CAUTION Don't make the mistake of finding a probability value by mindlessly dividing a smaller number by a larger number. Instead, think carefully about the numbers involved and what they represent. Be especially careful when determining the total number of items being considered, as in the following example.

Example 7 Tainted Currency

In a study of U.S. paper currency, bills from 17 large cities were analyzed for the presence of cocaine. Here are the results: 23 of the bills were not tainted by cocaine and 211 were tainted by cocaine. Based on these results, if a bill is randomly selected, find the probability that it is tainted by cocaine.

Solution

Hint: Instead of trying to determine an answer directly from the printed statement, begin by first summarizing the given information in a format that allows you to clearly understand the information. For example, use this format:

23	bills not tainted by cocaine
211	bills tainted by cocaine
234	total number of bills analyzed

We can now use the relative frequency approach as follows:

$$P(\text{bill tainted by cocaine}) = \frac{\text{number of bills tainted by cocaine}}{\text{total number of bills analyzed}} = \frac{211}{234}$$
$$= 0.902$$

Interpretation

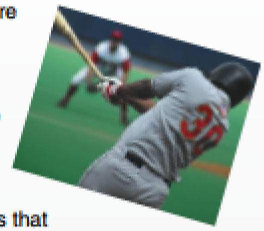
There is a 0.902 probability that if a U.S. bill is randomly selected, it is tainted by cocaine.

Simulations The statements of the three approaches for finding probabilities and the preceding examples might seem to suggest that we should always use the classical approach when a procedure has equally likely outcomes, but many situations are so complicated that the classical approach is impractical. In the game of solitaire, for example, the outcomes (hands dealt) are all equally likely, but it is extremely difficult to try to use the classical approach to find the probability of winning. In such cases we can more easily get good estimates by using the relative frequency approach, and simulations are often helpful when using this approach. A *simulation* of a procedure is a process that behaves in the same ways as the procedure itself so that similar results are produced. (See the Technology Project near the end of this chapter.) For example, it's much easier to use the relative frequency approach for approximating the probability of winning at solitaire—that is, to play the game many times (or to run a computer simulation)—than to perform the complex calculations required with the classical approach.

Example 8 Thanksgiving Day

If a year is selected at random, find the probability that Thanksgiving Day in the United States will be (a) on a Wednesday or (b) on a Thursday.

Simulations in Baseball



Simulations are being used to identify the most effective strategies in a variety of circumstances that occur in baseball. On this topic, *New York Times* reporter Alan Schwarz quoted Harvard University statistician Carl Morris as saying that "computer simulations work pretty well in baseball for two reasons. In general, they allow you to study fairly complicated processes that you can't really get at with pure mathematics. But also, sports are great for simulations—you can play 10,000 seasons overnight." Many baseball teams now use simulations to help them decide which players should be traded.

Here are some strategies suggested by computer simulations of baseball:

- It is not wise to intentionally walk a player.
- The sacrifice bunt should be used very rarely.