Triangle in the Matrix

ID: 11400

<div align="right">

Time Required
10–15 minutes

</div>

Activity Overview

In this activity, students will represent a triangle with a matrix and use the determinant to find the area of three given triangles.

Topic: Matrices

- *Area of Triangles*
- *Determinant*

Teacher Preparation and Notes

- *This activity is meant to be an introduction to using the formula to find the area of a triangle. Students will verify the formula works with a right triangle and practice applying the formula using two additional examples.*

- *The students should attempt the extension problem algebraically if they know how to calculate the determinant of a 3 x 3 matrix. A TI-Nspire CAS handheld will solve the problem and can be used as a teacher demonstration tool where students give the matrix to the teacher. Another option is to have students create a geometric model of the problem. The teacher solution TI-Nspire document file has a geometric model to demonstrate the answer.*

- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter "11400" in the keyword search box.***

Associated Materials

- *TriangleInMatrix_Student.doc*
- *TriangleInMatrix.tns*
- *TriangleInMatrix_Soln.tns*

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *Determining Area (TI-Nspire Technology) — 8745*

- *The Determinant of a Matrix (TI-Nspire Technology) — 16037*

- *Areas of Polygons (TI-Nspire Technology) — 11401*

Problem 1 – Testing the Formula

Students are told that the straight lines on either side of the matrix represent finding the determinant. On the *Calculator* page of the handheld, students will need to use the **det** command (**MENU > Matrix & Vector > Determinant**).

Note: students can simply type **det(** instead of selecting it form the menu.

To enter a matrix, students need to press ⌨ and then select the 3×3 template.

On page 1.4, students will find the area of a right triangle using a matrix, then verify the formula using $A = \dfrac{1}{2}bh$.

Students need to understand that the ± symbol is needed so show how the area of a triangle will still be positive when the determinant is negative.

Have students explore entering the coordinates into the matrix in a different order. They will see that the calculation of the determinant changes from positive to negative.
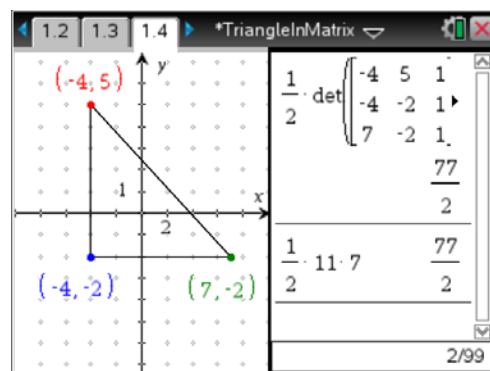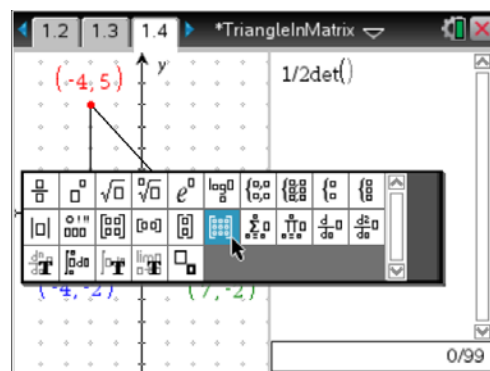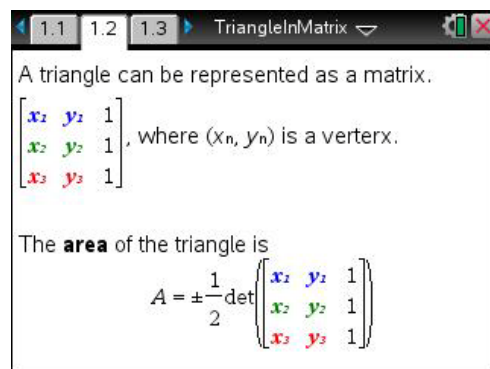
Problem 2 – Practice Problems

Students will find the area of two non-right triangles using matrices. They can check their answers on the Graphs application by using the **Area** tool (**MENU > Geometry > Measurement > Area**). When the entire triangle flashes, they can press ⏎ to make the value appear.

Challenge students to find two ways to enter the coordinates into the matrix so the determinant gives both a positive and a negative result.
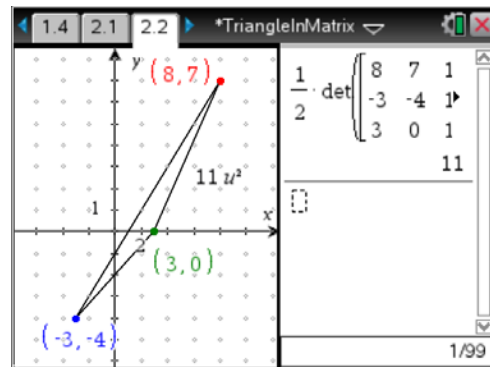
If a coordinate of a vertex does not appear on the screen, students can press **MENU > Actions > Coordinates and Equations** and then select the point.
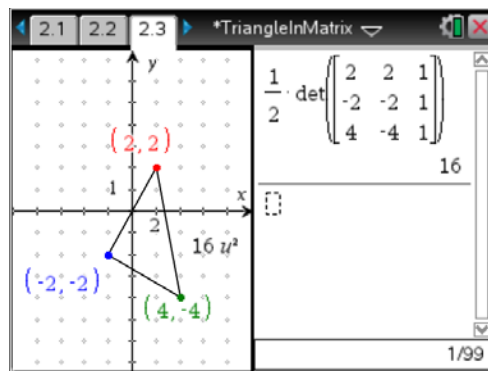
Extension – Fencing a Garden

Students are to find the point on $y = 100$ where the gardener should place the post.

They need to insert a *Graphs* page, turn the **Grid On** and set an appropriate window. In the screenshot at the right the window is [-1, 50] for *x* and [–5, 110] for *y*.

Students should construct the information from the problem using the **Point On** tool and the function entry line.

Then, they can place a point on the $y = 100$ line and connect all three points with the **Triangle** tool. After finding the area of the triangle (**Area** tool), students can move the point on the line until the goal area is reached.

If TI-Nspire CAS technology is available, students can use the **Solve** command on a *Calculator* page or in *Scratchpad*.