Round about Circles – ID: 8554

Time required
30 minutes

By Pat Flynn

Activity Overview
Students will measure the diameter and circumference of circles and then produce a scatter plot and linear regression of the data. They will then make the observation that the rate of change (slope) of the graph is equal to Pi.

Concepts
- *Scatter plots*
- *Pi*
- *Linear regression*

Teacher Preparation
Prior to beginning this activity, make sure that each student in the class has access to a metric tape measure (or a ruler and a long piece of yarn). Also make sure that there are at least 15 different-sized circular objects in the room for students to measure, or a sufficient number of compasses and paper for students to draw different-sized circles.

- *The screenshots on pages 2–3 (top) demonstrate expected student results. Refer to the screenshots on page 3 (bottom) for a preview of the student .tns file.*
- ***To download the .tns file and student worksheet, go to http://education.ti.com/exchange and enter "8554" in the search box.***

Classroom Management
- *After the data is collected by the students, this activity is intended to be **teacher-led** with students in **small groups**. You should seat your students in pairs so they can work cooperatively on their handhelds. You may use the following pages to present the material to the class and encourage discussion. Students will follow along using their handhelds. As the majority of the ideas and concepts are only presented in **this** document, be sure to cover all material necessary for students' total comprehension.*

- *The student worksheet 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 a separate sheet of paper, or just use the questions posed to engage a class discussion.*

- *The .tns file titled StatAct03_RndAboutCirc_Soln_EN shows the expected results of working through the activity.*

TI-Nspire™ Applications
*Graphs & Geometry, Lists & Spreadsheet, Notes, Data & Statistics*

Diameter v. Circumference

Students may work in pairs or small groups collecting the diameter and circumference measurements of at least 15 circular objects in the room (or circles they have drawn on paper). They should record their data in the spreadsheet on page 1.4.

After entering their data, students should arrow up to select the first column, press and hold the **SHIFT** (⟨CAPS⟩) key, and arrow right to extend the selection to include the second column. Choosing **Quick Graph** from the Data menu will produce a scatter plot similar to the one shown here. From this graph, students should conclude that a linear function appears to be a good model for this data.
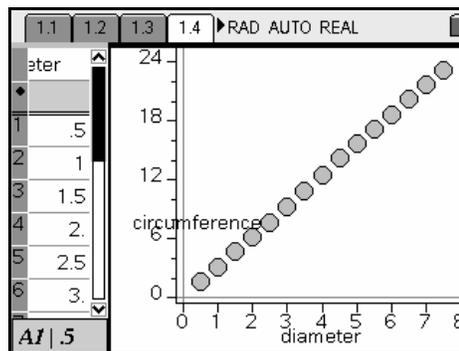
(Students may wish to adjust the 'split' of the screen so there is more room to display the scatter plot. This can be achieved by pressing ⟨ctrl⟩ + ⟨⌂⟩ and selecting **Page Layout > Custom Settings**. Arrowing to the left will decrease the size of the spreadsheet window and increase that of the graph window. Press ⟨enter⟩ when satisfied.)

Before computing a linear regression, students are first asked to sketch a line on the scatter plot (**MENU > Actions > Add Movable Line**) and drag and rotate it to achieve a reasonably good fit line. Then, back in the spreadsheet, they will perform a linear regression by choosing **MENU > Statistics > Stat Calculations > Linear Regression (mx+b)**, comparing the resulting equation to the one they found.
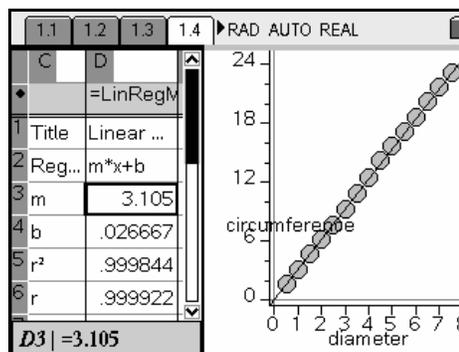
Tell students that the "r" value (the correlation coefficient) obtained from the regression must be looked at in conjunction with the graph of the regression equation to determine a goodness of fit. In general, values of r close to -1 or 1 represent very good fits, while values close to 0 give poorer fits. It is possible to find r values of 0.95 whose regression equation incorrectly models graphed data.

Students may now use the geometric model provided on page 1.7 to further explore this relationship. By selecting **MENU > Trace > Geometry Trace**, clicking on point *P*, and then dragging point *A* to stretch and shrink the circle, the path of *P* will be displayed. This provides yet another way for students to visualize the linear relationship between diameter and circumference. In addition, this path may be modeled by a line with slope π, which is also the result of the calculated ratio of circumference to diameter.
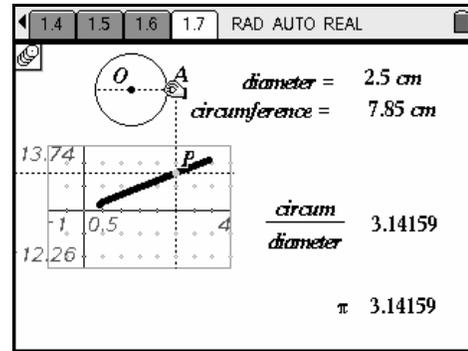
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(Student)TI-Nspire File: *StatAct03_RoundAboutCircles_EN.tns*

ROUND ABOUT CIRCLES

Statistics

Scatter Plots and
Linear Regression

In this activity, you will explore the relationship between a circle's circumference and its diameter by collecting measurement data, creating a scatter plot of the data, and computing the slope of a line of best fit.

Carefully measure the diameter and circumference of different-sized circular objects in your classroom (or circles you have drawn), and enter this data into the spreadsheet on the next page.

Arrow up to select the 1st column, hold the **SHIFT** key, and arrow right to select the 2nd column. Then select **Quick Graph** from the *Data* menu.

Once your *Quick Graph* has been plotted, choose **Add Movable Line** from the *Actions* menu.

Drag and turn this line to give the best fit to the data points—what do you notice about the slope of this line?

Now show a **Linear Regression (mx+b)** for this data (also from the *Actions* menu).

On the next page, drag point *A* on geometric model to stretch and shrink the circle, further exploring the diameter/circumference relationship.

Then turn on the **Geometry Trace** for point *P* on the coordinate grid (marked by the perpendiculars), and drag point *A*. What is this relationship?