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## **MATHEMATICAL MODELING AS A COMPONENT OF ECONOMIC DEVELOPMENT IN MODERN CONDITIONS**

### **Summary**

*The impact of the military operation on the state of Ukraine's economy is related to the growth of GDP in Ukraine in 2024 by 7.8%, the growth of inflation and national debt according to the consensus forecast of 10% and 90%, respectively. Therefore, attracting an investor to the business is one of the most important decisions, as it leads to increasing creditworthiness, risk distribution, incentive for innovation and infrastructure development. The main instruments of state regulation of investment activities include methods of financial planning, the economic-mathematical method, optimization of planned calculations, and the method of economic analysis. Within the framework of the above methods, we performed calculations for individual tasks to obtain the greatest profit from investing money; logistical issue of fast delivery of goods; optimal distribution of salespeople at retail outlets. Therefore, it is important to conduct simulations in the economy of Ukraine, even during the period of military operations, as this can contribute to the development of the country and increase its resilience to economic challenges.*

### **Introduction**

The military operation in Ukraine, which has been going on for more than 2 years, has significantly affected its economic condition. For a comprehensive analysis of the situation, the Spanish consulting company Focus Economics S.L.U. issued a report with an economic consensus forecast for 2023 and 2024 from leading international banks, investment companies and financial institutions Goldman Sachs, JPMorgan, Moody's Analytics, Fitch Ratings and Ukrainian analysts on economic growth rates, inflation, the dollar exchange rate and other key macro indicators [1]. Focus Economics forecasts foresee GDP growth in Ukraine in 2024 by 7.8%, inflation growth according to the consensus forecast to 10%. What will be the GDP growth, inflation, the dollar exchange rate, the state budget deficit and the state debt? The Institute of Economic Research and Political Consultations presented the results of a study of the number of small and medium-sized enterprises in Ukraine [2]. According

to research, medium-sized businesses show the best rates of economic growth of production indicators – volumes of production, sales, new orders, exports compared to enterprises of other sizes. Obstacles to the growth of small to medium-sized businesses include the loss of tax benefits, the lack of resources for investments and capital investments, and the high cost of credit. Therefore, attracting an investor to the business is one of the most important justified and harmonious decisions. Reasons for attracting an investor:

- Obtaining financing for expansion and development;
- Increasing creditworthiness;
- Access to new knowledge and experience;
- Business network expansion;
- Distribution of risks;
- Stimulus for innovation and development;
- Infrastructure development;
- Engagement of foreign specialists.

### **Chapter 1. Instruments of state regulation of investment activities**

The main instruments of state regulation of investment activities include the legal framework, tax policy, legal regime of foreign investment, state guarantees, etc. The development of the regulatory and legal framework contributes to the development and increase in the efficiency of the functioning of all spheres of the economy. The formation of the legal framework involves the adoption of laws regulating investment activities, as well as control over their compliance.

Ukraine is a country of horizontal informal ties and customary law. Customary law in Ukraine regulates most of the relations in the economic sphere and has a higher power than "written" laws. The gap between "written" laws and informal norms in Ukraine leads to corruption [3]. Fulfillment of the main goal of the regulatory framework in the system of state regulation of investment activities of banks is implemented through the restriction of monopoly control in the market of financial resources; ensuring banks' competitiveness; active stimulation of banking investment activity. Reducing the tax burden, state guarantees and attracting foreign capital also contribute to the development of banks' investment activities. In this aspect, in order to fulfill obligations to the budget, social funds, and banks, financial planning of enterprises is fundamentally important. The substantiation of indicators of financial operations, as well as the effectiveness of many economic decisions, is achieved in the process of financial planning.

