IMPORTANT ASPECTS OF THE METHODS USED IN THE RISK ANALYSIS OF INVESTMENT PROJECTS

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ANNOTATION

The article deals with the analysis of risks in investment projects. We present a comparative analysis of the methods for determining the risk in investment projects.

Key words: investment project, risk, fuzzy set, Monte Carlo method, linguistic variable, membership function.

Accounting for risk and studying it comprehensively is becoming an important part of the success of any industry, enterprise and organization. However, industries and businesses often have to make decisions in conditions of uncertainty, which can lead to losses and unintended consequences by them. Such serious consequences occur when making wrong decisions regarding long-term investments, i.e. in the process of misjudging investment projects. Therefore, timely identification of risks and their correct assessment is one of the most important problems of investment analysis today.

Unfortunately, the existing methods of risk identification today are not free from subjectivism and the existing situation, and they lead to an incorrect assessment of risks in investment projects [1].

Uncertain logic theory is a new, dynamically evolving approach to risk assessment. Recently, uncertain modeling has become one of the most active and promising areas of applied research in the field of management and decision making.

Let's look at the concepts of "risk" and "uncertainty".

Uncertainty is a situation in which there can be many consequences, but the results of actions are not clear, i.e. their probability is unknown.

Risk is a situation in which the number of outcomes is known and the probabilities for each of them are known, the impossibility of obtaining the expected results in achieving the set goal, or the insecurity that arises in achieving it, the probability of loss, or the probability of obtaining a different result.

Thus, risk is a subjective assessment of objective uncertainty. If uncertainty is an insurmountable quality of the market environment, risk is a quantitative characteristic of the possibility of loss.

The risk of an investment project is the possible deviation of future cash flows from the expected cash flows of the project, which is mainly due to external (legislation, market reaction to the developed product, competition behavior) and internal factors (competence of employees, errors in project characteristics) and information occurs as a result of lack and asymmetry.

One of the main ways to take risks into account when analyzing investment projects is qualitative analysis.

The purpose of the qualitative analysis method is to find specific types of project risks that affect the formation of cash flows and the possible causes of their occurrence.

Qualitative analysis methods include expert evaluation and analogy methods.

The advantage of these methods is that they can be used in the development of recommendations to obtain clear results and to minimize the identified risks. On the downside, there is no quantitative assessment of risk.

The purpose of the method of quantitative analysis is to determine a certain quantitative characteristic of the risks, to show what the consequences of this or that risk for the investment project.

As a measure of risk, the variance, the standard deviation, the coefficient of variation of the annual cash flows of the investment project, etc. is obtained.

Sensitivity analysis is important when considering risks in the analysis of investment projects. The purpose is to determine the sensitivity of the criteria in the "consecutive - single" change of each variable. The positive aspects of this analysis are its simplicity of application and demonstration of the results.

The purpose of the scenario analysis method is to view the inefficient risk of the project as the sum of the negative values of the NPV probability of the project. The disadvantages of this method are subjectivism in determining the probability of each scenario under consideration, and the fact that it does not cover all possible options and scenarios of project development.

The purpose of the simulation modeling method (Monte Carlo method) is to provide a distribution of project profitability using iterations, i.e., the average value for a set of NPV values and the amount of risk. The advantages of simulation modeling are that it can be successfully combined with obtaining accurate and quantitative estimates for project risks, economic-mathematical methods, and game theory and other methods of operations research.

Today, the method of uncertain logic plays an important role in the analysis of the risk of investment projects.

Uncertainty set theory is a new approach to the expression of business processes, in which there is uncertainty that denies and complicates even specific quantitative methods and approaches. A key distinguishing feature of fuzzy logic theory is the inclusion of linguistic variables in the analysis process.

Linguistic variables are variables that cannot be expressed using mathematical language, i.e. they are difficult to quantify accurately. For example, the concepts of “small” and “average” (in business), “high” or “low” (interest rate) have no clear boundaries and cannot be clearly expressed mathematically.

The main instrument of the indefinite set method is the relevance function. The relevance function is an instrument that then translates a linguistic variable into mathematical language using the indefinite set method.

Some mathematical function as a function of belonging $\mu_A(X)$ is calculated and then the elements of set X belong to the indefinite set A given. The more the argument X corresponds to the indefinite set A, $\mu_A(X)$ the value is also so large that the argument value is close to 1. Expert assessments are the basis for constructing the relevance function.

The main types of relational functions are triangular, trapezoidal, segmented-linear, Gaussian distribution, sigmoidal functions.

The triangular view of the affiliation function is the most commonly used type in practice in the analysis of investment projects.

The number A in the triangle is given using 3 parameters: minimum value (a), modal value (b) and maximum value (s), P = (a, b, c). This is consistent with pessimistic, baseline, and optimistic scenarios (Figure 1).

