Chapter 10: Game Theory

Total and Partial conflict
Pure and mixed strategies
Building a Linear model

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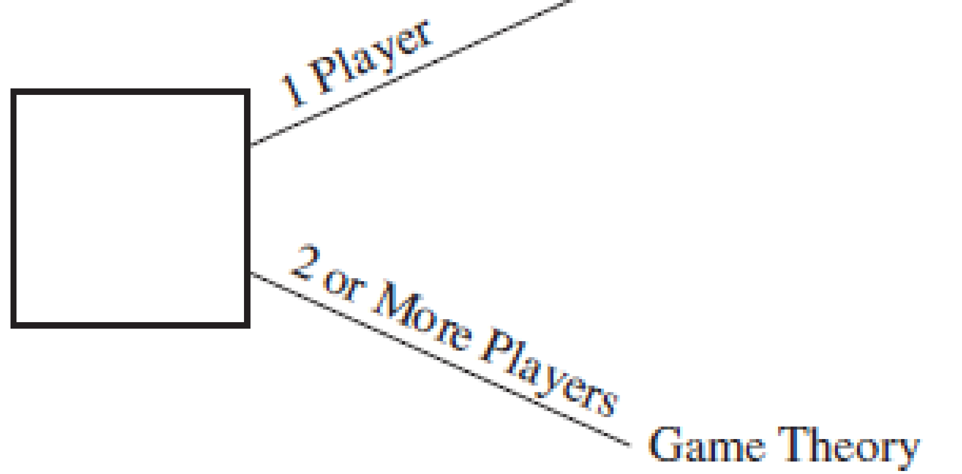
Game Theory

Figure 10.1

Game theory treats outcomes that depend on more than one player



Total Conflict Game: Example

- Home Depot: a mega hardware store
- Ace: hardware chain store
- Both should decide whether to locate in a small or a big city which are close to each other
- Market share (Home Depot, Ace):

		Ace	
		Large City	Small City
Home Depot	Large City	60, 40	68, 32
	Small City	52, 48	60, 40

Total Conflict Game

Definition

If for each possible outcome, the payoffs to each player sum to the same constant (100% in our example), the game is classified as total conflict.

- Total conflict games are also referred to as ***constant sum*** games.
- If the constant is zero, the total conflict game is also referred to as a ***zero-sum*** game.
- If there is not such a constant sum, then it's called a **Partial Conflict** game

Pure Strategy Nash Equilibrium

- For any game, we draw a vertical arrow from the smaller to the largest row value in each column, and we draw a horizontal arrow from the smaller to the largest column value in each row. When all arrows point to a value, we have a **pure strategy Nash equilibrium**.

