150000
		S = 300000
2	Staff departments	s = 300000
		S = 650000
3	Head of department	s =650000
		S = 948000
4	Deputy Director General	s = 948000
		S = 1550000
5	CEO	s = 1550000
		S = 2000000

Corporate utility function LLC "ProMedia" was approximated by the dependence of the form (3) with sufficient accuracy, as shown in the next Figure



The Corporation faced a financial problem that is characterized by the following conventional values of financial outputs (4, 8, 15) with probabilities (0.3; 0.3; 0.4). The expected yield for the problems (2) was

9.6 um. ed.; the expected utility of (3) is 6.2; average expected benefits go beyond (4) -4.13. The amount by which the corporation must be insured in order to avoid negative consequences for this issue was 9.6 - 8.9 = 0.7 um. units. This calculation gave an opportunity to decide on the financial operations of insurance companies. It was a contract of insurance with the company LLC "Mary Shen" in the amount of 116 thousand rubles .. And since the maximum amount of insurance that was designed for the corporate utility function is S_{max} = 252 thousand. UAH. Because the firm has savings of 136 thousand UAH.

So the algorithm found and developed a corporate function impairment. Showing procedure for its application, which can significantly accelerate the adoption of enterprise solutions, and therefore make the process of managing large corporations more dynamic.

3.2. Multifactor model innovation management [107]

Since decisions about investment and innovative development adopted at the micro level of the economy, such as business entities seeking to maximize profits in certain resource constraints, it is appropriate to ascertain their individual propensity to invest in the innovative direction. At the same time, given the fact that the relevant individual decisions in specific macroeconomic environment and significantly dependent on him, using the method of aggregation we will have an idea about the features of innovation and investment at the national economy. Given the complexity of obtaining reliable results of such work in national scale, we will carry out research in the regional framework Dnipropetrovsk region.

This administrative units was chosen for the following reasons. First, here are concentrated the production of 11.9% of GDP and of total innovation expenditures Ukraine. Second, the region is one of the most attractive for foreign capital.

The study was a survey of 85 business entities engaged in the production of real goods and services. Investors who have expressed consent to participate in the study were asked to answer a questionnaire to determine the factors that motivate the implementation of innovation and investment, as well as finding out their views on the factors that hinder the desire to implement innovations. The survey was conducted by interview the owners and managers of companies located in the Dnipropetrovsk region.

Among the respondents in the survey participated 45 owners theorist 3, 30 managers and 10 people who hold other positions. Figure 3.3 shows a distribution of respondents by subjects of business and administrative activity by which a percentage of holders accounted for 50% of managers - 35% theorists - 2.7%, and others - 12.16%, respectively (Fig. 1).

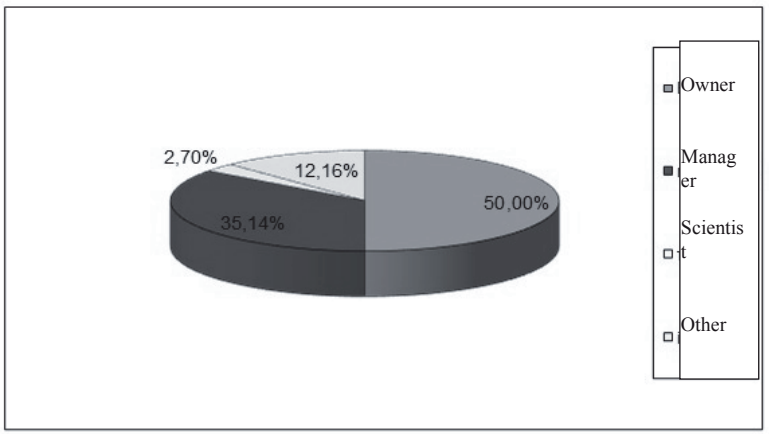


Fig. 1. Respondents by subjects of business and administrative activity

Given the sectoral structure of surveyed companies, 31.08% were industrial enterprises, 12.16%, agricultural enterprises, 36.49% - service industries, 20.27% - other sectors (Fig. 2).

Based on the competitive environment prevailing in markets where there are participants of the survey, 78% of them are representatives of monopolistic competition markets. A large number of companies, differentiation of products produced, the lack of high barriers to entry into the industry, inability to obtain economic gains in the long run - it features an environment where firms operate 5 industry, 45 companies of the service sector, 17 representatives of other areas. Among those companies that have been attributed to this market structure, are well-known to consumers as representatives of PE "Iceberg". OTP Bank, OJSC UK "Investtehnolohiyi", "Ukrainian Technological Systems" CE "Fantasia."

12% (10 companies) monopoly power market represent the most prominent of which are: OJSC "Dneproshina" metallurgical kombinat them. Dzerzhinsky "signature" Dniprokron "factory" Red Profyntern "NPO" Creator. " 10% - are representatives of agriculture that have some features of perfect competition market, if certain features, monopolistically competitive markets.

The survey was created a model of innovation and investment activity, which can be represented as determined multifactor model that describes the following

$$A = f(M, P), \quad (1)$$

where: A - Investment and innovative activity; M - factors of motivation of economic actors to implement innovations; P - obstacles to innovation and investment.

According to the model included in the factors, respondents were asked to answer the question about the main motive of their investment, and innovation. Motives for investment and innovation was mentioned in the questionnaire, they had to rank the degree of importance on a 10-point

scale. Each question had a serial number to simplify the construction of future economic and mathematical models.

All the figures presented in the international system of units. Mathematical data processing carried out according to the methods of variation statistics by processing data to spreadsheets using Excel. Thus the basic parameters of the samples were calculated by descriptive statistics followed multifactorial correlation analysis equations and linear and nonlinear regression. Also, the pair were calculated coefficients (r) and multiple (R) correlation. Numeric expression means not only a quantitative description of communication, but also points to a direct (positive) or backward (negative value) dependence between variables. The values of correlation coefficients from 1.0 to 0.8 point to a functional relationship between phenomena 0,8-0,5 - the close relationship between them, 0,5-0,3 - to moderate bond 0,3-0 - the weak link. Materiality coefficient of multiple correlation criterion determined by Fisher.

Initial processing of information and to examine the relationship between factors on the one hand, the impact on investment and the other on innovation, carried out using parametric methods (Pearson) and rank (Spearman) correlation analysis. The matrix of input data for further mathematical processing were left only those features that have found strong ($r > 0,7$), moderate ($0,7 > r > 0,3$) and statistically significant ($r < 0,05$) called ' links with the resulting lines.

Obviously, the most important parameter is the average score, which put respondents for each factor. But the average - is abstract, general characteristic features of the target population, it does not show the building together, which is very important for its knowledge. The average value does not represent how some important study features grouped around the middle, or they are concentrated near or significantly deviate from it.

In some cases, individual characteristics about values adjacent to the arithmetic mean and little of it is different. In such cases, the average well represents the totality. In others, on the contrary, some set of values are far from the average, and the average represents ill totality, that is a variation of the sample is large enough.

Table 1

The mean score obtained by factors of motivation for investment and innovation

The motives	The average value	
	Investments	Innovation
Profit growth	8,51	8,32
Increasing the size of the company	6,42	5,73
Achieving competitive advantage	6,93	7,77
The desire for self	5,23	5,27
Getting excess profits	6	6,66
Achieving monopoly	5	4,78
Keeping competitive position	7	6,78
The possibility of opening the creative potential	5,46	5,62

This mean score was calculated for different groups of respondents: owners, managers, theorists and others (Table. 1). To verify the accuracy of the data used Student's criterion, to determine the likelihood that the two samples taken from the general population, have the same average.

It was decided that if the probability is low (<0.55), one can assume that the sample averages are significantly different and, therefore, cannot be combined into one group to build a mathematical model. Therefore, there is a need to build two different models. Implementation of Student's distribution law of averages used by the function TTEST spreadsheets.

To determine the different variances of two samples used measure flowering of average - variance F-test (Fisher). It characterizes the unilateral probability that the variance arguments "array 1" and "array 2" differ slightly.

It was decided that if the probability distribution of the law Fischer is small (<0.55), this means that the dispersion of the sample differ significantly, and consequently, the simulation can not combine data from two samples. For this test a function FTEST spreadsheet Excel.

Based on the above, for questions relating to incentives to investment and innovation, we calculated the probability that the medium and dispersion of the samples belong to one of the population. Calculating the probability for each pair of questions presented in Table 3.7, where the top number (P_{Mx}), means the likelihood of coincidence middle and lower () - dispersions. As the table shows, these probabilities are small, therefore the factors that motivate entrepreneurs to make investments and innovations can be considered as not coincide.

Table 2

The coefficients for the factors that motivate to investment and innovation

Questions on investments		The question of innovation	
Room in the questionnaire	Phrase ratio averages (P_{Mx})	Room in the questionnaire	The coefficient of variance P_{Dx}
4.1	0,263242	5.1	0,665444
4.2	0,010124	5.2	0,500202
4.3	0,008605	5.3	0,15539
4.4	0,424453	5.4	0,339678
4.5	0,025774	5.5	0,877243
4.6	0,25238	5.6	0,476122
4.7	0,22519	5.7	0,424025
4.8	0,265943	5.8	0,961803

Based on statistical information processing array can make a number of theoretical generalizations to be statistically significant. This analysis is possible for each of the factors examined in the survey.

Thus, if we consider firms focus on investment and innovation due to revenue growth, we, firstly, to state the decisive influence of this factor to the possibility of investment or innovation, and, secondly, some differences in the statistical results. Although the main purpose of business is profit, yet this factor with intent to investment slightly more influence on the motivation of the entrepreneur than in solving them invest innovative character. According to research investments received 8.51 points, and innovation - 8.32 and this confirms the foregoing.

Orientation entrepreneur for excess profits, is certainly one of the main reasons of its activities. This motive in terms of specific social relations transformed into economic interest. The latter manifests itself in the form of market supply of goods or services and interacts with demand, which is on the side of the consumer. In terms of market saturation in goods and services, demand is increasingly focused on more complex products. In this regard, the importance of STP as a major factor in the creation of new products, and the manufacturer who masters this factor is able to obtain higher profits by establishing a temporary monopoly on their use.

If successful innovations and distribution costs of the development of overlapping avalanche build-up effect. This effect is shared between the entrepreneur-innovator and its competitors, which replicate innovation in order to maintain its competitiveness. And the more opportunities for the innovator maintenance of excess profits, the greater the incentives for their development and implementation. Here we see that the motivation given the profit on innovation much higher than for investment: investments - 6, innovation - 6.66.

Real economic situation in most commodity markets and the Ukraine including the Dnipropetrovsk region indicates the presence of objective factors that actually reduce the effectiveness of the competitive environment in the innovation field and do not stimulate a dynamic innovation. As evidence of this we have evidence that investment - 6.93, and innovation - 7.77 points.

The research experience of the world of business in countries with developed market economies have shown that firms seek not so much to create an innovative product to get additional income, and most want to keep competitive position. It is often in conflict with the interests of STP, as the latter leads to mass obsolescence of the productive apparatus. Big companies are buying the invention to prevent the competition of new products with old standardized, so that entrepreneurs, occupying a strong position, a new sabotage when such treatment meets their private interests. For example, in the US, a large number of patent applications are made with exceptional production to prevent innovation by competitors. In the area of proliferation of monopolistic competition among firms surveyed by us is the maintenance factor was dominant competitive position. As for the structure of monopoly power, this factor does not play a weighty role. Respondents are stamped -7 points for investment and innovation - 6,78 because they believe that only additional financial resources, not innovation will help them maintain a competitive advantage.

Increasing the size of the company is an important motivation for investment as a major production achieves significant advantages in cost of production (works economies of scale), the company receives a relatively high competitiveness and therefore stability. Therefore, investors will try to invest in a company financial resources. Innovation, by contrast, to minimize and make optimum size of the firm and achieve competitiveness here is due out with a unique product and a certain market share gains.

Since this process is marked by instability, regardless of the situation, then finds fewer supporters among businesses. Therefore, we have the following data investments - 6.42, innovation - 5.73 points.

Achieving monopoly reduces incentives to innovate through excess profits, business structure that can receive and without the implementation of innovations. Therefore, firms often resort to non-radical innovations that do not require complete replacement technology in the industry. For the same reasons the company with monopoly power can buy up patents that are associated with the ability to implement radical innovations, and use them as a barrier to entry into the industry competitors. But as stated above market monopolistic competition does not allow businesses to achieve a monopoly position and they do not seek it. The study showed that experts estimate the incentives for investment in order to achieve monopoly position in the field 5, and by means of innovation - 4.78 points.

