Geometric Dartboards

By Lauren Jensen

ACTIVITIES eXCHANGE ID: 8269

Activity Overview

In this activity, students create a geometric dartboard where they will explore finding the theoretical and experimental probability of a "dart" hitting one of their shapes within the dartboard. Once they have explored the theoretical and experimental probability, they will assign point values for hitting each shape. Students will use multiple representations to explore properties of area, ratios, and percents.

Concepts

- *Geometric, theoretical, and experimental probability*
- *Area, ratios, and percents*

Teacher Preparation

This investigation offers opportunities for review and consolidation of key concepts related to geometric probability based on areas of shapes.

- *This activity can serve to consolidate earlier work on area, ratios, and percents. It offers a suitable introduction to utilizing previous concepts to investigate the properties of geometric probability with respect to a game dartboard.*

- *Begin by discussing aspects of geometric probability with respect to the probability of a meteorite hitting land on the surface of the Earth.*

- *The activity pages that follow provide a brief overview of the steps students will complete as the activity progresses. The student worksheet provides more detailed instructions as to how to use TI-Nspire learning technology to complete each step.*

- *The screenshots on pages 18 and 19 (top) demonstrate expected student results. Refer to the screenshots on page 19 (bottom) for a preview of the student TI-Nspire document (.tns file).*

- ***To download the student .tns file and student worksheet, go to education.ti.com/exchange and enter "8269" in the quick search box.***

Classroom Management

- *This activity is intended to be **introduced by the teacher, but with students creating their own dartboards.** You should seat your students in pairs so they can work cooperatively on their handhelds. Use the following pages to present the material to the class and encourage discussion.*

- *The student worksheet GeoAct02_GeomDartboards_worksheet_EN is intended as an investigation through the main ideas of the activity. It also serves as a place for students to record their answers. Alternatively, you may wish to have the class record their answers on separate sheets of paper, or just use the questions posed to engage a class discussion.*
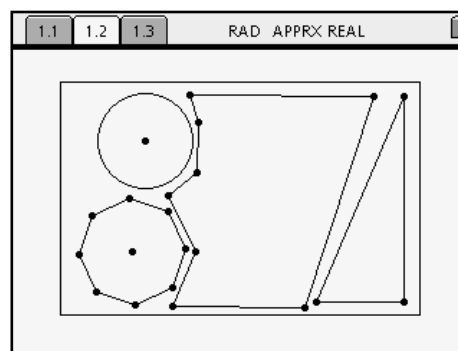
TI-Nspire™ Applications

Calculator, Graphs & Geometry, Notes

Students are shown a rectangular dartboard on a coordinate grid of approximately 40 × 24 where they are to create four shapes: triangle, circle, regular polygon, and irregular polygon. Students may place and size the shapes as they want, as long as they do not overlap. The object is to calculate the theoretical probability of, find the experimental probability of, and create a point system for hitting a particular shape.

Refer to the student worksheet for this activity for more detailed instructions as to how to use TI-Nspire learning technology to complete the steps outlined below.

Step 1: On page 1.2, instruct the students to create four shapes inside of the rectangle on the screen. They must use a triangle, a circle, a regular polygon, and an irregular polygon of their choosing. Make sure the shapes are drawn in such a way that they do not overlap.

Sample Dartboard

Step 2: Have students measure the area of each shape, including the dartboard, and drag the measurements to outside the dartboard in an organized fashion. Students should assign variables to each measurement, for use in future steps. (Sample variables are shown at right.) Then have students hide all vertices and/or center points. (Otherwise, these points could later be confused for "darts" that are thrown at the dartboard.)

