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Financial Portfolio: Optimization and Technology of ‘Structural Choice’

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INTRODUCTION & AIM

The report is devoted to the problem of choosing the structure of financial investments in a portfolio of financial assets. The effect of ambiguity of solutions is found for the case of maximizing income or minimizing risk.

The **aim** is to demonstrate the characteristic points at which the amount of income and risk are the same for different structures of financial resource allocation. In this case, making decisions without additional criteria becomes a major problem. Its solution is possible according to additional criteria, in particular, using artificial intelligence models when applying the results of the income maximization and risk minimization models.

METHOD

Financial portfolio theory and optimization models, as well as artificial intelligence models.

RESULTS & DISCUSSION

Breakdown of the optimization algorithm by introducing artificial intelligence models capable of analyzing the choice at specific points – when the result is not obvious and it is not possible to make an unambiguous decision. Thus, it is possible to obtain scenarios within the framework of the application of new financial technologies for decision-making in the field of financial resource allocation. Artificial intelligence has the function of weighing constraints within the framework of conditional optimization and making a fundamental choice between decision-making criteria, since the latter will depend on the criteria under consideration.

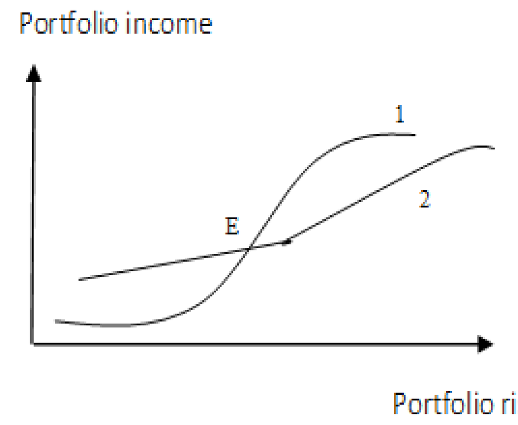
1) Maximizing portfolio revenue is $D=\sum_{j=1}^{N}\mu_j z_j \to \max$, under restrictions: $\sum_{j=1}^{N} z_j \le Q,\ z_j \ge 0,$

where D is total portfolio income; z_j are investments (resource) in the j_{th} object of the portfolio; $\mu_j=\frac{1}{T}\sum_{t=1}^{T} r_j(t)$ is average expected return (income for the j_{th} sector or type of activity per unit of resource invested); r_j is the amount of return (income at time t for the j_{th} object of the portfolio per unit of invested resource); T is time period of the model implementation; Q is – the total amount of investments (resources); N is the number of portfolio objects.

The mathematical formulation of the aggregate risk minimization model has the following form:

