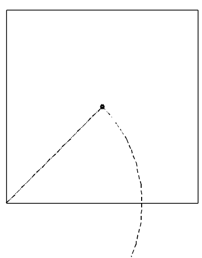
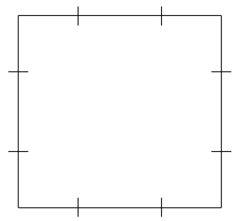
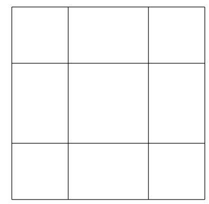
1. In the following exercise, we'll be investigating the Sacred Cut in more detail. (See pages 20-21 of Chapter 1 to review)



Cutting one side

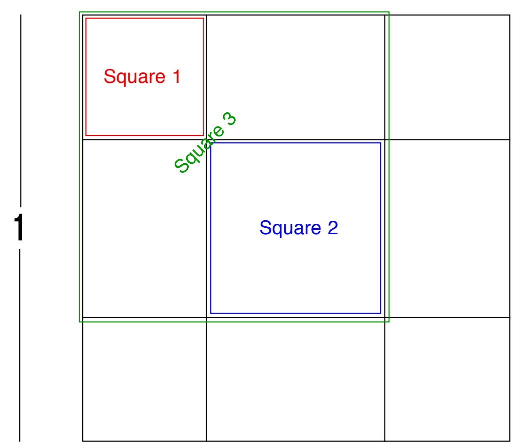


2 cuts per corner



Connecting the cuts

   (a) Use the Pythagorean theorem, addition and subtraction to figure out how long the sides of each smaller square is, if the original square has side 1 (Squares 1, 2, and 3 in the diagram below).



   (b) Consider the large square in the upper-left corner, labeled Square 3 in the above diagram. Show that the area of this square is one half that of the original square.

   (c) Suppose you started with a square of side 7, rather than side 1 as shown above, but still wanted to divide it as shown above. The placement of every cut, and the lengths of the sides of every sub-square, should all be in the same proportion. Using proportion, rather than geometry, figure out the length of the side of the three smaller squares (Squares 1,2, and 3 in the above diagram) that would be created by doing the above construction.

2. The archaeologist in Example 1.4.1 (Chapter 1, page 25) decides that in fact, she is positive that her measurements of the wall mosaic were accurate to within $\pm 2.5\%$. That is, the wall mosaics measurements are:

$$\text{width} = 100\text{"} \pm 2.5\% \qquad \text{height} = 46\text{"} \pm 2.5\%.$$

(a) What is the **measured ratio** of width to height for this mosaic. Write your answer accurate to within 2 decimal places.

(b) Mimic the process followed in Example 1.4.1 to find a range of values in which the **actual ratio** of width to height must lie, with these new margins of error. Express your answer in the form: *(smallest possible value you found)* $\leq$ actual ratio $\leq$ *(largest possible value you found)*, and give your answers accurate to two decimal places.

(c) Use your answer to Part (b) to decide whether, with these new margins of error, the mosaic could be twice as wide as it is tall. Be sure to briefly explain your conclusion.

(d) If the **actual ratio** is the smallest value possible in your range, how does it compare to the **measured ratio**? Specifically, what percentage of the **measured ratio** would the **actual ratio** be, in that extreme? (Give your answer accurate to two decimal places).

(e) Similarly, if the actual ratio is the largest value possible in your range, how does it compare to the measured ratio? That is, what percentage of the measured ratio would the actual ratio be, in that extreme?(Give your answer accurate to two decimal places).

(f) In terms of percents, how far off could the actual ratio be from the measured ratio? How does this result compare to the margins for error in the archaelogist's measurements?