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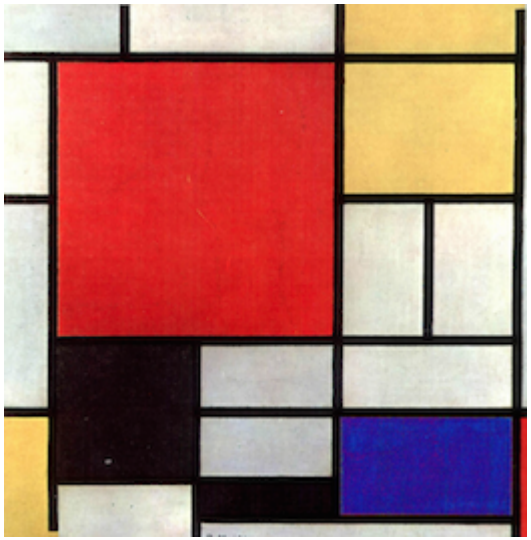
How to Find an Unknown in a Proportion

Artists, engineers, athletes, and accountants all use proportions in their daily lives, and setting them up is really quite easy once you know the rules. In this lesson, you'll learn how to solve proportions when there is an unknown value and work on some practice problems.

Finding the Unknown in a Proportion

Imagine you've been commissioned to create a mural on the side of a building. You decide on a replica of Piet Mondrian's *Composition with Red, Yellow, and Blue*, as shown here in this image.



While you probably feel confident replicating the colors, you're also a little unsure about the size of the rectangles. You know that the painting's dimensions are 28.5 x 27.1 inches, and the wall is 9 feet, or 108 inches, tall. So, the question is: how do you proportion your mural reproduction to fill the width of the wall while maintaining the integrity of Mondrian's original composition and size?

What Is a Proportion?

A **proportion** is simply two ratios that are equal to each other. We define a **ratio** as a comparison of any two numbers. In the painting *Composition with Red, Yellow, and Blue*, we can compare the height of the painting to the width of the painting. We can also compare the height of the painting to the height of the mural, or the width of one of the painting's rectangles to the width of the entire painting.

To make these comparisons, we'll use ratios, which can be written in several ways. Take a look at the examples appearing here that show the ratio of innings to outs in a baseball game:

- 9 innings : 54 outs
- 9 innings / 54 outs
- 9 innings to 54 outs

In the innings-to-outs ratio, we know how many outs there are in a 9-inning game. But we might want to know how many outs there would be in a rain-shortened, 7-inning game. To do so, we would:

1. Identify the known ratio, where both values are known
2. Identify the ratio with one known value and one unknown value
3. Use the two ratios to create a proportion
4. Cross-multiply to solve the problem

Let's go back to our inning example:

1. 9 innings / 54 outs represents the two known values
2. 7 innings / *x* outs represents the one known value and one unknown value
3. 9*x* = 54 * 7
4. 9*x* = 378
5. *x* = 42

As a result of our calculations, we know that there'd be 42 outs in a 7-inning game.

Calculating Proportions

Let's go back to the hypothetical mural we talked about at the beginning of the lesson and the ratio of the original painting height to wall height. This ratio is key, as it will allow us to take any dimension of the original and set up a proportion to figure out the mural dimension.

In terms of height, the ratio of the original painting to the mural is 28.5 inches / 108 inches. Now that we know the height of our mural, let's figure out the width.

1. 28.5 inches / 108 inches represents the painting height / mural height, or our known ratio

2. 27.1 inches / *x* inches represents the painting width / mural width, or the known and unknown values
3. 28.5 inches / 108 inches = 27.1 inches / *x* inches
4. 28.5*x* = 108 * 27
5. 28.5*x* = 2926.8
6. *x* = 102.7 inches

Therefore, by our calculation, the width of the mural will be 102.7 inches or 8 feet, 6.7 inches.

Now, for the sake of accuracy, let's say we want to mark off the horizontal and vertical lines in the painting. For example, if the first vertical line on the left is 3.8 inches from the edge, where would it be on the mural?

1. 28.5 inches / 108 inches
2. 3.8 inches / *x* inches
3. 28.5 inches / 108 inches = 3.8 inches / *x* inches
4. 28.5x = 108 * 3.8
5. 28.5*x* = 410.4
6. *x* = 14.4 inches

So, when painting the first vertical line on our mural, we'd start 14.4 inches from its left edge.

Checking the Results

When calculating proportions, make sure that your values occupy similar places in their corresponding ratios. For example, if the height of the known object ratio is in the numerator, the height of the ratio with the unknown value should also be in the numerator.

Additionally, if you're ''scaling up in size'' in your proportion, common sense dictates that the unknown will be larger than its proportional counterpart, such as in the mural. Second, take a look at the relative sizes of your calculated values. For instance, when we were calculating the width of the mural, at 28.5 : 27.1, the width in the original was just a little less than the height, so the calculated mural width should also be just a little less than its height, or 108 : 102.7.

Lesson Summary

All right, let's take a moment or two to review. Proportions are one of the most commonly applied math calculations used by many professionals, like engineers and artists. As we learned, the term **proportion** refers to two equal ratios, while a **ratio** is simply a comparison of two numbers.

In calculating a proportion, we need to identify the ratio with the known values and the ratio with one known and one unknown value, making sure the comparative values are in the same places in the ratio. We then use cross multiplication to solve for the unknown.