Financial planning is a scientific process, where the object of planning is the activity of the enterprise. For the formation and use of various funds, the movement of resources, financial relations and new value proportions are determined. Financial planning is the process of determining the volume of

financial resources according to the sources of their formation and directions of their targeted use in accordance with the production and marketing indicators of the enterprise. Without financial planning, it is impossible to achieve the level of economic management that will ensure the company's increased efficiency and market success. Therefore, in market conditions, a scientifically based level of planning of the financial and economic activities of enterprises is needed. The object of financial planning is income and accumulation, their formation and distribution. The main tasks of financial planning include:

- determination of sources and volumes of financial resources;
- identification of reserves for increasing financial resources;
- rational distribution of profits;
- determination of ways of effective investment of capital, assessment of the rationality of its use;
- financial control over the formation and use of financial resources and funds;
- establishment of rational financial relations with the budget, banks and other enterprises;
- compliance with the interests of shareholders and other investors;
- control over the financial condition, solvency and creditworthiness of the enterprise;
- strengthening the role of financial planning.

The importance of financial planning for an enterprise is that it:

- implements defined strategic goals into financial indicators;
- provides financial resources for production;
- determines the viability of financial projects;
- serves as a tool for obtaining financial support from external investors.

External investment not only enables the enterprise to receive funds at its disposal for the implementation of planned tasks, but also provides an opportunity to replenish the budget, extrabudgetary funds, ensure the balance of costs and revenues of the enterprise thanks to the increase in the volume of production, the range of goods and services, and the cost of production.

The main principles of financial planning include:

- scientific validity, carrying out calculations of financial indicators;
- the use of computer equipment, economic and mathematical methods, which provide for multivariate calculations and the selection of the most optimal of them;
- unified methodology for calculating financial indicators, etc.;
- continuity, which means the relationship of long-term, current and operational financial plans;
- the principle of solvency – cash planning must constantly ensure the solvency of the enterprise;

– the principle of profitability of capital investments – the cheapest methods of financing should be chosen for capital investments (financial leasing, investment sales, etc.).

The principles of financial planning include ensuring financial security (taking into account financial risks associated with making financial decisions), optimization (ensuring the selection of the best alternatives for the use of financial resources), coordination and integration. To implement the principles of financial planning, planning of financial indicators, it is necessary to apply a system of financial planning methods. The methods of financial planning consist in the application of methods, techniques, algorithms for calculating financial indicators of activity. The main methods of financial planning are:

- balance method;
- calculation and analytical method;
- optimization of planned calculations;
- normative method;
- economic and mathematical method;
- graphic analytical method;
- method of economic analysis;
- program-target method.

The balance sheet method consists in the fact that, by building a balance sheet, a connection between the available financial resources and the actual need for them is achieved. For the rational use of all sources of the organization's financial resources, a complete balance of financing volumes for each type of expenditure is required based on the distribution of each source.

According to the calculation and analytical method, planned indicators are calculated based on the analysis of actual financial indicators, which are taken as a base. Then, according to the method, the value of this indicator is calculated based on the analysis of the achieved value of the financial indicator taken as a base and the indices of its change in the planned period. This method is used when there are no technical and economic standards, and the relationship between indicators is established on the analysis of their dynamics and connections.

Optimization of planned calculations consists in compiling several variants of planned calculations. In order to obtain the most optimal variant of planned solutions, they are optimized. For this, different selection criteria can be used:

- maximum profit per unit of invested capital;
- minimum costs;
- minimum current costs;
- minimum capital investment under conditions of maximum result;
- maximum of the absolute amount of received profit.

The normative method consists in the fact that the enterprise's need for financial resources is calculated on the basis of established norms and

standards. Such standards include tax rates, rates of tariff fees and contributions, depreciation deductions, working capital needs, etc. Such standards are developed by the economic entity to regulate the production and trade process and financial activities, and control over the use of financial resources.

Economic models are connected with economic and mathematical methods based on the identification of their quantitative dependence on basic factors. With their help, thanks to the use of computer technology, it is possible to develop several alternative plan options and choose the optimal one from them. The construction of the economic-mathematical model is implemented through the following stages.

