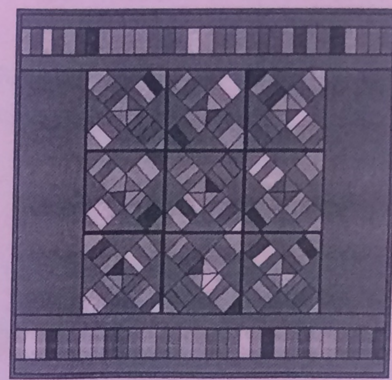
# 2.7 The x Factor

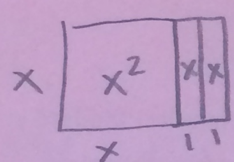
*A Solidify Understanding Task*





Now that *Optima's Quilts* is accepting orders for rectangular blocks, their business in growing by leaps and bounds. Many customer want rectangular blocks that are bigger than the standard square block on one side. Sometimes they want one side of the block to be the standard length, *x*, with the other side of the block 2 inches bigger.

1. Draw and label this block. Write two different expressions for the area of the block.

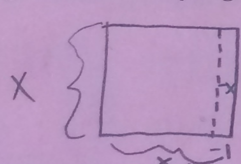



$A(x) = x^2 + 2x$

$A(x) = (x+2)(x)$

Sometimes they want blocks with one side that is the standard length, *x*, and one side that is 1 inch less than the standard size.

2. Draw and label this block. Write two different expressions for the area of the block. Use your diagram and verify algebraically that the two expressions are equivalent.

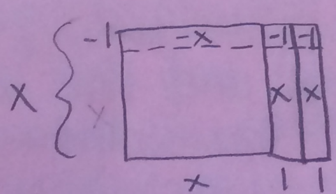



$A(x) = x^2 - x$

$A(x) = (x-1)(x)$

There are many other size blocks requested, with the side lengths all based on the standard length, *x*. Draw and label each of the following blocks. Use your diagrams to write two equivalent expressions for the area. Verify algebraically that the expressions are equal.

3. One side is 1" less than the standard size and the other side is 2" more than the standard size.

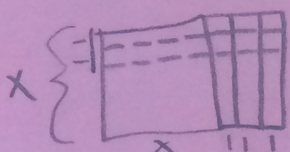



$A(x) = x^2 + 2x - 1x - 2$

$= x^2 + 1x - 2$

$A(x) = (x+2)(x-1)$

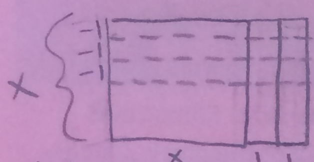
4. One side is 2" less than the standard size and the other side is 3" more than the standard size.




$A(x) = x^2+3x-2x-6 = x^2+1x-6$

$A(x) = (x+3)(x-2)$

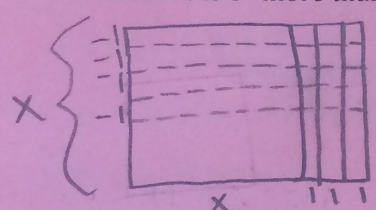
5. One side is 2" more than the standard size and the other side is 3" less than the standard size.




$A(x) = x^2+2x-3x-6 = x^2-1x-6$

$A(x) = (x+2)(x-3)$

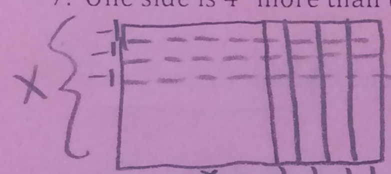
6. One side is 3" more than the standard size and the other side is 4" less than the standard size.




