

Chapter 6

Probability

6.0 Introduction

In chapter 6 we discovered that from the standpoint of arithmetic, probability calculations were fairly routine and the TI-83 performs those calculations without so much as a yawn. Where the TI-83 is a real blessing is with elementary simulations. (For complicated simulations, one needs a combination of computer and computer programmer.) The TI-83 has built-in functions that generate random numbers and more particularly random numbers that fit certain common statistical situations. If you have even a bit of computer programming experience, you will be able to write programs to do simulations beyond the elementary. Our short introduction here will not require programming, only a few as yet unused keystrokes. Our example for discussion will be the family planning example.

6.1 Simulation

Example 6.32 One-Boy Family Planning.

To help you recall the family planning example, here is a short synopsis:

Suppose that couples who wanted children were to continue having children until a boy is born. Assuming that each newborn child is equally likely to be a boy or a girl, would this behavior change the proportion of boys in the population? We will use simulation to estimate the long-run proportion of boys in the population if families were to continue to have children until they have a boy. This proportion is an estimate of the probability that a randomly selected child from this population is a boy. Note that every sibling group would have exactly one boy.

We will use a single-digit random number to represent a child. The odd digits (1, 3, 5, 7, 9) will represent a male birth, and the even digits will represent a female birth. An observation will be constructed by selecting a sequence of random digits. If the first random number obtained is odd (a boy), the observation is complete. If the first selected number is even (a girl), another digit will be chosen. We continue in this way until an odd digit is obtained.

We will use the TI-83 in place of the random number table, but keep the same symbols for the outcomes – odd digits will represent a male birth, even digits a female birth.

6.2 Generating random integers

For some simulations random digits may be generated in pairs, or 4 at a time, or whatever. In this particular case, we will generate random digits until we get a boy – that is, until we get an odd digit. The random number capabilities on the TI-83 can be found by keying the following sequence:

MATH > PRB

Your screen will now display its list of random number possibilities:

```
MATH NUM CPX PRB
1:rand
2:nPr
3:nCr
4:!
5:randInt(
6:randNorm(
7:randBin(
```

The choice we are looking for this time is

5:randInt(

Uh-oh, there's one of those "("s again – this means we need to supply some information for the calculator. For this particular function (we now recall after looking it up in the handy TI Manual.) the information that needs to be supplied is this:

RandInt(Low number, High number, How many?)

As we have set up the problem, we want single digits, so integers from 0 to 9 are desired. Thus, our desired keystrokes are:

MATH > PRB > RandInt(0,9,5) > Enter

We don't really know if we will need all 5 of these numbers, and we may actually need more than 5. Here is our screen's output (Remember – your output will be different.):

```
RandInt(0,9,5)
{9 6 7 5 3}
```

{9 6 7 5 3} = {boy girl boy boy boy}

Ha! We got a boy with our first try. Of course this wouldn't happen all the time – let's generate some more trials. From where you are now on the screen, press **Enter** a few times:

Enter > Enter > Enter

```
RandInt(0,9,5)
  {9 6 7 5 3}
  {2 6 8 1 4}
  {4 2 8 9 4}
  {4 2 6 6 8}
```

Sibling group 1: {9 6 7 5 3} = { boy girl boy boy boy}
Sibling group 2: {2 6 8 1 4} = {girl girl girl boy girl}
Sibling group 3: {4 2 8 9 4} = {girl girl girl boy girl}
Sibling group 4: {4 2 6 6 8} = {girl girl girl girl girl}

Oops – no boy yet in that sibling group 4. We'll have to simulate some more cherubs:

Enter

Sibling group 4 (Cont'd): {7 4 9 6 3} = { boy girl boy girl boy}

Since we only needed to get 1 boy, our trial stops after the first new cherub.

After simulating four sibling groups, we have 4 boys among 15 children. The proportion of boys is 4/15, which is not yet close to the theoretical probability of 0.5. However, continuing the simulation to obtain a large number of observations would be consistent with a probability of half the population being boys under this family planning method.

6.2 Afterword

We have only scratched the surface of the simulation possibilities for the TI-83 here. Consult your manual to see what some of those other options for random numbers can do, and try some more complicated simulations. They're actually fun!