

Welfare Comparisons Among Outcomes



- Pareto Efficient (PE) Criterion: The outcome $\hat{a}$ Pareto Dominates the $\bar{a}$ outcome if:
 - For every player i , $\pi^i(\hat{a}) \geq \pi^i(\bar{a})$ and
 - there exists at least one player j for whom $\pi^j(\hat{a}) > \pi^j(\bar{a})$
- The outcomes (opera, opera) and (football, football) are PE

Extensive Form Games (timing into the model)

- The Pilot and the terrorist (Minneapolis to NY)



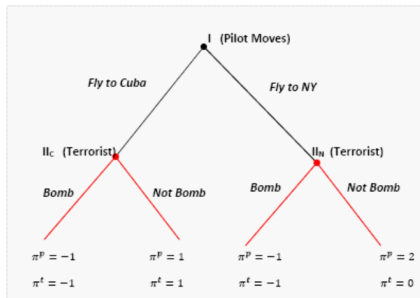
- Let us describe this game using an extensive form game...
- The branches connecting decision nodes describe actions available to the relevant player.
- $A_I^P = \{NY, Cuba\}$ and $A_{II_C}^T = A_{II_N}^T = \{B, NB\}$

Extensive Form Games (timing into the model)

- The Pilot and the terrorist (Minneapolis to NY)
- Definition: A game tree containing a starting node, other decision nodes, terminal nodes and branches linking each decision node
 - A list of $N \geq 1$ players
 - For each decision node, the name of the player
 - For each player i , a specification of i 's action
 - A payoff to each player at each terminal node

Extensive Form Games (timing into the model)

- Definition: A strategy S^i is a complete plan of actions:
- ① Pilot $S^P = \{NY, Cuba\}$
- ② Terrorist $S^T = \{(B, B), (B, NB), (NB, B), (NB, NB)\}$
- ③ This game has eight outcomes: $(NY, (B, B)), \dots$



Defining Strategies and actions in EFG

Definition 2.8. A **Strategy** for player i (denoted by s^i) is a complete plan (list) of actions, one action for each decision node that the player is entitled to choose an action.

- A strategy **IS NOT** what a player does at a single node but it is a list
- What are the strategies available to the terrorist?
- How many outcomes does the Pilot-Terrorist game have?

A normal form representation for EFG



		<i>Terrorist</i>			
<i>Pilot</i>		<i>B, B</i>	<i>B, NB</i>	<i>NB, B</i>	<i>NB, NB</i>
	<i>NY</i>				
	<i>C</i>				

- Identify the NE

Refinements of NE: Subgames and subgame perfect equilibrium (SPNE)

- Unreasonable equilibrium outcomes?
- Def. 2.10: An outcome is said SPE if it induces a *NE* in every subgame of the original game.
- Backward induction
 - What is the SPNE of our game???

Games with mixed actions

- Let us analyze the following game:

		<i>Player 2</i>	
		Left	Right
<i>Player 1</i>	Top	0, 0	0, -1
	Bottom	1, 0	-1, 3

- NE* in pure actions....
- Assume that player 1 chooses Top with a probability p and player 2 chooses left with a probability q .