4-7 Probabilities Through Simulations

Key Concept Simulations were briefly discussed in Section 4-2 of the Triola textbook. In this section we use simulations as an alternative approach to finding probabilities. The advantage to using simulations is that we can overcome much of the difficulty encountered when using the formal rules discussed in the preceding sections. We begin by defining a simulation.

> **DEFINITION** A **simulation** of a procedure is a process that behaves the same way as the procedure, so that similar results are produced.

Example 1 illustrates the use of a simulation involving births.

Example 1 Gender Selection

In a test of the MicroSort method of gender selection developed by the Genetics & IVF Institute, 127 boys were born among 152 babies born to parents who used the YSORT method for trying to have a baby boy. In order to properly evaluate these results, we need to know the probability of getting at least 127 boys among 152 births, assuming that boys and girls are equally likely. Assuming that male and female births are equally likely, describe a simulation that results in the genders of 152 newborn babies.

Solution

One approach is simply to flip a fair coin 152 times, with heads representing females and tails representing males. Another approach is to use a calculator or computer to randomly generate 152 numbers that are 0s and 1s, with 0 representing a male and 1 representing a female. The numbers must be generated in such a way that they are equally likely. Here are typical results:

0	0	1	0	1	1	1	. . .
↓	↓	↓	↓	↓	↓	↓	. . .
Male	Male	Female	Male	Female	Female	Female	

Example 2 Same Birthdays

A classical birthday problem involves finding the probability that in a randomly selected group of 25 people, at least 2 share the same birthday. The theoretical solution is somewhat difficult. It isn't practical to survey many different groups of 25 people, so a simulation is a helpful alternative. Describe a simulation that could be used to find the probability that among 25 randomly selected people, at least 2 share the same birthday.

Solution

Begin by representing birthdays by integers from 1 through 365, where 1 = January 1, 2 = January 2, . . . , 365 = December 31. Then use a calculator or computer to generate 25 random numbers, each between 1 and 365. Those numbers can then be sorted, so it becomes easy to examine the list to determine whether any 2 of the