Labeled Dartboard

Step 3: Students will fill out the **Area** row of the Results Table on their worksheets. The column labeled *Outside* refers to the area within the dartboard yet outside of the shapes created. It can be found by subtracting the areas of the shapes from the total area of the dartboard.
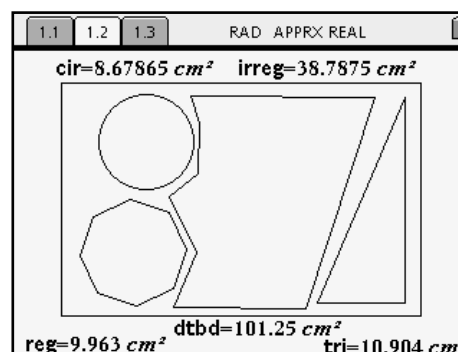
Step 4: The students then move to the *Calculator* application on page 1.3 to determine the theoretical probability for hitting each region:
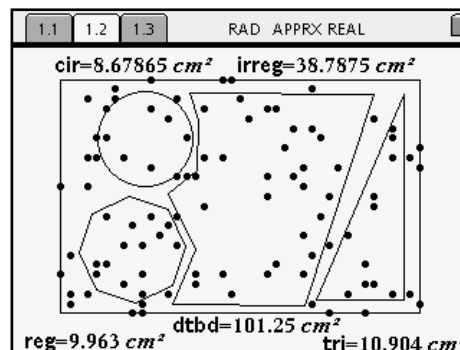
$$\text{Theoretical probability} = \frac{\text{area of shape}}{\text{area of dartboard}}$$

Discuss how to find the theoretical probability for the *Outside* region.
Students should check that the sum of all of these theoretical probabilities is 1.

Step 5: Once students have the theoretical probability calculated, instruct them to use the calculator command **RandSeed** to "seed" the random integer function with the last four digits of their telephone numbers. Then instruct students to use the **RandInt** function to randomly shoot darts at their dartboards. The students should use the command **RandInt**(−20, 20, 100) → *xco* to get random *x*-values and the command **RandInt**(−12, 12, 100) → *yco* to get random *y*-values for the coordinates of the darts.

Step 6: Instruct students to return to the dartboard on page 1.2. To shoot the darts, each student should set up a scatter plot with the *x*-variable set to **xco** and the *y*-variable set to **yco**. The darts should now appear on the board. (A sample screen is shown at right.)

Dartboard with Darts

Step 7: As a class, you should discuss what to do with the points that land on the boundary lines of the shapes. Instruct students to count the number of darts in each shape and record the experimental probability results on the table in Step 3.

Step 8: From here, students have all the necessary information to set up a scoring guide for their dartboards, justifying why they chose the scoring system that they did.

Extensions

1. To explore other experimental probabilities, the students can repeat Step 5 to obtain another set of 100 darts thrown at the board. Students can then compare these results with those they had from the first time through. This process can go on for as long as you see fit, for students to see how the experimental probability changes as more darts are randomly thrown at the dartboard.

2. Students can exchange handhelds and throw 10 darts on a partner's dartboard and determine who got the better score.

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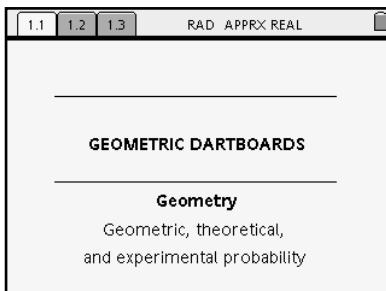
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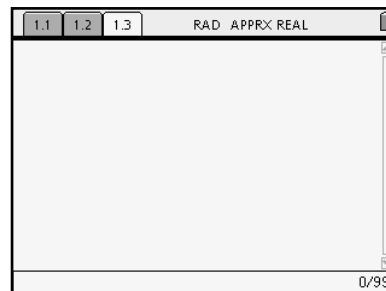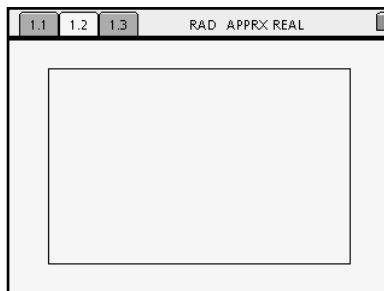
A Blank Page for Students' Calculations