The following two grounds relating to the subjective psychological factors along with economic factors influencing the adoption decision on the subject of business activity in general, and therefore innovation and investment. The desire to take risks, initiative, creativity, self-realization and self-identity - these are the features that define the individual entrepreneur and simultaneously released a mass of other members of the economically active population. According to the survey results, entrepreneurs took place fairly significant subjective and psychological factors that motivate them to investment and innovation.

The possibility of opening the creative potential for investments - 5.46 and innovations - 5.62 points. The desire for self-assertion on investments - 5.23, innovation - 5.27.

So average scores subjective impact of psychological factors of motivation to innovate exceed the corresponding figures for investment decisions. This indicates a real possibility and the desire of entrepreneurs to

show their potential is more volatile and therefore risky, which is the innovation sphere.

Seeing and analyzing the factors that motivate firms to invest and innovate, we should consider the main obstacle to the implementation of innovation and investment.

As for the lack of personal motivation as a factor that limits investment and innovation, our respondents have not taken it a meaningful place among obstacles. Entrepreneurs try to engage innovation and investment activities, but they begin to act other factors and therefore obstacles linked since their influence. Expert assessments: investments - 3,3 and Innovation - 3.7.

Table 3

The mean score obtained by factors barriers to investment and innovation

The main obstacles	Average	
	Investments	Innovation
Non-availability of the necessary credit	5,47	5,53
High interest rates on credit	7,9	7,2
The low expected return	5,57	5,6
Barriers to investment in other areas	4,35	3,9
Risk	7,03	7,4
Payback	6,78	6,9
Not predictability of future	7,6	7,1
The lack of personal motivation	3,3	3,7

Risk always accompanies business and therefore investors desire to invest is in inverse proportion to the degree of risk, which is expected. In this innovation obstacle influences as well as investment, but the risk is always innovative investment is higher. Making an investment we can not return your money, and making innovation a risk of losing the invested

money in a much greater extent given the nature of innovation. Also, the investments innovative emerging risks of loss of capital, aiming to create a product that does not meet the needs of the market and the opportunity cost of time lost when creating a product. Therefore investments - 7.03 and Innovation - 7.4 points.

Table 4

The coefficients for the factors that hamper innovation and investment activities

Questions on investments		The question of innovation	
Room in the questionnaire	Phrase ratio averages (P_{Mx})	Room in the questionnaire	The coefficient of variance P_{Dx}
6.1	0,377833	7.1	0,749896
6.2	0,003545	7.2	0,128493
6.3	0,456997	7.3	0,894003
6.4	0,003111	7.4	0,664232
6.5	0,13374	7.5	0,193886
6.6	0,144405	7.6	0,745669
6.7	0,050966	7.7	0,113833
6.8	0,017204	7.8	0,188827

High interest rates on loans are considered as a significant barrier to investment and innovation. When we make an investment or innovation, it certainly aims to get profit. If investment and innovation at the expense of credit resources, the need to return the loan and interest on it reduces the expected profitability. And even the results of the study confirmed this pattern. The higher the interest rate, the lower the investment. Investments - 7.9 innovations - 7.2 points lower innovation rate in only because innovations are starting to implement once have been found investment resources.

Not predictable future - this obstacle to a greater degree characteristic of developing countries. Financial expenses like investment and innovation oriented place for a calculated period, but the situation in the country is changing even faster than analysts expected. Therefore, experts estimate that obstacle to investment in 7.6, and innovation in 7,1 points, this factor is directly related next.

The next obstacle - low expected return - discourages entrepreneurs in innovation and implementation of investment projects. This factor is directly related to profitability. In the face of uncertainty and high risk both economic and political returns on innovative projects revealed little predictable factor. Therefore, under these conditions, entrepreneurs avoid its implementation. It should be noted that at this time in Ukraine has developed legal and regulatory framework for the implementation and state support of these activities, it is still not working properly. A businessman introduce tax rebates is almost impossible. The mean score of research investment - 5.57 points, and Innovation - 5.6.

Non-availability of the necessary credit resources as a barrier, a survey was not quite significant, despite the existence in Ukraine of high interest rates. Today the small impact of this factor businessmen explained the actions aimed at finding alternative solutions to the problem of attracting credit resources. In an additional survey it was found that most small and medium industrial enterprises and construction industry firms working mainly on prepaid, which acts as a resource for credit that does not have to pay interest. Investments - 5.47, innovation - 5.53.

Payback hinders innovation and investment, holding back as return on investment. Return on investments than year term, and innovation, it covers the long term. And because the amount of time that must pass before receiving a positive result affects the decision on the implementation

of the relevant investments. Investments are estimated at 6.78 and Innovation - 6.9 points.

Barriers to investment capital in other areas were respondents identifying as significant. Monopolistic competition make it easy to enter and exit the market. If the entrepreneur cannot make money on innovation, it is possible to invest capital investment in more profitable sphere and consistently earn additional income. Investments - 4.35, innovation - 3.9.

A similar analysis was conducted on risk factors and innovative investment activities (see. Table. 5 and 6).

The most significant influence among the types of risks interviewed recognized the risk of total loss of capital. It is fully natural as investment and innovation require significant financial investments and investors tend to consider almost all risks. But this is impossible, and the reluctance of the loss of all invested funds hinder entrepreneurs. Investments - 7.9 innovations - 7.8.

Table 5

The mean score obtained on the risk factors to investment and innovation

Risk	Average	
	Investment	Innovation
Risk of total loss of capital	7,9	7,8
The risk of non repayment	6,3	6
The risk of not receiving the expected profit	7	7,3
The risk of impairment of investments	5,8	5,9
Political instability	7,6	7,3
Macroeconomic instability	6,8	6,8

Table 6

The correlation coefficients for risk factors

Questions on investments		The question of innovation	
Phrase ratio averages (P_{Mx})	Room in the questionnaire	Phrase ratio averages (P_{Mx})	Room in the questionnaire
8.1	0,331457	9.1	0,775949
8.2	0,05122	9.2	0,990942
8.3	0,049406	9.3	0,024776
8.4	0,103773	9.4	0,923861
8.5	0,265626	9.5	0,92473
8.6	0,125452	9.6	0,439853

The risk of not receiving the expected profit entrepreneur requires a clear and deliberate decision on the introduction of investment and innovation. Additionally, he will have to make calculations of the project and expected profits and also note the minimum rate of return for such activities therein. Investments are already implemented in disseminating get 7 points, and innovation still remain higher risk at 7.3. This is obvious because innovative product ahead of time can not find the consumer.

The risk of non repayment of the loan - above mention risks businessman leading to a complete loss of capital and profit is not possible if one of them will come - then what entrepreneur will pay for the loan and for its percent. Given the opportunity in the domestic environment of doing business without attracting credit resources, this risk is not acquired during the survey determining influence. Investments - 6.3 innovations - 6.

The risk of impairment of investments - as innovation and investment activities related to large investment payback period, it can occur in unexpected inflation already took place which could lead to a complete loss of capital. Investments - 5.8 innovations - 5.9.

Political instability leads to the fact that there is no desire to engage in such investment and innovation activities in a country where there are no clear legal rules and order. The investor must be confident in the future, instability leads only to an increase in above-mentioned risks. Ukrainian businessmen have provided a sufficiently high value of this factor, as the political and economic instability in the country reached a critical value on investments - 7,6 and Innovation - 7.3 points.

Macroeconomic instability appear to instability in the middle of the economic system and show up in the following indicators: GDP, inflation, unemployment and so on. From unexpected inflation the investor may not make a profit, do not find additional funds for completion of the innovative project. Unemployment will stimulate innovative development, as cheap labor in sufficient numbers to replace the cost of new equipment. As we see the scores obtained on investments - 6.5, and innovation - 6.8 suggest a significant impact of this indicator.

The second phase of construction of economic and mathematical models to determine the motives and factors affecting innovation and investment activity was the elucidation of innovation. Based on the statistics we were able to get activity coefficient for Ukraine as a whole.

Given the fact that innovation began to register in statistical accounting in 2003, in the denominator of the formula (innovation activity) we will use the data for 2003-2005. In 2006, the total number of inventions, utility models and industrial designs was equal to 398 and the number of protection received in 2003 was 2716. Thus in 2006 the rate of innovation activity for Dnipropetrovsk region amounted = 0.1829.

By carrying out an additional survey companies were set individual activity coefficients for each of them, using this formula. And those companies that were not implemented innovations coefficient that is equal to 0. (Annex D)

We matrix was created based activity coefficient for each company and calculated correlation coefficients for each questionnaire. As the table shows, the factors which have values less than 0.25 not taken into account because it meant that the effect of this effect is negligible. This marked our boule factors and motives that in our previous opinion carried great influence on the value of the coefficient.

The next step was to create new matrices which included five correlation coefficients with the largest values. To the resulting matrix was calculated linear regression and compared the quality of approximation. Further factors added to the obtained nonlinear effect form $1/x$, x^2, Lnx. As a result, received initial table appearance, where the corresponding number was encrypted factor which in the opinion of respondents has the greatest impact on innovation and investment activity, a fragment of these calculations are presented in Table. 7.

Table 7

The activity coefficient of nonlinear effects

The activity coefficient for enterprises that carried out innovation	Code factor			
	1/x	x^2	x'^2	ln(*x*)
0,0003682	1	1	1	0
0,0014728	1	1	1	0
0,0007364	8	64	2,828427	2,079442
0,0011046	5	25	2,236068	1,609438
0,0003682	9	81	3	2,197225
0,0007364	1	1	1	0
0,0003682	8	64	2,828427	2,079442
0,0007364	9	81	3	2,197225
0,0007364	10	100	3,162278	2,302585
0,0011046	1	1	1	0
0,0000000	5	25	2,236068	1,609438
0,0018409	6	36	2,44949	1,791759
0,0003682	6	36	2,44949	1,791759
0,0014728	7	49	2,645751	1,94591
0,0003682	9	81	3	2,197225

hen regression was calculated for each of the factors that were determining the most influence on innovation and investment activity. Further approximation of comparable quality criteria for all options and R2 is selected next by this criterion, which was the largest Multiple R2 = 0,764554, which indicates a very high quality of approximation.

Then there were obtained the following formula coefficient of innovation and investment activity for the surveyed enterprises according to the numbers of questions that had the greatest correlation coefficient with him:

$$A=0{,}003803-0{,}000041\cdot R_i-0{,}00154/R_i-0{,}000074\cdot R_{in}+0{,}000836/R_{in}+$$
$$+0{,}000131\cdot R_{si}+0{,}000131/R_{si}-0{,}00019\cdot R_{pin}-0{,}00183/R_{pin}-0{,}00018\cdot R_{\sin}-$$
$$0{,}00146/R_{\sin}\,.\,, \qquad (2)$$

where R_i - investment risk; R_{in} - investment risk; R_{si} - the risk of devaluation of deposits for investment; R_{pin} - innovation risk; $R_{\sin}$ - the risk of depreciation contributions to innovation;

When analyzing the formulas (2), we see that a minus sign before the value of the investment risk indicates a decrease in activity in its growth and in direct and inverse dependence. Also negatively affecting positive innovation risk, no profit on innovation and risk of depreciation contributions to innovation when they rise. But innovative risk in inverse dependence confirms the assertion that the reduction in its rate of innovation and investment activity will increase. Positively to increased activity will affect the risk of depreciation of deposits for investment.

In order to find the best value R, which prompted businesses to invest in innovation was using "Search solution" Excel spreadsheets found most possible value coefficient activity for polling companies, which, as well as important factors in this study in which we get the biggest factor.

This was delivered following optimal problem:

$$\left.\begin{array}{l} A = f(R_i, R_{in}, R_{si}, R_{pin}, R_{\sin}) \to \max \\ 10 \geq R_i, R_{in}, R_{si}, R_{pin}, R_{\sin} \geq 1 \\ R_i, R_{in}, R_{si}, R_{pin}, R_{\sin} - \text{integers.} \end{array}\right\} \quad (3)$$

Table 8

The result of optimization

Activity	0,002118
Investment risk	6
Risk innovation	1
The risk of devaluation of deposits for investment	1
The risk of not making a profit for Innovation	3
the risk of depreciation contributions to innovation	3

Evaluating the result can be analyzed as follows. Given the fact that the respondents, respondents were asked to put conditional points to each question from 1 to 10, the maximum value of the activity coefficient must meet the quantitative characteristics of the risks presented in Table 3.13. Results of the study indicate that the risk of investing in investment should be above average and entrepreneurs are beginning to innovate; risk on innovation should be virtually absent, but to achieve this very difficult and indicates that currently the respondents are not willing to engage in innovation. This process is not in their consciousness that innovation can give them more profits.

