

6D Converting Games to Linear Programming Problems

When do you formulate a game as a linear programming problem?

Before formulating, always check for ...

To formulate a game as a linear programming problem:

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1. Alf and Bert play a zero-sum game, represented by the pay-off matrix below.

	B plays 1	B plays 2	B plays 3	Row minimum
A plays 1	-2	4	2	
A plays 2	0	-3	-2	
A plays 3	-6	1	3	
Column maximum				

- a) Formulate the game above as a linear programming problem for player A, writing the constraints as equations and defining your variables clearly.

	B plays 1	B plays 2	B plays 3
A plays 1			
A plays 2			
A plays 3			

b) Write down an initial simplex tableau for this problem.

	V	p₁	p₂	p₃	r	s	t	u	Value
r									
s									
t									
u									
p									

c) Outline how you would change the method to formulate the game as a linear programming problem for player B. (You do not need to formulate the problem.)

	A plays 1	A plays 2	A plays 3
B plays 1			
B plays 2			
B plays 3			

Why replace $p_1 + p_2 + p_3 = 1$ by $p_1 + p_2 + p_3 \leq 1$?

2. Jenny and Merry play a zero-sum game, represented by the pay-off matrix for Jenny shown below.

	Merry plays 1	Merry plays 2	Merry plays 3	Row minimum
Jenny plays 1	-3	0	2	
Jenny plays 2	-2	2	1	
Jenny plays 3	0	-3	-2	
Column maximum				

- a) Convert the game into a linear programming problem for Jenny, defining your decision variables. You should write the constraints as equations.

	M plays 1	M plays 2	M plays 3
J plays 1			
J plays 2			
J plays 3			

- b) Write down an initial simplex tableau, making your variables clear.

	V	p_1	p_2	p_3	r	s	t	u	Value
r									
s									
t									
u									
P									

- c) Using the simplex algorithm, the solution obtained is $p_1 = 0$, $p_2 = 3/7$, $p_3 = 4/7$. Find the value of the game to Jenny.

Watch out: at the end you must ...