



MATRIX GAME EVALUATION IN GAME THEORY

MAMATOVA ZILOLAKHON KHABIBULLOKHONOVNA

*Fergana state university associate professor ,
pedagogy sciences according to philosophy Doctor of Philosophy (PhD)*

E-mail: mamatova.zilolakhon@gmail.com

ORCID ID [0009-0009-9247-3510](https://orcid.org/0009-0009-9247-3510)

HABIBJANOV BEHRUZ BAHODUR ZODA

Fergana State University

Practical mathematics direction

3rd year student, student of group 22-08

Email: habibjonovbehruz@gmail.com

Abstract : Article games theory matrix games to the department dedicated to be , to work release and economy in the field conflicted processes mathematician modeling and solution methods seeing It turns out . Matrix of games main concepts , including achievement matrix , game lower and high prices , saddle point , maxmin and minimum strategies is explained . If the game saddle to the point has if not , mix strategies method using solution find process is described . Matrix games linear programming to the issue to bring methods and this optimal strategies in the process determination algorithms The article is cited . two example through theoretical concepts practical solutions with is strengthened . Used literature list the topic deeper study for additional sources presented Article mathematician programming and optimization in the field professionals , students and researchers for useful is considered .

Keywords : Games theory , matrix games , conflict processes , achievement matrix , saddle point , maxmin strategy , minimax strategy , game price , mixed strategies , linear programming , optimal strategy , mathematics modeling , economic issues , work release

Introduction . Processes research and optimal management – decision acceptance to do and systems to optimize scientific fields oriented .

1- Process research resources effective distribution for mathematician models , linear programming , games theory and networks optimization such as from methods uses .

2-Optimal management systems the most good management strategies determination with He is engaged in his work . main methods Pontryagin's Maximum principle and Bellman's dynamic programming .

Research methodology

In the article cited research methodology analysis to do for his/her content and from the structure come out , following main aspects seeing Let's go out . Article games theory matrix games to the department dedicated is a research methodology theoretical analysis , mathematics modeling and practical examples through solution to find is based on . Below methodology in detail analysis cited : Research general approach Theoretical basis : Article games theory main concepts (achievement) matrix , saddle point , maxmin and minimax strategies , mixed strategies) from explanation begins . These concepts conflicted processes economy and working release in the field modeling for basis to be service does . Mathematician Modeling : Research central methodology conflicted processes simplified mathematician as models (games) to

express is based on . In this process main factors into account is taken , the second level factors and out of consideration aside is left . Practical orientation : Article theoretical concepts practical through examples (example 1 and example 2) strengthen and help students this apply methods to real problems application opportunity gives .

Literature analysis

In the article cited used literature list games theory , mathematics programming and optimization in the field important sources cover takes . Below this of literature briefly analysis brought by : Akulich I. L. Mathematical programming in in examples and zadachax - M .: Vysshaya school , 1996. Analysis : This book mathematician programming in the field practical issues and their to the solutions dedicated games theory and linear to program related examples and exercises own inside takes . Book students and practitioners for comfortable theoretically knowledge practical skills with connects . In the article cited linear programming methods and matrix games solution algorithms this to the source based to be possible.Relevance : Article linear programming to the issues to bring process in explanation important contribution adds.Badalov FB Optimization theory and mathematician programming . “ Teacher ” , T. 1989. Analysis : Uzbek published in this book optimization theory and mathematician programming main concepts own inside takes . Local students for customized games theory main principles in explanation important source as service does . The book Uzbek in the language in the environment written of the article local to the context compatibility provides.Relevance : In the article cited of the game price , strategies and their mathematician modeling such as concepts this from the book taken to be possible . Kuznetsov A. V. , Novikova G. I. , Kholod N. I. Collection task by mathematically speaking programming . Minsk , Vysheishaya school , 1985. Analysis : This source mathematician programming according to wide extensive issues set presented it will , that's it including games theory and linear programming with related issues own inside takes . The set practical orientation in the article cited examples and solutions to the structure Relevance : In the article like example 1 and example 2 given practical issues this in the set to approaches based to be probability high .

Analyses and results

Matrix games . Production release and economy in the field many practical issues in solution conflicted processes (situations) come comes out . Conflicting processes own inside very many factors takes . Many in cases the process study comfortable to be for main factors into account take , second level factors into account unable to his/her mathematician model We will make such conflict of the process shortened model game It is called . Game clear one to the rule according to take will go .