The risk of devaluation of deposits for investments to be insignificant and then innovative projects find investors who will be sure that the funds investing considerable period (development of innovative product needs more time) do not lose their value and their innovative enough to complete the project.

Also, small value should be no risk profit on innovation, because only the confidence to create an innovative product stimulates entrepreneurs to implement this activity. Also, the risk of depreciation of deposits on innovation to be below average as relevant today is the question of sufficiency of funds for all stages of the innovation process.

It can be concluded that the introduction of innovative investment risk, which accompanies the investment should be high and so investors refrain from investing capital in something that percentage. A risk innovation contrary shall be reduced almost to the minimum level. The risk of devaluation of deposits for investment should also be almost absent, so that investors have not lost their investments during the implementation of the project and for innovation it can be a little higher because the innovative projects implemented for a longer period. There should be a very low risk of not making a profit for innovation - as will be the motivation for the introduction of innovative investments.

Results of the study provide greater opportunity for analysis of innovation and investment climate in our country, consideration of the reasons and risks that guide entrepreneurs in the implementation of investment and innovation projects. Also, it is, in our opinion, will more reliably manage these processes at regional and national levels through appropriate economic policies.

3.3. Formation model calculation of average wages by regression analysis of [108]

To meet the goals salary management strategy: development of a sense of community workers, educating them in a spirit of partnership, the rational combination of private and public interests, a change of motivation mechanism. Psychologically, and economically wages should target employee on a clear understanding of the relationship between their demands to him the company, the company and its contribution to the final results, and as a result - the size of salary. Unfortunately, in the modern organization of wages prevailing economic orientation. Dominant economic categories are: self-supporting income, payroll, internal prices (calculated, planning and accounting, etc.) And others that are not analyzed in terms of building motivation, motivation for activity of each employee.

In modern conditions are allocated following payment system pratsi-payment in the labor rating. It takes into consideration the following components:

- Education level;
- Experience;
- The ability of the employee to implement the specific business knowledge and experience.

Educational level characterized by the coefficient K, and increases in proportion to the growth of the knowledge worker, his ownership interest in rationalization and invention.

Experience is characterized by a coefficient Kc, the numerical value is chosen so as to reduce turnover in the first year of operation and to ensure a stable annual growth of wages by a certain percentage.

The last factor, implemented through Ks ratio indicates the place of the employee in the structure of the enterprise and responsible discharge of the employee. It is determined, according to the developers of the system,

not the guides and staff that "knows better who is who." Employment potential rating takes into account the ability of the employee, and other parameters adjust its contribution according to the employee's business results. The system is designed with the business practices of Japanese and bears the imprint features of labor relations in Japan.

In the modern system of economic relations in Ukraine this evaluation system can find a good use. Already used daily payroll system focused not on the ultimate economic efficiency of enterprises, and the individual and his potential.

In an earlier article, the authors cited factors set wages that directly affect its size [8,9]. Proposed relationship between these factors through weights that would determined by expert assessments.

Was algorithm, which is a system of peer review, to determine:

 effect of three factors (education, experience, physiological characteristics) deduction of wages

 degree career logistics;

 set of qualities necessary for success in the field of transport logistics [9].

The level of consistency of expert opinion determined by the coefficient of concordance Coefficient (W).

Full consistency of expert opinion calculation was performed using the software Microsoft Excel using functions to calculate ranks of experts answers. The calculation results concordance coefficient summarized in Table. 1.

Thus, the study makes it impossible to use formula (1) in [9], which was planned to substitute the mean values weighting coefficients according to expert estimates, way that the formula looked like

$$Z = (\Phi 1 * W 1 + \Phi 2 * W 2 + \Phi 2 * W 2) Z\text{tariff} ,$$

where Φ_i - factor, W_i - weight of expert opinion.

Table 1.

The coefficient of concordance Kendall.

Expert evaluation	The coefficient
three factors influence salary deduction	9,31 %
degree career Logistics	79,26%
physiological characteristics	94,54%

Research regarding the influence factor "experience" to perform the most complex logistics tasks previously conducted by the authors and fully described in [9]. Table 2 shows the results of such research. Mean values of Experts on this parameter can be considered as the final coefficients that are numerically show the impact factor of experience to the amount of wages. The results are shown in Table 2.

Table 2

Value of coefficient "Experience"

years of service	Value, %
By year	14,10714
Second year	48,21429
Third year	49,28571
Fourth year	50,35714
Fifth year	73,39286
Sixth year	93,57143
Seventh year	96,42857
Eighth year	96,78571
By the tenth year	97,07143

Thus, the resulting regression analysis was obtained formula for the mean wage

$$\overline{Payroll} = 1190,84 + 25,046 * C^{O} + 2122,506 * PFH + \\ + 1,0298 * O * \left[C + 35,612 * PFH \left(C - 132,64 \right) \right]'$$

where C - practical experience; O - coefficient of education; PFH - factor physiological characteristics. [9].

Calculation of a regression model for the standard deviation values salary looks

$$\sigma(Payroll) = 142,766 - 0,89 * C^{O} + 73,846 * PFH + \\ + 1,792 * O * \left[C + 2,033 * PFH(C - 188,56)\right],$$

where $\sigma(Payroll)$ - SD wages

According to the research the following conclusions:

1. With respect to physiological characteristics of individual workers all logistics (decorative block) are divided into 64 groups, allowing use these tests in regression models.

2. Calculated coefficients on experience in time scale from 0 to 10 years related coefficients of Education and physiological characteristics.

3. The calculated regression models allow to conduct research towards the development of methods (algorithm) Payroll logistics.

3.4. Determination of the risk in calculating the credit limit trade enterprises [115]

One of the popular methods of calculation of trade credit (limit) is the method where the limit is calculated as a percentage of equity by the following formula

$$L = K \cdot VC, \quad (1)$$

where L - the amount limit; K - the adjustment coefficient; VC - equity enterprise lending.

Different sources have different definitions of the size factor. Sometimes it is said that the limit should make up 10-20% [116], and in some countries it reaches 30-40% [117].

The advantage of this method is the simplicity of calculation. But in practical application there is a complication that no clear justification value correction coefficient K values range from 10% to 40% does not specify a particular value when calculating the limit for a particular case. Although obvious is the fact that all the authors understand by this factor as risk.

The propensity to risk the person who decides (hereinafter ESD) is defined utility function [118]. To this end, such a person is offered a game where you can win a large sum of S_2 and a small amount of S_1. Determined utility (U) of the winnings by assigning arbitrary values of utility gain for the worst and the best way, and the worst out of play (S_1) is associated with a smaller number of $U(S_1)$, and greater S_2 - more than the number of $U(S_2)$. The player is offered a choice: get some guaranteed cash sum of m, located between the best and worst values S_2 and S_1, or participate in a game that is obtained from the probability p largest amount of money S_2 and with probability (1 - p) - the smallest amount S_1. This chance to change (raise or lower) until the ESD will become indifferent with regard to the choice between a guaranteed amount and game. Let the stated value equal probability p_0. Then usefulness guaranteed amount m is defined as the mean value (expectation) utility lowest and highest amounts that

$$U(m) = p_0U(S_2) + (1\text{-}p_0)U(S_1) \qquad (2)$$

In general, the graph of the utility can be of three types (Fig. 1):

• for ESD are not at risk - strictly concave function, in which each arc curve lies above its chord AB - curve AEB;

• for ESD, indifferent to the risk - a straight line AB;

• for ESD at risk - strictly convex function, in which each arc of the curve is below its chord AB - curve ADB;

These provisions can be concluded that the higher of AB is the point of indifference $E[m, U(m)]$ curve utility function of ESD, the person is less prone to risk, or the lower of AB is the point of indifference $D[m, U(m)]$ the more risk-averse individual utility function is measured. S_o, if a person is quite cautious, the proposed game it will always choose the probability of winning the largest amount of close to 100%, it will then order that the calculation of the usefulness of the guaranteed amount m will value close to $U(S_2)$ - a point C, - that those responsible sum S_2, and if absolutely risky - it will always choose the probability of winning the largest amount of close to 0%. This result is that the calculation of the guaranteed amount m usefulness will value close to $U(S_1)$, ie, the amount of which correspond to S_1. This point D.

Then, for quite cautious individual utility function curve pass through the point of DIA, and for quite risky person - in terms ADB. The length of the line CD will determine the maximum possible range between absolute risk and absolute caution. Line length CD can be found by rule calculation of distances between two points $C[m, U(S_2)]$ and $D[m, U(S_1)]$, which is parallel to the y-axis [119, 120], the formula

$$\rho(C,D) = U(S_2) - U(S_1). \qquad (3)$$

Distance can be the absolute maximum extent possible range 'riskiness and there riskiness "for specific ESD. After finding the third point on the graph utility function - $E[m, U(m)]$ - which also lies on the line CD, you can draw the following conclusion. The closer this point to $t. C$, the ESD is less risky, and therefore the greater the amount of equity it can afford to pay in trade credit. Then, with the adjustment coefficient $K(1)$ can be defined as the ratio of ED to the length CD

$$K = \frac{\rho(E,D)}{\rho(C,D)}. \quad (4)$$

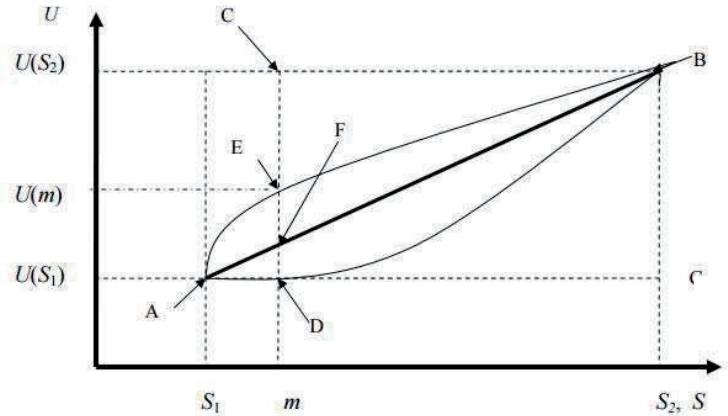


Fig. 1. Definition of the utility function of the person who makes decisions (ESD)

Factor will always vary [0.1] or [0%, 100%], because $\rho(E,D) \le \rho(C,D)$. What it is - the less risky is the ESD and the greater the amount of capital you can afford to give it in trade credit.

Distance $\rho(E,D)$ similarly (3) is as

$$\rho(E,D) = U(m) - U(S_1). \quad (5)$$

Substituting (4) - (5) (3) obtain numerical values of risk that was found by measuring the utility function specific ESD

$$K = \frac{U(m) - U(S_1)}{U(S_2) - U(S_1)}. \quad (6)$$

Substituting (2) to (6)

$$K = \frac{p_0 U(S_2) + (1-p_0)U(S_1) - U(S_1)}{U(S_2) - U(S_1)} = \frac{p_0 U(S_2) + U(S_1) - p_0 U(S_1) - U(S_1)}{U(S_2) - U(S_1)} =$$

$$= \frac{p_0 U(S_2) - p_0 U(S_1)}{U(S_2) - U(S_1)} = \frac{p_0[U(S_2) - U(S_1)]}{U(S_2) - U(S_1)} = p_0$$

Thus, the ratio of risks is likely to win the largest amount, at which point there comes indifference - or take the guaranteed amount m, or take part in the game and pay that amount.

In addition to the two characteristic parameter values P0 - absolutely zero risk for individuals and one for absolutely no risk - interest is the probability value for a person interested in the risk line utility function is represented by a straight AB. This probability is characterized by point *F*, which lies at the intersection of straight *AB* and *CD*.

The magnitude of value which corresponds to *t*. *F* consists of $U(S_1)$ and *DF*. You can find the latest rule similarities *ABG* and *AFD*, both of which have three equal angles [5] $\frac{DF}{BG} = \frac{AD}{AG}$ from

$$DF = \frac{AD}{AG} BG = \frac{m - S_1}{S_2 - S_1}[U(S_2) - U(S_1)].$$

Then ordinate t. *F* is $DF + U(S_1)$. By marking probability p_0 to a person indifferent to risk, as *RB*, substitute ordinate value in (2)

$$\frac{m - S_1}{S_2 - S_1}[U(S_2) - U(S_1)] + U(S_1) = p_B U(S_2) + (1\text{-}p_B)U(S_1).$$

After transformations, we obtain a probability value for a person indifferent to risk

$$p_B = \frac{m - S_1}{S_2 - S_1}. \qquad (8)$$

Now p_0 parameter can be used as adjusting factor in (1) the calculation of commercial credit limit. We show this as an example.