The grapho-analytical method allows modeling innovative, organizational, and production processes. Diagrams and graphs make it possible to see the relationship and understand the dependence of indicators on each other.

Economic analysis allows us to assess the financial condition of the enterprise, the dynamics of financial indicators and reserves for increasing resources. This method is appropriate in cases where there are no financial and economic regulations, and the predicted relationship of indicators will be preserved in the future.

The program-target method is used in the development of programs to achieve final results and to form a strategic plan. For example, programs for improving product quality and competitiveness, enterprise reconstruction, etc. are being developed.

## **Chapter 2. The mathematical methods for planning and management**

The current activity of the organization, which provides profit as a priority goal, is the main source of income, therefore it should generate the main flow of funds. Enterprise activities related to the acquisition of land plots, buildings and other real estate, equipment, vehicles, intangible assets and other non-current assets, as well as their sale, are recognized as investment activities. Sources of funds for investment activities can be income from current activities in the form of retained earnings and depreciation deductions; income from the investment activity itself (issue of shares and corporate bonds, long-term bank loans). In stable operating enterprises, cash flows generated by current activities can be directed to investment and financing activities, for example, to repayment of credits and loans, payment of dividends and interest on emission securities, acquisition of non-current assets, etc. Investments express investments in tangible, intangible and financial assets for income or other benefits. As an economic category, investments are characterized by:

- capital investment in objects of entrepreneurial activity to increase the advanced value;
- financial relations arising between participants in investment activities.

Investment activity is the process of investing funds in objects of entrepreneurial activity and carrying out practical actions to obtain profit or social effect. It can be aimed at internal and external development of the organization. Investment activities aimed at internal development include:

- replacement of existing equipment;
- increase in production volume, including its new types;
- expansion and reconstruction of production facilities;
- research and development works, etc.

Investment activities aimed at external development include:

- acquisition of shares of third-party issuers;
- absorption of other companies;
- contributions to the authorized capital of third-party enterprises;
- placement of capital abroad, etc.

The investment process is a set of procedures for the formation of monetary resources, their investment in projects, obtaining income and reinvesting part of it for business expansion. The basis of the investment market is the investment of funds in the real sector of the economy, that is, in the fixed and working capital of organizations.

Any investment is associated with a certain degree of risk. All investments to one degree or another are affected by changes in the political and economic climate, as a result of which there is always a risk that the investor will not be able to return the invested capital without losses. Inflation is also a risk factor for investments. The success of an individual company is influenced by both general economic factors and specific reasons, such as the type of products or services it produces, competitiveness within the industry, and management factors. Another type of risk associated with individual companies is the financial risk associated with the possibility of losses during the sale of securities due to changes in their value. Credit risk is associated with the possibility of a situation where the issuer cannot pay interest and/or principal on debt securities. There is also a currency risk. All investments in foreign objects are subject to the risk that, regardless of the performance in local currency units of a particular type of investment, may change under the influence of exchange rate fluctuations. Therefore, the ability to calculate the effectiveness of investments in production is one of the key tasks of a modern economist.

The use of mathematical methods in economics is related to the study of various aspects of the development of an economic phenomenon and has a rich past associated with three directions, such as the mathematical school in political economy, the statistical direction, and econometrics. The founder of the first direction was Auguste Cournot (1801–1877) – "Investigation of the mathematical principles of the theory of wealth", and the followers were Walras, Pareta, Edgeworth, Slutsky. Representatives of the second direction

with the slogan "Measurement generates theory" were Pearson, Person. The concept of econometrics was introduced by the Norwegian economist Frisch (1895–1933) and developed by Samuelson, Tinbergen, Hicks, and Leontiev.

Since there are problems in the use of economic and mathematical methods for implementation in planning and management, the question arose of selecting the most important and relatively simple methods that are relevant for solving current economic problems. At the same time, it should be understood that the modeling process is a reflection of the fact of the impossibility of direct research of objects, phenomena and processes and includes three elements:

- 1) researcher;
- 2) object of research;
- 3) the model as a mediator of the relationship between the subject and the object.

