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Matrix Games to the Theory Implementation

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Abstract: This in the article various similar two from the player consists of games in solution matrix to compose way with matrix games to the theory implementation and clear examples cited.

Key words: move, row, column, matrix, positive, negative, strategy, maximum, minimum, optimal strategy, saddle point, position.

Two from the player consists of the game Let's see. The usual in a way A the player can was to $i = 1, 2, \dots, m$ many parts has line player, B and the player $j = 1, 2, \dots, n$ possible was column migrations player as Let's define.

Every one $(i = 1, 2, \dots, m)$ and $(j = 1, 2, \dots, n)$ s for a_{ij} through if A the player moves i by row and when B the player j moves by column, B the player's A We define the game as ending when the player is caught. These numbers are the game end matrix harvest does:

$$C = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix}.$$

Matrix elements positive, negative or zero to be possible. Hypothesis let's do it, every one $i = 1, 2, \dots, m$ s for A player$i$ to the line p_i perhaps with and every one $j = 1, 2, \dots, n$ s for B player j to the line q_j Let it probably move. Then it is clear that,

$$p_1 + p_2 + \cdots + p_m = 1 \text{ va } q_1 + q_2 + \cdots + q_n = 1$$

will be. Players to each other independent migrations harvest We assume that it does. In that case every one $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$ number A player $i$for s $p_i q_j$ line according to and B player j column according to migration gives the probability of. Then following double gathered expected B player A catches player game the end represents:

$$E_C(p, q) = \sum_{i=1}^{m} \sum_{j=1}^{n} a_{ij} p_i q_j.$$

The following

$$p = (p_1\ p_2\ \cdots\ p_m)\ va\ q = \begin{pmatrix} q_1 \\ q_2 \\ \vdots \\ q_n \end{pmatrix}$$

matrices suitable accordingly A and B players strategies represents

Clearly, expected game end

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$$E_C(p,q)=\sum_{i=1}^{m}\sum_{j=1}^{n}a_{ij}p_iq_j=(p_1\ p_2\ \cdots\ p_n)\begin{pmatrix}a_{11} & \cdots & a_{1m}\\ \vdots & \ddots & \vdots\\ a_{n1} & \cdots & a_{nm}\end{pmatrix}\begin{pmatrix}q_1\\ q_2\\ \vdots\\ q_m\end{pmatrix}=pCq.$$

Now we have the following issues let's see: Assumption let's do it C Let the matrix be fixed. A player expected $E_C(p,q)$ game the end maximal p strategy choice Is it possible? This in place B player expected $E_C(p,q)$ game the end to a minimum attainable q strategy choice Is it possible?

Theorem (Game) fundamental theorem of termination). A every player how p strategy and B any of the player'sq strategy for so p^* and q^* there are strategies that

$$E_C(p^*,q)\geq E_C(p^*,q^*)\geq E_C(p,q^*)$$

will be.

Note p^* strategy A as the player's optimal strategy and q^* the strategy B known as the player's optimal strategy. $E_C(p^*,q^*)$ amount of the game value is considered. Optimal strategies only must be not. If p^{**} and q^{**} s other optimal strategies if , then

$$E_C(p^*,q^*)=E_C(p^{**},q^{**})$$

will be.

Here game end matrix C contains saddle points. If a_{ij} an element C is the smallest element in the rows of the matrix and the largest element in its columns if, then he point In this case strategies as follows will be:

$$p^*=(0\ \cdots\ 0\ 1\ 0\ \cdots\ 0)\ va\ q=\begin{pmatrix}0\\ \vdots\\ 0\\ 1\\ 0\\ \vdots\\ 0\end{pmatrix}.$$

Here are 1s $i$position p^* and j the occurrence of optimal strategies in the position q^* they are, therefore for of the game value a_{ij} will be.

Example: Athletes school teacher rowers (A) and cricketers (B) among 100 students to choose demand did. Students in their own way content they can't fix it and rowers coach and cricketers coach The school selects 3

rowers. coach and 4 cricketers their coaches can hire. Every one in the scenario rowers from cricketers before is selected as follows, this on the ground A_1, A_2 and A_3 s possible was rowing coaches and B_1, B_2, B_3 and B_4 s cricketers coaches marked:

	B_1	B_1	B_1	B_1
A_1	75	50	45	60
A_1	20	60	30	55
A_1	45	70	35	30

Example for, if A_2 and B_1 coaches chosen If, then 20 student rowers and the remaining 80 students from cricketers chosen will be.

At first we one 50 of the item let's separate and game end matrix harvest we do:

$$C=\begin{pmatrix}25\ 0\ -5\ 10\\ -30\ 10\ -20\ 5\\ -5\ 20\ -15\ -20\end{pmatrix}.$$

Example for, the top left element if every 50 students in one sport with if it starts, then 25 cricketers students to the rowers lost. First line and third on the column located -5 number saddle point will be, therefore rowers for optimal strategy for A_1 use of a coach and cricketers optimal strategy for B_3 is to use a coach.

In general, if points there is not to be possible, therefore the issue is definitive. is not defined. Then the optimal problem solution linear programming methods using is found. The following game end matrix 2×2

$$C = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$$

matrix if and saddle points own inside If not, then we $p_2 = 1 - p_1$ can write and $q_2 = 1 - q_1$ possible. In that case

$$E_C(p,q) = a_{11}p_1q_1 + a_{12}p_1(1-q_1) + a_{21}q_1(1-p_1) + a_{22}(1-p_1)(1-q_1) =$$
$$= \big((a_{11} - a_{12} - a_{21} + a_{22})p_1 - (a_{22} - a_{21})q_1\big) + (a_{12} - a_{22})p_1 + a_{22}.$$

Hypothesis let's do it

$$p_1 = p_1^* = \frac{a_{22} - a_{21}}{a_{11} - a_{12} - a_{21} + a_{22}}.$$

Let it be. Then q to independent without

$$E_C(p^*,q) = \frac{(a_{12} - a_{22})(a_{22} - a_{21})}{a_{11} - a_{12} - a_{21} + a_{22}} + a_{22} = \frac{a_{11}a_{22} - a_{12}a_{21}}{a_{11} - a_{12} - a_{21} + a_{22}}$$

will be. Just like so if

$$q_1 = q_1^* = \frac{a_{22} - a_{12}}{a_{11} - a_{12} - a_{21} + a_{22}}$$

if, then p to independent without

$$E_C(p,q^*) = \frac{a_{11}a_{22} - a_{12}a_{21}}{a_{11} - a_{12} - a_{21} + a_{22}}$$

will be. So, all p and q strategies for

$$E_C(p^*,q) = E_C(p^*,q^*) = E_C(p,q^*)$$

will be.

Highlight must,

$$p^* = \left(\frac{a_{22} - a_{21}}{a_{11} - a_{12} - a_{21} + a_{22}} \; \frac{a_{11} - a_{12}}{a_{11} - a_{12} - a_{21} + a_{22}}\right), (1)$$

$$q^* = \begin{pmatrix} \dfrac{a_{22} - a_{21}}{a_{11} - a_{12} - a_{21} + a_{22}} \\ \dfrac{a_{11} - a_{21}}{a_{11} - a_{12} - a_{21} + a_{22}} \end{pmatrix}. \; (2)$$

From this,

$$E_C(p^*,q^*) = \frac{a_{11}a_{22} - a_{12}a_{21}}{a_{11} - a_{12} - a_{21} + a_{22}}.$$

equality harvest will be.

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