There have been measuring the utility function for company director and his deputy.

Limit the amount of games were labeled as follows

$S_1 = 10\,000$ UAH, $S_2 = 100\,000$ UAH.

Guaranteed prize amount was determined $m = 20\,000$ UAH.

The corresponding values for marginal utility amounts were chosen as

$U(S_1) = 1$, $U(S_2) = 10$.

After the game turned out that the indifference point was reached when the probability of winning a larger amount, for the head p_0 = 0.85, and for the Deputy p_0 = 0.63. For (2) was calculated utility value that fits the points of indifference:

For Director $U(m)$ = 10*0,75 + (1-0,85)*1 = 8,65.

For Deputy $U(m)$ = 10*0,63 + (1-0,63)*1 = 6,67.

By (6) was calculated ratios of risks to both leaders:

For Director $$K = \frac{9,65-1}{10-1} = 0,85,$$

For Deputy $$K = \frac{6,67-1}{10-1} = 0,63.$$

As can be seen from the calculations, the values of these coefficients equal to p_0. The magnitude of p_B found the terms of the game

$$p_B = \frac{20000-10000}{100000-10000} = 0,11.$$

Consequently, studies show that the Director encouraged to provide trade credit according to (1) to 85% of own funds, and his deputy - no more than 63%.

As a result of research the following results:

1. For the first curve of the utility function defined as risk of ESD.

2. It is shown that this ratio is useful as a corrective in determining commercial credit limits for agribusinesses.

3. The influence factor designed to limit calculation results.

3.5. Personnel management of the bank on the basis of a questionnaire[121]

In terms of the threat of unemployment, the closure of banks, most banks are willing workers employed anywhere, just to get a job. Often, they get paid less than what obtained before.

Therefore, banks have surplus staff. Sometimes, to save Fund salaries, bankers are taking the technical position of people with uncertain status and experience, hoping that low responsibility such workers do not worsen the work of the whole team. Obviously, on average, these workers will only worsen the situation.

Oversupply allows banks to get rid of employees who do not show a sufficient level, which would help lift the banking activity.

Obviously, the need to develop methods for evaluating employment and bank employees based on sociological research performance of employees, develop employee questionnaire and methodology of analysis to reorganize and increase the impact of employees. Cascade received

Having reviewed the current models such efficiency, we can see that all researchers aim at model of motivation. That is, the manager must create a system of rewards that would give confidence to meet requirements through activities aimed at achieving the objectives of the organization. Everyone is inherent definite motivational structure. Manager should always take into account the needs of a variety of personnel, their important interests. The problem is that the motives vary depending on the individual worker, the tasks of the organization and time. Therefore, even with a deep study of the motivational structure of human systems motives of action are possible at all unexpected changes in human behavior and unexpected reaction to his motivating influence. Thus, we can state the fact

that the process of motivation is very complex, multifaceted and ambiguous.

The process of motivation is complex and ambiguous.

A renowned scholar in Leadership J. Mack. Gregor, highlighting two fundamental principles influence the behavior of people who formulated the "theory X" and "Y theory" [129].

"Theory X» - a type of authoritarian control, leading to the direct regulation and strict control. According to this theory, people do not like to work, so they should coerce, control, direct, threaten punishment to force to work to achieve the goals of the company. The average person agrees to it ran, it avoids responsibility.

"Theory Y» based on democratic principles of delegation of authority, enrichment of content, improving relationships, recognizing that the motivation of men that determines a complex set of psychological needs and expectations. Democratic leader believes that "external" control head and not the only means of influence, the employee can exercise self-control, seeks to justice, prone to self and ingenuity.

The first column include the most ignorant and negligent employees. Questionable need for their internal motivation. You can also say that the movement of the left column to the right is a process of evolution of the staff. Statistics confirm that only one - two per cent of people committed to the top of the pyramid of Maslow [126]. Such people should be given the opportunity to express themselves, ensuring the stability of the base of the pyramid. Internal promotion pays off only if the social security employee. Otherwise, the enthusiasm of praise quickly forgotten.

It is obvious that in a surplus of bank employees is primarily based on the "Theory X", despite its anti-social orientation.

The easiest way to determine the level of employees are questioning. Questionnaire must be made in terms of employers and reflect three main

areas: personal experience, loyalty to the employer and the desire to take a higher position.

The last line is accompanied by definition wish to improve their skills.

Each answers to the questionnaire X_i should put their weight where W_i,- the question number ($1 \leq$ and $\leq N$), N - number of questions.

Then each bank employee answering the questionnaire will receive a rating R_s, which is defined as the sum of estimates of answers

$$R_s = \sum_{i=1}^{N} W_{is}, \tag{1}$$

where s - Bank employee number ($1 \leq s \leq K$), K - number of employees.

Having a complete sample of responses from each employee is the average rating

$$M_R = \frac{\sum_{s=1}^{K} R_s}{K}, \tag{2}$$

Standard

$$\sigma_R = \sqrt{\sum_{s=1}^{K} R_s^2 - M_R^2}, \tag{3}$$

and confidence interval for the average rating

$$\varepsilon_R = \sigma_R \Phi^{-1}(\beta), \tag{4}$$

where β – confidential probability $\Phi^{-1}(\beta)$ – reverse Laplace integral value.

•Further ranking bank employees conducted by rule - if the ranking officer within [130]

- $R_s < M_R - \varepsilon_R$, – employee transferred to a lower position or fired;
- $M_R - \varepsilon_R \le R_s \le M_R + \varepsilon_R$, – employee remains in the same position;
- $R_s > M_R + \varepsilon_R$, - Employees are offered a higher position.

Now, with the average of the rating of the bank employees can evaluate the candidates on the same rule. Only instead transfer to less paid position, the applicant denied. In two other cases, the applicant shall, or even offer a position higher than he expected.

The method was tested on JSC "Bank" Concord. " For the study questionnaire was developed 15 questions, which offered workers to fill contains (Table. 1).

The table also shows the grade answers. Value of rating points determined by the bank's management. Employees of the cost of each response not reported.

Table 1

The cost of employee responses to a questionnaire

Questions	Possible answers and points for them	
1. Your gender		
2. Experience, full years (B_7)		
Total	Multiply on 3	
In our bank	Multiply on 5	
3. Are you satisfied with your work?	**5** Yes	**1** No
4. Your level of education corresponds to your work?	**4** Yes	**1** No

Questions	Possible answers and points for them	
5. Does your knowledge enough to perform rail work?	**5** Yes	**1** No
6. Do you need to increase the level of qualifications?	**4** Yes	**6** No
7. Do you satisfy relationships in the team?	**3** Yes	**1** No
8. Do you have the opportunity to make a career in our company?	**3** Yes	**1** No
9. Do you meet the conditions of work in our company?	**4** Yes	**1** No
10. Are you satisfied with the salary you get?	**6** Yes	**1** No
11. Are you informed of what you get wages?	**2** Yes	**1** No
12. Your position (underline)		
Auditor, Accountant, Cashier, the operators, Economist, Director, Credit Expert, Crisis Manager, Manager of Customer Service, Technical Worker, Financial Analyst, Financial Manager		
13. How would you change the type of work for	Yes	No
01 Head		
02 Financial Analyst	24	0
03 Finance Manager	24	0
04 Economist	18	0
05 Auditor	18	0
06 Accountant	12	0
07 Crisis Manager	12	0
08 Credit Expert	12	0
09 Manager of Customer Service	6	0
10, The operators cashier	6	0
11 Technical workers	6	0

Questions	Possible answers and points for them	
14. You agree to perform additional duties without salary increases?	**6** Yes	**1** No
15. If you were offered a job in a similar institution of higher wages, would you change jobs?	**1** Yes	**7** No

The study interviewed 30 people, 8 of them - men and 22 - women.

As seen from the results, 88% of employees are satisfied with their work and selected profession. However, 12% or satisfied with their work at all or in the analyzed company.

The survey results show that 33% of employees believe that education is not the level of their work.

According to the poll, 75% of employees believe that training corresponds to their work, 25% - not sure. But at the same 5% of workers count that knowledge of them is not enough and 33% would like to improve their skills.

The majority of employees - 72% - estimate the climate prevailing in the team as favorable, while 28% noted the existence of conflicts.

According to the data, more than half of the employees have the opportunity to promotion.

The majority of employees satisfied with conditions in the enterprise. Analysis of financial motivation showed that 60% of workers financially satisfied.

Thus, 15% of employees do not know what the rate they receive a salary, but only 18% of workers have not agreed to perform additional duties without increasing wages. This means that many employees appreciate and love their work.

Calculations based on the results of questioning workers conducted using MS Excel.

The following values were obtained

$$M_R = 106{,}966667,\ \sigma_R = 35{,}35971147.$$

For confidence level $\beta = 0{,}75$, take $\Phi^{-1}(\beta) = 0{,}67448975$, then the confidence interval was $\varepsilon_R = 23{,}84976296$.

As a result of these calculations, seven employees were cut off in their posts, and five were offered higher positions.

To create the numerical data that would provide employment algorithm, a poll processed unanswered questions №12 and №13.

As a result, payments were received following values

$M_R = 97{,}7666667$, $\sigma_R = 31{,}924137$, $\varepsilon_R = 12{,}3010237$.

Abbreviated questionnaire (questions without №12 and №13). As a result, seven were denied, two taken at those positions, which are claimed, and offered a higher position.

The implementation of the algorithm in PJSC "Bank" Concord "" possible to minimize the relative proportion of staff costs to 18% of the total income of the bank with an average of this indicator in the banking system of Ukraine - 30%. Increase the number of clients by improving the skills of workers, simplify system acceptance employees to the bank.

Such an algorithm can be applied to any team of office workers.

3.6. Improved methods of calculating bonuses workers producing station coal mines [131]

The main division in this multifaceted production facilities, as mine is mining district, effective work which primarily determines the successful operation of the mine. The process of increasing competition intensifies

motivation guide shafts toward the development of forms of payment miners that would compensate for the drop in sales of coal increase the quality and decrease cost. The first step is to encourage workers producing stations to increase the volume of coal production and improve its quality by decreasing ash-based incentive pay various forms of allowances.

In scientific literature, many approaches to building a system of pay according to the specifics of the company and its corporate culture. The largest number of publications account for the assessment of factors that stimulate increases in workers of wages. In domestic practice stimulation was carried out by various factors, such as labor force participation rate, coefficient creative contribution rate the quality of work [136], R-theory [137]. The main disadvantages of these methods and approaches is a subjective determination of these factors. In addition, all authors note an important catalytic function in the system of wage labor motivation of workers, but in these and other works are no quantitative assessment of this factor and its place in the ranking of other factors motivation.

Due to the large number of concepts used both domestic and foreign experts in wages refers payments that reimburse expenses in accordance with the labor laws in the form of monetary compensation payments) - cash payments of compensation, wages, consisting of fixed and variable parts, in cash [139].

Monetary compensation include [139]:

- A permanent part of the salary (salary and base rate paid to an employee for work performed in accordance with official duties);

- The variable part of the salary paid depending on the performance of employees

The work enhances employees bonuses mining districts depending on the planned coal and its ash content (variable part).

Unlike the provisions for awarding workers operating mines if mining district plan does not comply with coal, the workers do not receive bonuses. This does not encourage them to work because no implementation plan for the coal may depend not only on the work employees, and, for example, deterioration of mining and geological conditions (violation hypsometry reservoir breakthrough quicksand, lava watering etc.). Therefore, a new approach to bonuses - the amount of premium received is determined based on the planned commitments, and premium is determined and when behind schedule. To this end, the employee interviewed 24 middle-level managerial and mines of Western Donbass. Their responses were processed by the criterion Coefficient [136] to determine the level of consensus answers. The coefficient was 0.84, allowing you to decide on the possibility of averaging the opinions of experts. Table. 1 shows the results of the procedure regarding the value of premiums depending on the achievement of planned coal production.

If the data table. 1 plot (Fig. 1), we can see that it has two fractures, which are determined by the levels of the plan,%: 80-90, 90-100 and 100-110.