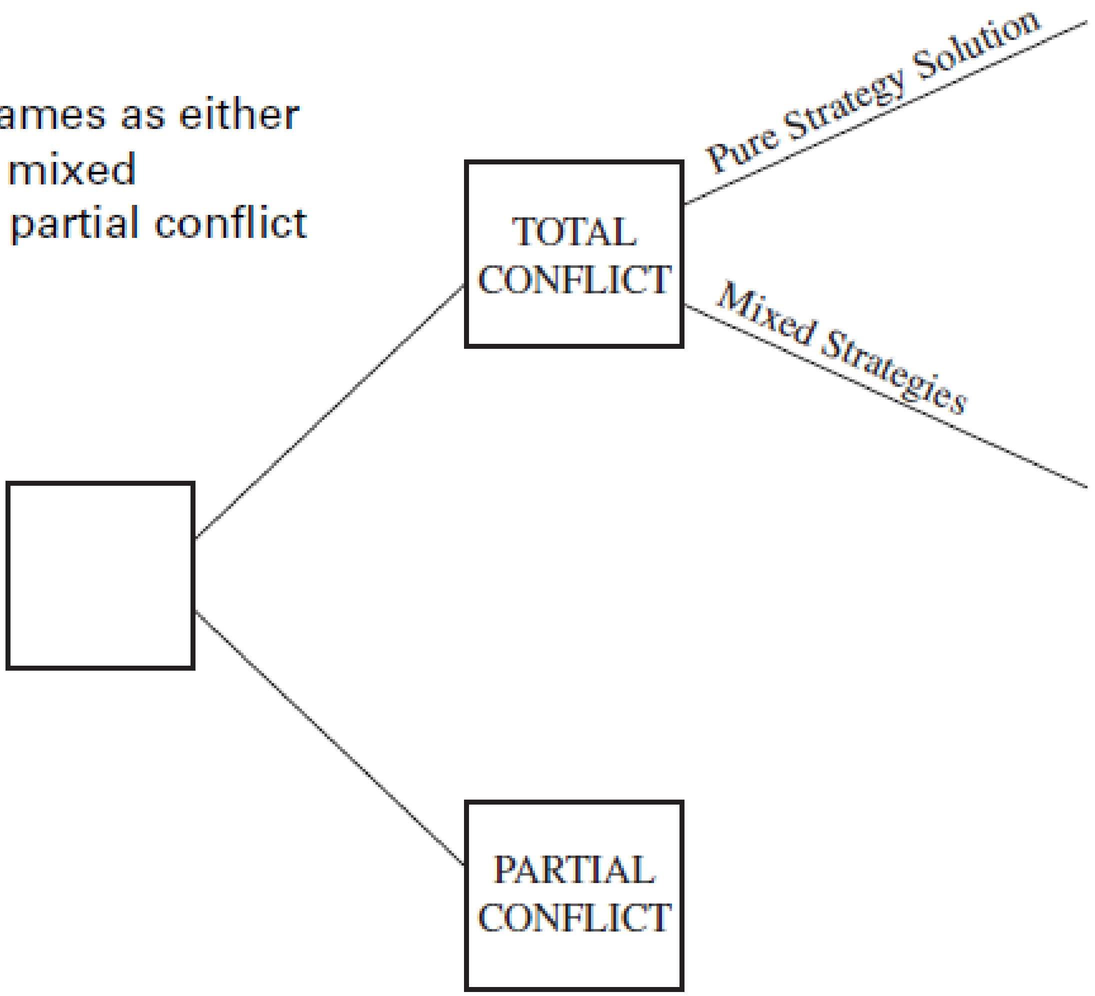
		Ace		
		Large City		Small City
Home Depot	Large City	60, 40	⇐	68, 32
		⇑		⇑
	Small City	52, 48	⇐	60, 40

- (large city, large city) is also called a **dominant strategy**.
- If there is not such a dominant strategy, then there is a **mixed strategy** in that game

