Розділ 4

Економіко-теоретичні аспекти розвитку фінансово-кредитних систем

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UNCERTAINTY, RISKS, INCOME

Abstract. The principles of accounting and estimations of probabilistic character of productive activity of enterprises, accepted in the methodology of accounting of uncertainty and risks, worked out by the author of this researches , are stated. The methodology is based on the fundamental postulates of probability theory, the theories of functions linearization and on the qualitative and quantitative technico-economical analysis in decision making are discussed. An example of the using this methodology with the solutions optimization is given. This methodology was adapted by the author over the past 10-15 years.
Keywords: probability, uncertainty, risks, performance of enterprise indicators, enterprise.
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НЕВИЗНАЧЕНІСТЬ, РИЗИКИ, ПРИБУТОК

Анотація. У статті наведені основні принципи обліку та оцінки імовірнісного характеру виробничої діяльності підприємств, прийняті в методології обліку невизначеності і ризиків, розробленій автором цього дослідження. Вказана методологія базується на основних постулатах теорії вірогідності, теорії лінеаризації функцій і на якісному і кількісному техніко-економічному аналізі при ухваленні рішень. Наданий приклад використання вказаної методології при оптимізації цих рішень. Вказана методологія адаптована автором упродовж останніх 10-15 років.
Ключові слова: вірогідність, невизначеність, ризики, показники діяльності підприємства, підприємство.
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НЕОПРЕДЕЛЕННОСТЬ, РИСКИ, ПРИБЫЛЬ

Аннотация. В статье приведены основные принципы учета и оценки вероятностного характера производственной деятельности предприятий, принятые в методологии учета неопределенности и рисков, разработанной автором этого исследования. Указанная методология базируется на основных постулатах теории вероятностей, теории линеаризации функций и на качественном и количественном технико-экономическом анализе при принятии

решений. Дан пример использования указанной методологии при оптимизации этих решений. Указанная методология адаптирована автором на протяжении последних 10-15 лет.

Ключевые слова: вероятность, неопределенность, риски, показатели деятельности предприятия, предприятие.

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Introduction.

The ideas of man about surrounding him nature constantly changed in time, however, it is hard to say with confidence if they are possibly get close to the truth. However, lately humanity considerably moved in understanding of the surrounding world, setting the rows of inevitabilities (laws) in the surrounding us world and some phenomena in terms of which they are appearing, and also studied properties of some separately taken material objects.

One of such objects is socio-economic objects or enterprises. Studying of these objects is necessary to be examined in the context of income and distribution of income. The source of difficulties here is a mess in thoughts that goes deep in fundamentals of our thinking. To extricate this ball, it is necessary to appeal to the concept of uncertainty and risk. Usually by term "risk", that is so freely used in everyday life and economic discussions, in researches and practical activities of enterprises different meaning is implied. Furthermore, our approaches to the risk will be depending directly on its type. A risk is displaying measurable uncertainty, and he so differs from an immeasurable uncertainty, that essentially is not uncertainty. There are a great number of «risk» concepts, and that is why this concept is so ambiguous, "uncertainty" concept is objectively enough and even classified. Immeasurable (authentic) uncertainty, but not a risk as it is accepted to assert, gives explanation of difference between the real and ideal ("calculation") economies.

Rising of task.

Uncertainty is the reason of consequence appearance – risks. A risk category becoming apparent with the help of a concept, which characterizes the uncertainty of flowing of economic processes, i.e. uncertainty gives an enterprise such feature, as risk. Uncertainty is the objective form of the surrounding world, it is conditioned by existence of accidentals as form of necessity displaying and reflection of the real phenomena in human consciousness, that is insurmountable because of general connection of all objects of the real world in endlessness of their development. One of the world's objects – an enterprise is hierarchical, not fully defined incidental system, which is continuously have influenced by a great number of reasons that are functioning in our world.