Table 1

The value of bonus awards depending on achievement of planned values of coal

The level of the plan, %	Percentage premium level in terms of the plan,%	The level of the plan,%	Percentage premium level in terms of the plan,%	The level of the plan,%	Percentage premium level in terms of the plan,%
80	30	91	55	101	101
81	32	92	60	102	102
82	34	93	65	103	103
83	36	94	70	104	104

The level of the plan, %	Percentage premium level in terms of the plan,%	The level of the plan,%	Percentage premium level in terms of the plan,%	The level of the plan,%	Percentage premium level in terms of the plan,%
84	38	95	75	105	105
85	40	96	80	106	106
86	42	97	85	107	107
87	44	98	90	108	108
88	46	99	95	109	109
89	48	100	100	110	110
90	50	-	-	-	-

The graph in Fig. 1 was only approximated formula based on methodological approaches developed in [132-135]. In this case, it can be used to determine the levels of the plan beyond the specified limits. In this regard, was selected fifth order polynomial [136], by which we can determine the percentage of premium calculation. The calculation is made using the application "Regression" spreadsheet Excel.

The quality of the approximation was $R^2 = 0{,}999$. Such values of R2 suggests that the average approximation error does not exceed 0.1%, and is therefore quite acceptable.

$$PPP = 0{,}00006RVP^5 - 0{,}0287RVP^4 + 5{,}4317RVP^3 - \\ - 510{,}98RVP^2 + 2390RVP - 44391, \quad (1)$$

where PPP - percent in terms of premiums (premium accrual percentage) %; RVP - level implementation plan for coal,%.

Despite the high accuracy of the formula (1), it was recognized not convenient for calculations in accounting mines. Therefore, to describe the analytical data from the table. 1 was used participant-linear approximation graph of Fig. 1. This chart has two fractures among whom almost linear plots ranging from 80 to 90%, 90% to 100 and from 100 to 110.

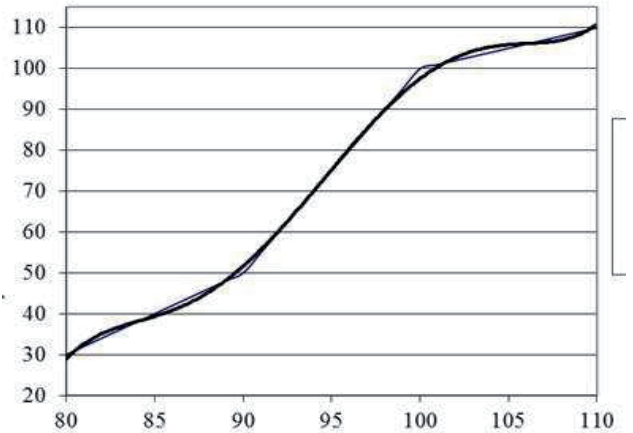


Fig. 1. Graph of the size of the premium the level of implementation of planned tasks

Calculation models made using the application "Regression" spreadsheet Excel. As a result, received the following formula:

- Within 80 to 90%:

$$PPP = 2RVP - 130, \quad (2)$$

– Within 91 to 100 %:

$$PPP = 5RVP - 400, \quad (3)$$

– Within 101 to 110 %:

$$PPP = RVP \quad (4)$$

where *PPP* - percent in terms of premiums (premium accrual percentage)%; *RVP* - level implementation plan for coal,%.

For formulas (2) - (4) the quality of approximation R2 = 1, ie, perfect precision, which indicates the correct approach to the use of piecewise linear approximation data from the table. 1.

Thus, equation (2) - (4) the description of the incentives for workers to increase coal production over the plan, but do not provide the level of quality, which is expressed in terms of ash.

In order to determine how a change value of prizes specified on the table. 1 and formulas (2) - (4) was again interviewed 27 workers and middle managers guiding mines of Western Donbass. Their responses were processed by the criterion Coefficient [136] to determine the level of consensus answers. The coefficient was 0.734, which allows you to make a decision on the possibility of averaging the opinions of experts. Table. 2 shows the results of the procedure relative size of premium performance level planning (installed) rules ash.

Table 2

These awards dependence of the level of implementation of planned (installed) rules ash

Ash content,%	% premium in terms of coal ash
45	63
44	66
43	69
42	72
41	75
40	78
39	81
38	84
37	87
36	90
35	110
34	115
33	120
32	125
31	130
30	135

Since established norms ash content is 35%, then the excess of the premium surcharge is reduced, and if the ash will be lower - premium

premium increase. In [138-140] proved this figure with the norms of use of produced coal.

Dependence percent premium reduction on the level of ash, which is shown in Fig. 2 and shows that in this case also to apply piecewise linear approximation of schedule.

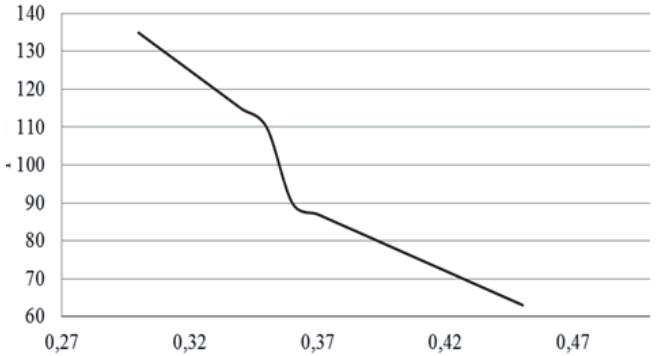


Fig. 2. A plot of percent changes Prize the level of the ash content of coal produced

Calculations made using the application "Regression" spreadsheet Excel, and the result is presented as a formula (5).

The quality of the approximation method has been proposed as $R^2 = 1$, as in the previous case.

$$PPP = \begin{cases} 0, \text{ якщо } RH > 45\% \\ -3RH + 1{,}98, \text{ if } 45\% \geq RH > 37\% \\ -20RH + 8{,}1, \text{if } 37\% \geq RH > 36\% \\ -5RH + 2{,}85, \text{if } 35\% \geq RH \end{cases}, \quad (5)$$

where *PPP* - the percentage change in premiums,%; *RH* - level ash content of coal mined%.

Thus, the premium increase to the tariff rate should be calculated with (2) - (5) in their product:

$$PPP = \left\{ \begin{array}{l} 2RVP - 130, \text{ if } 80\% \ge \text{ RVP } \ge 90\% \\ 5RVP - 400, \text{ if } 91\% \ge \text{ RVP } \ge 100\% \\ RVP, \qquad \text{if RVP } \ge 101\% \end{array} \right\} \text{x}$$

$$\text{x} \left\{ \begin{array}{l} 0, \qquad\qquad \text{if } RH > 45\% \\ -3RH + 1{,}98, \text{ if } 45\% \ge RH > 37\% \\ -20RH + 8{,}1, \text{if } 37\% \ge RH > 36\% \\ -5RH + 2{,}85, \text{if } 35\% \ge RH \end{array} \right\}. \qquad (6)$$

This formula can be easily formalized such as spreadsheets and is simple to use.

The advantage of the proposed method of calculation is simple calculations, but it is based on expert findings. The disadvantage is the small number of experts surveyed.

The technique is one of the four levels of motivation mechanism for mining section [139]. Guidelines for the improvement of the motivational mechanism adopted for implementation in SE "Selydiv coal" and tested in the mining district number 2 LE "Selydiv coal." It is possible to increase coal production by 1.6 times, to reduce the ash content of coal 3.4 times and increase the salaries of employees polling 12.2% [141]. Such calculations salary of miners in coal mines can be used on all West Donbass mines and the mines of Eastern Donbas, where mining and geological conditions are similar.

Future plans to develop a method of improving workers producing districts on the basis of the needs of its practical implementation.

3.7. The development objective method of adjusting wages chiefs mining station coal mines [142]

The current mine is not only individual operating stations with different technological processes, diverse and complicated mining equipment, but also the environment, employing many people. The functioning of this multifaceted production complex can be effective only with close cooperation of all its elements and parts. In this connection special importance acquire science-based management decisions, based on work motivation to lie. Therefore, one of the key elements of effective collective enterprises can and should be of motivation.

One of the main factors of motivation are the needs of workers station. Moreover, if the miners have specific needs, as chiefs of polling stations, the latter should take into account the needs of their employees for the following reasons:

- Firstly, heads of districts are the direct organizers and managers working in coal production faces;

- Secondly, as necessary cause of workers striving to meet them, the heads of polling stations should create an environment that would allow workers to understand that they can meet their needs so their attitude to work, which would help achieve the objectives facing collective mining district;

- Thirdly, for sustained and focused motivation of workers, chiefs should consider the benefits and needs of not only district employees, but also their own. Only with this approach leaders of these units to motivational management can encourage their employees to effectively work to achieve personal goals and purposes, they headed stations.

Based on the foregoing purpose of the study is to develop algorithm of adjustment of salaries of managers of mining districts that have prompted

them to better address the needs of their subordinates.

To achieve this goal it is necessary to solve the following problems:

1. Identify needs and types of rating for different categories of workers at the mine.

2. Determine the level of coincidence of the interests of workers so that the interests of these leaders knows stations.

3. To develop this method of adjusting wages heads mining districts that have prompted them to better address the needs of their subordinates.

Most modern theories of motivation Maslow, K. Alderfer, J. Makklelanda, F. Herzberg [143-147] based on the determination of the list structure and needs of people of all often used for motivation. In the presence of these needs, the employee becomes more pliable leader attempts to motivate his attitude towards their work.

One of the most prominent theories of motivation is a model of Abraham Maslow's hierarchy of needs. Unlike the other areas of American behaviorists in psychology (from the English. Behavior - behavior) was one of the first pointed to the complexity of human needs and their impact on motivation. Maslow believed that people have many different needs, but those needs can be divided into five main categories [145]

1. The physiological needs for food, shelter and medical care.

2. The needs of security, including protection from physical and psychological dangers guarantees protection from environmental threats.

3. Social needs - a concept that includes a sense of belonging, a sense of social responsibility, commitment and support.

4. Requirements assertiveness and independence from others.

5. Requirements of expression - the need to realize their potential opportunities and growth as a person.

Maslow also believed that people should first satisfy the lower needs (physiological). Then they go to meet these needs, which are higher in the

pyramid. Thus, a person needs arising from small to larger, hierarchical needs that have a fixed order.

In theory C. Alderfer needs are classified in three main categories - existence, affinity and growth [145, p 135]

1. Existence (existence) - needs that are met by factors such as food, air, water, wages and working conditions.

2. Relationship (relatedness) - needs that are met significant social and interpersonal relations.

3. Growth (growth) - needs that are met personal creative or productive contribution of the individual.

As noted above, Maslow believed that unmet needs are dominant and that each higher level needs are not involved until you are satisfied the needs of a lower order. In this contradiction K. Alderfer says that complement the progressive sequential climb Maslow is the possibility of regression process. This theory may be directed meet the needs of both bottom-up and top-down.

Notable contributions to the theory of acquired needs motivation did David McClelland. Unlike biological and other "basic" needs, procedural theories D. McClelland tried to identify the most important among the so-called "secondary needs." He believes that many human needs arising from the relevant culture. Three of these needs -Три з таких потреб – це потреба досягнення, потреба приналежності й потреба влади. By the theory argues that there needs three fourth, that the need to avoid troubles or obstacles, such situations are not allowed to succeed, opportunities authorities deprive a person or group recognition [146].

At the heart of one of the most popular theories is dvochynnykova procedural theory F. Herzberg, where necessary divided into two categories "hygiene factors" and "motivation".

Hygiene factors related to the environment in which the work and

motivation - with the very nature and essence of the work.

"The essence of health is to eliminate the potential danger to human health from the environment. It does not include therapeutic functions, but rather is prevention. Modern technologies of waste management, water and air pollution do not cure the disease, but without them the disease would be many times more. Similarly, when in the context of adverse factors are present, they are the cause of the negative attitude to work "[147, p 186].

In these and many other works of authors determined qualitative, not quantitative needs of people. Moreover, not taken into account the specificity of professions or others not cited studied priority and ranking factors, and the consistency of expert opinion is not justified.

Identifying the needs of the most successful in our opinion, is contained in the basic provisions of the theory of motivation with the general and specific motivations. Regarding definitions Reiner Nirmayera and Manuel Seifert, they understand the motivations under the "desire to do something, to achieve something. This desire, albeit expressed varying degrees inherent in every person "[148, p 16]. "The specific motivation - the reason that a person with persistence committed to a specific goal. Driven by motivation by specific subjective value that this goal has to face. By this defined duration and effort, and flow forces to achieve this goal "[6, p.17]. These authors make emphasis on the fact that "the question of how compelling the person to a specific motivation is incredibly important because it affects, which he will take up the energy performance of professional tasks" [148, p.17].

