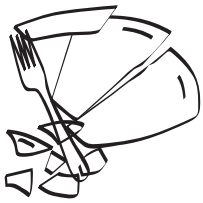

1. The Clumsy Dishwasher Problem

A broken dish is not something to take lightly. It was a broken, dirty banquet dish that killed the French mathematician Edouard Lucas in 1891; he died, at age fourty-nine, from an erysipelas infection resulting from a cut after a sharp fragment from a dish dropped by a waiter flew up and hit him in the face.

Suppose a restaurant employs five dishwashers. In a one-week interval they break five dishes, with four breakages due to the same individual. His colleagues thereafter call him "clumsy," but he claims it was just bad luck and could have happened to any one of them. The problem here is to see if he has some valid mathematical support for his position. First, see if you can calculate the probability that the same dishwasher breaks *at least* four of the five dishes that are broken (this includes, of course, the event of his breaking all five). It's an easy combinatorial calculation. Assume the dishwashers are equally skilled and have identical workloads, and that the breaking of a dish is a truly random event. If this probability is small, then the hypothesis that the given dishwasher actually *is* clumsy is more compelling than the hypothesis that a low-probability event has occurred. (What "low" means is, of course, subjective.) Second, after you have calculated this probability—and even if you can't—write a Monte Carlo simulation that estimates this probability. Are the two approaches in agreement?

2. Will Lil and Bill Meet at the Malt Shop?

Journeys end in lovers meeting . . .
—Shakespeare, *Twelfth Night*

The introduction used some examples of geometric probability from pure mathematics to open this book, and here's a problem from real life that can also be solved with a geometric probability approach. It can, however, also be easily attacked with a Monte Carlo simulation if the theoretical solution escapes you, and so I think it perfect for inclusion in this collection.

I used this problem in every undergraduate probability class I taught at the University of New Hampshire, and I originally thought the initial puzzlement I saw on my students' faces was because the math was strange to them. Then I learned it was mostly due to not knowing what a malt shop is—or I should say was. In New England, an ice cream milkshake is called a frappe, a term that, as a born-in-California boy, I had never heard before moving to New Hampshire in 1975. (Older readers can relive the nostalgia by watching Episode 189—"Tennis, Anyone?"—or Episode 195—"Untogetherness"—of *Leave It to Beaver* on the TV Land channel in which casual mentions of "the malt shop" are made. Younger readers, ask your grand parents!) So, if the malt shop is a problem for you, we could simply have Lil and Bill meeting instead at the theater, the high school gym, the local fast-food outlet,

and so on, but as a fellow who went to high school in the 1950s, I still like the malt shop. Anyway, here's the problem.

Lil and Bill agree to meet at the malt shop sometime between 3:30 and 4 o'clock later that afternoon. They're pretty casual about details, however, because each knows that the other, while he or she will show up during that half-hour, is as likely to do so at any time during that half-hour as at any other time. If Lil arrives first, she'll wait five minutes for Bill, and then leave if he hasn't appeared by then. If Bill arrives first, however, he'll wait seven minutes for Lil before leaving if she hasn't appeared by then. Neither will wait past 4 o'clock. What's the probability that Lil and Bill meet? What's the probability of their meeting if Bill reduces his waiting time to match Lil's (i.e., if both waiting times are five minutes)? What's the probability of their meeting if Lil increases her waiting time to match Bill's (i.e., if both waiting times are seven minutes)?