Software system for supporting the decision-making on the investments

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Abstract. Investments in real estate are considered by investors as the best way to preserve and increase capital in the long term. Investing in real estate allows the investor to dispose independently of the acquired property at his discretion, including giving and inheriting, and using it for investment purposes - to lease or resell for profit. It is proposed to analyze the algorithm of actions to facilitate the decision-making on the investment purchase of residential real estate and to work out some “unchanged” points of the algorithm that can help in making this decision. Based on this, the stages that are included in this algorithm are analyzed, as well as three types of strategies for investing in residential real estate. A program is considered that allows calculating the profitability of investing in an object for an investor for each type of strategy, using certain factors associated with the property.

1. Introduction
Interest in assessing the market value of the residential real estate is determined by the value that has the result of the assessment when making decisions regarding actions with this real estate [1, 2]. This assessment result may be a guideline when deciding whether to conduct sales transactions, to enter into the rights of heirs, for insurance or privatization of property, for the division of property, for registration of a mortgage loan [3, 4].

The economic success of investments in residential real estate depends on the choice of the investment object, its current and future value, which is influenced by various factors. In this connection, this issue of determining the factors affecting the value of real estate should be given maximum attention to make the right decisions when investing in the real estate market of the city of Krasnoyarsk. Under the investment, the investor’s activity based on investments and expenses of own capital will be taken in order to achieve long-term business goals that are not related to current consumption but are aimed at the result in the form of profit and income[5 - 7].

2. Explanatory part
The data were analyzed, with the help of which the methodology for assessing the investment attractiveness of residential real estate in the form of an algorithm will be further developed. This algorithm will be implemented in a program that will help resolve the issue of investment. Within the
framework of the methodology, the following conditions for the formation of the algorithm will be considered:

- Investments occur at the expense of the investor’s own funds, (borrowed funds are not considered since it was found that the use of borrowed funds is a way to save capital, and not to increase it).
- Investor - an individual who can also be represented as an individual entrepreneur whose main purpose is to make a profit from a purchased residential property.

3. Consideration of the stages of algorithm

Consider this algorithm, based on the generated input data for the methodology of assessing the attractiveness of investment in residential real estate, in stages.

Stage I. «Collection and refinement of information on the investor's incoming data», that is, at this stage the investor must identify the need for investments and form expectations from them. Next, we need to determine the investment budget. Since we have adopted for the main goal - making a profit, it is therefore advisable to first allocate a budget, and then pick up real estate.

Stage II. «The formation of many models/alternatives for use». Based on the results of the first stage, in the second stage, the investor can determine the directions and types of residential real estate available for purchase. To do this, the investor should further analyze the current state of the market and determine whether it is worth investing at a given time, since it is possible that the cost of objects on the market is artificially increased. The market is oversaturated and in this situation, the acquired property will become illiquid residential real estate that can not be sold or leased rent for profit.

In this case, the investor understands how much money he has in circulation and, based on the general state of the market, begins the selection of real estate objects that fit his investment criteria. In parallel with this, the investor determines for himself the terms for which he is ready to invest these investments, as well as the investment strategy and the residential property suitable for the purposes of the strategy according to the parameters. Figure 1 provides a brief description of the strategies.

![Figure 1](image)

**Figure 1.** Strategies for use of residential property.

Together with the definition of the strategy, the type of property is selected: primary real estate, resale property. **For each type of strategy, a specific type of property is considered.**

Therefore, for an aggressive strategy, it is necessary to choose the primary real estate, which is at the stage of early construction, because in this case, earnings are possible on the increase in value after the commissioning of the property. It is not advisable to take secondary real estate, since it can rise sharply in value due to investments in repairs or in case of a drastic change in the infrastructure of the facility’s environment, which can only be provided by a market expert and not an average individual.

In the case of a conservative strategy, both primary and secondary housing can be considered. In this situation, the advantage of the primary market is the low purchase price, while the secondary is a ready-made repair and a facility ready for rent.
For a comprehensive strategy, an interesting option is the acquisition of primary real estate and rental sales for 5 years. This will be the minimum threshold for entry into investments and minimum costs due to non-payment of sales tax after 5 years. In this case, there will be a maximum increase in the value of the residential property.

After choosing the type of residential property and the strategy for using this object, the investor needs to decide on a specific property according to characteristics that are significant for it.

Stage III. «Assessment of the effectiveness of investments in the selected object». This assessment is based on an assessment of all potential revenues and expenses. In the case of an aggressive strategy, profitability is calculated as the ratio of resale income to the value of the property at the time of purchase (formula 1). In this case, all possible expenses are deducted from income from resale.

\[ I_1 = \frac{D_p - R_s}{S + R_p} \times 100\% , \]

where \( I_1 \) – aggressive strategy profitability, \( D_p \) – income from the sale of the object, \( R_s \) – costs of the residential property, \( S \) – value of the object at the time of purchase, \( R_p \) – expenses for the purchase of a residential property.