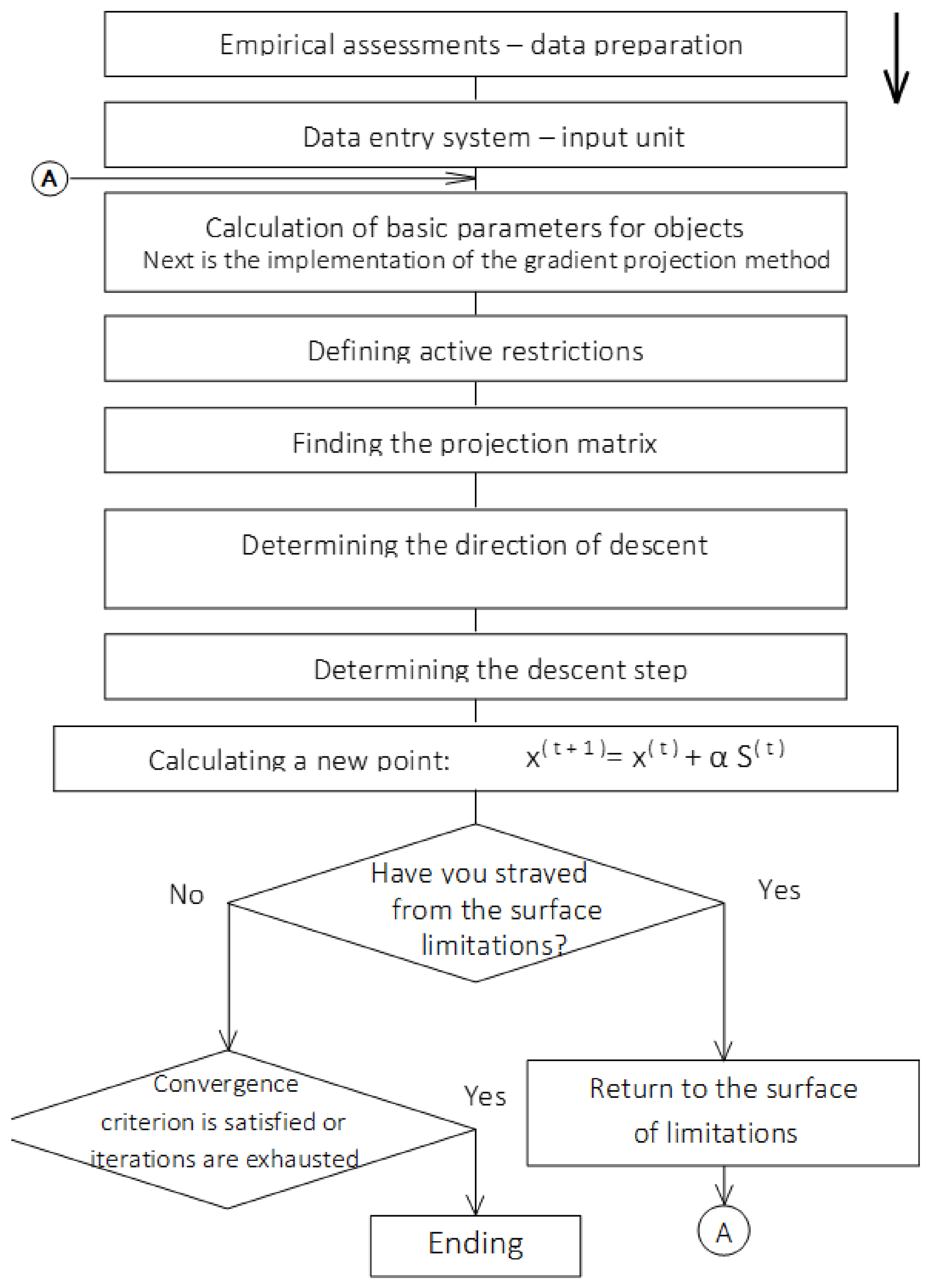
2) Minimizing portfolio risk is $R=z^T H z \to \min$, under restrictions: $\sum_{j=1}^{N} z_j \le Q,\ z_j \ge 0,\ \mu^T z \ge D_0,$

where $H=[\sigma_{ij}^2]$ is covariance matrix for N portfolio objects, D0 is minimum average expected income, R is – total portfolio risk.



A characteristic point when superimposing the results of optimization models: maximizing income is 1. minimizing risk is 2.