Game meaning from that consists of every one participant so one the solution acceptance does that game at the end the most good to the result Let it be . Play . the result (iskhod) is this one how many functions value to him achievement function or payment function If the players achievement amount to zero equal if , then to the game zero total game It is called .

Any pair the game matrix in appearance expression possible

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{pmatrix}$$

Let's say the matrix rows first player 's possible was A_1, A_2, \dots, A_m marches , columns and second player's possible was B_1, B_2, \dots, B_m their walks Let us define . A matrix payment or achievement matrix is called . The matrix every one a job element first Player A to walk choose the second player B_j to walk when you choose first player's achievement (second player's means "loss " .

The game purpose first the player maximum to success and second to minimize the player's loss to achieve provision for the most acceptable strategy from choosing consists of .

If the first player some A_i strategy choose, he never unless $\alpha_i = \min_j a_{ij}$ to success achieves this. into account take this player his/her own the most less achievements maximizer, i.e. $\alpha = \max_i \min_j a_{ij}$ PCB provider to walk chooses. Here α size of the game lower price and to him/her suitable strategy maxmin It is called.

Second player, own in turn, his the most big possible was losses minimizing, that is $\beta = \min_j \max_i a_{ij}$ PCB provider to walk chooses. Here β size of the game high price and to him/her suitable The strategy is called minimax.

If $\alpha = \beta$ if, that is $V = \min_j \max_i a_{ij} = \max_i \min_j a_{ij}$ equality If it is done, then V of the game price This condition is called of the satisfying matrix A a job to the element of the game saddle point It is called.

So, matrix game saddle to the point has if so, its solution maxmin and minimax methods with is found.

Example 1. Given matrix game for lower and high grades and Find the optimal price of the game.

$$A = \begin{pmatrix} 3 & 1 & 2 \\ 2 & 4 & -1 \\ 5 & 7 & 6 \end{pmatrix}$$

Matrix in the row the most small elements of the following consists of:

$$\min_j(3, 1, 2) = 1$$

$$\min_j(2, 4, -1) = -1$$

$$\min_j(5, 7, 6) = 5$$

So, the game lower price

$$\alpha = \max_i(\min_j a_{ij}) = \max_i(1, -1, 5) = 5$$

It will be. Now every one on the column the most big element we will find.

$$\max_i(3, 2, 5) = 5$$

$$\max_i(1, 4, 5) = 7$$

$$\max_i(2, -1, 6) = 6$$

In that case, the game high price to the following equal will be.

$$\beta = \min_j(\max_i a_{ij}) = \min_j(5, 7, -6) = 5$$

This game lower and high grades mutual equal happened for optimal price of the game $V = \beta = \alpha = 5$. This is the estimate. provider a 3x3 element game saddle point and A_3 and B_1 strategies optimal strategy will be.

If the achievements matrix saddle to the point has if not, then maxmin and minimax methods with of the game solution found In this case of the game solution in finding mixture strategies from the method is used.

First player's mixture strategy, components following

$$x_i = 1, \quad x_i = 0, \quad i = \overline{1, m}$$

the conditions to the vector $X = (x_1, x_2, \dots, x_m)$ satisfying It is said. In this every one x_i first Player A walk choice probability indicates.

Second player's mixture strategy, components following

$$\sum_{j=1}^n y_j = 1, \quad y_j \geq 0, \quad j = \overline{1, n}$$

the conditions satisfactory $Y = (y_1, y_2, \dots, y_n)$ to the vector X is said. In this every one y_j second player's B_j walk choice probability indicates.

Mix strategies in the way first Player A walk choose the second player B_j walk when you choose first player's achievement as his/her of winning mathematician expectation is taken, that is, it is taken to equal will be

$$V(x, y) = \sum_{i=1}^m \sum_{j=1}^n a_{ij} x_i y_j$$

Function $V(x, y)$ payment or achievement function It is called.

