5.63 **A POLITICAL POLL, I** An opinion poll selects adult Americans at random and asks them, “Which political party, Democratic or Republican, do you think is better able to manage the economy?” Explain carefully how you would assign digits from Table B to simulate the response of one person in each of the following situations.

The choice of digits in these simulations may of course vary from those made here. In (a)–(c), a single digit simulates the response; for (d), two digits simulate the response of a single voter.

(a) Of all adult Americans, 50% would choose the Democrats and 50% the Republicans.
   
   Odd digits – voter would vote Democratic  
   Even digits – voter would vote Republican

(b) Of all adult Americans, 60% would choose the Democrats and 40% the Republicans.
   
   0, 1, 2, 3, 4, 5 – Democratic  
   6, 7, 8, 9 – Republican

(c) Of all adult Americans, 40% would choose the Democrats, 40% would choose the Republicans, and 20% would be undecided.
   
   0, 1, 2, 3 – Democratic  
   4, 5, 6, 7 – Republican  
   8, 9 – Undecided

(d) Of all adult Americans, 53% would choose the Democrats and 47% the Republicans.
   
   00, 01, . . . 52 – Democratic  
   53, 54, . . . 99 – Republican

5.68 **GAME OF CHANCE, I** Amarillo Slim is a cardsharp who likes to play the following game. Draw 2 cards from a deck of 52 cards. If at least one of the cards is a heart, then you win $1. If neither card is a heart, then you lose $1.

(a) Describe a correspondence between random numbers and possible outcomes in this game.
   
   Read two random digits at a time from Table B. Let 01 to 13 represent a Heart, let 14 to 52 represent another suit, and ignore the other two-digit numbers.

(b) Simulate playing the game for 25 rounds. Shuffle the cards after each round. See if you can beat Amarillo Slim at his own game. Remember to write down the results of each game. When you finish, combine your results with those of 3 other students to obtain a total of 100 trials. Report your cumulative proportion of wins. Do you think this is a “fair” game? That is, do both you and Slim have an equal chance of winning? You should beat Slim about 44% of the time.
5.71 **BATTER UP!** Suppose a major league baseball player has a current batting average of .320.

Note that the *batting average* = \( \frac{\text{number of hits}}{\text{number of at-bats}} \)

(a) Describe an assignment of random numbers to possible results in order to simulate the player’s next 20 at-bats. Let 000 to 999 \( \Leftrightarrow \) at bats, 001 to 320 \( \Leftrightarrow \) hits, and 321 to 999 and 000 \( \Leftrightarrow \) no hits.

(b) Carry out the simulation for 20 repetitions, and report your results. What is the relative frequency of at-bats in which the player gets a hit?

We entered \( 1 \rightarrow \text{c ENTER} \) to set a counter

\[
\text{randInt}(0,999,20) \rightarrow L1 : \text{sum} (L1 \geq 1 \text{ and } L1 \leq 320) \rightarrow L2 : C + 1 \rightarrow C
\]

Press ENTER repeatedly. The count (number of the repetition) is displayed on the screen to help you see when to stop. The results for the 20 repetitions are stored in list L2. (You might want to sort L2 to make it easier to count the frequencies.) We obtained the following frequencies:

<table>
<thead>
<tr>
<th>Number of hits in 20 at bats</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

(c) Compare your simulated experimental results with the player’s actual batting average of .320.

The mean number of hits in 20 at bats was \( \bar{x} = 6.25 \). And \( 6.25/20 = .3125 \), compared with the player’s batting average of .320. Notice that even though there was considerable variability in the 20 repetitions, ranging from a low of 3 hits to a high of 9 hits, the results of our simulation were very close to the player’s batting average.
5.75  **TREATING BREAST CANCER**  What is the preferred treatment for breast cancer that is detected in its early stages? The most common treatment was once removal of the breast. It is now usual to remove only the tumor and nearby lymph nodes, followed by radiation. To study whether these treatments differ in their effectiveness, a medical team examines the records of 25 large hospitals and compares the survival times after surgery of all women who have had either treatment.

(a) What are the explanatory and response variables?

Explanatory variable: treatment method; response: survival times.

(b) Explain carefully why this study is not an experiment.

No treatment is actively imposed; the women (or their doctors) chose which treatment to use.

(c) Explain why confounding will prevent this study from discovering which treatment is more effective. (The current treatment was in fact recommended after a large randomized comparative experiment.) Doctors may make the decision of which treatment to recommend based in part on how advanced the case is. Some might be more likely to recommend the older treatment for advanced cases, in which case the chance of recovery is lower. Other doctors might view the older treatment as not being worth the effort, and recommend the newer method as a way of providing some hope for recovery while minimizing the trauma and expense of major surgery.

