STRATEGY

AN INTRODUCTION TO GAME THEORY

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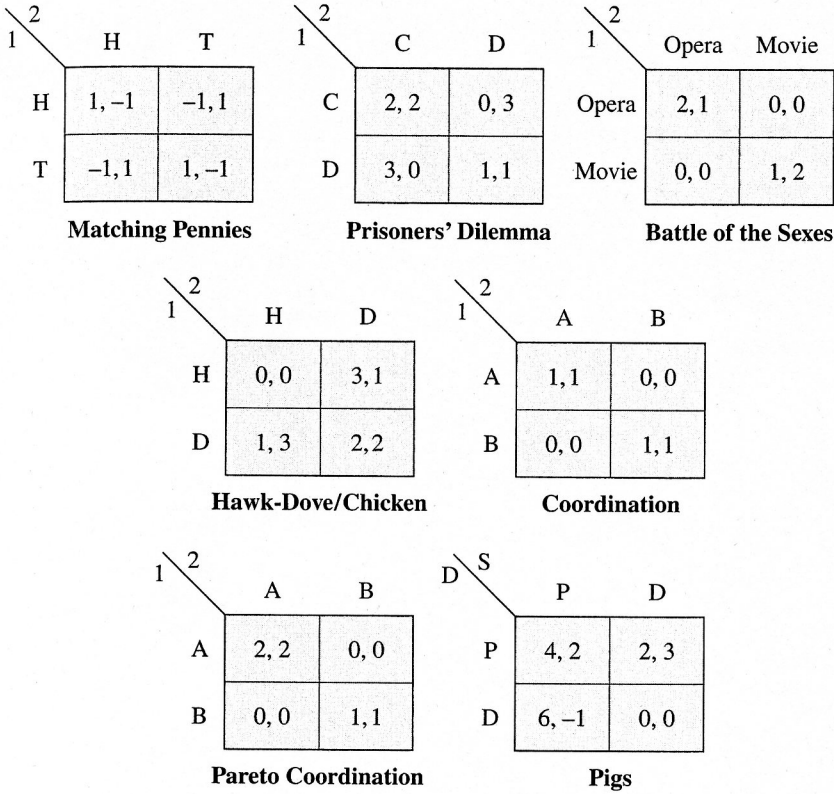
(2002)

W. W. NORTON & COMPANY
NEW YORK • LONDON

Some classic normal-form games are depicted in Figure 4.2. In the game of matching pennies, two players simultaneously and independently select "heads" or "tails," by each uncovering a penny in his hand. If their selections match, then player 2 must give his penny to player 1; otherwise, player 1 gives his penny to player 2.

In the coordination game, both players obtain a positive payoff if they select the same strategy; otherwise they get nothing. The "Pareto coordination"

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[2] In fact, it is often easier to analyze a game without having to consider a tree structure.

[3] The normal form was first defined by J. von Neumann and O. Morgenstern in *Theory of Games and Economic Behavior* (Princeton, NJ: Princeton University Press, 1944).

FIGURE 4.2   Classic normal-form games.

1＼2	H	T
H	1, −1	−1, 1
T	−1, 1	1, −1

Matching Pennies

1＼2	C	D
C	2, 2	0, 3
D	3, 0	1, 1

Prisoners' Dilemma

1＼2	Opera	Movie
Opera	2, 1	0, 0
Movie	0, 0	1, 2

Battle of the Sexes

1＼2	H	D
H	0, 0	3, 1
D	1, 3	2, 2

Hawk-Dove/Chicken

1＼2	A	B
A	1, 1	0, 0
B	0, 0	1, 1

Coordination

1＼2	A	B
A	2, 2	0, 0
B	0, 0	1, 1

Pareto Coordination

D＼S	P	D
P	4, 2	2, 3
D	6, −1	0, 0

Pigs

game has the added feature that both players prefer to coordinate on strategy A rather than on strategy B.[4]

The prisoners' dilemma is a well-known example and is motivated by the following story. The authorities have captured two criminals who they know are guilty of a certain crime. However, the authorities have only enough evidence to convict them of a minor offense. If neither crook admits to the crime, then both will be charged with the minor offense and will pay a moderate fine. The authorities have put the prisoners into separate rooms, where each prisoner is asked to fink on the other. Finking corresponds to strategy D (defect), and not finking corresponds to strategy C (cooperate with the other prisoner). Each is told that, if he finks, he will be granted immunity and be released; his testimony, however, will be used to convict the other prisoner of the crime. If each finks on the other, then they both get sent to jail, but their term is reduced because of their cooperation. The best outcome for a prisoner is to defect while

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[4] Outcome (A, A) is said to "Pareto dominate" (B, B). This criterion is defined in Chapter 6.

the other cooperates (payoff 3); the next-best outcome occurs when neither defects (payoff 2); then comes the outcome in which both defect (payoff 1); the worst outcome for a prisoner is when he cooperates while the other defects.[5]

The ill-titled "battle of the sexes" is a game in which two friends have to decide whether to see a movie or go to the opera. Unfortunately, they work in different parts of the city and, owing to a massive outage of the telephone system, find themselves incommunicado. They must simultaneously and independently select an event to attend. There is only one movie theater and only one opera venue, so the friends will meet each other if they manage to coordinate their decisions. Both prefer to be together, regardless of which event they attend. However, player 1 prefers the opera and player 2 prefers the movie.

The game of chicken you will recognize from several movies, in particular the 1955 James Dean film *Rebel Without a Cause*. Two players drive automobiles toward each other at top speed. Just before they reach each other, each chooses between maintaining course (H) and swerving (D). If both swerve, they both save face and are satisfied. If only one swerves, then he is proved to be a wimp, whereas the other is lauded as a tough guy with steely nerves. If both maintain course, they crash and are each horribly disfigured (and, needless to say, their girlfriends dump them).[6]

The pigs game refers to a situation in which a dominant and a submissive pig share a pen. On one side of the pen is a large button, which if pushed releases food into a dish at the other side of the pen. Each pig has the option of pushing the button (P) or not (D). If neither pushes, the pigs go hungry. If the submissive pig pushes the button and the dominant one does not, the released food is eaten entirely by the dominant pig because it gets to the food first. (Here the submissive pig is even worse off than if neither played P, because it expended the effort to push the button but got no food.) If the dominant pig pushes the button, then the submissive pig can enjoy some of the food before the dominant one reaches the dish.[7]

INTERPRETATION OF THE NORMAL FORM

One way of viewing the normal form is that it models a situation in which players simultaneously and independently select complete contingent plans

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[5] Those who first described this game called it the "prisoner's dilemma." I prefer the plural form to highlight that it is a strategic situation. For an early account of this game and the battle of the sexes, see *Games and Decisions,* by R. D. Luce and H. Raiffa (New York: Wiley, 1957).

[6] In *Rebel Without a Cause*, the players actually drive toward a cliff. My description of the chicken game more accurately describes the chicken scene in the 1984 Kevin Bacon film *Footloose*.

[7] The pigs game is inspired by B. A. Baldwin and G. B. Meese's "Social Behaviour in Pigs Studied by Means of Operant Conditioning," *Animal Behaviour* 27(1979):947–957.