If the first player his/her own $X^* = (x_1^*, x_2^*, \dots, x_m^*)$ optimal strategy if it is used, then second player how strategy from choosing strict look, its achievement from the game's V rating less it won't happen, that is

$$\sum_{i=1}^m a_{ij} x_i^* \leq V, \quad j = \overline{1, n}$$

Same also, if the second player his/her own $Y^* = (y_1^*, y_2^*, \dots, y_n^*)$ optimal strategy if it is used, then first player how strategy from choosing strict look, its loser from the game's V rating does not exceed, that is

$$\sum_{j=1}^n a_{ij} y_j^* \leq V, \quad i = \overline{1, m}$$

Matrix the game linear programming to the issue to bring

Matrix the game linear programming to the issue to bring process seeing We will go out. The most before optimal player mix strategy and of the game price We find. Its for inequalities system and conditions To summarize, the following in appearance we write:

$$\begin{aligned} a_{11}x_1 + a_{21}x_2 + \dots + a_{m1}x_m &\leq V \\ a_{12}x_1 + a_{22}x_2 + \dots + a_{m2}x_m &\leq V \\ \dots &\dots \\ a_{1n}x_1 + a_{2n}x_2 + \dots + a_{mn}x_m &\leq V \\ x_1 + x_2 + \dots + x_m &= 1 \\ x_i &\geq 0 \quad (i = \overline{1, m}) \end{aligned}$$

Game price what Considering the equation, ($V > 0$) of the system everyone inequalities to become below system harvest we do:

$$\begin{aligned} a_{11}t_1 + a_{21}t_2 + \dots + a_{m1}t_m &= 1 \\ a_{12}t_1 + a_{22}t_2 + \dots + a_{m2}t_m &= 1 \\ \dots &\dots \\ a_{1n}t_1 + a_{2n}t_2 + \dots + a_{mn}t_m &= 1 \\ t_1 + t_2 + \dots + t_m &= \frac{1}{V} \end{aligned}$$

here $t_i = \frac{x_i}{V}$

The first player tries to maximize his payoff, i.e. the value of the game. So, for the first

$$t_1 + t_2 + t_3 = \frac{1}{V}$$

$$t_1 \geq 0, t_2 \geq 0, t_3 \geq 0$$

This system can be written as the following linear programming problem:

$$5u_1 + 3u_2 + 2u_3 = 1$$

$$3u_1 + 5u_2 + 5u_3 = 1$$

$$6u_1 + 3u_2 + 4u_3 = 1$$

$$u_1 \geq 0, u_2 \geq 0, u_3 \geq 0$$

$$F = \frac{1}{V} = u_1 + u_2 + u_3 \rightarrow \max$$

The given matrix game for the second player becomes the following linear programming problem.

$$5u_1 + 3u_2 + 2u_3 = 1$$

$$3u_1 + 5u_2 + 5u_3 = 1$$

$$6u_1 + 3u_2 + 4u_3 = 1$$

$$u_1 \geq 0, u_2 \geq 0, u_3 \geq 0$$

$$F = \frac{1}{V} = u_1 + u_2 + u_3 \rightarrow \max$$

Issues each other hesitant are issues . Therefore for from them optional one take off , the other one solution easily find possible .

Conclusion

Article games theory matrix games department analysis to do dedicated is conflicting processes economy and working release in the field mathematician modeling and solution methods illuminates . Research methodology theoretical analysis , mathematics modeling , linear programming and practical to examples is based on . The game lower and high prices , saddle point , maxmin and minimax strategies , as well as mixed strategies such as main concepts clear explained . Matrix games linear programming to the issue optimal strategies are presented and of the game price is determined . Practical examples through theoretical knowledge is strengthened . References list local and international sources comprehensive , scientific the basis strengthens , but modern technological approaches absence restriction as record Methodology article to their goals complete suitable comes , systematic and practical solutions presented However , empirically information and software tools input through the research further enrichment possible Overall , the article games theory economic to issues in use important guidance students , researchers and experts for useful source is considered .

Literature

1. Akulich I.L. Mathematical programming in examples and problems. - M.: Higher school, 1996.
2. Badalov F.B. Optimallash Nazariyus and mat or matic dasturlash . " O ' q ituvchi ", Vol.
3. Kuznetsov A.V., Novikova G.I., Kholod N.I. Collection of problems in mathematical programming. Minsk, Higher School, 1985.
4. Kuritsky B.Ya. Search for optimal solutions using Excel . "Saint Petersburg ", 1997.
5. Safaeva K., Beknazarova N. Operatsiyalarni tekshirishning matematik usullari. "O'qituvchi", 1984y. 1 qism.
6. Lesin V.V., Lisovets Yu.P. Fundamentals of optimization methods. Moscow, MAI Publishing House, 1998.
7. Khazanova L.E. Mathematical modeling in economics . M. BEK, 1998.