### **Chapter 3. Three mathematical models of effective economic management**

Let's consider three actual problems and methods of solving them, which are the most common in terms of the need for their application.

I. Investment models are important for theoretical and practical application for making decisions on the efficiency of business development of companies, etc. In order to make informed investment decisions, it is necessary to solve the problems of applying mathematical models and algorithms, which are implemented within the limits of information technologies. Such tools in the theory of control and the theory of computational systems include dynamic programming (DP), which was first used in the 1940s by Richard Bellman to describe the process of solving a problem by solving a previous problem [4]. Properties of DP:

1. DP is an approach to problem solving. That is, it is not just a formula or an algorithm, but rather a methodology that tells you how to think in order to solve a problem;
2. This is an approach to solving tasks, where you need to break down tasks into smaller subtasks that are easy to solve;
3. Solving small problems can be used to solve the original problem.

Let's apply the DP method for the problem of the largest profit.

3.1. Task 1. Calculate the maximum profit from investing 100 units in three projects. Profits depending on investments in these projects are shown in Table 1.

To solve such problems and find the optimal investment allocation plan, the method of forward and reverse sweep is used. We will apply the method of direct running, which is divided into two stages:

- conditional optimization;
- unconditional optimization.

Table 1

**Profits depending on investments**

<b>Contributions</b>	<b>20</b>	<b>40</b>	<b>60</b>	<b>80</b>	<b>100</b>
Project 1	3	7	9	11	12
Project 2	2	8	9	10	13
Project 3	3	8	9	12	11

At the stage of conditional optimization, conditional optimal options and conditional control are determined. Direct running is implemented from the first step to the last. At the stage of unconditional optimization, the optimal solution to the original problem is built and max(min) is determined.

*The first stage. Conditional optimization (Tables 2, 3, 4).*

1 step.  $k = 3$ .

Table 2

**1 step of conditional optimization**

$e^2$	$u^3$	$e^3 = e^2 - u^3$	$f_3(u^3)$	$F_3^*(e^3)$	$u_3(e^3)$
20	0	20	0	3	20
	20	0	3		
40	0	40	0	8	40
	20	20	3		
	40	0	8		
60	0	60	0	9	60
	20	40	3		
	40	20	8		
	60	0	9		
80	0	80	0	12	80
	20	60	3		
	40	40	8		
	60	20	9		
	80	0	12		
100	0	100	0	12	100
	20	80	3		
	40	60	8		
	60	40	9		
	80	20	12		
	100	0	11		



2 step. k = 2.

Table 3

**2 step of conditional optimization**

$e^1$	$u^2$	$e^2 = e^1 - u^2$	$f_2(u^2)$	$F^*_2(e^1)$	$F^*_{1}(u^2, e^1)$	$F^*_{2}(e^1)$	$u_2(e^2)$
20	0	20	0	3	3	3	0
	20	0	2	0	2		
40	0	40	0	8	8	8	40
	20	20	2	3	5		
	40	0	8	0	8		
60	0	60	0	9	9	11	40
	20	40	2	8	10		
	40	20	8	3	11		
	60	0	9	0	9		
80	0	80	0	12	12	16	40
	20	60	2	9	11		
	40	40	8	8	16		
	60	20	9	3	12		
	80	0	10	0	10		
100	0	100	0	12	12	17	40
	20	80	2	12	14		
	40	60	8	9	17		
	60	40	9	8	17		
	80	20	10	3	13		
	100	0	13	0	13		

3 step. k = 1.

