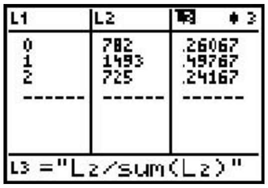
CHAPTER 5

Probability Models

Calculator Note 5A: Computing Relative Frequencies From a Frequency Table

A frequency table can easily be converted into a relative frequency table using the List Editor of the TI-83 Plus or TI-84 Plus. This allows you to assign probabilities based on observed data (long-run relative frequencies). First enter the possible values into list L_1 and enter the frequencies into list L_2. Then define list L_3 as the relative frequencies with the expression **L_2/sum(L_2)**. Find the **sum(** command by pressing [2ND] [**LIST**], arrowing over to **MATH**, and selecting **5:sum(**.

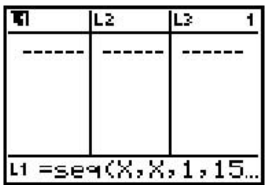
For example, here are the data from Display 5.2 on page 290 of the student book.

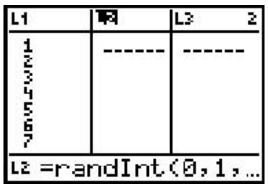


Calculator Note 5B: Performing Many Runs of a Simulation

You can use the TI-83 Plus or TI-84 Plus to simulate flipping a coin, keep track of the cumulative proportion of heads, and make a graph similar to Display 5.4 on page 293 of the student book.

a. Enter the flip numbers into list L_1, for example, the whole numbers 1 to 150. The sequence command, found by pressing [2ND] [**LIST**], arrowing over to **OPS**, and selecting **5:seq(**, is a convenient way to enter these whole numbers. Enter the command in the form **seq(***formula, variable, start, end, increment*). For example, define list L_1 with the expression **seq(X,X,1,150,1)**.

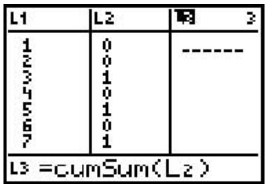




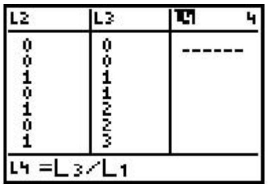
b. Enter the outcomes of the flips into list L_2: 1 = heads or 0 = tails. To simulate flipping a fair coin that has 0.5 probability of heads, use the random integer generator **randInt(0,1,150)**. You find the **randInt(** command by pressing [MATH], arrowing over to **PRB**, and selecting **5:randInt(**. The command's syntax is **randInt(***lower integer, upper integer, number of trials*). That is, **randInt(0,1,150)** randomly selects 0 or 1 one hundred fifty times with equally likely results.

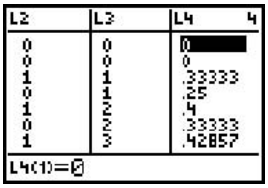
To simulate a coin that has a different probability of heads, for example, 0.4, use the random binomial generator **randBin(1,.4,150)**. You find the **randBin(** command by pressing MATH, arrowing over to **PRB**, and selecting **7:randBin(**. The command's syntax is **randBin(***number of trials, probability of success, number of simulations*). Because you want the individual results from 150 flips, *number of trials* equals 1 and *number of simulations* equals 150. That is, **randBin(1,.4,150)** randomly selects 0 or 1 one hundred fifty times where the probability of success (1 = heads) is 0.4. You'll learn more about binomial probability in Chapter 6 of the *Statistics in Action* student book, and you'll revisit the **randBin(** command in Calculator Note 8A.

c. Define list **L3** as the cumulative number of heads, **cumSum(L2)**. Find the **cumSum(** command by pressing 2ND [**LIST**], arrowing over to **OPS**, and selecting **6:cumSum(**.

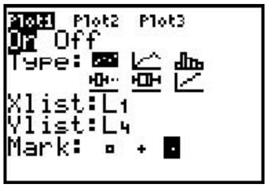


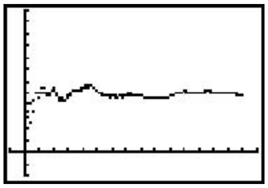
d. Define list **L4** as the proportion of heads accumulated after each flip, or list **L3** divided by list **L1**.



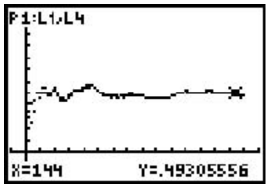


e. Make a scatterplot of the proportion of heads accumulated after each flip (**L4**) versus the number of the flip (**L1**). Tracing the plot supports the Law of Large Numbers. For this simulation, as the sample size gets larger, the sample proportion approaches the population proportion of 0.5.





[−10, 160, 10, −0.2, 1.2, 0.1]



[−10, 160, 10, −0.2, 1.2, 0.1]

Calculator Note 5C: Using a Program to Perform Many Runs of a Simulation Involving Two Events—The WASH Program

This program will perform many runs of the simulation for the *Men and Women and Hand Washing* example on pages 305–306 of the *Statistics in Action* student book. The program can be modified for other similar scenarios.

This program is written to run the simulation 500 times, selecting one man from a population of 75% hand washers and one woman from a population of 90% hand washers and then comparing the two and recording whether the combination is both washed, man washed/woman didn't, both didn't wash, or man didn't wash/woman did. The number of each outcome is reported, in that order.

Line 5 of the program can be modified for a different number of runs, and lines 6 and 7 can be modified to change the probability of a success.

```
PROGRAM:WASH
0→A
0→B
0→C
0→D
For(I,1,500)
randBin(1,.75)→M
randBin(1,.9)→W
If M=0
Then
If W=0
Then
A+1→A
Else
B+1→B
End
Else
If W=0
Then
C+1→C
Else
D+1→D
End
End
End
Disp {A,B,C,D}
```