Introduction to a System of Equations

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WHAT'S COVERED

In this lesson, you will learn how to select the solution to a system of equations. Specifically, this lesson will cover:

1. What Is a System of Equations?

Simply put, a **system of equations** consists of at least two equations, and each equation in the system contains the same variables. Additionally, the variables must represent the same quantity.

EXAMPLE If x in one equation represents "cost per person", but represents "number of people" in another equation, they cannot be part of the same system.

This typically only requires consideration for problems in context. Out of context, if the variables are the same, we can consider them part of the same system.

EXAMPLE Here are two equations that make up a system:

$$y = 2x + 4$$
$$y = 3x - 2$$

TERM TO KNOW

System of Equations
Two or more equations with the same variables, considered at the same time.

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2. Solutions to a System of Equations

A solution to a system of equations is a set of values for each variable in the system that satisfies all equations in the system. It is important to remember that the solution to one equation must satisfy every other equation in the system. If it doesn't satisfy all equations, it is not a solution to the system.

EXAMPLE Consider the system of two equations from above. Test a random value for x, plug it into one of the equations, and get a y-value. This will represent a solution to that specific equation:

$y = 2x + 4$ For the first equation, plug in a random value for x, for instance, 3, and

	solve
$y = 2(3) + 4$	Multiply 2 and 3
$y = 6 + 4$	Add 6 and 4
$y = 10$	Our solution for y when $x = 3$

One solution for the first equation $y = 2x + 4$ is (3, 10).

But is (3, 10) also a solution for the second equation $y = 3x - 2$? Let's test it out by plugging in $x = 3$ and $y = 10$ into the other equation in our system:

$y = 3x - 2$	For the second equation, plug in $x = 3$ and $y = 10$
$10 = 3(3) - 2$	Multiply 3 and 3
$10 = 9 - 2$	Subtract 2 from 9
$10 = 7$	This is a false statement, thus NOT a solution to $y = 3x - 2$

As we can see, the point (3, 10) was a solution to the first equation in the system, but it wasn't a solution to the second equation in the system. Since (3, 10) does not satisfy all equations in the system, it is not a solution to the system.

BIG IDEA

Solutions to systems of equations satisfy all equations in the system. Be careful for solutions that satisfy one, but not all equations. While a solution satisfies an equation, it does not necessarily represent a solution to the entire system.

→ EXAMPLE The solution to the above system is actually the point (6, 16). We can test this point by plugging in 6 for x and 16 for y in both equations.

$y = 2x + 4$	In the first equation in the system, use the point (6, 16); Plug in 6 for x and 16 for y
$16 = 2(6) + 4$	Multiply 2 and 6
$16 = 12 + 4$	Add 12 and 4
$16 = 16$	This is a true statement, thus a solution to $y = 2x + 4$

$y = 3x - 2$	In the second equation in the system, use the point (6, 16); Plug in 6 for x and 16 for y
$16 = 3(6) - 2$	Multiply 3 and 6
$16 = 18 - 2$	Subtract 2 from 18
$16 = 16$	This is a true statement, thus a solution to $y = 3x - 2$

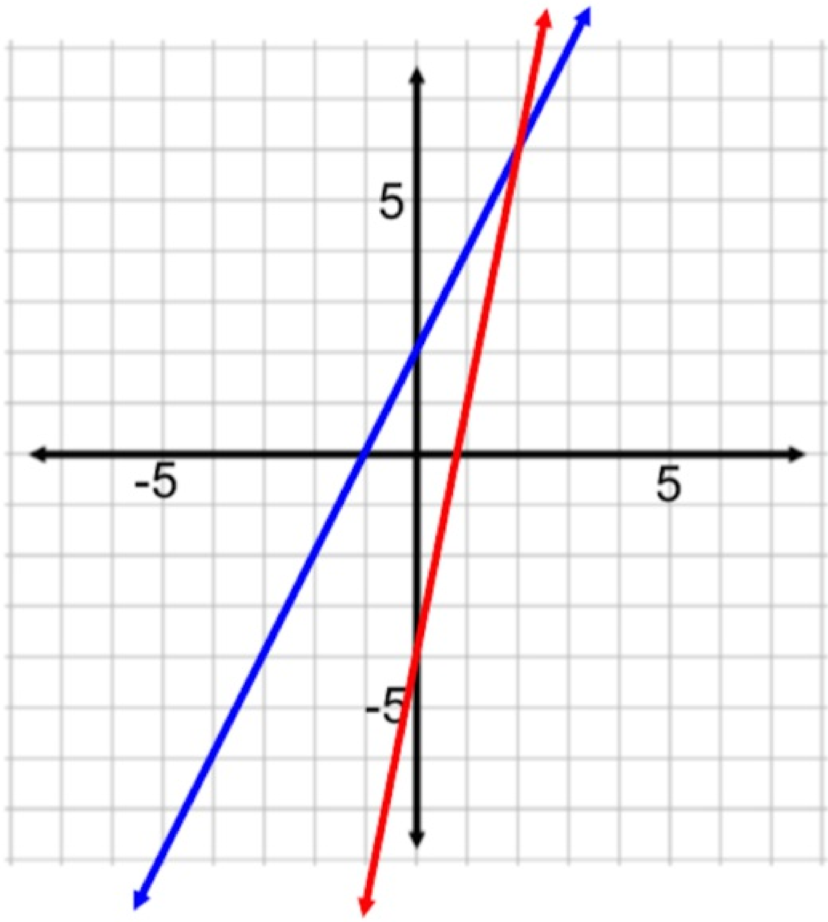
3. Solutions to a System on a Graph

We know that solutions to a system of equations must satisfy all equations in the system. What does this look like on a graph? Let's start by examining the graph of a system of equations:

↱ EXAMPLE Consider the system of equations:

$$y = 2x + 2$$
$$y = 5x - 4$$

The graph of this system is show below:



The point of intersection represents a single coordinate point that is a solution to both equations simultaneously. This intersection point is at the point (2, 6). We can confirm algebraically that (2, 6) is a solution to all equations in the system:

$y = 2x + 2$	In the first equation in the system, use the point (2,6); Plug in 2 for x and 6 for y
$6 = 2(2) + 2$	Multiply 2 and 2
$6 = 4 + 2$	Add 4 and 2
$6 = 6$	This is a true statement. (2, 6) satisfies $y = 2x + 2$

$y = 5x - 4$	In the second equation in the system, use the point (2,6); Plug in 2 for *x* and 6 for *y*
$6 - 5(2) - 4$	Multiply 5 and 2
$6 = 10 - 4$	Subtract 4 from 10
$6 = 6$	This is a true statement. (2, 6) satisfies $y = 5x - 4$

SUMMARY

When thinking about **what is a system of equations**, we can define this as two or more equations with the same variables, considered at the same time. The **solutions to a system of equations** is the solution to all equations in the system. The **solutions to a system of equations on a graph**is the intersection point of the lines on the graph. There is no solution to a system of equations represented by lines that are parallel because the lines will never intersect. However, there are an infinite number of solutions to a system of equations represented by lines that are identical because the lines share all points.

TERMS TO KNOW

System of Equations
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