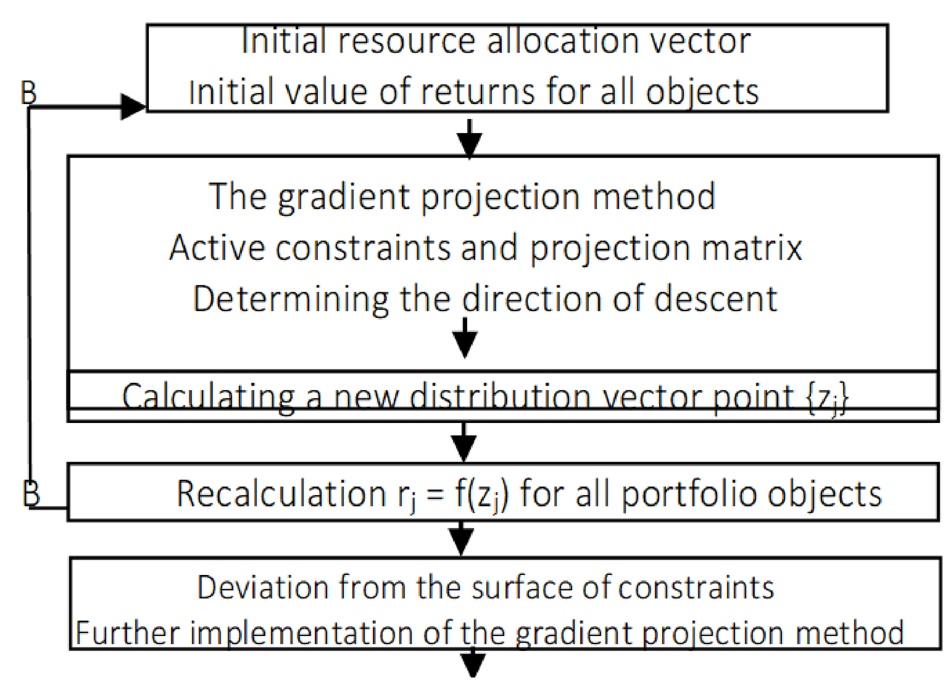
The problem of ‘structural selection’ arises both at point E and in its vicinity, as well as at a distance to the left and right.

