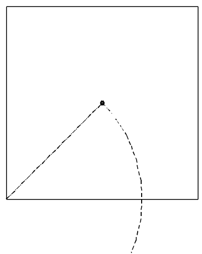
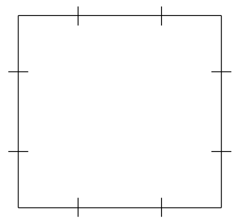
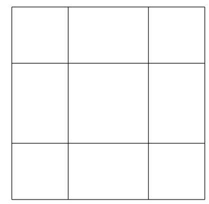
1. In the following exercise, we'll be investigating the Sacred Cut in more detail. (See pages 20-21 of Chapter 1 to review)



Cutting one side

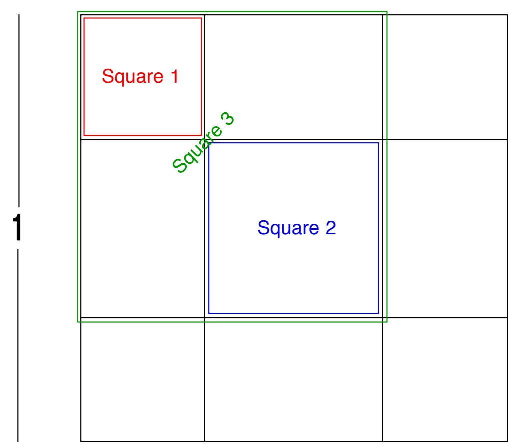


2 cuts per corner



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. You measure a painting and find that it's measured width is 61 cm, and its measured height is 76 cm. You decide that your measurements are accurate to within 1%.

   We have shown that measurements that are accurate to within 1% lead to an accuracy of within 2% for the ratio of two measurements. Use this fact to find a range of values in which the ratio of the actual width to the actual height must fall. (Do not re-create where the 2% came from, just use it.)

   Express your answer in the form: *(smallest possible value you found)* $\leq$ actual ratio $\leq$ *(largest possible value you found)*

3. 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 ±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) 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)*.

   (b) Use your answer to Part (a) 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.

4. Suppose you measure the length and width of a rectangle, paying attention to how accurately you are measuring. Your results:

$$\text{width} = 3 \text{ feet } \pm .02\% \qquad \text{length} = 6 \text{ feet } \pm .03\%.$$

(a) Find the value of the ratio of the measured length to the measured width.

(b) Find the range of values that the *actual* ratio of length to width could fall in. (That is, take into account the errors your measurements could have had.) *Remember:* the errors are percents, so you'll need to calculate what the actual error range is. Express your answer in the form: *(smallest possible value you found)* ≤ actual ratio ≤ *(largest possible value you found).*

(c) What's the furthest off from the measured ratio the *actual* ratio could be? Express your answer as a percent: *The actual ratio could be no more than ______% off from the measured ratio."*