

## Systems of Linear Equations 2x2

### Infinite Solutions

MATH by Wilson  
Your Personal Mathematics Trainer  
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A Linear System may have an infinite number of solutions!

**System: 2x2**

$$3x + 2y = 4$$

$$6x + 4y = 8$$

*Solution* :  $(x, y) = (?, ?)$

Often written as

$$3x_1 + 2x_2 = 4$$

$$6x_1 + 4x_2 = 8$$

*Solution* :  $(x_1, x_2) = (?, ?)$

**Matrix Method:**

$$3x_1 + 2x_2 = 4$$

$$6x_1 + 4x_2 = 8$$

Goal: Transform  $\begin{array}{cc|c} x_1 & x_2 & \\ \hline 3 & 2 & 4 \\ 6 & 4 & 8 \end{array}$  into  $\begin{array}{cc|c} 1 & 0 & x_1 \text{ sol} \\ 0 & 1 & x_2 \text{ sol} \end{array}$ , if possible

$\frac{1}{3} * R_1 \rightarrow R_1 : \begin{array}{cc|c} 1 & \frac{2}{3} & \frac{4}{3} \\ \hline 6 & 4 & 8 \end{array}$  <Multiple Row 1 by "1/3" and store result in Row 1>

$-6 * R_1 + R_2 \rightarrow R_2 : \begin{array}{cc|c} 1 & \frac{2}{3} & \frac{4}{3} \\ \hline 0 & 0 & 0 \end{array}$  <Multiply Row 1 by "-6" then add Row 2 and store

result in Row 2>

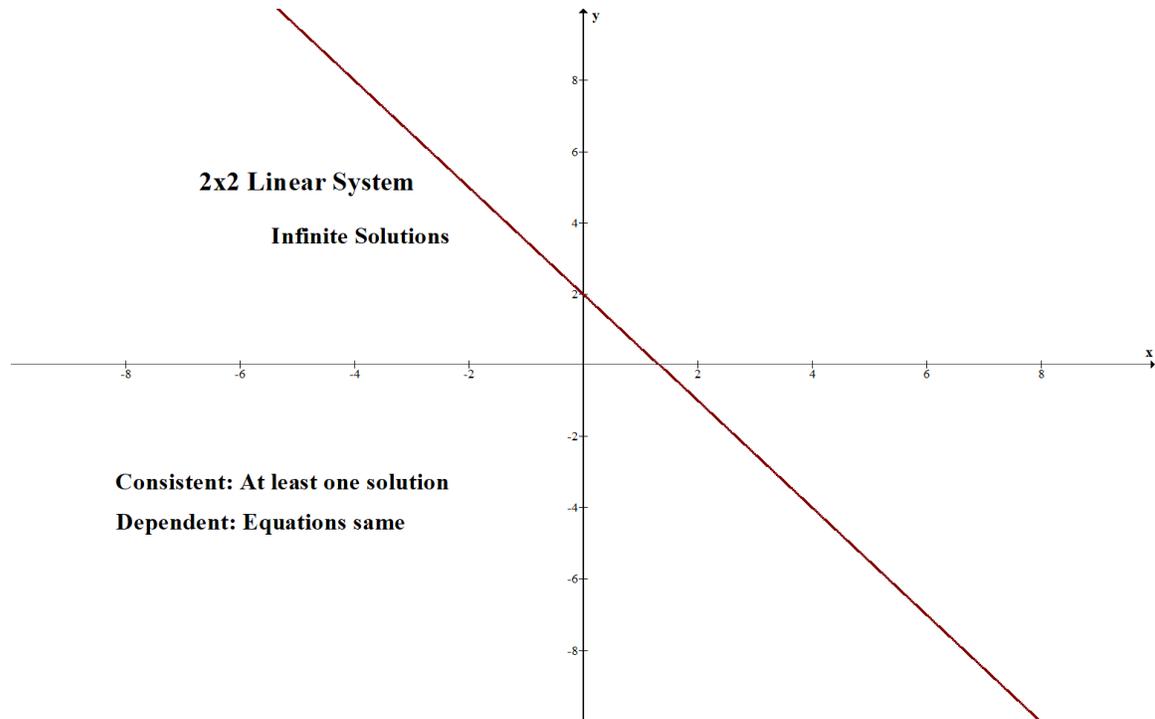
Solution: Infinite solutions since  $0 = 0$

From Row 1,  $x_1 + \frac{2}{3}x_2 = \frac{4}{3} \Rightarrow x_1 = \frac{4}{3} - \frac{2}{3}x_2$

Set  $x_2 = t$  (t is called a parameter)  $\Rightarrow$

$\left(\frac{4}{3} - \frac{2}{3}t, t\right); t \in \mathbb{R}$  <For each real number t, we get a point that satisfies the "two" (2) equations>

Graphs below:





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