Simultaneous Equations Concepts – Elimination*

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Abstract

This module teaches elimination as a means to solve simultaneous equations.

Here is the algorithm for elimination.

1. Multiply one equation (or in some cases both) by some number, so that the two equations have the **same coefficient** for one of the variables.
2. Add or subtract the two equations to make that variable go away.
3. Solve the resulting equation, which now has only one variable.
4. Finally, plug back in to find the other variable.

Example 1: Solving Simultaneous Equations by Elimination

$3x + 4y = 1$
$2x - y = 8$

1 - The first question is: how do we get one of these variables to have the **same coefficient in both equations**? To get the x coefficients to be the same, we would have to multiply the top equation by 2 and the bottom by 3. It is much easier with y; if we simply multiply the bottom equation by 4, then the two y values will both be multiplied by 4.

- $3x + 4y = 1$
- $8x - 4y = 32$

2 - Now we either **add** or **subtract** the two equations. In this case, we have $4y$ on top, and $-4y$ on the bottom; so if we add them, they will cancel out. (If the bottom had $a+4y$ we would have to subtract the two equations to get the " y"s to cancel.)

- $11x + 0y = 33$

3-4 - Once again, we are left with only one variable. We can solve this equation to find that $x = 3$ and then plug back in to either of the original equations to find $y = -2$ as before.

Why does elimination work?

As you know, you are always allowed to do the **same thing** to both sides of an equation. If an equation is true, it will still be true if you add 4 to both sides, multiply both sides by 6, or take the square root of both sides.

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Now—consider, in the second step above, what we did to the equation $3x+4y=1$. We **added** something to both sides of this equation. What did we add? On the left, we added $8x-4y$; on the right, we added 32. It seems that we have done something **different** to the two sides.

However, the second equation gives us a guarantee that these two quantities, $8x-4y$ and 32, are in fact **the same as each other**. So by adding $8x-4y$ to the left, and 32 to the right, we really have done exactly the same thing to both sides of the equation $3x+4y=1$.