Attempts to motivate workers to mines wages only by adjusting its volume of coal produced [149, 150], or interfere with the miners by their moral encouragement [151] is not effective.

It is obvious that only a combination of all kinds of incentives, and taking into account the needs of different types can affect the motivation of

miners. In these circumstances, the need to conduct case studies on the impact of different types of motivation. It is necessary to use a concordance rate [152] as an indicator of the reliability of the survey results.

Identification of needs made following algorithm:

1) based on the identified needs of motivational theories;

2) identify needs in interviews with the heads of the mining districts;

3) rejection of those needs that are not important;

4) The union needs groups on the needs of the same number in each group.

The end result was obtained identification requirements after discussion with training courses heads, which were organized on the initiative of the Ministry of Coal, called "School of the Minister."

Students in the school number 64 people. That is in store as director and chief engineer of mines have been carefully selected initially in mines and state owned enterprises (former industrial associations), and the Ministry of Coal Industry. Their positions - deputy heads of districts to Deputy Technical Director of the production association. Moreover, almost all the students who occupied the post of deputy director of the mine production,. at. chief engineer of mines and other work in the past chiefs stations. Experience listeners in the coal industry ranged from 3.5 to 18 years and averaged 9.5 years. Since these listeners is the closest reserve of the first leaders of the mines, then they especially characteristic of motivation specific work and how motivated they now depend on future motivation of workers of mines, they will head.

In addition to general and specific motivation in identifying and shaping the list of needs into account also the following specific characteristics of workers in the coal industry as the difficult working conditions, the high injury rate, the output of workers to retire before the

age of 50, long vacation, a reward for long service years, the presence of mines on the balance of the social sphere and others.

Thus, identification of needs was justified according to the main theories of motivation, as well as the specific motivation of managers producing stations and characteristics of the coal industry.

Structuring needs fulfilled in four groups:

- The need for existence;
- Social needs;
- The need for recognition;
- The need for self-realization.

Each team consists of five types of needs, which, according to the heads of polling stations, are most important to them. The structure of each group needs below.

Requirements existence: a decent wage; guarantee a stable income; permanent jobs (employment); to work after retirement; ensure safe working conditions.

Social needs: life and health insurance, medical care (in t. H. Regress prophylactic examinations, preventive); long paid leave; opportunity to retire before 50 years; provision of decent housing; the opportunity to rest in sanatoria, homes and recreation centers, children's camps, tourist trips workers and their families on preferential permits.

Need for recognition, respect in the team; recognition of the leadership; professional (career) growth in t. h. training, getting adjacent disciplines, university studies by the company; material compensation (bonuses, allowances to salary, and so valuable gift. p.); moral compensation (presentation of the award to the honorary title, gratitude, honor boards, public recognition, and so on. p.).

The need for self-realization: the ability to have an independent piece of work and implementation of organizational skills (goal setting,

monitoring their achievement, focus on results and so on. P.); the opportunity to make independent organizational and technical solutions prove their value, and the importance of his job, and participate in solving the issues in which they understand and competent; the relative freedom of action; impact on other people control their behavior, willingness to answer for others; Established minded and friendly relations in the team.

Heads stations (respondents) for the written questionnaire had to evaluate each of the four groups of four-point system needs in order of importance. Opposite the most significant for the heads of polling stations had to put the needs of figure 1. In front of the second most important needs - number 2 and so on. D. This put zeros, dashes or no answer is not allowed. For the survey questionnaires were developed based material contained in [7-9].

The methodology to identify priority needs groups and in the middle of each group assigned the following algorithm [10]

1. Data from survey respondents defined priority seats each factor motivating moved to the table.

2. Determine the total score of each factor. To do this:

a) the value of each cell in the row multiplied by the price of priority;

b) assess priority highest number of points:

- First place - 4 points;
- Second place - 3 points;
- Third place - 2 points;
- Fourth place - 1 point, and so on. D.

3. Calculate each rating factor percentage. For this line the total score (total score factor) divided by the product of the number of processed questionnaires (answers of respondents) and the amount of the price for the seats, that is:

$$P_i = \frac{\sum_{j=1}^{K} Ts_j \cdot n_{ij}}{N \cdot \sum_{j=1}^{K} Ts_j} \cdot 100\%, \qquad (1)$$

where P_i - rating and first group needs; K - number of groups needs (i =) Ts_j - the price of j-th place ($Ts_j = K + 1 - j$); n_{ij} - number of respondents who put the group, and the j-th; N - number of completed questionnaires.

The survey results are presented in Table. 1.

To determine the reliability of the results calculated coefficient of correlation coefficient ranks Kendall W [8], which compares the ranks for all units together pairs that are subject to pre poznaky's value.

Since the calculated value of W = 0,4734 - this indicates satisfactory agreement collective opinions of respondents Therefore concordance coefficient consistency of opinions held by respondents verification of statistical hypotheses on criterion Pearson.

Criterion Pearson $\chi^2 = 21,3$ critical value in the $\alpha = 0,05$ and $\upsilon = n - 1 = 3$ $\chi^2_{crit} = 7,82$, and that $\chi^2 \geq \chi^2_{crit}$, Respondents believe it can be considered consistent with confidence probability of 0.95.

Thus, the evaluation found generalized groups needs and proven consistency opinions of respondents with high confidence probability.

The analysis reveals that table data follows. In the first 81% of respondents put the need to exist, in second place - social needs (56%). In the third priority set by the need for self-realization (41%). And in last place - the need for recognition. In the fourth set this group needs 44% of respondents.

We now return to motivating leaders. Their task - to provide a guide workers so that they gave the best results of their work. In this connection, put forward the hypothesis that if the needs of workers rankings, compiled by them is the same as their rankings drawn up by the leaders, while

management is carried out well, because leaders are fully aware of the needs of their workers.

To this end, polled 342 working mines "Ukraine", "Russia", "Kurakhovskaya" and "number 1-3 Novogrodivskyy" association "Sevydivvuhillya."

Results of the survey (W = 0,903) are listed in the table. 1, which calculated rankings and heads mining station coal mines.

Table 1

The comparison of assessments needs of managers and workers according to executives

Groups needs	Priority% in place				Rating, %
	1-м	2-м	3-м	4-м	
Quantifying the needs of executives stations					
Requirements existence	81	11	6	2	0,371
Social needs	2	56	20	22	0,238
Need for recognition	4	19	33	44	0,183
The need for self-realization	13	14	41	32	0,208
Quantitative assessment of priority needs of working groups					
Requirements existence	85	10	5	0	0,38
Social needs	2	78	7	13	0,269
Need for recognition	7	5	56	32	0,187
The need for self-realization	2	7	35	56	0,155

Comparison of ratings requirements calculated by (1) shows that despite the benefits of a similar structure, assess priorities for managers and workers are somewhat different. This is especially noticeable on the rating requirements for self - workers is lower at 0.053.

Obviously, management better understand the goals and needs of the enterprise as a whole, therefore conducted a survey of the same 64 leaders

on the importance of the needs of working in the mine for production purposes.

The survey results are presented in Table. 2. concordance coefficient for this survey was W = 0,783, which indicates the high level of consistency of expert opinion.

Salary Chief mining district consists of rates and premiums. The latter depends on the volume of production. Obviously, adjustments must be subject to only a bonus.

Table 2

Mean values the importance of the needs of workers to produce the opinion leaders

Groups needs	The average value of importance needs for production,%
I -Requirements existence	58
II - Social needs	25
III - Need for recognition	12
IV - The need for self-realization	5

If the hypothesis that the greater the distribution needs of workers coincide with the distribution requirements laid their heads, the discount should be less than premium. When complete coincidence discount should be zero. If no matches, the percentage of premiums manager must be reduced by the weighted average of the difference. In addition, the magnitude of differences ratings must take into account the importance of the needs for production under the table. 2. Where are we:

$$ZPRK = \frac{\sum_{i=1}^{4}(5-i)VP_i\left|RK_i - RP_i\right|}{\sum_{i=1}^{4}(5-i)VP_i}, \qquad (4)$$

where *ZPRK* - discount premiums when leaders discrepancies needs assessments workers *VPI*- th importance and need workers for opinion leaders, RP_{ik} - rating and th needs of workers in the *k*-th working unit. Star "modulo" raised the case of excess RP_{ik} over VP_i.

Calculate the value of discounts according to Table. 2. Reduction Award will be 1.4%, which may seem insignificant, but the scale of large enterprises will fund savings or wages or increase output.

Thus, the algorithm for calculating the premium is as follows:

1. Conduct a survey of defined needs for management and for workers.

2. Conduct a survey of the needs assessment for their workers.

3. According to the formula (4) to calculate the percentage of premium discounts Chief mining district.

Chapter 4. TRADE

4.1. The optimal choice of promotional activities [153]

Few companies today can successfully do business without advertising in one or another of its kind. Almost all sectors of the economy experiencing a real need for prompt notification of consumers. And satisfies this need a network of different structure and capabilities of promotional organizations.

The national manufacturers make most of the advertisers. Typically, these producers, ie firms that produce goods with which we meet in supermarkets, show rooms, trade shows, etc. The share of the ten largest national advertisers have almost 70% of total advertising spend in the country [154]. Local advertisers - mainly retailers. Eager to play the role of agents to seize his part, retailers spend on advertising heavily to inform the public that they have developed for him or purchased and justify why you need to do is purchase them. Today's retail advertising, probably much more national approaches to the concept of "market information". Due to its regularity, focus on pricing and information about the local sale of goods in the county retail advertising has become a guide for many of the shops. But as professionals they consider media as media that deliver advertising addressing the audience gathered mainly through (non-advertisement) material which offers radio - and television stations, newspapers or magazines. Magazines, newspapers, television and radio stations usually attract the right audience to its non-advertisement content and the advertiser is able to apply it to this audience. However, the development of the advertising market in Ukraine is the complexity of choosing the types of advertising as determine the most effective one for each type of business might be different.

It should be noted that the role and place of advertising in terms of transitional economy is not yet fully defined, there are no studies that allow creative study and adapt to local conditions, the experience of Western countries in this area, not exhaustively clarified the problem of choosing distribution channels of advertising information and development of advertising campaigns and assessments of their effectiveness. The significance of these studies and other problems of formation of the advertising business in Ukraine and the lack of development in the scientific literature determine the relevance of this work.

The main direction of improvement of advertising is considered the invention of the advertising techniques that can increase the consumption of products advertised [155-157]. Typological characteristics of advertising discourse in the mass media often defined emotional component, lowering the technical details of a product using such marketing moves additional prizes or lower prices. In editions of the professional nature focuses on the functional features of the advertised goods are characteristics that distinguish the product from similar items indicate the prestige of the brand. Thus, consideration of the issue of advertising products is in terms of those that advertising creates.

Objective - research economic basis in the selection of promotional activities in terms of advertisers, the choice of independent parameters that affect this choice of mathematical modeling to determine the components of the commercial portfolio of promotional activities of the company.

To address this goal need to solve the following problems:

 analyze statistics on the results of advertising campaigns previously carried out by other companies;

 determine the reliability of statistical data to define the limits of the confidence interval;

 make estimates for various types of marketing activities, and the effects of their implementation;

 develop a model selecting optimal marketing activities program

 identify the optimal combination of marketing activities

 that minimizes costs and maximizes the resulting profits.

First, a study of the cost of advertising businesses of various types (Table. 1). Research has shown that these costs accounting for 0,5-6,7% of revenue, may constitute a significant share of the profits (up 26%).

