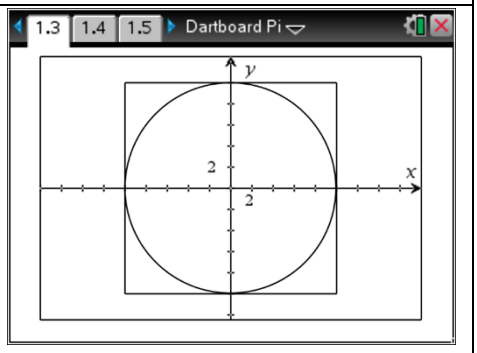
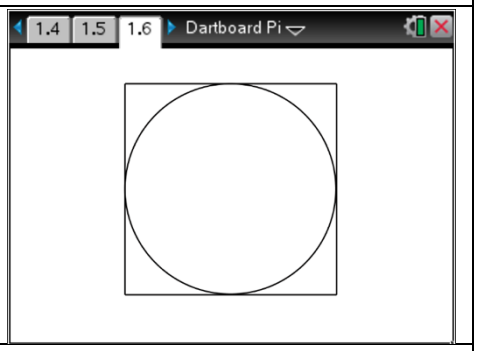
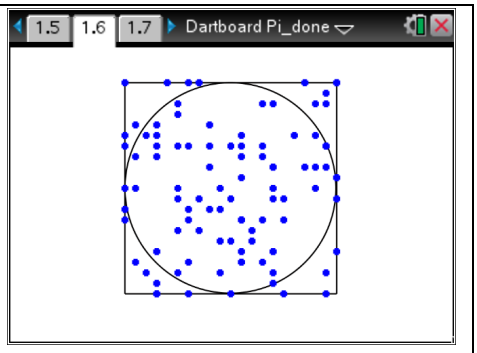
Dartboard Pi – Geometric Probability

1	Open the TI-Nspire file *Dartboard Pi*.	
2	The graph on page 1.3 has scale of 2 units for each axis scale mark. What is the area of the square? What is the exact area of the circle (in terms of π)? Do not convert to a decimal. Square area = _____ Circle area = _____	
3	You will be simulating throwing 100 darts at the dartboard. The ratio of darts hitting the circle (X) to 100 will approximately equal the ratio of circle area to square area. $$\frac{Circle\ \ area}{Square\ area} = \frac{X}{100}$$ Substitute the areas you found above into the proportion, and solve for π in terms of X. π = _____	
4	The graph on page 1.6 has the axes hidden, but is otherwise the same as page 1.3. Advance to page 1.7 to simulate throwing 100 darts using the steps below. Access the commands by pressing MENU > PROBABILITY > RANDOM	
5	Step 1: Use the **RandSeed** command with any 4-digit number and press ENTER. *This "seeds" the random command for random results.* Step 2: Next use **RandInt**(–10,10,100)→*xco* for *x*-values and **RandInt**(–10,10,100)→*yco* for *y*-values. *These create random coordinates for the darts.* Advance to page 1.8 to view the full list of random coordinates. Return to page 1.6 to view the darts.	

6	Count the darts that hit the interior or edge of the circle on your TI-Nspire (*NOT on the sample diagram shown at right)*. Trial 1: X = _____ Use the result you found in #3 above to solve for π. π = _____	
7	For more trials, return to page 1.7, and repeat both **RandInt** commands (scroll up, press ENTER on the desired command and press ENTER a second time to execute). Trial 2: X = _____ π = _____ Trial 3: X = _____ π = _____ Trial 4: X = _____ π = _____ Add up the 4 values of X for your 3 trials. Find the combined value of π by dividing this "Total X" by 100. Total X = _____ π = _____	
8	How close did you get to the decimal approximation for π? Which value was the closest (Trial 1, 2, 3, 4 or Total)?	
9	Look at the proportion we used in step 3 above. Explain why this is the expected relationship between the number of darts hitting the circle (*X*), 100, and the two areas. $$\frac{Circle\ \ area}{Square\ area} = \frac{X}{100}$$	
10	Do you agree with the choice to include darts on the edge of the circle in the dart count X? Why or why not?	

2 The area of the square is 400 units^2 and the area of the circle is 100π units^2.

3 The calculation is the following:

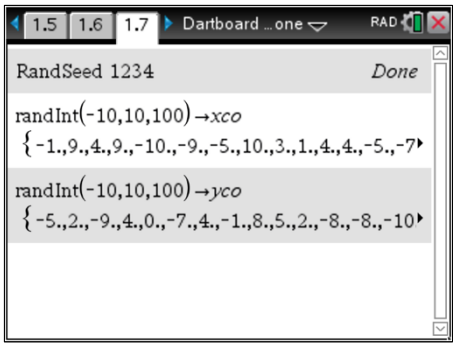
$$\frac{100\pi}{400} = \frac{X}{100}$$

$$100\pi = 4 \cdot X$$

$$\pi = \frac{X}{25}$$

5 Remind students to use a unique 4-digit number for the **RandSeed** command (such as the last 4 digits of their phone number).

The commands are shown here:



7 The different calculation happens because Total Darts = 400 so the denominator of both parts of the proportion is 400. Solving for π in terms of *X* yields this result:

$$\pi = \frac{X}{100}$$

8 The Total is likely to yield the closest approximation for π because experimental probability improves as number of trials increases.

9 The proportion is the expected relationship because we expect the ratio of darts hitting the circle (*X*) to 100 (total darts) to equal the ratio of circle area to total square area.

10 Although the edge of the circle has no "thickness", we include darts hitting the edge as circle darts because the edge completes the circle. If students are skeptic, run the experiment again and *don't* include the edge of the circle in the count. Is the result more or less accurate as an approximation of π ?