Table 4

**3 step of conditional optimization**

$e^0$	$u^1$	$e^1 = e^0 - u^1$	$f_1(u^1)$	$F^*_{1}(e^0)$	$F^*_{0}(u^1, e^0)$	$F^*_{1}(e^1)$	$u_1(e^1)$
1	2	3	4	5	6	7	8
20	020	200		3	3	3	0
40	0	40	0	8	8	8	0
	20	20	3	3	6		
	40	0	7	0	7		
60	0	60	0	11	11	11	0
	20	40	3	8	11		
	40	20	7	3	10		
	60	0	9	0	9		

(End of Table 4)

1	2	3	4	5	6	7	8
80	0	80	0	16	16	16	0
	20	60	3	11	14		
	40	40	7	8	15		
	60	20	9	3	12		
	80	0	16	0	16		
100	0	100	0	17	17	19	20
	20	80	3	16	19		
	40	60	7	11	18		
	60	40	9	8	17		
	80	20	11	3	14		
	100	0	12	0	12		

### ***II stage. Unconditional optimization.***

From the table of the 1st step (Table 4), the result  $F^*_1(e^0 = 100) = 19$  was obtained. That is, the maximum profit of the enterprise with the number of investments of 100 units is equal to 19 units. From the same Table 4, we see that  $u_1(e^0 = 100) = 20$  units should be allocated to the first enterprise. At the same time, the balance of funds is  $e^1 = e^0 - u^1 = 100 - 20 = 80$  units. From the Table 3 of the 2nd step, we see that  $F^*_2(e^1 = 80) = 16$ . That is, the maximum profit of the entire system with the amount of funds  $e^1 = 80$  is equal to 16. From the same Table 3, we see that  $u_2(e^1 = 80) = 40$  monetary units should be allocated to the second enterprise. The remaining funds will be  $e^2 = e^1 - u^2 = 80 - 40 = 40$ . Thus, the investment of 100 must be distributed as follows:

- 1st enterprise 20;
- 2nd enterprise 40;
- 3rd enterprise 40.

This will ensure the maximum profit from investing 100 units in three projects of 19 units. Thus, the application of the dynamic programming method allows you to significantly improve the forecasting of the result of investment, which, accordingly, will lead to the following positive changes: economic growth (attracting investments contributes to the development of the economy, increased production and the creation of new jobs); technological innovations (investments provide access to modern technologies, which helps to improve production processes and increase competitiveness); improving the quality of life (investors can invest in social projects, education, health care and other areas, which helps to improve the quality of life of the population); infrastructure development (investments make it possible to improve the country's infrastructure, develop the transport network, communications, energy and other industries); involvement of foreign specialists (investments

attract foreign companies and specialists, which contributes to the exchange of experience, improvement of qualifications and development of international relations).

**3.2. Task 2.** Another relevant issue regarding the development of small and medium-sized businesses is related to logistical issues of fast delivery of goods to demand points (stores, warehouses, enterprises, etc.), or the business of home, office food delivery, which is popular in large cities. The task of the traveling salesman is the task of optimizing the route between several points in order to reduce costs of time, money and resources. This task is of great importance for economic development, as its solution can lead to significant economic benefits for enterprises and organizations. The main advantages of solving the traveling salesman problem for the economy include:

1. Reduction of operating costs: the optimal route allows you to reduce fuel, transport and labor costs.
2. Increased productivity: efficient allocation of resources and reduced travel time helps businesses work more productively and efficiently.
3. Increased competitiveness: The speed of delivery of goods and services can be a key factor in a competitive environment, and route optimization helps reduce delivery times and improve customer service.
4. Improvement of logistics: solving the traveling salesman problem helps to develop an optimal system of logistics and supply, which ensures maximum efficiency of the entire supply chain.