A risk appears only in those cases, when the system makes a decision (does purposeful actions). Therefore a risk is the practical estimation of possibility and consequences of realization of these actions. Uncertainty is a failure in prognostication of behavior a system on the base of the supposed (forecast) laws of her behavior and accessibility of information in her initial state. In the conditions of uncertainty a system can carry out an idea, postpone its realization or to cancel the idea implementation. Uncertainty is basis and reason for appearance of any crisis phenomena and situations (crises), therefore it is necessary to be able to estimate uncertainty, take into account in productive activity, to control it and manage the level fixed by it.

Analysis of science and practice latest achievements

As a result of analysis of a prevailing opinions, persuasions, looks, tendencies and conceptions of different researchers and practical workers in relation to a uncertainty and risks in the socio-economic systems it is necessary to mark following. The indicated opinions in relation to uncertainty are more or less set, risks opinions controversially – not set and most heterogeneous, even opposite.

A lot of foreign and home researchers were engaged in questions of uncertainty, such as Markoviz M., Cherkasov V, Truhaev R., Kapustin V ("Conception of Kapustin ") of and other questions of risk appearance, forming and management were investigated by the group of home and foreign researchers: Balabanov I., Bochkan T., Glushenko V., Algin A., Vitlinsky V., Granaturov V., Hovanov N., А.П. Backs, Arginbaev K., Kaminsky A., Postyshkov A., Chernoff V., Dubrov A., Dubrov V., Cherkasov F., Nait, A. Marshal A. and other.

Questions of uncertainty and risks, errors and mistakes at determination of enterprise performance are considered by the author of current research in which main principles of his methodology are given. Detailed definition of this methodology is given in his published treatise [1-26].

Research materials.
A. Appearance and forming of uncertainty, risks and errors and calculation of indexes.

Main reasons of uncertainty appearance (risk source) can be united in the following three large groups:

1. Spontaneity of natural processes and phenomena, natural calamities (earthquakes, floods, storms, hurricanes), and ordinary natural phenomena (frost, icy surface, hail, drought etc.). In the same group it is possible to add antagonistic tendencies and formation of contradictory interests (wars and international conflicts, competition and ordinary interests discrepancy).

2. Incompleteness, insufficiency, uncertainty, complete absence of information about the system or process phenomenon: limited possibilities of a man in collection and processing of information, and also errors that a person can make during this processes.

3. Probability of processes that take place in nature and in society (on enterprise). It is explainable by nature of the surrounding us phenomena, existing independently of us and our desires. It is necessary to distinguish three types of probabilities: prior probability (generates a priori, unstatistical, immeasurable uncertainty), statistical probability (generates a statistical measurable uncertainty). To the same group it is necessary to add on probabilistic character of scientific and technical progress.

There is no settled opinion about economic essence of risks, but there is a classification of uncertainty. It is characterized by next three qualifying signs:

1. On the degree of appearance of events a uncertainty is subdivided into a complete uncertainty (near to a "0" events which cannot be found neither in theory nor in practice); partial uncertainty (probability of occurrence of events ranges from 0 to 1 – theoretically and practically most common), total uncertainty (probability of occurrence of events is equal to 1 - theoretically and practically does not occur).

2. In accordance with the object of uncertainty it is divided on human, technical and social uncertainty.

3. Depending on how you define uncertainty * There are two types of it – measurable (statistical) and immeasurable (priori) the uncertainty. The most common type of uncertainty is mixed.

It is necessary to point out again that uncertainty and risks generated by it are shown in the case of decision-making and afterwards making specific action on this basis. If a decision and action appear statistically (measurable), we say that it is accepted at risk terms, if the decision is not statistically evident (infinitely), then we should talk about a priori uncertainty. From this point of view – the risk is the qualitative side of manifestation of measurable uncertainty, quantitative aspect of risk characterizes the degree of loss and income generated mainly repetitive (not random) causes.

Accounting of such systematic reasons can be made with the help of their elimination or reduction with using of qualitative or quantitative economic analysis. This will require additional resources (costs) which are defined on the basis of this analysis, and characterizes loses of their actions. For accounting of accidental causes influence it is necessary to you probability theory mechanism, there may be produced only a comprehensive record of all accidental causes; nowadays it is impossible to the each random reason even by using scientific researches. We can only determine the changes in selected enterprise indicators from the complex influence of accidental causes, tin other words we need to determine maximum and minimum values of the selected indicator (criterion), which characterizes considered enterprise in the best and the most ways. In the capacity such indicator either gross, net income or the value of the business entity or other indicator can be used.

