

## ◆ Computer Key-In

If you break a stick into three pieces, what is the probability that you can join the pieces end-to-end to form a triangle?

It's easy to see that if the sum of the lengths of any two of the pieces is less than or equal to that of the third, a triangle can't be formed. This is the Triangle Inequality (Theorem 6-4).

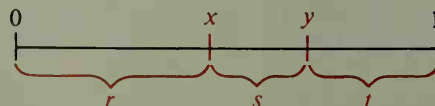


By an experiment, your class can estimate the probability that three pieces of broken stick will form a triangle. Suppose everyone in your class has a stick 1 unit long and breaks it into three pieces. If there are thirty people in your class and eight people are able to form a triangle with their pieces, we estimate that the probability of forming a triangle is about  $\frac{8}{30}$ , or  $\frac{4}{15}$ .

Of course, this experiment is not very practical. You can get much better results by having a computer simulate the breaking of many, many sticks, as in the program in BASIC on the next page.

Computer simulations are useful whenever large numbers of operations need to be done in a short period of time. In this problem, for example, an accurate probability depends on using a large number of sticks. Computer simulations have been used when a real experiment would be costly or dangerous; aeronautics companies use real-time flight simulators on the ground to train pilots. Simulations are also applied to investigate statistical data where many variables determine the outcome, as in the analysis and prediction of weather patterns. In the stick-triangle problem, using the computer has another advantage—a computer can break very small pieces that a human couldn't, so the probability figure will be theoretically more accurate, if less “realistic.”

In lines 30 and 40 of the following program, you tell the computer how many sticks you want to break. Each stick is 1 unit long, and the computer breaks each stick by choosing two random numbers  $x$  and  $y$  between 0 and 1. These numbers divide the stick into three lengths  $r$ ,  $s$ , and  $t$ .



The computer then keeps count of the number of sticks ( $N$ ) which form a triangle when broken.

Notice that RND is used in lines 70 and 80. Since usage of RND varies, check this with the manual for your computer and make any necessary changes. The computer print-outs shown in this text use capital letters. The  $x$ ,  $y$ ,  $r$ ,  $s$ , and  $t$  used in the discussion above appear as  $X$ ,  $Y$ ,  $R$ ,  $S$ ,  $T$ .