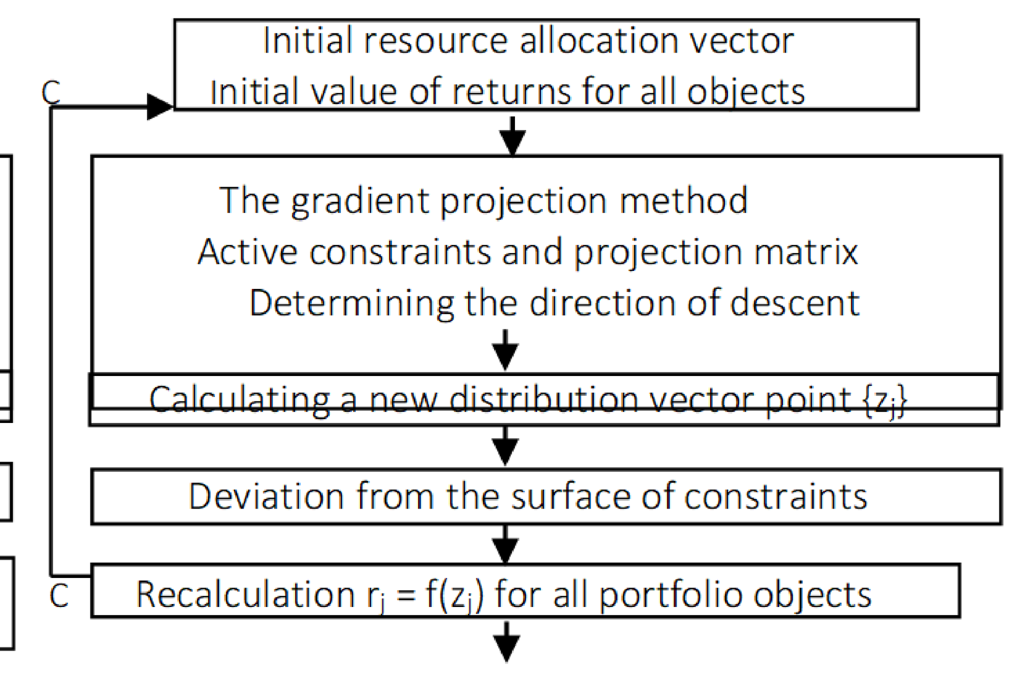


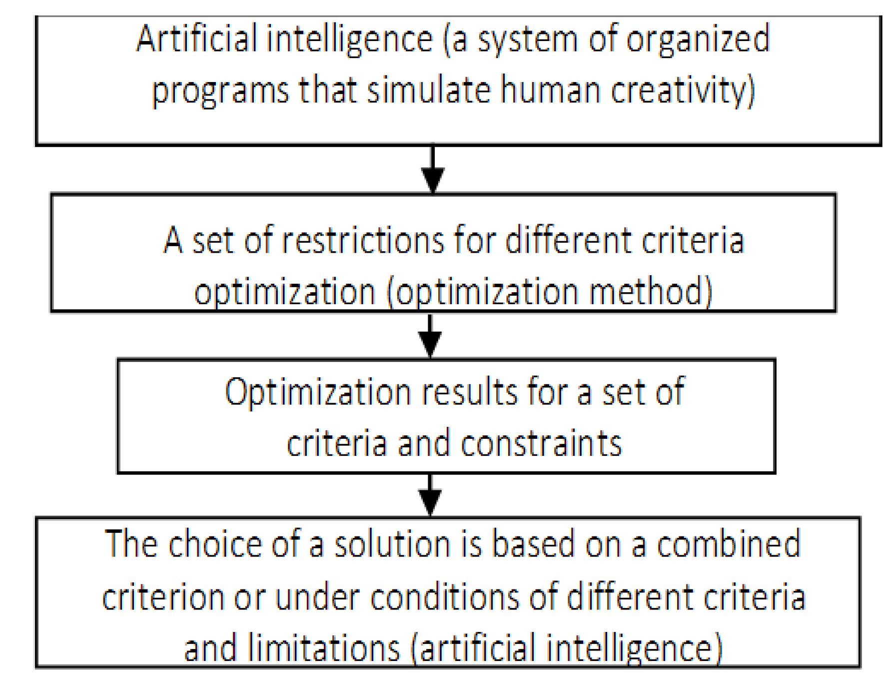
Algorithm for solving the problem of optimizing the portfolio of financial assets

The effectiveness of each element of the portfolio is changing, which cannot but affect the solution of the optimization problem. But it is precisely this aspect that is not taken into account in standard optimization solutions. Optimization methods do not allow us to take this into account.

Optimization can be built taking into account the recalculation of the profitability of portfolio elements, as well as linking the amount of return to the amount of resources invested. However, such a recalculation of returns in the optimization algorithm (by algorithm) can generate a cycle.







The figure shows that the artificial intelligence (AI) software module will need a "solver" in the form of various optimization options performed by many optimization methods and under various constraints. In this case, the choice itself is not predetermined, but it is possible to reject decisions based on other parameters – trust, risk, liquidity dynamics, financial market volatility, or for a specific portfolio - taking into account the assessment of each of the elements and the entire portfolio structure, for example, sustainability, effectiveness, etc. His task is to select a criterion and coordinate solutions. And for approval, a criterion is needed. Thus, a decision will be obtained with precision to the choice of using AI technology.

CONCLUSION

Firstly, optimization tasks in managing a financial portfolio within the framework of specific decision-making criteria are a very good method for ‘portfolio selection’. At the same time, the complexity of using artificial intelligence may increase dramatically, and then this application is not mandatory. Moreover, it can also give an erroneous result, leading to losses rather than an increase in benefits.

Secondly, artificial intelligence will be effective in ‘portfolio selection’ when the entire block of optimization tasks and optimization methods are included in the software and in flexible algorithms for the use of intelligence itself, and the decision maker will have minimal influence on the correction of program parameters.

Thus, the technology of structural choice within the financial portfolio can be implemented within a stable system of constraints even without artificial intelligence, which can complicate everything. But it can give you an ambiguous choice, a decision that no optimization model or scenarios based on them can identify.

FUTURE WORK / REFERENCES

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