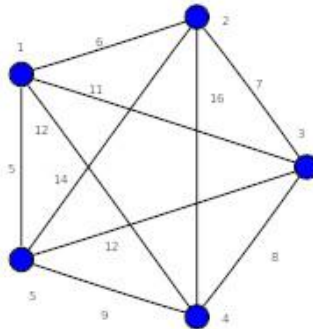
There are several methods for solving the traveling salesman problem, which include both exact and approximate algorithms. Here are some basic methods:

1. **Brute Force Method**: This method consists in going through all the possible routes, determining the cost for each of them and choosing the best one. It guarantees finding the optimal solution, but it is inefficient for large numbers of points.
2. **Branch and Bound methods**: This method is used to improve the efficiency of the brute force method. It is designed to filter out branches of the decision tree that cannot solve the problem better than the current best found solution.
3. **Genetic Algorithms**: This approach uses the principles of evolution to optimize the route. The main steps include generating a random population of routes, selection, crossover and mutation to generate new routes, and evaluation, selection of the best ones.
4. **Held-Karp algorithm**: This is an effective dynamic programmable method for solving the traveling salesman problem. It uses dynamic programming and memoization to reduce the number of operations required to find the optimal route.

These methods represent only some of the possible approaches to solving the traveling salesman problem. The choice of a specific method depends on the

size of the problem, the availability of resources and the time that can be devoted to solving the problem. It is clear that for the successful launch of delivery and sales, not only advertising, marketing, placement on Google maps, but also timely and fast delivery of the product plays a significant role. Since there is no definitive representation about the convenience of the option to solve this problem, we will present an economical and convenient sorting method for the number of delivery points  $n = 5$ .

**The task** is to choose the shortest delivery path in 4 points from 1 point, and the points should not be repeated. To implement this task, it is convenient to draw a graph with vertices of delivery points for  $n = 5$ , Figure 1.



**Figure 1. A complete graph with the number of vertices  $n = 5$**

The next step is to construct all possible paths with no repeating points from point 1 that return to the same point 1. Since the graph is symmetric, the number of possible paths from 1 to 1 via points 2,3,4,5 is  $(n-1)!/2 = (5-1)!/2 = 12$ :

- 123451 = 6+7+8+9+5 = 35
- 124351 = 6+16+8+12+5 = 47
- 123541 = 6+7+12+9+12 = 46
- 134251 = 11+8+16+14+5 = 54
- 132451 = 11+7+16+9+5 = 48
- 135421 = 11+12+9+16+6 = 54
- 143521 = 12+8+12+14+6 = 52
- 145321 = 12+9+12+7+6 = 46
- 143251 = 12+8+7+14+5 = 46
- 153241 = 5+12+7+16+12 = 52
- 154231 = 5+9+16+7+11 = 48
- 153421 = 5+12+8+16+6 = 47

From the calculations of the length of the path, we choose the shortest one, the length of which is 35 and corresponds to the path 123451.

The task of the traveling salesman is especially important for small and medium-sized businesses, since effective route management is a key success factor in this segment. Its solution is especially important, as it solves such problems as:

- efficient use of resources: small and medium-sized businesses have limited resources, and optimal route planning allows efficient use of available resources, such as fuel, vehicles and labor;
- improving customer service: speed and efficiency of delivery can be important factors for small and medium business customers, so optimized routes can improve service and customer satisfaction.

Thus, solving the traveling salesman problem has a direct positive impact on small and medium-sized businesses, helping to reduce costs, increase productivity and improve customer service. The development of optimal routes can be a key factor in ensuring the success and sustainability of business in this segment.

**3.3. Task 3.** Optimum distribution of salespeople across retail outlets is important for efficient business operation. Properly positioned sellers will help ensure that all potential customers are covered, reduce customer wait times, increase sales volume, and overall improve customer service. Thus, the optimal distribution of sellers will help increase the company's profit and increase its competitiveness in the market. We can use optimization theory to solve the problem of the optimal distribution of sellers by sales points in mathematical modeling. The main steps of such modeling can look like this:

1. Formulate an objective function that represents the lens we want to optimize. For example, it can be minimization of the total cost of employment of salespeople or maximization of the amount of sales.
2. Identify limitations of the model, such as the number of available sellers, geographic limitations, or the volume of requests from buyers.
3. Create a mathematical model that will determine the optimal distribution of sellers so as to satisfy the objective function and take into account all restrictions.
4. Use optimization algorithms, such as linear programming or genetic algorithms, to find the optimal distribution of salespeople.
5. Analyze the simulation results and make a decision regarding the optimal distribution of sellers by retail outlets.

