

# Investigate the Shapes of Data Distributions



Use appropriate tools strategically.

**MATERIALS** • graph paper • graphing calculator

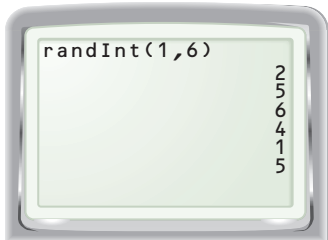
**QUESTION** How do you describe and interpret data distributions with various shapes?

A histogram of data can have different shapes. It may be symmetrical or not, may be bell-shaped or not, or may have a long “tail” in one direction. It may have no recognizable shape. There are recurring patterns in data distributions, however, that let you predict probabilities involving data values.

**EXPLORE 1** Simulate rolling a die repeatedly until you get a 5

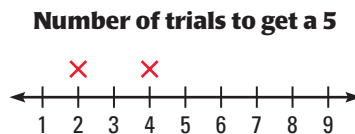
**STEP 1** Perform a simulation

Press **MATH**, then select “PRB,” then “randInt(.” The command randInt(1, 6) gives a random integer from 1 to 6 when you press **ENTER**. The screen shows 6 results.



**STEP 2** Make a plot

In Step 1, a “5” first appears in the 2nd trial. It takes 4 more trials to get the next “5.” These two results are shown below. Make a similar plot for your data. Plot 40 or 50 results.



**STEP 3** Observe and compare

Describe your plot. Include the following.

- What is the general shape?
- Is it symmetric?
- Does it have a clear “middle?”

Compare your plot with those of other groups. Were their results similar?

What was the greatest number of rolls required by any single group to get a 5?

**EXPLORE 2** Simulate rolling a die 100 times

**STEP 1** Perform a simulation

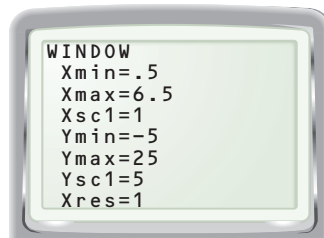
To simulate 100 rolls of a die, you can perform all 100 “rolls” at once and store the results in a list by entering the command below.

randInt(1, 6, 100) **STO** **▶**  
**2nd** [L1]

Pressing **ENTER** displays the list on the home screen and enters it in the Statistics memory.

**STEP 2** Make a histogram

Press **2nd** [Stat Plot], turn on Plot1, and select the histogram icon. Set “Xlist” to L1 and “Freq” to 1. Enter the window below, then press **GRAPH**.



**STEP 3** Observe and compare

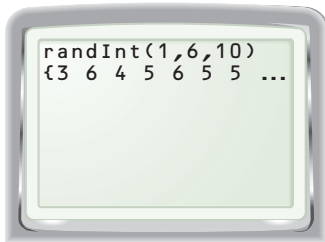
Describe your plot and compare plots as you did in Step 3 above. You can very quickly make a new plot:

Press **2nd** [QUIT] to return to the home screen. Press **ENTER** to produce a new list. Then press **GRAPH**. Do this a few times. How does the graph change?

### EXPLORE 3 Simulate rolling 10 dice and counting how many display “even results”

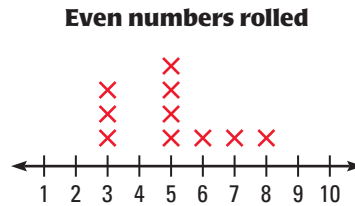
#### STEP 1 Perform a simulation

Enter `randInt(1, 6, 10)` and press **ENTER** to simulate rolling 10 dice. Below you can see three “dice” that display even results. (To see the last three results in the list, scroll to the right.)



#### STEP 2 Make a plot

Press **ENTER**, count the number of even numbers in the new list, and record it in a plot like the one below, which shows results for 10 rolls of 10 dice. Repeat as many times as time allows.



#### STEP 3 Observe and compare

Describe your plot and compare plots as you did in Explore 1 and 2.

How does the shape of this plot compare with the shapes of the plots from Explore 1 and 2?

### EXPLORE 4 Combine data

**STEP 1 Combine results from Explore 1** Combine the results of all groups to make a class histogram. Compare your plot and the class histogram.

**STEP 2 Simulate combining results from Explore 2** To simulate combining results from Explore 2 for 10 groups, repeat the first two steps of Explore 2, but use the command `randInt(1, 6, 999)`. (Note that 999 is the largest number the calculator allows.) Also, change the viewing window to  $Y_{\min} = -50$ ,  $Y_{\max} = 250$ , and  $Y_{\text{scl}} = 50$ . Compare your histogram and the class histogram.

**STEP 3 Combine results from Explore 3** Combine the results of all groups to make a class histogram. Compare your plot and the class histogram.

### DRAW CONCLUSIONS Use your observations to complete these exercises

1. Did the graphs in each Explore have similar or very different shapes? Explain.
2. For each Explore, how did combining the results of the groups into one graph change the shapes? Predict what you think the shape of each histogram might be if you could repeat each simulation thousands of times.
3. Symmetric, bell-shaped data distributions, such as the one at the right, occur frequently in real world models. This curve has special properties that make it extremely useful for finding probabilities. Which of the Explore results most closely resembles a curve with this shape?