Accounting and assessment of the impact of systematic and random factors are needed only if at the same time we are able to determine how the main indicators are changing, taking into account the uncertainty of two types, that is necessary to make a quantitative calculation with deterministic (perfect enterprise and ideal economy) and " indefinite " (a real company and the real economy) approach to the subject. In most of the known approaches and is not provided. In other words, we need to determine the size (amount) of the errors and mistakes that we assume in the calculations in an ideal economy based on norms and standards that we are applying in this settlement.

Thus, by taking into account the uncertainty we receive following chain of impact: the reason is forming the uncertainty, uncertainly raises risks, risks form errors in calculations and computations produce some errors in determining the enterprise performance. This leads to almost one and all not mastering of the basic project (predictable) indicators (productivity, cost, profit, business value, capital investments and others.) of an enterprise. And this, in turn, leads to non-fulfillment of macroeconomic indicators of the state. Accounting the effects of parameters considered above "in chain" will help to avoid such drawback for the economies of all countries and any economy. To resolve this issue, many large companies (corporations, companies), and some countries have resorted to plan their activities, which is called "to nail" and have some success in doing so. As an alternative to this activity, which has a number of shortcomings, we propose the transition to probabilistic calculations of enterprise performance, which allows taking into account the uncertainty of their work. Summing up, it should be noted that on the basis of data about process structure of incorporating measurable uncertainty, it is necessary to point out that systematic theoretical reasons (risks) do not exist, but there is the cost required for the alignment of losses that can and should be calculated in managing of such uncertainty.

In terms of accounting, assessment, regulation, control and assurance of enterprises activity in terms of uncertainty, all parameters that are considered "in chain" parameters of uncertainty accounting (the reasons of uncertainty, risk, uncertainty and errors) can be divided into two groups; for ease of future use of these terms, we call them "systematic" and "random".

Random parameters in terms of non-measurable uncertainty are characterized by the fact that the causes of uncertainty (therefore uncertainties by themselves, generated risks, errors and inaccuracies formed by them) isn't know for us and will not be known separately on the current stage of economic science and practice development. We can only define the limits of the main changes (minor) complex (not complex) enterprise performance indicators under the influence of random factors complex (parameters). There is implied only identify these limits, as confidence intervals using probability theory and the theory of functions linearization (for a system of random variables).

Systematic reasons (uncertainty, risks, errors, bugs) are repeated systematically and well known in the direction of magnitude, location and time, thus may be take into account by

identifying and controlling of size these measurable uncertainty causes with different methods of qualitative and quantitative feasibility analysis for different situations by determining the losses and costs for their elimination. Examples of systematic risk are shown in Table 1. Figure 1 shows the general diagram of the appearance and accounting uncertainty risks, errors and the formation of profit.

In economic research and in practical economic activity it is necessary to determine the existence and size of a complex random and systematic causes of uncertainty, risks, mistakes and errors in determining performance of enterprises in the conditions of uncertainty. Below methods and means of determining and accounting of those parameters will be given.

Table 1

Systematic uncertainty and risks

№	Reasons of uncertainty and risks	№	Systematic risks
1	Demand Instability	1	The decrease in demand because of price rising
2	Alternative product appearance	2	Decrease in demand
3	Competitors Price-cutting	3	Price abatement
4	Increase competitors manufacturing	4	Drop in sales or price reductions
5	Tax increase	5	Net income reduction
6	Decrease in consumers purchasing power	6	Drop in sales
7	Rising prices on raw materials and transportation	7	Decline in profit because of rising prices on raw materials and transportation.
8	Dependence from suppliers (absence of alternative)	8	Decrease in profit because of price rising.
9	Lack of circulating assets	9	Increase in credits or a decrease in production.

