

Solving Simultaneous Linear Equations (Elimination Method)

A method for solving simultaneous linear equations is to eliminate one of the variables by adding or subtract the equations in the system.

There are a few rules that we need to keep track of

- We can multiply each of the equations by a constant (we do this to make the coefficients of one the variables in both equations the same)
- We can add the equations together to form a third equation that only has one variable

Example: (no multiplication needed)

$$\begin{aligned}x + y &= 8 \\x - y &= 4\end{aligned}$$

Notice that if we add the two equations together we eliminate the y.

$$\begin{aligned}x + y &= 8 \\x - y &= 4 \\ \hline 2x &= 12 \\x &= 6\end{aligned}$$

now we put $x = 6$ into either equation to solve for y

$$\begin{aligned}6 + y &= 8 \\y &= 2\end{aligned}$$

so the point (6,2) solves this system

Example: (multiplication in only one equation)

$$\begin{aligned}3x + 2y &= 5 \\9x - 4y &= 5\end{aligned}$$

if we multiply the top equation by 2 we get $6x + 4y = 10$ and then addition will eliminate the y

$$\begin{aligned}6x + 4y &= 10 \\9x - 4y &= 5 \\ \hline 15x &= 15 \\x &= 1\end{aligned}$$

now, we can substitute $x = 1$ into either equation to get y

$$\begin{aligned}9(1) - 4y &= 5 \\9 - 4y &= 5 \\-4y &= -4 \\y &= 1\end{aligned}$$

therefore, (1,1) is the solution

Example: (multiplication in both equation)

$$4x - 3y = 8$$

$$3x + 5y = -2$$

if we multiply the top by 5 and the bottom by 3 we can get the coefficients of y to be -15 and 15 which will add to 0 and eliminate y

$$20x - 15y = 40$$

$$\underline{9x + 15y = -6}$$

$$29x = 34$$

$$x = \frac{34}{29}$$

now we can substitute $\frac{34}{29}$ into the first equation to solve for y

$$4\left(\frac{34}{29}\right) - 3y = 8$$

$$\frac{136}{29} - 3y = 8$$

$$-3y = 8 - \frac{136}{29}$$

$$-3y = \frac{232}{29} - \frac{136}{29}$$

$$-3y = \frac{96}{29}$$

$$y = \frac{-32}{29}$$

therefore the point $\left(\frac{34}{29}, \frac{-32}{29}\right)$ is the solution.

Don't let fractions frighten you, they appear occasionally and we have to deal with them