METHODOLOGY FOR EFFECTIVE PLANNING OF MEANS OF DESTRUCTION LOCATED IN THE COVER AND IN THE STERN FOR VARIOUS TYPES OF TARGETS

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Abstract: In the article, the issue of effective planning of covert and open means of destruction against various types of tanks, infantry fighting vehicles, infantry groups, as well as aerial targets (helicopters, UAVs) flying from a height of up to 200 m, is solved for combat activities using the game theory method. The result shows that it is possible to select favourable options before deploying cover and open means of destruction against targets. This issue can be used before combat activities are planned.

Keywords: various types of targets; means of destruction; mathematical modeling; theory of games

Introduction

XXI century wars require rationality and a precise approach in the application of means of destruction. When planning combat activities, their effective application is required, taking into account the capabilities and capabilities of the means of destruction (Piriyev, Hashimov & Bayramov 2016;

Karimov 2019). The experience of Karabakh II and the Russian-Ukrainian wars shows that the result of hostilities is influenced not only by a quantitative, but rather by a qualitative concept. And this increases the relevance of the requirements for effective planning of means of destruction located in cover and open against various types of targets. During the planning of combat activities, preliminary accurate knowledge of the capabilities of various means of destruction applied in battle also ensures the effectiveness of their planning. The main goal of knowing in advance the capabilities of the means of destruction applied in battle against targets of various purposes is to compare their capabilities and be able to make the right decision for their effective application.

To achieve this goal, the article presents the procedure for solving the problem of optimal selection of means of destruction of targets for more effective execution of activities at the stage of planning and distribution of forces, which is one of the main stages of the target management process, by bringing to the problem of two linear programming of mutual attachment.

With the results of the analysis of the influence of the available means in the planning and distribution of forces, the executed operation is coordinated, the means corresponding to the predetermined goals are assigned. This stage ensures the fulfillment of the task and is the basis of execution. During the planning and distribution of the force, the focus should be on the maximum benefit both from the capabilities and capabilities of the forces and the fulfillment of the task. This stage of target management can be solved using mathematical modeling methods to perform it more efficiently. By applying mathematical modeling, we will facilitate the solution of such issues in the future, as well as the work of commanders and headquarters planning combat activities.

Theoretical Methodology

Suppose that n numbers of different types of targets are given. According to the technical characteristics, these targets are m_1 number of H_1 species, m_2 number of H_2 species, etc. m_n can be divided into a number of H_N-type targets. Then according to the condition

$$m_1 + m_2 + \cdots + m_n = N \quad (1)$$

and the possibility of using the target of type H_J in the region of combat activity

$$P_j = \frac{m_j}{N}, \quad j = 1,2,\ldots,n \quad (2)$$

it can be calculated by the Formula. Suppose that m type A_1, A_2,..., A_m the probability of hitting j-type H_j targets through A_i weapons is given by thea_{ij} matrix (Table 1). It is an urgent issue to make recommendations on the effective selection of a type of weapon that provides the best solution to a combat mission during the planned identification and elimination of an enemy object.

Let's solve the issue using the theory of games (Samarsky & Mikhailov 2005; Samarov 2009).

Suppose the strategies of player I are A_1, A_2,..., A_m and II player's strategies $H_1, H_2, \dots, H_n$. Then I player any A_i $i = 1, 2, \dots, m$ II player against n departure H_j, $j = 1, 2, \dots, n$ makes its course. In this case, let's point out player I's winnings a_{ij}, which means the amount lost for player II. All $i = 1,2,\dots,m$ for cases m and $j = 1,2,\dots,n$ the matrix of size m × n, consisting of winnings a_{ij} is called the payment matrix of the game (Table 1).

The optimal strategy found for player I is the A_i strategy, which provides the maximum possible winnings regardless of which H_j strategy the opposing player II chooses. Player I believes that when he chooses the A_i strategy, his minimum win is equal to the smallest number in the line numbered I. Therefore, player I wants to find a strategy that maximizes the minimum possible winnings (maximin's strategy)

$$\alpha = \max_i \min_j a_{ij} \tag{2a}$$

α is called the low cost of the game. Player I's winnings will not be lower than α. The optimal strategy for player II is one in which the maximum possible winnings of player II are the least and the minimum, and in no case

$$\beta = \min_j \max_i a_{ij} \tag{2b}$$

do not exceed its price(minimax strategy). β is called the upper value of the numerical game.

Table 1. Effectiveness coefficients of means against targets

Type of weapon	Target type						$\alpha_i = \min_j a_{ij}$
	H_1	H_2	…	H_j	…	H_n	
A_1	a_{11}	a_{12}	…	a_{1j}	…	a_{1n}	α_1
A_2	a_{21}	a_{22}	…	a_{2j}	…	a_{2n}	α_2
…	…	…	…		…	…	…

A_i	a_{i1}	a_{i2}	…	a_{ij}	…	a_{in}	
…	…	…	…	…	…	…	…
A_m	a_{m1}	a_{m2}	…	a_{mj}	…	a_{mn}	α_m
$\beta_j = \max_i a_{ij}$	β_1	β_2	…	β_j	…	β_n	

The maximin strategy of player I and the minimax strategy of player II are strategies that insure the most prudently selected players. Player II has the guarantee that player I will never have more than the minimax, while player I knows that the minimum winnings will be as much as the maximum. The theory of games does not always recommend applying the strategies of minimax or maximin. It depends on whether the payment matrix has a saddle-shaped point. Suppose that in any game under consideration, the maximin and minimax winnings are the same:

$\alpha = \beta$. Then the element a_{ij} is called a saddle-shaped point or element. In games with a saddle-shaped point, both players must choose Maxim's (minimax) strategies. It will not be profitable for the player who deviates from this principle. If there is no saddle-shaped point in the game, then none of the pure strategies A_i and H_j will be optimal and do not ensure the stability of the solution. Then it is required that,

$$S_I^* = \begin{pmatrix} A_1, A_2, \dots, A_m \\ p_1^*, p_2^*, \dots, p_m^* \end{pmatrix} \quad \text{and} \quad S_{II}^* = \begin{pmatrix} H_1, H_2, \dots, H_n \\ q_1^*, q_2^*, \dots, q_n^* \end{pmatrix} \tag{2c}$$

find the optimal strategies. Where p_i* is the probability of the application of player I's pure A_i strategy, while q_i* is the probability of the application of player II's pure $H_j$strategy:

$$p_1^* + p_2^* + \dots + p_m^* = 1, \qquad q_1^* + q_2^* + \dots + q_n^* = 1. \tag{3}$$

The optimal S_I^*strategy of player I means that it provides player I with an average win, the cost of the game in an arbitrary strategy of player II is not less than v. In player II's optimal strategy, the win is equal to v. Without violating the generality, we can assume that $v > 0$. This can be achieved by making all the elements of the payment matrix non-negative numbers. If player I throws his own mixed S_I^* strategy against player II's arbitrary pure $H_j$strategy, then that average win or mathematical expectation of the win

$$a_{1j}p_1 + a_{2j}p_2 + \dots + a_{mj}p_m, \quad j = 1, 2, \dots, n \tag{4}$$

which makes your winnings earned. In the optimal S_I^* strategy of player I, all average winnings are not less than the price of the game v.

$$\begin{cases} a_{11}p_1 + a_{21}p_2 + \cdots + a_{m1}p_m \geq v, \\ a_{12}p_1 + a_{22}p_2 + \cdots + a_{m2}p_m \geq v, \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . \\ a_{1n}p_1 + a_{2n}p_2 + \cdots + a_{mn}p_m \geq v \end{cases} \tag{5}$$

(5) if we divide both sides by the positive number $v > 0v > 0$ in their inequalities, and the new

$$x_1 = \frac{p_1}{v}, x_2 = \frac{p_2}{v}, \ldots, x_m = \frac{p_m}{v} \tag{6}$$

if we accept its variables, then their inequalities (5) will be as follows:

$$\begin{cases} a_{11}x_1 + a_{21}x_2 + \cdots + a_{m1}x_m \geq 1, \\ a_{12}x_1 + a_{22}x_2 + \cdots + a_{m2}x_m \geq 1, \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . \\ a_{1n}x_1 + a_{2n}x_2 + \cdots + a_{mn}x_m \geq 1. \end{cases} \tag{7}$$

The goal of player I is to maximize (improve) his guaranteed winnings. And his guaranteed win is the price of the game v. For this

$$p_1 + p_2 + \cdots + p_m = 1 \tag{7a}$$

if we divide each side of its equality by the number $v \neq 0$

$$x_1 + x_2 + \cdots + x_m = \frac{1}{v} \tag{8}$$

we'll take it. Here, $x_i = \frac{p_i}{v}$ və $p_i \geq 0,\ v > 0$ since. The price of the game is the same strong as the maximization of $1/\ v$. Thus the solution of the game $m\ x\ n$ which satisfies the constraint conditions of the variables $x_i \geq 0$.

$$f = \frac{1}{v} = x_1 + x_2 + \cdots + x_m \rightarrow min \tag{9}$$

it is brought to the finding of the variables $x_i \geq 0$, which give the smallest value to the linear funtion. Price of the play solving problem of (7), (8), (9)

$$v = 1/f_{min} \tag{9a}$$

like, while player I's optimal mix strategy $p_i = x_i \cdot v$ is defined as (Casanov 2018; Hashimov, Talibov & Gasanov 2018). Hence, finding the game's price v and player I mixed optimal S_I^* strategy(7), (9), (10) is brought to the solution of its issue. (7) , (9), (10) let's build the attachment of the issue.

Limitation conditions:

$$\begin{cases} a_{11}y_1 + a_{12}y_2 + \cdots + a_{1n}y_n \leq 1, \\ a_{21}y_1 + a_{22}y_2 + \cdots + a_{2n}y_n \leq 1, \\ \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. \\ a_{m1}y_1 + a_{m2}y_2 + \cdots + a_{mn}y_n \leq 1. \end{cases} \qquad (10)$$

$$y_1 \geq 0, y_2 \geq 0, \dots, y_n \geq 0. \qquad (11)$$

Purpose function

$$z = y_1 + y_2 + \cdots + y_n = 1/v \to max. \qquad (12)$$

(11) - (13) the cost of the game by solving the attachment issue (Samarov 2009; Casanov 2018).

$$v = 1/z_{max} \qquad (12a)$$

like, II player's optimal mixed strategy while

$$q_j^* = y_j^* * v, \quad j = 1, 2, \dots, n \qquad (12b)$$

is defined as. Thus, the problem of the optimal selection of means of their destruction for various goals can be solved by bringing to the issue of programming two lines of mutual attachment. With this method, the goal management process can be carried out more effectively.

Conclusion

The game theory method of mathematical modeling was applied to solving the problem of effective planning of covert and open destruction means of different types of targets. The result of the study shows that the problem of optimal selection of the means of destruction in the cover and in the open according to different targets can be solved by reducing it to a bilinear programming problem. With this method, the goal management process can be implemented more effectively.

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