1-10-Pareto-2

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Pareto Optimality

Game Theory Course:
Jackson, Leyton-Brown & Shoham

Analyzing Games

- We've defined some canonical games, and thought about how to play them. Now let's examine the games from the outside
- From the point of view of an outside observer, can some outcomes of a game be said to be better than others?

Analyzing Games

- We've defined some canonical games, and thought about how to play them. Now let's examine the games from the outside
- From the point of view of an outside observer, can some outcomes of a game be said to be better than others?
  - can't say one agent's interests are more important than another's
  - imagine trying to find the revenue-maximizing outcome when you don't know what currency is used to express each agent's payoff
- Are there ways to still prefer one outcome to another?

Pareto Optimality

- Idea: sometimes, one outcome o is at least as good for every agent as another outcome o', and there is some agent who strictly prefers o to o'
  - in this case, it seems reasonable to say that o is better than o'
  - we say that o Pareto-dominates o'.

o (7, 8) → at least good for everybody
o' (7, 5)
equally for player 1
strictly better for player 2

Pareto Optimality

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Definition (Pareto Optimality)
An outcome o^* is Pareto-optimal if there is no other outcome that Pareto-dominates it.

nothing else prefer to it

Pareto Optimality

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- can a game have more than one Pareto-optimal outcome? ✓

2 outcomes neither Pareto-dominate each other
nothing dominate else.
sb strictly prefer sth

Pareto Optimality

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Definition (Pareto Optimality)
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- can a game have more than one Pareto-optimal outcome?
- does every game have at least one Pareto-optimal outcome? ✓

cycle in Pareto-dominance – everybody [illegible] sth. [illegible]

Pareto Optimal Outcomes in Example Games

	Left	Right
Left	1, 1	0, 0
Right	0, 0	1, 1

both pareto-optimal

Pareto Optimal Outcomes in Example Games

	Left	Right
Left	1, 1	0, 0
Right	0, 0	1, 1

	B	F
B	2, 1	0, 0
F	0, 0	1, 2

Pareto Optimal Outcomes in Example Games

	Left	Right
Left	1, 1	0, 0
Right	0, 0	1, 1

	B	F
B	2, 1	0, 0
F	0, 0	1, 2

	Heads	Tails
Heads	1, −1	−1, 1
Tails	−1, 1	1, −1

every Pareto-Optimal
no pair of outcomes equally well
zero-sum

Pareto Optimal Outcomes in Example Games

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Right	0, 0	1, 1

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B	2, 1	0, 0
F	0, 0	1, 2

	Heads	Tails
Heads	1, −1	−1, 1
Tails	−1, 1	1, −1

	C	D
C	−1, −1	−4, 0
D	0, −4	−3, −3

Pareto Optimal.
pareto dominant

Pareto Optimal Outcomes in Example Games

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every body play Nash

Dominant strategy

The paradox of Prisoner's dilemma:
the (DS) Nash equilibrium is the only non-Pareto-optimal outcome!