

What if we want to contruct a utility fiunction which is not the normalized one?

Money lotteries and attitudes to risk

A money lottery is a lottery whose outcomes are sums of money.

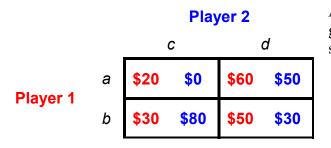
$$L = \begin{pmatrix} \$4 & \$12 & \$24 & \$36 \\ \frac{1}{4} & \frac{1}{12} & \frac{1}{3} & \frac{1}{3} \end{pmatrix}$$

The expected value of L is \dots

We use the expected value to define the **risk-attitude** of an agent: offer the agent a choice between $\mathbb{E}[L]$ for sure, that is, the lottery and the lottery L. If the agent says that

•

In the above example,



Assume that each player is selfish and greedy (only cares about how much money she herself gets.

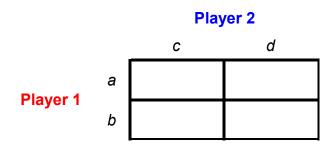
CASE 1: Suppose that Player 1 is **risk neutral** and thinks that Player 2 is **equally likely** to play *c* and *d*.

Then

NOTE: when a player is risk neutral we can take as von Neumann-Morgenstern utility function:

because with such a function expected utility = expected value and, by risk neutrality, the player ranks money lotteries according to their expected values.

If both players are risk neutral, the above game becomes:



		Player 2				
		С		d		
Player 1	а	\$20	\$0	\$60	\$50	
	b	\$30	\$80	\$50	\$30	

Assume that each player is selfish and greedy (only cares about how much money she herself gets.

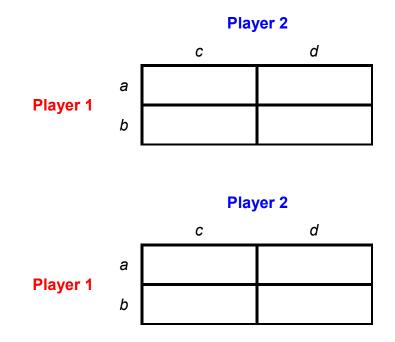
CASE 2: Suppose that Player 1 has the following von Neumann-Morgenstern utility function:

$$U(\$x) = \sqrt{x}$$

and thinks that Player 2 is equally likely to play c and d.

Then

If both players have the above von Neumann-Morgenstern utility function then the game becomes





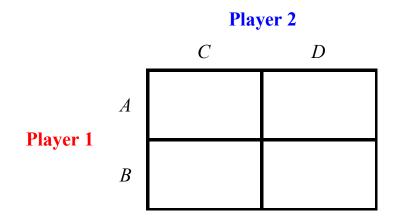
D

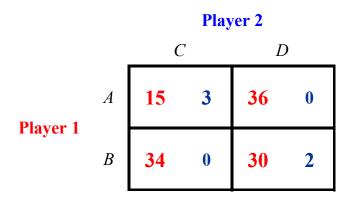
 Z_3

 Z_4

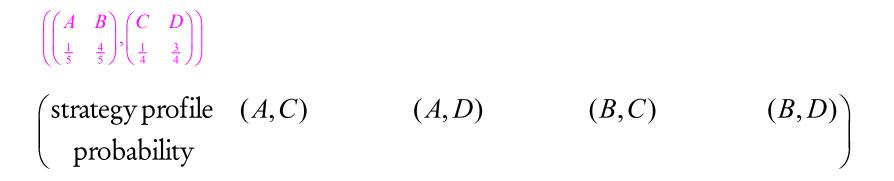
$B = \begin{bmatrix} C \\ \begin{pmatrix} z_1 & z_2 \\ \frac{1}{2} & \frac{1}{2} \end{bmatrix}$ $B = \begin{bmatrix} z_1 & z_3 \\ \frac{1}{3} & \frac{2}{3} \end{bmatrix}$

	Z_1	Z_2	Z_3	Z_4
vNM utility function of Player 1:	30	0	36	30
vNM utility function of Player 2:	0	6	0	2





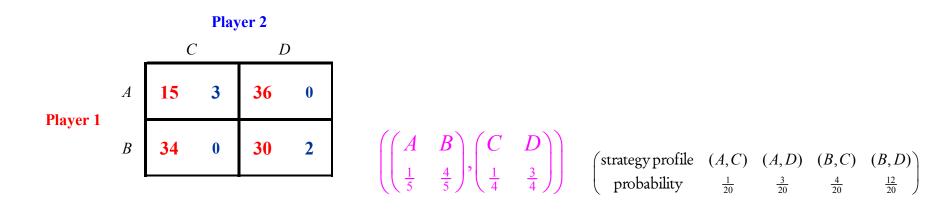
MIXED STRATEGIES



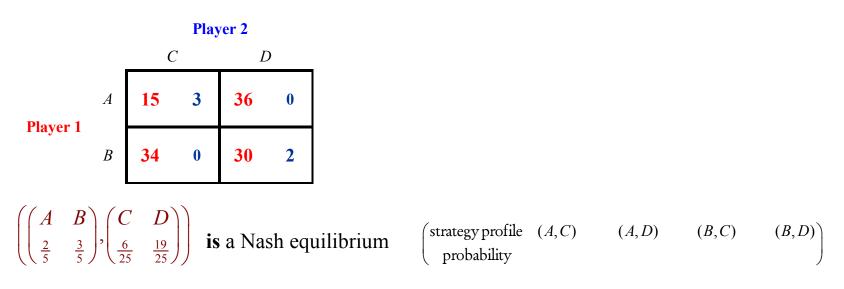
next page \rightarrow

30.95 < 31 = B

Is $\begin{pmatrix} A & B \\ \frac{1}{5} & \frac{4}{5} \end{pmatrix}$, $\begin{pmatrix} C & D \\ \frac{1}{4} & \frac{3}{4} \end{pmatrix}$ a Nash equilibrium?



expected utility (or payoff) of Player 1 is



expected utility (or payoff) of Player 1 is

Computing the mixed-strategy Nash equilibria

Theorem. At a Nash equilibrium in mixed strategies, a player must be indifferent between any two PURE strategies that she plays with positive probability.

		Player 2				
		C	r ⁄	D		
Player 1	A	15	3	36	0	
	В	34	0	30	2	