This approach will help to find the optimal solution for the distribution of sellers, ensure optimal use of resources and increase business efficiency.

Let's consider the **task** of the optimal distribution of sellers by retail outlets in the following form. There are 4 sellers A1, A2, A3, A4 and 4 sales points B1, B2, B3, B4, which are listed in Table 5. The effectiveness of the work of salespeople at the sales points is given by the following matrix:

Table 5

**Distribution of sellers by retail outlets**

sellers	A1	A2	A3	A4
sales points				
B1	8	7	11	15
B2	6	3	9	5
B3	12	13	18	6
B4	3	8	9	11

Since the efficiency matrix is given, it is necessary to search for the maximum value, accordingly, the objective function goes to the maximum. Therefore, when considering this problem, the maximum profit is chosen. We modify this matrix by the product of all elements by (-1) and then add to each of them the maximum element of the matrix (18) so that the matrix does not contain negative elements.

sellers	A1	A2	A3	A4
sales points				
B1	10	11	7	3
B2	12	15	9	13
B3	6	5	0	12
B4	15	10	9	7

**Step 1.**

We reduce each matrix by terms (find the minimum element of each strip and subtract it from each element of the corresponding strip). That is, there will be at least one zero in each matrix.

7	8	4	0	<b>3</b>
3	6	0	4	<b>9</b>
6	5	0	12	<b>0</b>
8	3	2	0	<b>7</b>

We reduce each matrix by columns (find the minimum element of each column and subtract it from each element of the corresponding column)

4	5	4	0
0	3	0	4
3	2	0	12
5	0	2	0
<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>

That is, we got a completely reduced matrix.

### Step 2.

By trial and error, we search for an admissible solution for which all assignments have zero cost.

4	5	4	<b>[0]</b>
<b>[0]</b>	3	[-0-]	4
3	2	<b>[0]</b>	12
5	<b>[0]</b>	2	[-0-]

$$Z_{\text{Max}}=15+6+18+8=47$$

1st seller – trading point N 4

2nd seller – trading point N 1

1st seller – trading point N 3

1st seller – trading point N 2

With such an appointment, the maximum efficiency will be **47**.

### Conclusions

Modeling economic processes in the period of military operations is a very important and necessary task, as it allows predicting and managing the economic consequences of war. Military conflicts lead to significant losses for a country's economy, including production costs, currency depreciation, inflation, higher unemployment, and lower living standards. Observations show that the military conflict leads to an increase in state spending on defense, reconstruction, and humanitarian aid to the affected regions. This leads to a decrease in social spending, an increase in public debt, a loss of investment and a reduction in economic growth. Therefore, the modeling of economic processes during the period of military operations makes it possible to determine optimal business strategies, as well as to effectively adapt the country's economy to the changes occurring under the influence of war. In addition, it allows us to assess investment opportunities and risks associated with the parallel development of the economy and military events.

In this aspect, the first task of optimizing investment contributions within the framework of a convenient method of dynamic programming is important. Modeling economic processes during military operations also helps manage the country's financial resources and ensure the stability of the financial system in wartime. The use of a convenient and economical sorting algorithm for the task of a traveling salesman allows us to make reasonable economic decisions for the supply of products in the field of small and medium-sized businesses. To promote economic growth, increase the productivity of the economy, trade and the introduction of new goods and services to the market, as well as the creation of new sales markets, play an important role in the city. In this aspect, an important task is the optimal distribution of sellers at retail outlets, which is

important for the effective operation of business, solving complex problems related, for example, to the delivery of medical products and basic necessities.

Therefore, it is important to conduct simulations in the economy of Ukraine, even during the period of military operations, as this can contribute to the recovery and development of the country after the conflict and increase its resilience to economic challenges.

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