Categories of games in game theory

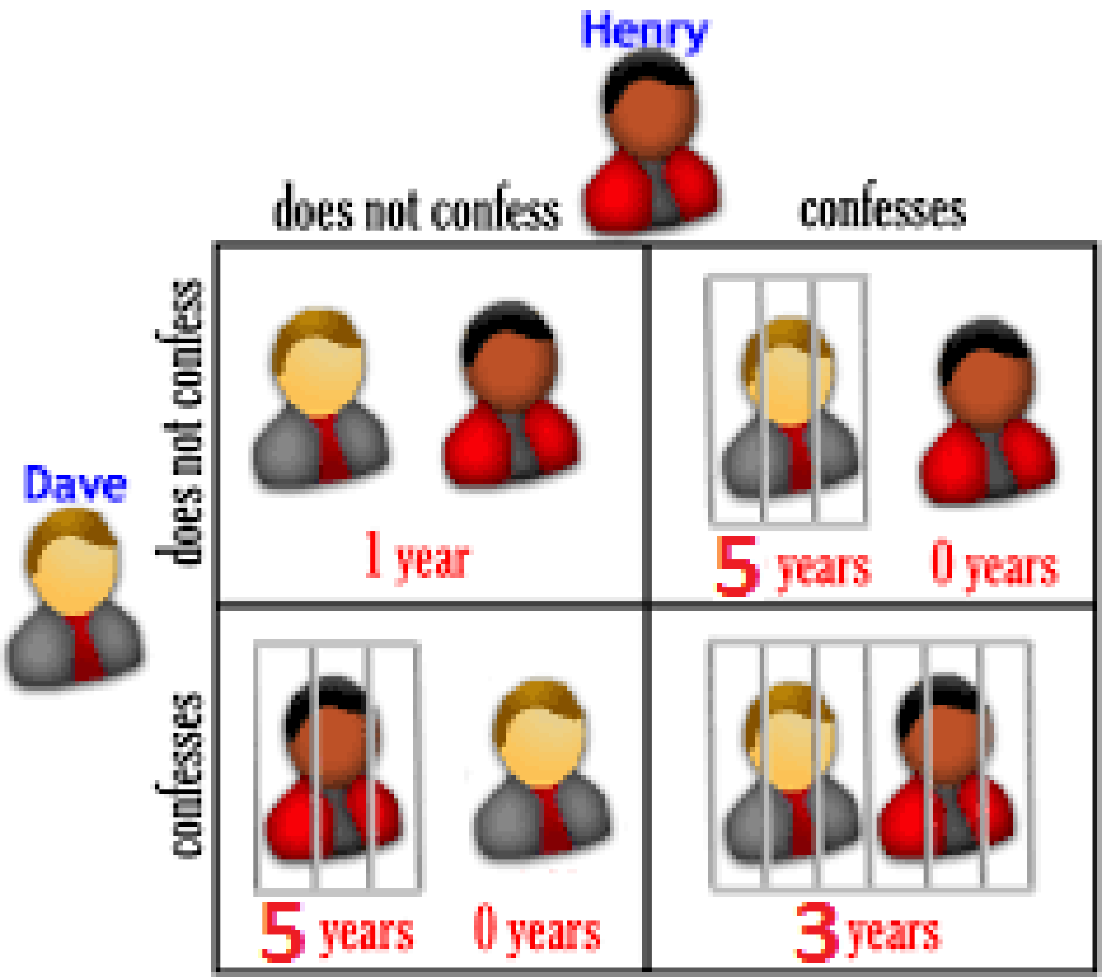
Figure 10.2

We classify games as either total (pure or mixed strategies) or partial conflict



If for each possible outcome the payoffs to each player do not sum to the same constant, the game is classified as **partial conflict**.

