Simulation modelling as a method of risk analysis in real estate valuation

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Abstract. The advent of the fourth industrial revolution was marked by the fact that changes became the main characteristics of the new time. It means a high level of uncertainty and instability in the business environment. The real estate market, being a part of the investment market, is changing. The current development of Russia's investment potential leads to an increasing need for professional management of the profitability of such investments. Thus, the main goal of this research is to present non-traditional methods of risk assessment, which should be used in determining the market value of the real estate object at the present time. Simulation modelling is a method of research in which the system under study is replaced by a model that describes the real system with sufficient, with which experiments are conducted in order to obtain information about this system. An example of the application of simulation modelling in the analysis for the purpose of choosing the best and most effective use of a land plot as conditionally free is given. Financing of investment projects is a dynamic process that requires a risk assessment.

1. Introduction

The fourth industrial revolution has an impact on all spheres of activity, and the economic sphere is experiencing the most significant changes. Big changes and a high degree of uncertainty in the external environment are new challenges of our time [1-2]. The real estate market, being a part of the investment market, is the sphere of capital investment in real estate objects as a financial instrument in real form. The current development of Russia's investment potential [3-6] leads to an increasing need for professional management of the profitability of such investments. In addition to evaluating the effectiveness of investment projects, the management functions include:

- qualitative risk analysis (structuring and forecasting of income and expenses for a real estate object as an investment asset, choosing the optimal size of a real estate object when investing in its development, evaluating the rate of return on capital) [7];
- quantitative risk assessments of real estate investments;
- finding ways to reduce risks in investment design [8];
- the development of recommendations about the increase of management efficiency with return on investment in real estate [9].

There are two types of investment in real estate [10]: the purchase of a profitable real estate object and the creation of a new profitable object. An investor almost always first needs to solve a strategic problem: whether to purchase a ready-made object (with or without subsequent reconstruction) or create a new object that meets the modern needs of the market. The final decision is made by the investor based

on the analysis performed in order to select the best and most effective use of the object, taking into account the fundamental principles of valuation.

Evaluating the effectiveness of investment in real estate is based on processing a large amount of current input data, and also requires forecasting future cash flows and the value of the rate of return on capital. The characteristics of the investment object (its uniqueness and the lack of reliable market information in the public domain) lead to the fact that it is usually known not the specific values of the quantities used in calculations, but the ranges of their changes. Possible errors in the source data or in the forecast of their changes require the use of methods to account for the impact of such uncertainty on the results obtained.

And so, the final decision is made by the investor at the preparatory stage of the investment project [11], guided by the results of choosing the best and most effective use of the object. This analysis should be accompanied by an assessment of hazard indicators (under conditions of uncertainty) and importance (under conditions of risk). In addition to traditional methods of quantifying possible losses (sensitivity analysis and scenario analysis), it is necessary to use methods of simulation modelling, game theory, quasi metric modelling and hierarchy analysis.

So, the main goal of this study is to present non-traditional methods of risk assessment, which should be used in determining the market value of the real estate object at the present time, which is characterized by a high degree of uncertainty and instability of business environment. An example of the simulation modelling method is done.

2. Materials and Methods

Simulation modelling is a method of research in which the system under study is replaced by a model that describes the real system with sufficient accuracy (the built model describes the processes as they would take place in reality), with which experiments are conducted in order to obtain information about this system. Such a model can be "played" in time, either for a single test or for a given set of tests. The results will be determined by the random nature of the processes. You can use this data to get fairly stable statistics. Experimentation with a model is called imitation (imitation is the comprehension of the essence of a phenomenon, without resorting to experiments on a real object).

The use of the simulation modelling method [12-14] when choosing the best and most effective use of the real estate object allows to:

- simultaneously simulate random changes of several components of the project, taking into account the conditions of correlation;
- automatically generate scenarios from the ranges of possible changes in random variables and selected distribution laws;
- avoid errors when assigning probabilities for each scenario;
- to make a decision, being guided not only by maximizing the effective variable but also by an acceptable (minimal) measure of risk.

3. Results and Discussion

An example of the application of simulation modelling in the analysis for the purpose of choosing the best and most effective use of a land plot as conditionally free is given. The remainder technique is used to determine the value of a land plot.

The distribution of factors (cost of improvements, capitalization coefficient for improvements, net operating income, capitalization coefficient for land) is chosen evenly, since the ranges of input parameters are found for a specific object and it is assumed that in a given interval, the factor can take any value with equal probability. Based on the dependence of the test result on their number, derived by the author in [15], we assume the number of tests equal to 20,000. There is no multicollinearity between factors. The results of the analysis in order to select the best and most effective use of the land plot according to the cost maximization criterion are shown in figure 1 and figure 2.