5.79  **FOOD FOR CHICKS**  New varieties of corn with altered amino acid content may have higher nutritional value than standard corn, which is low in the amino acid lysine. An experiment compares two new varieties, called opaque-2 and floury-2, with normal corn. The researchers mix corn-soybean meal diets using each type of corn at each of three protein levels, 12% protein, 16% protein, and 20% protein. They feed each diet to 10 one-day-old male chicks and record their weight gains after 21 days. The weight gain of the chicks is a measure of the nutritional value of their diet.

(a) What are the experimental units and the response variable in this experiment?

The chicks are the experimental units; weight gain is the response variable.

(b) How many factors are there? How many treatments? Make a table to describe the treatments. How many experimental units does the experiment require?

There are two factors: corn variety (2 levels) and percent of protein (3 levels).
This makes 6 treatments, so 60 chicks are required.
5.82 **McDONALD’S VERSUS WENDY’S** Do consumers prefer the taste of a cheeseburger from McDonald’s or from Wendy’s in a blind test in which neither burger is identified? Describe briefly the design of a matched pairs experiment to investigate this question.

Each subject should taste both kinds of cheeseburger, in a randomly selected order, and then be asked about their preference. Both burgers should have the same “fixings” (ketchup, mustard, etc.). Since some subjects might be able to identify the cheeseburgers by appearance, one might need to take additional steps (such as blindfolding, or serving only the center part of the burger) in order to make this a truly “blind” experiment.
5.83 REPAIRING KNEES IN COMFORT Knee injuries are routinely repaired by arthroscopic surgery that does not require opening up the knee. Can we reduce patient discomfort by giving them a nonsteroidal anti-inflammatory drug (NSAID)? Eight-three patients were placed in three groups. Group A received the NSAID both before and after the surgery. Group B was given a placebo before and the NSAID after. Group C received a placebo both before and after surgery. The patients recorded a pain score by answering questions one day after the surgery.

(a) Outline the design of this experiment. You do not need to do the randomization that your design requires. The two extra patients can be randomly assigned to two of the three groups.

(b) You read that “the patients, physicians and physical therapists were blinded” during the study. What does this mean? No one involved in administering treatments or assessing their effectiveness knew which subjects were in which group.

(c) You also read that “the pain scores for Group A were significantly lower than Group C but not significantly lower than Group B.” What does this mean? What does this finding lead you to conclude about the uses of NSAIDs? The pain scores in Group A were so much lower than the scores in Groups B and C that they would not often happen by chance if NSAIDs were not effective. We can conclude that NSAIDs provide real pain relief.
A SPINNER GAME OF CHANCE  A game of chance is based on spinning a 0 – 9 spinner like the one shown in the illustration two times in succession. The player wins if the larger of the two numbers is greater than 5.

(a) What constitutes a single run of this experiment? What are the possible outcomes resulting in win or lose? A single run: spin the 0–9 spinner twice; see if the larger of the two numbers is larger than 5. The player wins if either number is 6, 7, 8 or 9.

(b) Describe a correspondence between random digits from a random number table and outcomes in the game. If using the random digit table, let the digits 0 – 9 represent themselves.

(c) Describe a technique using the randInt command on the TI-84 to simulate the result of a single run of the experiment. randInt (0, 9, 2).

(d) Use either the random number table or your calculator to simulate 20 trials. Report the proportion of times you win the game. Then combine your results with those of other students to obtain results for a large number of trials. In our simulation of 20 repetitions, we observed 13 wins for a 65% win rate. Using the methods of the next chapter, it can be shown that there is a 75% probability of winning this game.
SELF-PACED LEARNING, I  Elaine is enrolled in a self-paced course that allows three attempts to pass an examination on the material. She does not study and has 2 out of 10 chances of passing on any one attempt by luck. What is Elaine’s likelihood of passing on at least one of the three attempts? (Assume the attempts are independent because she takes a different exam on each attempt.)

(a) Explain how you would use random digits to simulate one attempt at the exam. Elaine will of course stop taking the exam as soon as she passes. A single digit simulates one try, with 0 or 1 a pass and 2 to 9 a failure. Three independent tries are simulated by three successive random digits.

(b) Simulate 50 repetitions. What is your estimate of Elaine’s likelihood of passing the course? With the convention of (a), 50 tries beginning in line 120 gives 25 successes, so the probability of success is estimated as 25/50 = 1/2. [In doing the simulation, remember that you can end a repetition after 1 or 2 tries if the student passes, so that some repetitions do not use three digits. Though this is a proper simulation of the student’s behavior, the probability of at least one pass is the same if three digits are examined in every repetition. The true probability is $1 - (0.8)^3 = 0.488$, so this particular simulation was quite accurate.]

(c) Do you think the assumption that Elaine’s likelihood of passing the exam is the same on each trial is realistic? Why? No—learning usually occurs in taking an exam, so the probability of passing probably increases on each trial.