Partial Conflict: Prisoner's Delimma

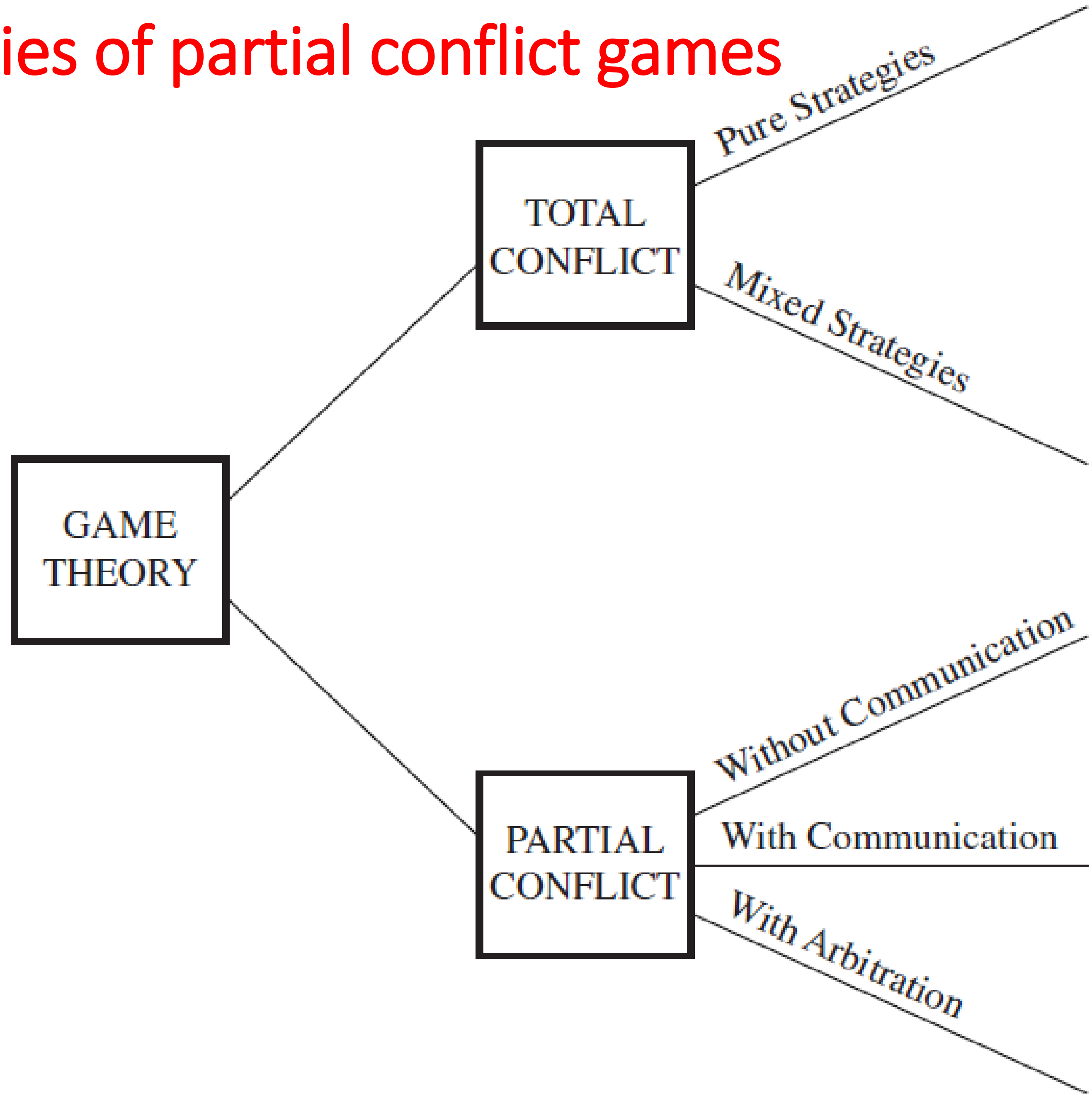


Prisoner's Delimma

- Is there any pure strategy Nash equilibrium?
- Draw arrows

		Henry: No confess	Henry: confess
Dave	No confess	1,1	5,0
Dave	confess	0,5	3,3

Categories of partial conflict games



Total Conflict as a Linear Program Model

- Remember Home Depot and Ace Hardware Store Location
- For simplicity, we will consider only Home Depot's market share,
- Home Depot maximizing its share and Ace minimizing Home Depot's share,

		Ace	
		Large City	Small City
Home Depot	Large City	60	68
	Small City	52	60

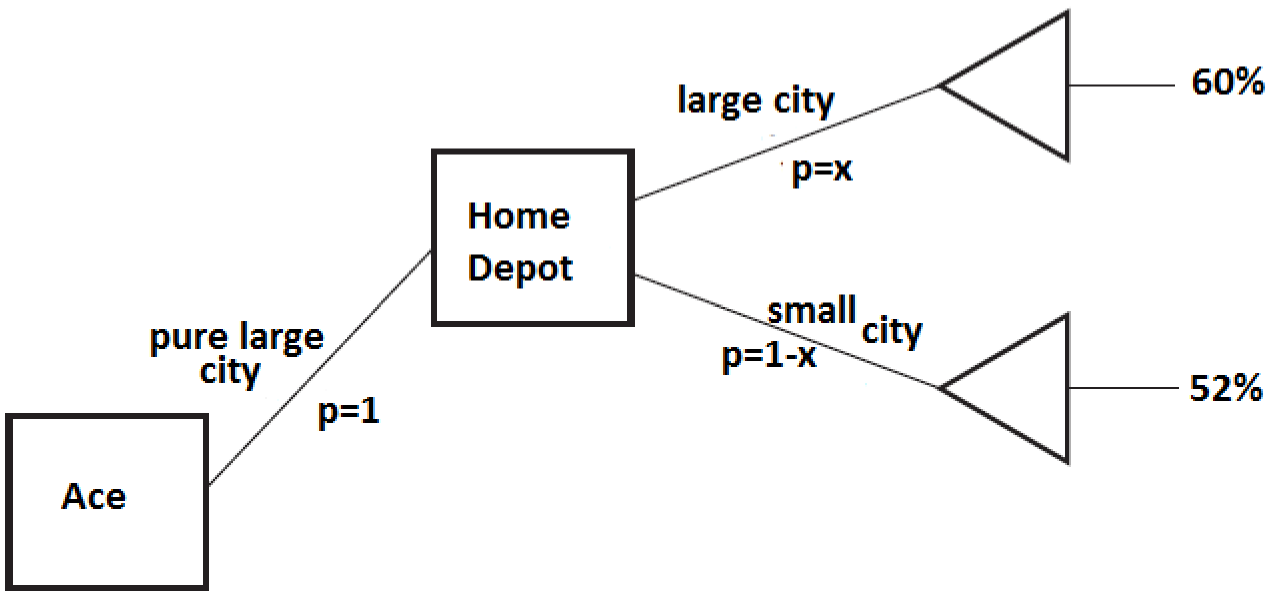
For Home Depot, we define the following variables:

S Percentage of market share

x Portion of the time to locate in a Large City

$(1 - x)$ Portion of the time to locate in a Small City

Ace plays a pure Large City (ALC) strategy

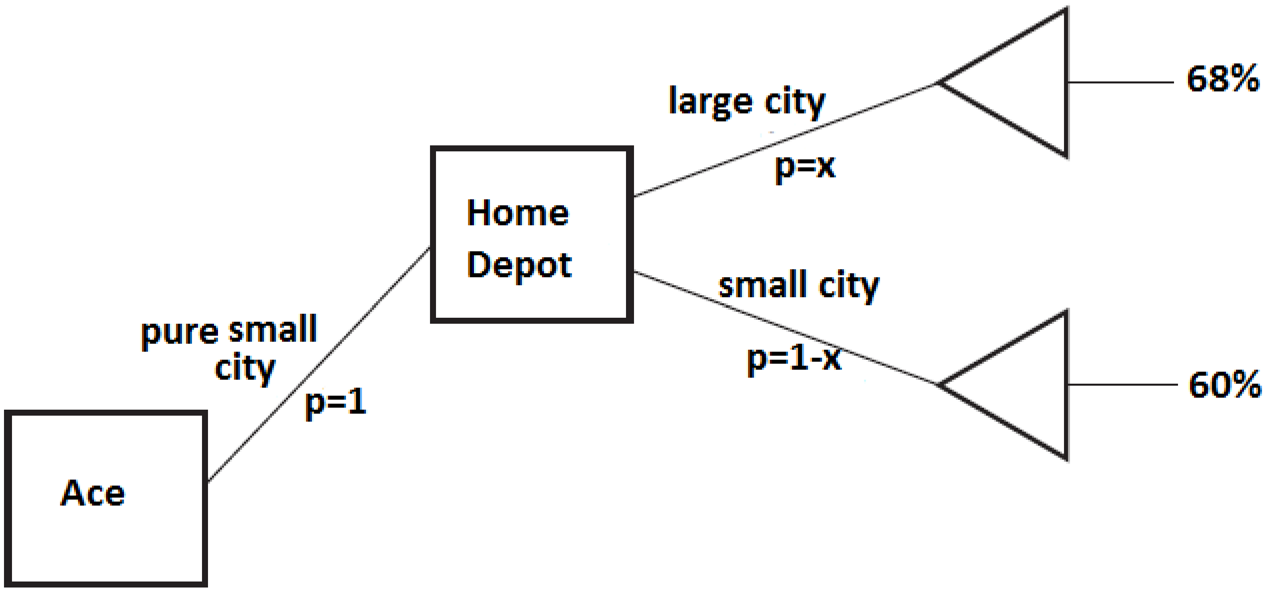


$$EV(ALC) = 60x + 52(1-x)$$

The expected value of Ace tends to be higher than Home Depot's market share

$$S \leq 60x + 52(1-x)$$

Ace plays a pure Small City (ALC) strategy



$$EV(ASC) = 68x + 60(1-x)$$

The expected value of Ace tends to be higher than Home Depot's market share

$$S \leq 68x + 60(1-x)$$

Linear Program Model for Home Depot and Ace Hardware Store Location

$$Maximize\ S$$

$$S \leq 60x + 52(1 - x)$$

$$S \leq 68x + 60(1 - x)$$

$$x \geq 0$$

$$x \leq 1$$

Sample Questions

- Problems 10.1,
  - Question 3, page 386
- Problems 10.2,
  - Questions 2 and 3, page 404, without solving geometrically and algebraically.