Table 1

Average spending on marketing activities retailers

Product or type of business	Average% marketing costs of sales	Advertising costs (for 1 mln. UAH. Sales)
Dealers of building materials and wood	0,5	5 000,00
Meat markets	0,6	6 000,00
Realty	0,6	6 000,00
Restaurants	0,6	6 000,00
Confectionery & Bakery	0,7	7 000,00
Wine shops	0,7	7 000,00
Bars, cafes, etc.	0,7	7 000,00
Car dealers	0,8	8 000,00
Shops film and cameras	0,8	8 000,00
Auto Parts Stores	0,9	9 000,00
Leisure facilities	0,9	9 000,00
Office equipment dealers	1	10 000,00
Pharmacies	1,1	11 000,00
Fast Food	1,1	11 000,00
Banks	1,3	13 000,00
Stores of household goods	1,3	13 000,00
Stores Paint, glass, wallpaper	1,3	13 000,00
Children's clothing store	1,4	14 000,00
Gift and souvenir shops	1,4	14 000,00
Supermarkets	1,5	15 000,00
Household shops	1,6	16 000,00
Bookstores	1,7	17 000,00
Dry	1,7	17 000,00
Insurance agents, brokers	1,8	18 000,00
Music stores	1,8	18 000,00
Shoe stores	1,9	19 000,00

Product or type of business	Average% marketing costs of sales	Advertising costs (for 1 mln. UAH. Sales)
Beauty	2	20 000,00
Florists	2,1	21 000,00
Dealers tire covers	2,2	22 000,00
Dealers electricity, radio and TV technician	2,3	23 000,00
Discount Stores	2,4	24 000,00
Deli menswear	2,4	24 000,00
Photo Lab	2,4	24 000,00
Department	2,5	25 000,00
Specialized shops	3	30 000,00
Sporting goods stores	3,5	35 000,00
Jewelry stores	4,4	44 000,00
Furniture stores	5	50 000,00
Travel agencies	5	50 000,00
Cinemas	5,5	55 000,00
Hotels (up to 300 rooms)	6,7	67 000,00

Processing of the data of the study conducted by statistical methods. It found the average amount of advertising costs UAH 19 780.49 and standard deviation of the sum of 2 264.36 UAH. These data allowed for confidence level 95% find the interval in which the exact value of the average [158], which was $\varepsilon = 3\ 724.54$ UAH.

That is, the range of the exact value of the average cost in the range [16, 055.94; 23 505.03] UAH.

The next study concerned the price the introduction of specific promotional activities. The data was obtained through a telephone survey. Results are presented in Table. 2. At the same time experts conducted a survey on the effectiveness of promotional activities. As experts was selected managers who work in firms that bought advertising. Fragment expert assessment results as presented in Table. 2. In general, attracted 18 experts.

Table 2

Prices implementation of promotional activities and expert assessments on the implementation of measures of influence

Name Promotional	Price proceedings h UAH	Expert assessments				
		1	2	3	4	5
Direct: mail, personally handed over promotional materials, newsletters and others.	600,0	10	9	3	8	7
A press: newspapers, magazines, newsletters, directories, telephone books	5 000,0	6	2	3	7	8
Print advertising, souvenirs, booklets, catalogs, brochures, leaflets, cards, calendars	2 000,0	7	2	3	8	3
Screen advertising, film, television, slide projection, etc	50 000,0	5	4	4	6	2
Outdoor advertising: banners, panels with fixed or moving inscriptions, three-dimensional design, shop with the goods	20 000,0	2	9	8	3	8
Advertising on transport: transport labels, print ads in the salon, shop windows with goods at the station	5 000,0	3	4	9	10	5
Advertising to sell, shop windows, signs, signs, plates, packing	800,0	5	3	6	4	9
Discounts on the price	750,0	8	4	6	8	1
Distribution of coupons for discounts on the purchase of a particular product	400,0	6	4	9	8	2
Various prizes offered in material form subject to purchase a specific number of commodity items or goods for a certain amount	500,0	3	9	1	6	5
Free samples used for market promotion of new products	350,0	10	10	9	3	2
Games (contests, raffles or quizzes) that can help attract potential customers to action	1 200,0	8	7	3	7	8

To calculate the level of consistency of expert assessments were used concordance coefficient [159] to which - 0.8 - leads to the conclusion that the work of the experts agreed, that no complete disagreement among experts. Confidence probability was found on the distribution of "chi-squared" and amounted to 95%.

Completed studies allow mathematical model to make a decision when selecting specific promotional activities. In the role of variables was selected fraction of the cost for a particular type of event, because, according to calculations optimization problem, this setting can be changed on the orders of the management. This extends to influence the result of the management company.

Size costs and *j*-type event advertising calculate the formula:

$$C_{loss.\,j} = P_j y_j, \tag{1}$$

where P_j – price for the *j*-th type of promotional event, y_j – the share of expenditure on the *j*-th type of promotional event.

Thus, the total cost of advertising up

$$C = \sum_{j=1}^{L} C_{loss.\,j} \tag{2}$$

These costs may not exceed the average cost of advertising in the range of the confidence interval is

$$C \leq E[X] \pm \varepsilon. \tag{3}$$

On the other hand, each firm seeks to minimize the cost of advertising, because (1) can serve as a criterion for optimization, which seeks to minimize

$$C \rightarrow min. \tag{4}$$

We find the average score (according to expert estimates) for each promotional event Bj. If a company chooses several measures average score should seek maximum

$$\sum_{j=1}^{L} B_j y_j \rightarrow \max \tag{5}$$

That is, we have the optimal task with two criteria, each of which seeks in opposite directions.

Using the method of rolls [159] to multi task, we find a criterion that will seek maximum

$$\frac{\sum_{j=1}^{L} C_{loss.j} \cdot y_j}{\sum_{j=1}^{L} B_j y_j + 1} \rightarrow \max \tag{6}$$

Now define limits to the functional (6). In addition to (3) they are following. Obviously, by definition, share costs and j-type event advertising can not be less than zero, ie,

$$y_j \geq 0, \tag{7}$$

and the amount of these particles is unity

$$\sum_{j=1}^{L} y_j = 1 \tag{8}$$

Thus, combining condition optimization model will look like

$$\left.\begin{array}{l} \dfrac{\sum_{j=1}^{L} C_{loss.j} \cdot y_j}{\sum_{j=1}^{L} B_j y_j + 1} \rightarrow \max \\ \sum_{j=1}^{L} C_{loss.j} \cdot y_j = E[X] \pm \varepsilon \\ y_j \geq 0 \\ \sum_{j=1}^{L} y_j = 1 \end{array}\right\} \quad (9)$$

where L - total number of promotional activities, E – the estimated average costs for advertising measures – confidence interval estimates average.

The best solution to this problem was found for both the upper and for the lower confidence limits using "Search solution" MS Excel. Results are presented in Table solution. 3.

As seen from the results, effectiveness was recognized only two promotional events - screen advertising and distributing free samples of products, and the second considered the most effective measure.

These findings have been recommended for use on firm "YUZHKOM", whose leadership has chosen the cost 40% to 60%. After six months of work in the advertising field that was conducted a financial analysis [160], which showed the following.

The amount of economic resources at the disposal of the company increased by 14.21%, the cost of fixed assets - by 12.56%. OB wear ratio decreased by 8.75%, from which it can be concluded that the company has updated its main production assets. The amount of equity over the past period increased by 12.7 thousand. UAH (43.49% compared with the beginning of the year). The share of equity in the total mass of the company

has increased, as evidenced by a decrease of 22.69% ratio of own and borrowed funds. During this period, the company reduced the value of short-term debt for goods and services by 99%, but increased the size of commitments to payments. In general, in the absence of long-term liabilities to banks of things that can give a positive evaluation.

Table 3

The share of expenditure on implementation and its cash equivalent

Name Promotional	The lower limit of expenses%	The upper limit of expenditure,%	The lower limit costs UAH.	The upper limit of cost, UAH.
Screen advertising, film, television, slide projection, etc.	31,6%	46,6%	15 816,66	23 318,25
Free samples used for market promotion of new products	68,4%	53,4%	186,77	239,28
In general:	100%	100%	16 055,94	23 505,03

Production costs and business expenses dramatically increased (respectively 95.68% and 119.47%) also rose sharply the profitability of debt - which means that the company fulfills effectively invested in his funds. It should be noted that the profitability of debt increased faster than costs. This is certainly a positive development.

Revenues from sales increased by 606.2 thousand. UAH (91, 96% from baseline). Increased turnover means (both core and working capital) of the company, which can also be called effective activities of the company.

Thus, based on the considered material to the following conclusions:

- Evaluate the effectiveness of different types of advertising to experts does not match the value of advertising;

- Most effective screen advertising and free samples;

- Mathematical model allows to determine the optimal set of promotional activities on the criteria of minimum cost and maximum efficiency;

- Use model confidence interval as the minimum and maximum limits spending on promotional activities makes it possible to change the degree of confidence in the data.

4.2. Determining the level of security of e-commerce [161]

Safety of e-commerce can be viewed from several aspects: virus danger cheating clients and counterparties deliberate attempt to make the site inaccessible firm or cyber attacks. Let the last element that can threaten e-commerce.

Called cyber situation where the number of applications from the Internet to the information system (IS), serving client requests via the Internet, dramatically increasing [2]. In this case, the server IP starts slower, trying to satisfy all the requests until the stops.

Determine the initial moment of cyber attacks is important because it will reduce the loss to compensate for its effects.

Find the beginning of cyber criterion for statistical calculations.

To do this, divide the entire period of the information system, serving external requests eCommerce at regular intervals. They are: hour, day, week, but in terms of the Internet, it is best to set these intervals not exceeding ΔT = 20-30 min.

Next you need to establish permanent control over the number of incoming requests.

After determining the number of requests in each period of not less than 40, you need to calculate the average number of hits Mx.

We use the hypothesis that the flow of events often characterized by exponential distribution law [3]. It is characterized by the type of distribution function

$$F(x)=\int_0^x \lambda\cdot e^{-\lambda x}dx=1-e^{-\lambda x},\ \text{at } x\geq 0,\ F(x)=0,\text{at } x<0 \qquad (1)$$

Expected is

$$M_x=\int_0^{\infty} \lambda x e^{-\lambda x}dx=\frac{1}{\lambda}\ . \qquad (2)$$

The median can be found as

$$M_e=\text{-Ln}0.5/\lambda\approx 0.69/\lambda. \qquad (3)$$

Whence

$$\left.\begin{aligned}\lambda&=\frac{1}{\mathrm{M_x}},\\ \lambda&=-\frac{Ln0.5}{Me}\end{aligned}\right\} \qquad (4)$$

Expression (5) can find the relationship between median and average

$$Me\ =-\frac{M_x}{Ln\,0.5}. \qquad (6)$$

Ask confidence probability β, which will determine the acceptable level of probability of getting of incoming requests in the interval [*Me; K*], where *K* – the actual number of applications in the interval ΔT. Obviously, the probability of getting this interval may account for half of confidence

$$\frac{\beta}{2}\geq P(\mathrm{Me<x<K})=\mathrm{EXP}(\text{-}\lambda\mathrm{Me})-\mathrm{EXP}(\text{-}\lambda\mathrm{K})\ . \qquad (7)$$

Substituting values of λ from (6) to (7)

$$\frac{\beta}{2}\geq \mathrm{EXP}(-\frac{\mathrm{Me}}{\mathrm{M_x}})-\mathrm{EXP}(-\frac{\mathrm{K}}{\mathrm{M_x}}), \qquad (8)$$

A median in turn express through the middle

$$\frac{\beta}{2}\geq \mathrm{EXP}(\frac{\mathrm{M_x}}{\mathrm{M_x\,Ln0.5}})-\mathrm{EXP}(-\frac{\mathrm{K}}{\mathrm{M_x}}). \qquad (9)$$

Let us give expression to type

$$\beta \geq 2 \cdot \mathrm{EXP}(\frac{1}{\mathrm{Ln}0.5}) - \mathrm{EXP}(-\frac{K}{M_x}) = 0{,}47258018 - 2 \cdot \mathrm{EXP}(-\frac{K}{M_x}). \qquad (10)$$

Now find acceptable excess of incoming call information system on average their value

$$\frac{\beta - 0{,}47258018}{2} \geq -\mathrm{EXP}(-\frac{K}{M_x})$$

whence

$$M_x \cdot \mathrm{Ln}\left(\frac{\beta - 0{,}47258018}{2}\right) \geq K \qquad (11)$$

So, if the number of appeals to the IS C will exceed the value of the expression on the left side (11), we can assume that cyber attacks have already started.

Realizing that ratio $\frac{K}{M_x}$ is exceeded the average in relative units, make the calculation of some of the popular values of confidence to an extent exceeding the number of incoming calls on average. The calculation results are presented in Table. 1

Table 1

Calculation accordance importance of confidence and extent exceeding the number of incoming calls to their average value

β	$\frac{K}{M_x}$
0,6	2,753415
0,75	1,975370
0,8	1,809659
0,85	1,667544

0,9	1,543136
0,95	1,432506
0,98	1,371564
0,99	1,352048
0,999	1,334803
0,9999	1,333095

From table we can conclude that in excess of the number of requests to the information system of commercial enterprise on the average number of only half can be more likely with 0.9 to believe that cyber attacks have already started.

4.3. The best stock of products in stock trading firm [162]

The best plan of distribution ratio of products can be made using the methods of economic-mathematical modeling.