Uncertainty reasons

Probability (P)

- Measurable (statistical) — 1 type
- Evaluation (intermediate) — 2 type
- Immeasurable (a priori) — 3 type

Account and management

B

- Complete definiteness
- Partial indefinite (0< P <1)
- Complete uncertainty (P=0)

Degree of event appearance

Offered methods of management
1. Probabilistic-statistical
2. Methods of interval mathematics
3. Theory methods

IV group
1. Probabilistic nature of STP

III GROUP
1. Indeterminacy (random) of systems (probabilistic nature of systems)

II GROUP
1. Incompleteness of information
2. Unreliability of information
3. Lack of information

I GROUP
1. Natural disasters
2. Anomalous natural phenomena
3. Antagonistic tendencies

Uncertainty

A method of probability determining of uncertainties appearance.

B

IMMEASURABLE uncertainty (a priori)

MEASURABLE uncertainty (statistical)

Determination of confidence intervals, indexes (total account of all reasons of risks)

Liquidation of reasons that causing certain reason of uncertainty appearance

Quantitative side - losses of income /or profit

Losses degree - risk degree

I and II groups of uncertainty reasons

Existent criteria of making decision
1. Rule of maximin (criteria of Wald)
2. Maximax rule
3. Minimax rule (Sevige criterion)
4. Hurwitz rule
5. Baisse rule
6. Bernoulli criterion
7. Laplace criterion
8. M and B criterion

A

Uncertainty object
- Social uncertainty
- Technical uncertainty
- Human uncertainty

RISK (at decision-making)

Casual: reasons, vagueness, risks

III and IV groups of uncertainty reasons

Quality side – " RISK" concept

Systematic: reasons, uncertainty, risks

INCOME (loss)

Errors of indexes determination

Random errors (reasons, uncertainty, risks)

Systematic errors (reasons, uncertainty, risks)

Verification of presence of systematic and casual errors

Systematic errors

Accidental errors
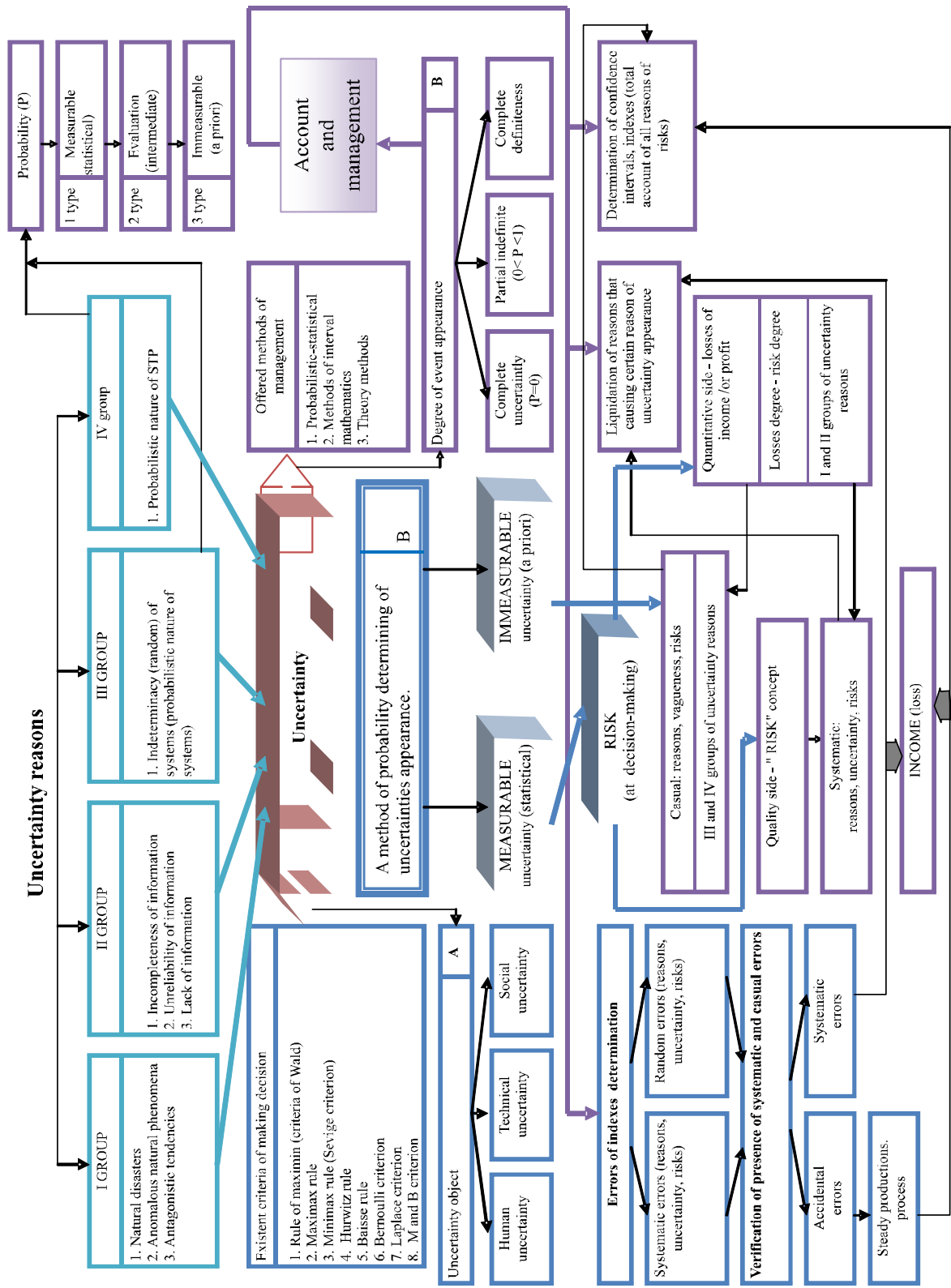
Steady productions. process