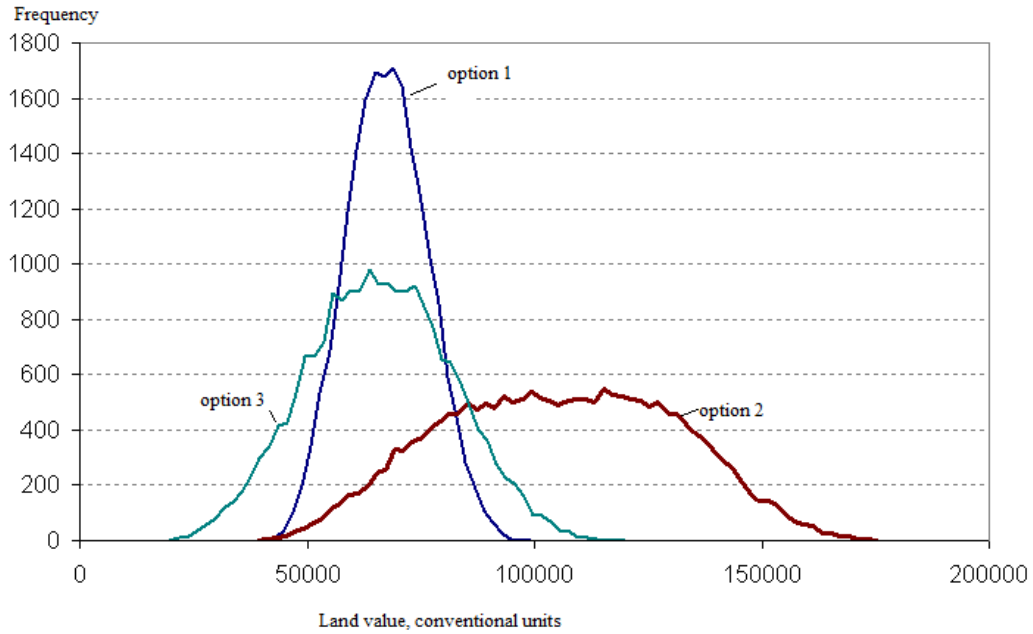

Figure 1. The histogram for the use of land (developed by the authors)

The first option has a wide and flat polygon, which indicates a high risk of uncertainty with a large spread. The polygon of option 1 is shifted to the right along the abscissus axis, i.e. this option corresponds to the maximum cost of land. Options 1 and 3 overlap, so the cost of land is about the same, but option 1 has a smaller spread (the polygon is narrow and drawn up), and therefore less risk than option 2,

Comparing the probability of realizing the value of land in these use cases, you can see that with a probability of 60%, the first of them has a greater value of the land plot in comparison with the third. The second option is 100% likely to have the maximum cost (figure 2).

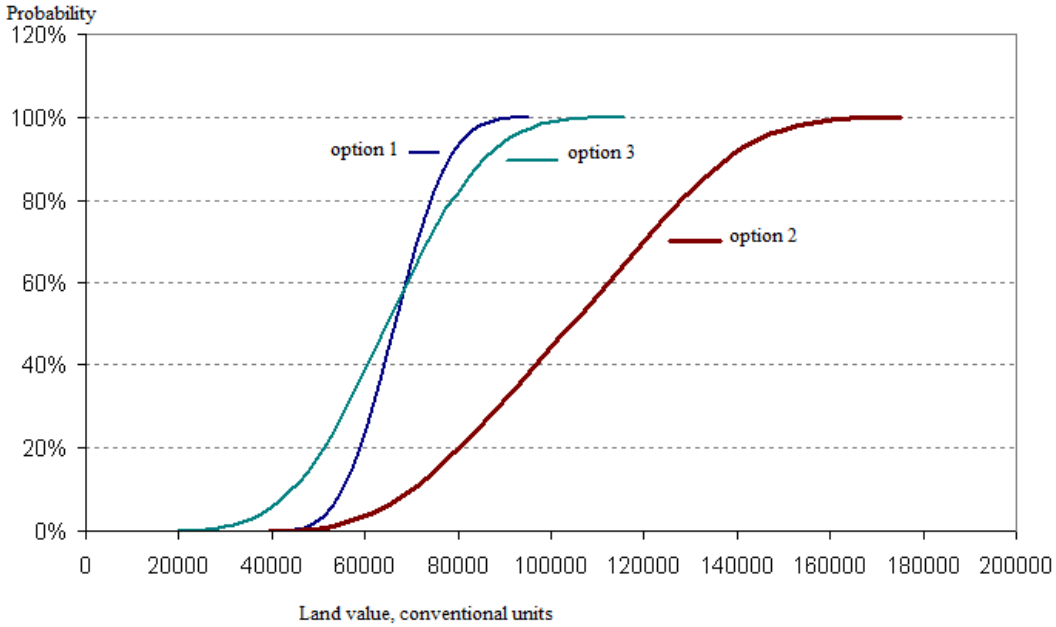

Figure 2. The cumulative probability for the use of land (developed by the authors)

Thus, the analysis confirmed the analyst's decision to choose the second option even at greater risk.

The application of the simulation modelling method will also help to determine the rate of return of the extraction technique and the cost of the object with a profitable approach. In this case, the variable factors will be the rental rate, operating expenses, the cost of reversion, as well as the dynamics of changes in these factors.

When evaluating investments in real estate, the question of the comparability criteria of the compared options in terms of choosing the size of the compared buildings of various functional purposes is not addressed. Meanwhile, it should be borne in mind that in accordance with the principle of added productivity and the above-mentioned principle of increasing and decreasing returns, the value of a land plot will first increase with the growth of the size of the building, and then begin to decrease.

Indeed, for a fixed plot size changes the size of the structure will be mainly due to the increase in the height of the building, which would itself increase the cost of construction per unit area of the latter.

4. Conclusion

In conclusion, it should be noted that a common disadvantage of investment design is the lack of development of the marketing strategy. Insufficient market and competition research leads to an overestimation of projected rental rates and occupancy rates.

In the conditions of uncertainty and instability of business environment provoked by the onset of the fourth industrial revolution, it is proposed to use not only traditional methods of quantitative assessment of possible losses (sensitivity analysis and scenario analysis), but also methods that are not used in standard packages (such as simulation modelling method) at the stage of choosing the best and most effective use of the object at a strategically important stage for the investor.

Financing of investment projects is a dynamic process at any moment, the project implementation conditions may change, which leads to automatic changes in the previously calculated project results. Therefore, much attention should be paid to risk analysis in project performance calculations.

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Acknowledgements
This research work was supported by the Academic Excellence Project 5-100 proposed by Peter the Great St. Petersburg Polytechnic University.