Enter the notation:

X_i - kind commodity groups (assortment) position;

N - The number of all types of product groups;

M - number of months;

Q_1, Q_2 - lower and upper limits for the volume of turnover;

R_{1i} - purchase price per unit of product DP TD "Sandora";

R_{2i} - unit price of goods TD SE "Sandora";

k_1 - plus the cost of additional storage costs 1 unit of product that has not been sold at the scheduled time because the demand for it was less than that predicted;

k_2 - loss of income for 1 piece of product, due to the lack of goods, demand for which exceeded the amount ordered;

S - total area of the warehouse;

Si - the area of the warehouse, which occupies the *i*-th type of product;

Parameters box: *l* - length; *h* -height; *w* - width.

S_{od} - area, occupying unit (box);

$X_{\text{zah.sk.}}$ - The total number of boxes that can be placed in the warehouse at the same time;

X_{opt} - the best (estimated) quantity, and the type of stock;

S_{zbi} - the cost of storing the goods;

$S_{\text{zb/ode}}$ - cost storage unit price and species;

The statistical method for calculating optimal stock of products is based on observations of the supply of goods over time.

On the basis of this observation is based empirical distribution function form

$$F(X) = P(x < X), \tag{1}$$

where P - the probability that demand - *x* - will be less pre-set value *X*.

Then optimal demand (X_{opt}) found optimal value for this function, which is calculated by

$$F(X_{\text{opt}}) = k_1 / (k_1 + k_2), \tag{2}$$

Need solution (2) with respect to (X_{opt}). Because, often empirical distribution function describes the function of the form

$$F(X_{opt}) = a + b\ln(X_{opt}), \tag{3}$$

where *a, b* – constants, solution has the form

$$X_{\text{opt}} = \exp\left(\frac{1}{b}\left(\frac{k_1}{k_1 + k_2} - a\right)\right). \tag{4}$$

Merchants has a limited area of (S) and the range of products of n items that are in stock in an amount of chi. For each name known area occupied by the unit of production s_i ($1<i<n$).

In these circumstances, the problem is multi. On the one hand you need to profit

$$\Pr = \sum_{i=1}^{n} k_{1i} x_i \,, \tag{5}$$

was the maximum. On the other hand it is desirable that the difference between the optimal value of stock and real output

$$Oz = \sum_{i=1}^{n} \left| x_i - \exp\left(\frac{1}{b_i} \left(\frac{k_1}{k_1 + k_2} - a_i \right) \right) \right|, \tag{6}$$

would be minimal. The "modulo" means that deviations from the optimal stock of chi can be in both directions. The limitation here is the total area of

$$S = \sum_{i=1}^{n} s_i x_i \,. \tag{7}$$

To solve this problem proposed functional form

$$\frac{\Pr}{Oz} \to \max \,, \tag{8}$$

or

$$\frac{\sum_{i=1}^{19} k_{1i} x_i}{\sum_{i=1}^{19} \left[\frac{k_{1i}}{k_{1i} + k_{2i}} - (a + b \ln x_i) \right]} \to \max \tag{9}$$

restricted to the area (total area of warehouses in the limit multiplied by 5, so as pallets of boxes you can put one on a high, but not more than 5 pieces).

$$\sum_{i=1}^{n} s_i x_i \le S * 5 \,, \tag{10}$$

and not on negative values the number of each type of product.

$$x_i \geq 0 \quad (1 \leq i \leq n). \tag{11}$$

Put additional restrictions on the upper and lower limits of the turnover in stock: $$Q_{1i} \leq xi \leq Q_{2i} \tag{12}$$

Statistical monitoring of demand for each type of product within one year were collected by tracking requests customers to order goods. From the first, initial data for optimal scaling calculations and model units were transferred from dimension "pieces / bottle" in "boxes".

Reba noted that each box of goods (regardless of type) has the same size, but differ only in the number of packages in it. So, to translate quantity depending on the capacity in boxes number of packages must be divided by their number in the box. Data on the number of packages per box depending on the type of juice are shown in next Table .

Data on the number of packages per box depending on the type of juice.

Capacity packaging l	0,2	0,5	1	1,5
Quantity in box, pcs	18	18	12	8

So we sampled values of the random variable X = x_1, x_2, ... x_n, with the number of observations - m.

Divide whole range of possible values of a random variable observations on the d sites. Find the value of a random variable on the right boundaries of each site as

$$d_{max}(i) = x_{min} + (x_{max} - x_{min})i/d, \tag{13}$$

where, i - number of areas [1, d]; x_{max}, x_{min} - respectively the largest and the smallest value of a random variable in the sample. Right limit of

segment and is also the left boundary and + 1 - th plot. Left limit for 1st area - it x_{min}. A right border of segment - a x_{max}.

Tentatively, the number of these areas can be defined as

$$d_{op} = \frac{x_{\max} - x_{\min}}{1 + 3.332 \ln N}. \quad (14)$$

Define the number of values of the random variable that ended up in a particular area as Ki. This number is called the "frequency". "Relative rate" is the number

$$k_i = K_i / N. \quad (15)$$

Pocket	Frequency	Relative frequency	Accumulated frequency
7	1	0,05	0
47	2	0,1	0,05
88	1	0,05	0,15
128	6	0,3	0,2
168	4	0,2	0,5
208	1	0,05	0,7
248	1	0,05	0,75
288	4	0,2	0,8
328	0	0	1

Set aside on the horizontal axis value of the random variable X, dividing these values into bands according to (13). On the vertical axis for each band postpone the frequency or relative frequency in a horizontal line for each band. We get a graph called a "histogram" (Fig. 1). This schedule is widely used in mathematical statistics and partly replaces the function of the density distribution, but not a full equivalent.

The next step will perform exponential smoothing data for each product.

To do this, add the schedule of demand for each product line trend. We

mention logarithmic type and parameters in use "Display equation on chart". Thus we get the equation of demand for each type of product. This equation of the form $y = a + b \ln x$. For convenience, all ratios are summarized in a table.

Table exponential smoothing coefficients distribution function of demand for certain types of goods.

Type	A	в
Fortified wines	0,25	-0,74
Dry wines	0,38	-1,27
Wines SC	0,08	-0,012
GIFT 0.2	0,83	-6,6
DAR 1	1,24	-10,57
GIFT 1.5	1	-7,55
0.2 Sandorik	0,83	-6,29
Sadochok 0,2l	0,58	-4,7
0.5 Sadochok	2,38	-16,9
Sadochok 1L	0,93	-8,21
Sadochok 1,5l	0,65	-4,81
Juices "Ukrainian classic" 1l	-0,73	-4,89
Juice "Fruit World" 1l	0,19	-6,79
Classic Juice 1l	1,35	-10,31
Juices Gold 1,5l	0,77	-5,72
Juices Gold 1L	1,12	-10,07
Juices Gold 0,25l	1,02	-7,88
Drinks 0.2	0,22	-0,49
Drinks 1	0,24	-0,61

Further, based on financial activity optimize the input data for the model:

- Purchase price SE TD "Sandora" one box for all kinds of goods;
- Price realization DP TD "Sandora" one box for all kinds of goods;
- Cost plus additional storage costs 1 pc product has not been sold at the scheduled time because the demand for it was less than that predicted;

Type	P_1, buying UAH / box	P_2, implementation UAH. / box	(P_2-P_1)	Set 1 product cost, UAH,K_{1i}
Fortified wines	P_{2i}	P_{1i}	K_{2i}	K_{1i}
Dry wines	53,55	76,5	22,95	0,123843
Wines SC	45,976	65,68	19,704	0,126456
GIFT 0.2	57,75	82,5	24,75	0,132832
DAR 1	19,845	28,35	8,505	0,126247
GIFT 1.5	27,09	38,7	11,61	0,121092
0.2 Sandorik	29,904	42,72	12,816	0,120032
Sadochok 0,2l	7,98	11,4	3,42	0,139613
0.5 Sadochok	16,443	23,49	7,047	0,126655
Sadochok 1L	21,546	30,78	9,234	0,125369
Sadochok 1,5l	24,696	35,28	10,584	0,12776
Juices "Ukrainian classic" 1l	24,192	34,56	10,368	0,1386
Juice "Fruit World" 1l	26,46	37,8	11,34	0,131859
Classic Juice 1l	65,45	93,5	28,05	0,128713
Juices Gold 1,5l	27,216	38,88	11,664	0,128687
Juices Gold 1L	33,6	48	14,4	0,124837
Juices Gold 0,25l	36,036	51,48	15,444	0,134996
Drinks 0.2	17,01	24,3	7,29	0,127348
Drinks 1	16,443	23,49	7,047	0,131725
	23,94	34,2	10,26	0,130286

The next step should specify inputs such models as options warehouse. Namely:

- Settings box (length, height and width);
- The total (net) area warehouse;
- Price for 1 m^2 of warehouse space.

In this case were used following data:

storage area, m^2	Price for 1 m2 per month, UAH/ m^2	total storage costs cont., UAH per month	Sq. 1pc.	The number of pieces in stock	Options box, m		
S	P_{s1}	P_s	*S od/tov*	*Q stor*	*L*	*W*	*H*
6490	4	25960	0,315	20603,17	0,7	0,45	0,35

Thus indicators such as total cost of storage in a warehouse area of a box product and the quantity of stock is calculated automatically by the system.

Restrictions faced in solving this problem are the following:

 The maximum volume of production (now allowed to build production capacity for not more than 50% of current production volumes)

 Minimum sales of goods for each (which means that the parent company stipulated by regulations for each type of goods, storage and price target specific segments of the market of the region.)

 The total area of which can be optimally distributed for goods is real (usable area of multiplied by 5. This is because the ability to set and store pallets of juice products at each other in height, but not more than 5 pieces. Not damaging the product.)

 inherent value of the number of product units.

Then using Solver add-in MS Excel find the value of products in stock, using links to centers of coefficients - exponential smoothing parameters and parameters k_1 and k_2.

For the above named input the following results:

several products to deliver	storage costs by types	deviations from the optimal allocation	income from sales for the month to deliver an average of UAH	restriction on the number of each type, min	restrictions on some. each type, max	output area under the guise m^2
Xi^*				Q_1	Q_2	Si
271	33,5096	3,899790849	6210	90	271	85
64	8,11266	4,91121393	1264	64	192	20
242	32,0963	0,008812743	5980	81	242	76
8822	1113,71	59,14539987	75028	2941	8822	2779
11202	1356,502	97,32366282	130 059	3 734	11 202	3529
4564	547,7766	62,62454422	58 487	1 521	4 564	1438
5662	790,5097	53,56461804	19 365	1 887	5 662	1784

several products to deliver	storage costs by types	deviations from the optimal allocation	income from sales for the month to deliver an average of UAH	restriction on the number of each type, min	restrictions on some. each type, max	output area under the guise m^2
11686	1480,043	43,45839816	82 349	3 895	11 686	3681
266	33,30775	91,97395408	2 453	266	797	84
18263	2333,22	79,64343986	193 291	6 088	18 263	5753
5947	824,3076	41,16548638	61 662	1 982	5 947	1873
1452	191,4617	36,34416656	16 466	484	1 452	457
814	104,7604	45,32009657	22 830	271	814	256
4527	582,619	85,44953611	52 808	1 509	4 527	1426
4850	605,4293	47,78242196	69 836	1 617	4 850	1528
18449	2490,596	97,80412142	284 932	6 150	18 449	5812
5566	708,7644	66,95710858	40 573	1 855	5 566	1753
199	26,23908	2,392550695	1 404	66	199	63
18	2,31474	1,527706835	182	18	53	6
102862	13265,28	921,2970297	1125 179	34 519	103 558	32 402

The value of the objective function thus amounted to 14.3984. The profit amounted to 34567 UAH.

introduction of calculating profit company increased to 32,567 UAH.

CONCLUSIONS

All of the models in the book, solution methods and techniques developed on the basis of the real problems that have been identified in real companies, banks, trade organizations, warehouses and more.

These problems are based on financial analysis of companies, but the approach to their solution was based only on the current achievements of cybernetics and applied mathematics.

The results of the economic and mathematical modeling always given company profits, reduced the risk of its activities, increased speed of execution of orders, and so on.

In most cases, the ease in obtaining optimal solutions based on the achievements of the great mathematicians cohort of 17-20 centuries. Therefore, it is worth mentioning the phrase Isaac Newton: "I climbed so high, because standing on the shoulders of giants."

In fact, now, in the 21st century we all stand on the shoulders of giants, thanks to tireless work which we can easily get the best possible solution to any economic problems.

So use them, adapt ready solutions when their problems, consult with experts, and so, therefore, achieves the best results in their work.

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