Fig. 1. Chart of appearance, estimation and management of uncertainty, risks, errors, income

B. Assessment and accounting of uncertainty and risks.

Before defining the enterprise performance indicators with taking into account the uncertainty and risks it is necessary to determine existence of systematic and random errors.

a) the Basic signs of stable productive process.

Quantitative technical-economical performance of the enterprise, defining the level of the production process, that changing continuously in certain intervals and are objects probability theory. They can be applied to qualitative technico-economical indicators. From the standpoint of probability theory, stable production process is called a process of production in which all production error, i. e. the error in determining the value of technico-economical parameters, arising from errors in case of their determination, are referring random. Thus, problem of stabilization in any manufacturing process adding up to detecting of systematic errors and to eliminate their causes.

Detection of the errors and inaccuracies presence in the manufacturing process may be made by comparing of the average values of the i-th indicator calculated for a quarter (month) for two consistent t-periods of time. If it will appear that:

$$\Delta \bar{X}_{i,t} = \bar{X}_{i,t} - \bar{X}_{i,t-1} \rangle K_s, \qquad (1)$$

It should be considered that in determining of the i-th index characterizing this production process, there are systematic errors, and so the production process is not sustainable and stable. Then with the help of quantitative and qualitative techico-economical analysis determine the causes of these errors and begin to identify the size of considered indicators with taking into account only random errors. The size of criterion K is driven to the table 2. Stated ratio (1) (inequality) and value can be seen at the conviction of researcher in normality of distribution index X and which following conditions: homogeneity of the samples, the adequacy of its volume, independence of the arguments and lack of dominant inaccuracy. If the specified condition is not satisfied, then we can assume that in the prospective and retrospect (for a period equal to 2t). This production process is stable and we should immediately begin to determine the parameters of its activities, with taking into account only random errors. Ability of transferring production process stability from pre-history for perspective should be confirmed by a certain techno-economic analysis of the production process.

Method for determining the enterprise performance with taking into account and without consideration of uncertainties and risks, let's consider following example.

B) Example of calculation of indexes with taking into account probabilistic character of production.

