Each girl would prefer to have a unique dress, so a girl's utility is zero if she ends up purchasing the same dress as at least one of her friends. All three know that Julie strongly prefers black to both lavender and yellow, so she would get a utility of 3 if she were the only one wearing the black dress, and a utility of 1 if she were either the only one wearing the lavender dress or the only one wearing or the yellow dress. Similarly, all know that Kristin prefers lavender and secondarily prefers yellow, so her utility would be 3 for uniquely wearing lavender, 2 for uniquely wearing yellow, and 1 for uniquely wearing black. Finally, all know that Larissa prefers yellow and secondarily prefers black, so she would get 3 for uniquely wearing yellow, 2 for uniquely wearing black, and 1 for uniquely wearing lavender.

(a) Provide the game table for this three-player game. Make Julie the Row player, Kristin the Column player, and Larissa the Page player.

(b) Identify any dominated strategies in this game, or explain why there are none.

(c) What are the pure-strategy Nash equilibria in this game?

U10. Bruce, Colleen, and David are all getting together at Bruce’s house on Friday evening to play their favorite game, Monopoly. They all love to eat sushi while they play. They all know from previous experience that two orders of sushi are just the right amount to satisfy their hunger. If they wind up with less than two orders, they all end up going hungry and don’t enjoy the evening. More than two orders would be a waste, because they can’t manage to eat a third order and the extra sushi just goes bad. Their favorite restaurant, Fishes in the Raw, packages its sushi in such large containers that each individual person can feasibly purchase at most one order of sushi. Fishes in the Raw offers takeout, but unfortunately doesn’t deliver.

Suppose that each player enjoys $20 worth of utility from having enough sushi to eat on Friday evening, and $0 from not having enough to eat. The cost to each player of picking up an order of sushi is $10.

Unfortunately, the players have forgotten to communicate about who should be buying sushi this Friday, and none of the players has a cell phone, so they must each make independent decisions of whether to buy (B) or not buy (N) an order of sushi.

(a) Write down this game in strategic form.

(b) Find all the Nash equilibria in pure strategies.

(c) Which equilibrium would you consider to be a focal point? Explain your reasoning.

U11. Roxanne, Sara, and Ted all love to eat cookies, but there’s only one left in the package. No one wants to split the cookie, so Sara proposes the following extension of “Evens or Odds” (see Exercise S11) to determine who gets to eat it. On the count of three, each of them will show one or two
132 [CH. 4] SIMULTANEOUS-MOVE GAMES WITH PURE STRATEGIES

fingers, they'll add them up, and then divide the sum by 3. If the remainder is zero Roxanne gets the cookie, if the remainder is 1 Sara gets it, and if it is 2 Ted gets it. Each of them receives a payoff of 1 for winning (and eating the cookie) and zero otherwise.

(a) Represent this three-player game in normal form, with Roxanne as the Row player, Sara as the Column player, and Ted as the Page player.
(b) Find all the pure-strategy Nash equilibria of this game. Is this game a fair mechanism for allocating cookies? Explain why or why not.

U12. (Optional) Construct the payoff matrix for your own two-player game that satisfies the following requirements. First, each player should have three strategies. Second, the game should not have any dominant strategies. Third, the game should not be solvable using minimax. Fourth, the game should have exactly two pure-strategy Nash equilibria. Provide your game matrix, and then demonstrate that all of the above conditions are true.

Simultaneous-Move Games with Pure Strategies II: Continuous Strategies and III: Discussion and Evidence

The discussion of simultaneous-move games in Chapter 4 focused on games in which each player had a discrete set of actions from which to choose. Discrete strategy games of this type include sporting contests in which a small number of well-defined plays can be used in a given situation—soccer penalty kicks, in which the kicker can choose to go high or low, to a corner or the center, for example. Other examples include coordination and prisoners’ dilemma games in which players have only two or three available strategies. Such games are amenable to analysis with the use of a game table, at least for situations with a reasonable number of players and available actions.

Many simultaneous-move games differ from those considered so far; they entail players choosing strategies from a wide range of possibilities. Games in which manufacturers choose prices for their products, philanthropists choose charitable contribution amounts, or contractors choose project bid levels are examples in which players have a virtually infinite set of choices. Technically, prices and other dollar amounts do have a minimum unit, such as a cent, and so there is actually only a finite and discrete set of price strategies. But in practice the unit is very small, and allowing the discreteness would require us to give each player too many distinct strategies and make the game table too large; therefore it is simpler and better to regard such choices as continuously variable real numbers. When players have such a large range of actions available, game tables become