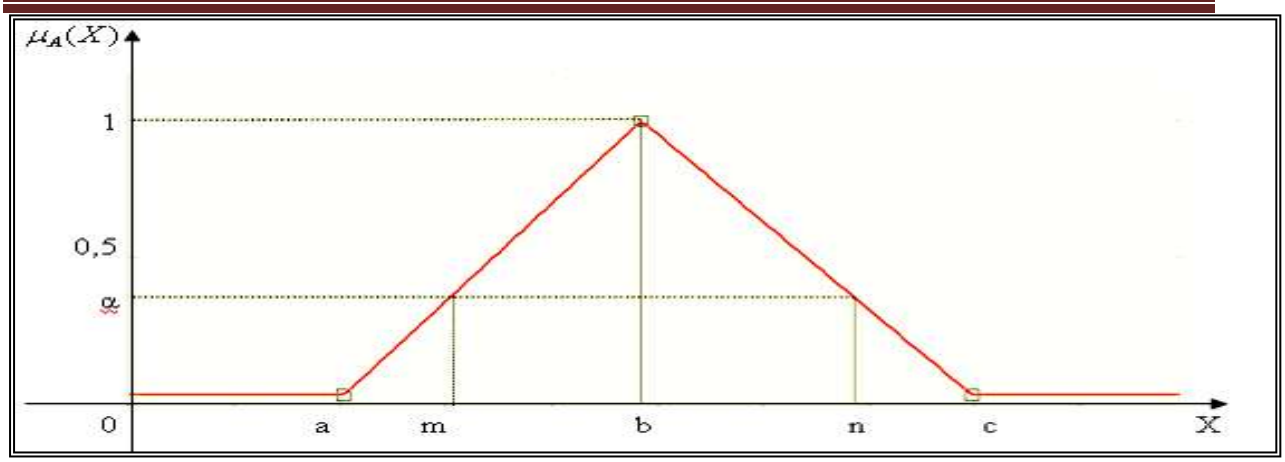

Figure 1. The triangular type of the relation function

The NPV in an optional investment project can be reduced to a triangular number:

$$NPV = \left(NPV_1, \overline{NPV}, NPV_2\right), \qquad (1)$$

here NPV_1 - net cash flow in the optimistic scenario;

NPV_2 - net cash income in a pessimistic scenario;

$\overline{NPV}$ - expected net cash income;

G – project efficiency criterion (usually assumed to be zero).

If the NPV value is greater than the G criterion given by the investors, the project is considered profitable. Determining the marginal values of net income, the relation function can be expressed as follows:

$$NPV_1 = \alpha\left(\overline{NPV} - NPV_{\min}\right) + NPV_{\min} \qquad (2)$$

$$NPV_2 = NPV_{\max} - \alpha\left(NPV_{\max} - \overline{NPV}\right) \qquad (3)$$

$$V\,\&\,M^* = \int_0^{\alpha_1} \varphi^*(\alpha)\,d\alpha\,, (*)$$

here $\varphi^*(\alpha) = \begin{cases} 0, & G \le NPV_1 \\ \dfrac{G - NPV_1}{NPV_2 - NPV_1}, & NPV_1 < G < NPV_2 \\ 1, & NPV_2 \le G \end{cases}$.

Integrally, the above equation can be summarized as follows:

$$V\,\&\,M^* = \begin{cases} 0, & G < NPV_{\min} \\ R \times \left(1 + \dfrac{1-\alpha_1}{\alpha_1}\ln(1-\alpha_1)\right), & NPV_{\min} \le G < \overline{NPV} \\ 1 - (1-R) \times \left(1 + \dfrac{1-\alpha_1}{\alpha_1}\ln(1-\alpha_1)\right), & \overline{NPV} \le G < NPV_{\max} \\ 1, & NPV_{\max} \le G \end{cases} \quad (**),$$

here $R = \begin{cases} \dfrac{G - NPV_{\min}}{NPV_{\max} - NPV_{\min}}, & G < NPV_{\max} \\ 1, & NPV_{\max} \le G \end{cases}$

$$\alpha_1 = \begin{cases} 0, & G < NPV_{\min} \\ \dfrac{G - NPV_{\min}}{\overline{NPV} - NPV_{\min}}, & NPV_{\min} \le G < \overline{NPV} \\ \dfrac{NPV_{\max} - G}{NPV_{\max} - \overline{NPV}}, & \overline{NPV} \le G < NPV_{\max} \\ 0, & NPV_{\max} \le G \end{cases} \quad (4)$$

prices take values from 0 to 1, each investor can classify their values based on their investment preferences, for which they must select unacceptable parts of the risk.

Based on the use of the method of indefinite packages, the following can be achieved:

- possible complete scenarios of the investment process are formed;

- decisions are made not on the basis of two assessments of project effectiveness, but on the basis of a whole set of assessments;

- the expected efficiency of the project is not a point indicator, but reflects the interval areas that have their expected distribution value, and indicates that the relevance function has an indefinite number.

In addition, the inclusion of qualitative variables in the analysis, operations on ambiguous input data, work with linguistic criteria, rapid modeling of complex dynamic systems and their comparison at a given level of accuracy allow to overcome the shortcomings and limitations of existing methods of project risk assessment.

Thus, the method of uncertain aggregates in the analysis of the risk of investment projects is a method of active economic analysis in the absence of the use of other methods without rejecting the use of statistical methods.

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