At the considered enterprise for some time periods (quarter, month) total prehistory of t-period average value of income was determined and is equal to 100 UAH. and operating cost value equal 80grn. (= 100 n = 80). Based on the analysis in t period it was found that there are no (stable production process) systematic errors on particular enterprise (production) and random errors are normally distributed (with fulfillment of all additional conditions mentioned above). As a result of enterprise activity analysis it was assumed that the prospective indicator of the company for the T period (prospective) can be accepted at the

level of arithmetical mean values for the retrospective period t. $D_T = \bar{D}_t$ =100 UAH and $Ç_T$

= $\bar{Ç}_t$ =80 UAH. Then we can assume that the deterministic (estimated) value of the gross

profits of the enterprise for the prospective T period will be $\ddot{I}_T$ = 20 UAH. ($\ddot{I}_T = D_T - Ç_T$ = 100 - 80 = 20 UAH. - For simplifying of calculations such method of determining the gross profit is accepted).

On this basis, we can calculate the minimum and maximum possible values of profit that can be met a number of times (n) for the T period with reliability of this assumption, equal P=95% and accuracy, not less that θ =90%. (error $\tau = 1 - \theta \leq 10\%$)

Minimum value $\ddot{I}_T$ - min $\{ \ddot{I}_T \}$ can be calculated, on the basis of following ratio:

$$\min \{ \ddot{I}_T \} = \min \{ D_T \} - \max \{ \zeta_T \}; \qquad (2)$$

The maximal value of income for the same period will be equal to:

$$\max \{ \ddot{I}_T \} = \max \{ D_T \} - \min \{ \zeta_T \}. \qquad (3)$$

Where, the "min" index means minimum, and "max" index mean maximal value of the examined index (X_T - D_T or ζ_T).

The minimum and maximum value of index X_T is determined from next correlations:

$$\min \{ X_T \} = X_T \ K_a ; \qquad (4)$$

$$\max \{ X_T \} = X_T \ (2 - K_a). \qquad (5)$$

Where, K_a is a coefficient which is taking into account minimum size of interval of the examined index $X_T = I (X_T) = \min \{ X_T \} \div \max \{ X_T \}$; values of K_a are given in the table 2 (depending on the reliability size P and accuracy θ =10%.

Table 2

K_a and K_s coefficients value

P, %	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
K_s	1,282	1,310	1,340	1,371	1,404	1,439	1,475	1,513	1,554	1,597	1,643	1,694	1,750	1,810	1,880	1,960	2,093	2,169	2,323	2,576
K_a	0,87	0,87	0,87	0,86	0,86	0,86	0,85	0,85	0,84	0,84	0,84	0,83	0,82	0,82	0,81	0,80	0,80	0,78	0,77	0,74

Thus minimum (min $\{ \ddot{I}_T \}$) and maximum (max $\{ \ddot{I}_T \}$) possible size of gross revenue in separate moments of prospect T period, for all parameters can be equal to P=95%% and accuracy $\theta = 10\%$, can compose next values:

$$\min \{ \ddot{I}_T \} = D_T \times K_a - \c{C}_T (2 - K_a) = 100 \times 0{,}80 - 80(2 - 0{,}80) = 80 - 96 = -16$$

$$\max \{ \ddot{I}_T \} = D_T (2 - K_a) - \c{C}_T \times K_a = 100 (2 - 0{,}8) - 80 \times 0{,}80 = 120 - 64 = 56$$

Therefore, with probability of 95% and accuracy of not less than 90%, it can be stated that on the considered enterprise, gross margin in prospective T period may vary from loss of 16 USD. to profit equal to 56 UAH. Furthermore, it will sometimes be equal to deterministic calculated value, 20 UAH. Such situation can not satisfy us, so we should define it with taking into consideration mentioned values of P and θ what should be the size of $D_T^{(\c{C})}$ and/or $\c{C}_T^{(\c{C})}$. Minimum value needs to be not less than, 10 UAH. These calculations can be made by the following rations:

$$D_T^{(\c{C})} = [\min \{ \ddot{I}_T \} = \ddot{I}_T^{(\c{C})} + \c{C}_T (2 - K_a)] : K_a = [10 + 80 \times 1{,}2] : 0{,}8 = 116 : 0{,}8 = 132{,}5 \text{ UAH.}$$

if $\c{C}_T$ =80 UAH.

$$\c{C}_T^{(\c{C})} = [D_T \times K_a - \min \{ \ddot{I}_T \} = \ddot{I}_T^{(\c{C})}] : (2 - K_a) = (100 \times 0{,}8 - 10) : 1{,}2 = 58{,}3 \text{ UAH}$$

if D_T = 100 UAH.