The amount of the resale of the residential property under an agreement with the final buyer. The costs of maintaining the property include: utility bills (provided that the property is owned after acceptance by the state commission), repair costs, tax deductions (tax on income from the sale of property when it is resold less than 5 years after purchase and income tax, received from the rental)[10]. In a conservative strategy, when calculating profitability, the profit from the rental of property and, accordingly, the costs of this activity are taken into account (formula 2).

\[ I_2 = \frac{D_a - R_s}{S + R_p} \times 100\% , \]

where \( I_2 \) – the yield on the conservative strategy, \( D_a \) – rental income.

In this case, rental income is the sum of the difference between actual gross income and the cost of carrying out rental activities.

Profitability with a comprehensive strategy will be determined as follows (formula 3):

\[ I_3 = \frac{CD_p + CD_a}{S + R_p} \times 100\% , \]

where \( I_3 \) – comprehensive strategy return, \( CD_p \) – net income from the sale of the object, \( CD_a \) – net rental income.

Net income from the sale of the object is calculated as the difference between the income from the sale of the object and the expenses incurred by the investor for the period of searching for a buyer and conducting a transaction. Net rental income is taken into account for the entire rental period and is calculated as the difference between rental income and expenses incurred by the investor, described above when calculating the yield for a conservative strategy. In this case, rental income for the entire life of the facility is taken into account, just as all expenses for the entire life of the facility are taken into account [11].

4. The algorithm of the program

We consider a program that allows calculating the profitability of investing in an object for an investor for each type of strategy, using certain factors associated with the property.

To begin, consider the general scheme of the program, shown in figure 2.
Next, consider the tabs of the program, their functions and an example of the program. When we open this program, the “Main” tab opens, in which we can choose the language. There are also several more tabs, which are shown in figure 3.

When we go to the «DB» tab, a database opens in which all objects with their characteristics are reflected. Through the tab «Work with DB» we can add, modify or delete objects. Let us consider in more detail the sub-item «Adding an object». «The Adding an object» sub-item allows the user to add his own object, give a name to this object and an estimate of 1 to 5 for each of the factors that are shown in figure 4. There is also a «Manual» button with which the user can open instructions explaining how points can be allocated to factors. Add a new object to the database.

In the «Optimality» tab, the best option for aggressive, conservative and comprehensive strategies is displayed by searching the entire database, after which we can compare the results on the charts for each strategy, where the upper graph is the aggressive strategy chart with a single segment on the y axis equal to 0.2; the graph in the middle is a conservative strategy with a single segment on the y axis equal to 0.1; the bottom graph is an integrated strategy with the same single segment as in the conservative strategy (figure 5).

The factors by which the graphs are constructed are indicated as follows: a – location in relation to the business center; b – availability and state of communication; c – the presence of social and cultural facilities; d – placement of objects in the plan of the city (area), adjacent surroundings; e – ecological situation of the area, f – area size, dimensions, shape, material of construction, level of decoration, number of storeys, etc.; g – quality of construction and operation; h – functional suitability; i – attractiveness, comfort; j – design style, etc., layout; k – space-planning indicators, etc.; l – builder reliability; m – operating costs; n – repair cost.

**Figure 2.** Block diagram of a general program algorithm.

**Figure 3.** Program tabs.
Thus, based on these graphs, we can compare the most optimal objects of our database for all three strategies and for all factors that were filled when adding the object to the database.

Tab «Comparison». This item allows selecting the ID of two objects, comparing with each other, choosing the most suitable (figure 6), and building comparison graphs (figure 7). Comparison factors are denoted in the same way as on optimality graphs.

Let us compare two objects listed in the database and build comparison graphs.

In the «Graphs» item, the user can select an object ID that will display a graph constructed according to the values of its criteria previously entered in the database.

The «Calculations» tab contains three sub-items: aggressive strategy, conservative strategy and integrated strategy. These sub-items are necessary for calculating and calculating the profitability of investing in an object for an investor.
Consider the listed sub-items in more detail:

- **Aggressive strategy**. Opening this sub-item, a window appears in front of the user in which we need to enter a number of necessary data, and then click the «Calculate» button (figure 8 a). We will make the calculations. We get the following program conclusions: «The real annual rate of return, taking into account the discount amount, will be $-\infty$. This object is not attractive for investors.».

- **Conservative strategy**. In this sub-item, we also need to fill out the necessary data, then click the «Calculate» button and see the result (figure 8 b). We will make the calculations. We get the conclusion: «This object is not attractive for investors.».
• «Comprehensive strategy». This sub-item, like the previous two, requires the user to enter all the necessary data and click on the «Calculate» button (Figure 8 c). We will make the calculations. We get the conclusion: «Annual return is 13.4458. This object is investment attractive for an investor».

![Figure 8](image)

**Figure 8.** The calculations according to the strategy: a) aggressive; b) conservative; c) comprehensive.

After performing calculations for a certain type of strategy, we see the result of the program, which allows understanding whether the object is investment attractive to the investor or not.

The last tab is «Exit», when clicked the program closes.

5. Conclusion
The algorithm of actions was analyzed that facilitates the decision-making on the investment purchase of residential real estate, and some “fixed” points of the algorithm were developed that can help in making this decision. Based on this, the stages that were part of this algorithm were analyzed as well as three types of strategies for investing in residential real estate. A work program, that allows calculating the investment attractiveness of an object for an investor for each type of strategy using certain factors related to the property, is considered.

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