**Solutions to Chapter 2 Exercises**

**UNSOLVED EXERCISES**

U1. (a) This is a game, because the choice of funding may hinder or help the candidate run against her opponent. For example, if her opponent had committed to public financing and the public viewed private financing as serving special interests, then she may wish to choose public funding in order to avoid the appearance of serving special interests. In most cases, this game is one with a small number of players.

(b) Fred is trying to optimize his purchase of songs by determining whether he would get more enjoyment out of purchasing songs, albums, or a mixture. However, these are only decisions, because they do not affect other individuals.

(c) One might be tempted to consider this to be merely a decision on Belle’s part, unless you consider the suitors to be players in the game in which case it is a game with a small number of players. Because Belle will presumably end up dating only a small number of the 100 suitors, the suitors’ payoffs will be affected by Belle’s choices. Furthermore, Belle may wish to be strategic in deciding how many to reply to, and when to respond to each. If she replies to several suitors early on, and turns out not to like any of them on a first date, she may wish to return to others. However, the delay may cause the other suitors to lose interest.

(d) This is a game with many players. All residents of the East Coast are considering whether to head west and the decisions made by each have an impact on the payoffs of all.

(e) This is a game between NBC and the potential distributors, in which the distributors may compete on price, and NBC may also choose to go it alone: a game with a small number of players. For example, NBC initially distributed shows for a fee via Apple’s iTunes store. They simultaneously developed NBC.com in order to distribute shows with commercials included. In 2007, NBC balked at Apple’s price and withdrew its shows from iTunes.

(e) This is also a game with a small number of players, China and the United States. China’s outcome is directly affected by how the United States responds to imports on its goods. A large Chinese tariff on U.S. goods could start a trade war, in which the United States reacts by placing a similar import tariff on Chinese goods.

U2. (a) (i) Interests are partially but not fully aligned so non-zero-sum game; (ii) simultaneous moves, because the two sales representatives privately decide how hard to work; (iii) fixed rules; (iv) imperfect information because neither sales representative knows how hard the other will work; (v) could be repeated if one models the interaction as happening each day, or a one-time game if each sales representative decides once, right after learning about the opportunity, how hard they will work to win the car; (vi) cooperative agreements are not possible, because each representative has an incentive to cheat.

(b) (i) Interests are partially aligned—the game is not zero-sum; (ii) sequential, because the contestants are asked one at a time; (iii) fixed rules; (iv) imperfect information for the first three contestants (because they do not know what the subsequent contestants will bid), perfect information for the final contestant (who heard the first three bids), and incomplete information (because no contestant can be certain of the product’s price); (v) repeated game for the losers, but not for the winner; (vi) cooperative agreements are not possible.

(c) (i) Interests are totally in conflict: zero-sum game: (ii) each hand of poker is a distinct simultaneous game, but the tournament requires repeated hands, so it is also sequential; (iii) fixed rules; (iv) imperfect and incomplete (asymmetric) information: no player knows the cards that the other players hold; (v) tournament is not repeated, but individual hands are, so this game may be considered a repeated, simultaneous game; (vi) cooperative agreements are possible: there are multiple prizes, and a subset of players could collude to defeat other players. (While possible, cooperation through collusion is forbidden in poker and results in expulsion from the game if discovered.)

(d) (i) Interests are totally in conflict (zero-sum) because any seat I have, you cannot have; (ii) passengers do not know when others check in, so it is simultaneous; (iii) fixed rules (enforced by the airlines); (iv) imperfect information about the actions of other flyers; (v) repeated game for frequent flyers; (vi) cooperative agreements possible (for example, two frequent flyers could agree to alternate between the best seats they could obtain).

U3. This is only true for constant-sum games. There are numerous games in which both can win, for example, two investors purchasing stock in the same company can both win as the stock price increases. Two students working on a group project must choose between working or letting the other person finish the project. If they both work, then the project will be of high quality, and both students will learn more and receive a higher grade. Finally, even though an employer may give up marginal profit to increase employee pay, the overall sales may dramatically increase as employees respond to incentives, thus increasing the employer’s profit.

U4. Before answering the subquestions, it helps to calculate the probability of each player winning or losing. The probability of winning and losing for Confucius is identical to the probability for Bob.

(a) For Alice, the probability of having all heads is 0.5 • 0.5 • 0.5 = 0.125, and the probability of all tails is the same, so Alice will win with probability 0.25, and accordingly lose with probability 0.75.

(b) Alice’s expected payoff is 0.25 • 2 + 0.75 • –1 = –0.25.

(c) For Confucius, there are three ways to have two heads and one tail land: the first quarter could be the tail, the second quarter could be the tail, or the third quarter could be the tail. The probability of having a tail in one position and two heads in the others is 0.5 • 0.5 • 0.5 = 0.125, but there are three positions that could be the tail, so we must multiply this by three: 3 • 0.125 = 0.375. Thus, Bob’s probability of winning is 0.375, and of losing is 0.625.

(d) The payoff of Confucius is 0.375 • 2 + 0.625 • –1 = 0.125.

(e) Yes, this is a constant-sum game, because any money won comes directly from the two losers.

U5. One possible example is that in many card games, when a player has only one remaining card, she must declare it, and if she does not and another player catches her, then she receives a penalty, usually more cards. If she was not informed of this rule, then someone could surprise her by catching her with one card.

But players may know all the rules and still surprise another, because their actions are not observable, or they may have information that others do not. For example, in poker, you may surprise your opponent who has a full house by revealing a straight flush. Both of you knew the rules, but your opponent did not know which cards you were holding.