Thereby that a minimum value of income was no less 10 UAH. on the examined enterprise during T period it is necessary to keep profit on the level not less than 132,5 UAH, and expanses shouldn't exceed 80UAH. Or, that expanses should no more 58,3 UAH, and profits no less than 100 UAH.

This example shows that with the help of developed uncertainty accounting methodology it is possible to determine boundary values of key a performance indicators of the considered enterprise in with fixed value of a criterion function.

Computational (deterministic) and probability values of the main company performance indicators (revenues, expenses and gross profit) for the different, variants of calculations mentioned above summarized in the Table 3.

Analyzing the data in this table, it should be noted that the first variant of calculations for the relation between income (D) and costs ($\c{C}$), equal to their calculated values D : $\c{C}$ =100, : 80, is totally ineffective, since the minimum possible value of gross profit (P) can be negative n number of times during the period T; the second variant of calculation (calculated ratio: D : $\c{C}$ =132,5: 80) does not have this drawback, but it has wider range of changes interval.

Table 3

Variants of calculations of indexes

№	Type of values indexes	Indexes, UAH.			Possible interval of income
		Profits	Expenses	Gross revenue	
I	Miniamal	80	64	-16	I = -16 ÷ 56
	Calculation*	100	80	20	
	Maximal	120	96	56	
II	Minimal	106	64	10	i = 10 ÷ 95
	Calculation*	132,5	80	52,5	
	Maximal	159	96	95	
III	Minimal	80	46,6	10	i = 10 ÷ 73,4
	Calculation*	100	58,3	41,7	
	Maximal	120	70	73,4	

*) determined value

Profit value (85 UAH. against UAH 63.4. of third variant of calculations) – the ratio of the calculated values for the third option is $D : \zeta$ =100: 58,3, which is worse than second variant of the calculation, but it (the second option) has large value of profit (52,5 UAH versus 41,7 UAH.), which is more preferable in terms of its effectiveness.

Summing up a brief analysis of the calculations, it should be noted that using the proposed method of accounting, valuation, standardization, control and enforcement of uncertainty and risks is possible, except indicated one, to determine the optimal ratio of the values of the main indicators of the company, taking into account the probabilistic nature of the manufacturing on it.

example of uncertainty calculations to the realities which are more close to realities of economic life with taking into account the individual cost, components, such as income and/or expenses (functional relationships), with determination of optimum reliability and accuracy of the calculations can be performed by using the proposed methodology, published in detail and with mathematical calculations in scientific works of the author of this study.

Conclusions and recommendations

One of those problems is accounting and evaluation of the probabilistic nature of production at the delaminated enterprise. This raises a number of problems that must be solved in order to achieve an optimal level of these decisions.

One of these problems is an account and estimation of probabilistic character of production on the examined enterprise. For solving this issue, a large number of approaches based on qualitative economic analysis in the aggregate with the applied mathematical methods are existing. But analysis have showed that almost all o f them, don't give an opportunity quantitatively evaluate changes of main enterprise indicators which taking into account pobalistic character of enterprise. Developed by the author of this study, methodology of accounting of invalidation, risks and uncertainties deterministic calculation of key performance indicators of manufacturing enterprises allows taking into account the probabilistic nature of its production.

According to the author's opinion, in practice of economic researches and in practice activity it is necessary to use along with the deterministic calculations, calculations based on the probabilistic accounting of production activities of the enterprises, which are real, but not to use ideal-calculation instruments of accounting enterprises activity of the real economy. In this work, an example of using this methodology is given, which took great amount of adaptation calculations and studies carried out by the author and his colleagues over the past 10-15 years.

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