$A(x) = x^2+3x-4x-12 = x^2-1x-12$

$A(x) = (x+3)(x-4)$

7. One side is 4" more than the standard size and the other side is 3" less than the standard size.



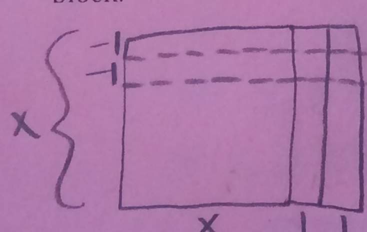

$A(x) = x^2+4x-3x-12 = x^2+1x-12$

$A(x) = (x+4)(x-3)$

8. An expression that has 3 terms in the form: $ax^2+bx+c$ is called a trinomial. Look back at the trinomials you wrote in questions 3-7. How can you tell if the middle term $(bx)$ is going to be positive or negative?

If you take off more squares that you add on, "b" will be negative.

9. One customer had an unusual request. She wanted a block that is extended 2 inches on one side and decreased by 2 inches on the other. One of the employees thinks that this rectangle will have the same area as the original square since one side was decreased by the same amount as the other side was increased. What do you think? Use a diagram to find two expressions for the area of this block.




$A(x) = x^2+\underline{2x-2x}-4$

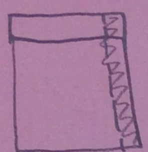
$= x^2-4$

No

Standard square is $x^2$ and this $x^2-4$. So the standard squa[re] is 4 in. bigger.

10. The result of the unusual request made the employee curious. Is there a pattern or a way to predict the two expressions for area when one side is increased and the other side is decreased by the same number? Try modeling these two problems, look at your answer to #8, and see if you can find a pattern in the result.

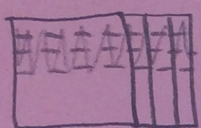
a. $(x + 1)(x - 1)$



$A(x) = x^2 - 1x + 1x - 1$

$A(x) = x^2 - 1$

b. $(x + 3)(x - 3)$



$A(x) = x^2 - 3x + 3x - 9$

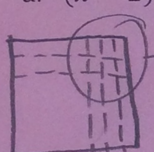
$A(x) = x^2 - 9$

11. What pattern did you notice? What is the result of $(x + a)(x - a)$?

You can multiply the first two numbers in each factor and the last two numbers to get: $x^2 - a^2$

12. Some customers want both sides of the block reduced. Draw the diagram for the following blocks and find a trinomial expression for the area of each block. Use algebra to verify the trinomial expression that you found from the diagram.

a. $(x - 2)(x - 3)$

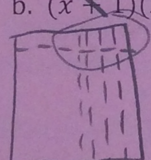


subtracted twice so we add 6 blocks in

$A(x) = x^2 - 3x - 2x + 6$

$A(x) = x^2 - 5x + 6$

b. $(x \cancel{+} 1)(x - 4)$



$A(x) = x^2 - 4x - 1x + 4$

$= x^2 - 5x + 4$

13. Look back over all the equivalent expressions that you have written so far, and explain how to tell if the third term in the trinomial expression $ax^2 + bx + c$ will be positive or negative.

If you subtract from both sides or add to both sides it will be positive.
If you subtract from one side and add to the other it will be negative.

14. Optima's quilt shop has received a number of orders that are given as rectangular areas using a trinomial expression. Find the equivalent expression that shows the lengths of the two sides of the rectangles.

a. $x^2 + 9x + 18$

$(x+6)(x+3)$

b. $x^2 + 3x - 18$

$(x+6)(x-3)$

c. $x^2 - 3x - 18$

$(x-6)(x+3)$

d. $x^2 - 9x + 18$

$(x-6)(x-3)$

e. $x^2 - 5x + 4$

$(x-4)(x-1)$

f. $x^2 - 3x + 4$

$(x-4)(x+1)$

g. $x^2 + 2x - 15$

$(x+5)(x-3)$

14. Write an explanation of how to factor a trinomial in the form: $x^2 + bx + c$.

(x _)(x _) → multiply to c and add to b.

signs: if c & b are pos. → both signs +
if c is pos. but b is neg. → both signs −
if c & b are neg. → one +, one −, bigger # −
if c is neg. but b is pos. → one +, one −, bigger # +