Simulation

Simulation is a modeling technique that is used to help people answer questions about real situations by using probability experiments that are similar to the real situation. It is important to understand the basic steps involved in conducting a simulation. A simple example is given to illustrate the process.

Problem 1: What are the chances that when you toss a coin 7 times you will have a run of at least 3 consecutive heads or 3 consecutive tails?

Step 1 State the Problem

If you toss a coin 7 times, what is the probability that you will have a run of at least 3 consecutive heads or 3 consecutive tails? (Note: It is important to have all of the information available and to understand the objective of the simulation.)

Step 2 State the Assumptions

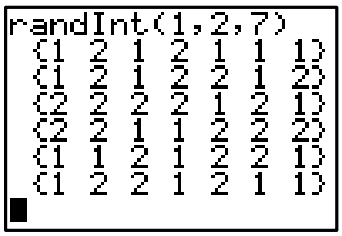
When you toss a coin, a head or a tail is equally likely to appear. Tosses are independent. In other words, the outcome of any toss will not influence the next toss.

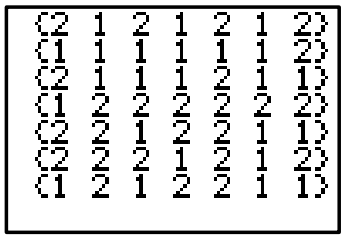
Step 3 Select a Model to Generate Outcomes

Let the digit 1 represent heads and the digit 2 represent tails. Use a random number generator or a random number table for getting digits.

Step 4 Simulate Many Repetitions

For this problem use the random integer feature of the TI-83. (Note: randInt is found by pressing MATH then PRB and selecting 5:randInt. The numbers 1, 2, 7 indicate that you are generating 7 random integers ranging from 1 to 2.)





Each time you press the enter key you generate another repetition of the experiment. When you are estimating the probability of getting a run of 3 heads or 3 tails when a coin is tossed 7 times, the more repetitions you have, the better your estimate will be. The results displayed on the calculator screen show that out of 13 trials there were 7 times when there were 3 heads or 3 tails in a row.

Problem 2: What are the chances that when you toss a coin 7 times you will get exactly 3 heads? Use the random binomial feature of the TI-83 to generate 5 trials of 7 tosses at a time. Then each time you press enter another 5 trials are simulated. (Note: randBin is found by pressing MATH then PRB and selecting 7:randBin. The numbers 7, .5, 5 indicate that you are completing 7 tosses with a probability of success (heads) of 0.5 and you are generating 5 trials at one time.)

```
randBin(7,.5,5)
      {3 0 5 3 3}
      {2 5 4 3 4}
      {5 5 2 5 5}
      {3 4 5 4 4}
      {3 4 4 6 4}
      {2 3 4 1 4}
```

Out of the 30 simulations generated by the calculator, exactly 3 heads appeared 7 times. So the experimental probability is (7/30) = 0.2333.

Problem 3: If you roll a die 5 times, what is the probability that you will get exactly one 6?

Method 1:

```
randInt(1,6,5)
      {4 3 5 3 6}
      {3 3 1 4 5}
      {4 4 3 2 3}
      {2 2 2 2 2}
      {5 3 4 4 2}
      {6 1 3 3 3}
```

```
      {1 4 4 1 2}
      {4 2 6 4 5}
      {3 4 4 3 6}
      {1 4 1 6 2}
      {1 6 5 2 6}
      {3 4 1 2 4}
      {5 3 6 4 6}
```

Since you rolled exactly one 6 in 5 out of 13 trials, the experimental probability is (5/13) = 0.3846.

Method 2:

```
randBin(5,(1/6),
5)
      {2 0 1 1 1}
      {1 1 0 1 2}
      {0 0 2 0 1}
      {2 2 0 1 0}
      {0 0 0 0 1}
```

Since you rolled exactly one 6 in 9 out of 25 trials, the experimental probability is (9/25) = 0.36.