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Distributive Property: Definition, Use & Examples

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After completing this lesson, you will be able to state the distributive property and apply it to various types of problems. You will also be able to accurately perform the mathematical operations that are involved with the distributive property.

Distribution Property Defined

The **distributive property** involves the operations of multiplication and addition or multiplication and subtraction. When we use the distributive property, we are multiplying each term inside the parentheses with the term outside of the parentheses. The distributive property, which is displayed here, holds true for all real numbers *a*, *b* and *c*. Also notice that, if you view the formula in the opposite direction, we are just taking out the common factor of *a*.

Examples of the Distributive Property

Let's start with a simple application in arithmetic: 5(3 + 5). Using the distributive property, we can work through the problem like this: 5(3) + 5(5) = 15 + 25 = 40.

$$a(b + c) = ab + ac$$
$$a(b - c) = ab - ac$$

Distributive Property

Of course, we would normally add 3 and 5 first and then multiply 5 by 8 to get the same answer. But this basic example allows us to demonstrate the distributive property before we get into more complex problems.

The distributive property can also help when you need to calculate equations using mental math, making some numbers easier to work with. Let's say that you purchased three sandwiches at a local eatery for $5.85 each, including tax; however, you are not sure if you have enough money to pay the check. You can think of $5.85 as $6 - $.15. Then think of the problem like this: 3(5.85) = 3(6 - .15) = 3(6) - 3(.15) = 18 - .45 = 17.55.

Applications in Algebraic Expressions

We can also use the distributive property with variables. Let's simplify the following equation: 7(2*x* + 7) - 11*x*.

1. 7(2*x*) + 7(7) - 11*x* (applying distributive property)
2. 14*x* + 49 - 11*x* (simplifying)
3. 3*x* + 49 (combining like terms)

We also use the distributive property when we multiply two binomials. When we multiply two binomials, we are actually using the distributive property twice. This is commonly referred to as foiling, especially when multiplying the factors of a quadratic equation, as in this example: (2*x* + 3)(*x* - 5).

1. 2*x*(*x* - 5) + 3(*x* - 5) (rewriting expression)
2. 2*x*(*x*) - 2*x*(5) + 3(*x*) - 3(5) (applying distributive property)
3. 2*x*^2 - 10*x* + 3*x* - 15 (simplifying)
4. 2*x*^2 - 7*x* - 15 (combining like terms)

The Distributive Property & Changing Signs

Be careful when you have a negative sign as part of an expression. For instance, the expression -(*x* - 4) really means that we are distributing a -1 to both the *x* and the 4, like this: -1(*x*) - (-1)(4) = -*x* + 4.

Make sure that you distribute the negative sign to each term within the parentheses as shown here:

Let's simplify this example: 5(4*x* - 7) - 4(-3*x* + 8).

1. 5(4*x*) - 5(7) - 4(-3*x*) - 4(8) (applying distributive property)
2. 20*x* - 35 + 12*x* - 32 (simplifying)

$$-(a + b) = -a - b$$
$$-(a - b) = -a + b$$

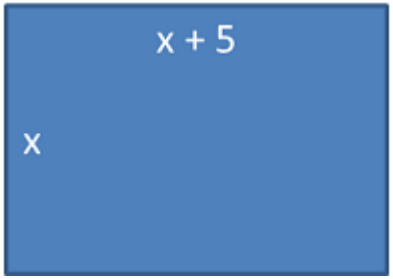
3. 32x - 67 (combining like terms)

The Distributive Property and Geometry

When you take a course in geometry, don't think that you can forget about algebra for a while - the two mathematical topics are very much linked. Algebra is a very important tool when solving geometric problems. Let's consider the following problem: 'The length of a rectangle is 5 more than its width. The total area of the rectangle is 84 square units. What is the width and length of the rectangle?'

Let's call the width x. That means that the length is x + 5.

We know that the area of a rectangle is width multiplied by length, so we can write the following equation and solve for x:



1. $x(x + 5) = 84$
2. $x^2 + 5x = 84$ (applying distributive property)
3. $x^2 + 5x - 84 = 0$ (writing as a quadratic equation)
4. $(x + 12)(x - 7)$ (factoring)

The possible solutions for x are -12 and 7. We know that the side of a rectangle cannot be negative, so x must equal 7. The width is x = 7 and the length is 7 + 5 = 12.

Extension of the Distributive Property

The distributive property can be extended for additional terms. For instance $a(x + y + z) = ax + ay + az$.

We can also use the converse of the distributive property, which is factoring. If we wanted to factor $x^2 - 37x$, we would get $x(x - 37)$.

Lesson Summary

The **distributive property** allows us to multiply one factor with many different factors that are being added and/or subtracted together. The property often makes problems solvable mentally or at least easier to solve.

Learning Outcome

Once you are finished with this lesson, you should be able to recall and apply the distributive property to solve different types of math problems.

Additional Activities

Practice Problems: Distributive Property of Multiplications Across Addition and Subtraction

Key Terms

- Addition, Subtraction, Multiplication, and Division: These are the four basic operations in Algebra. All algebraic manipulations are comprised of one or more of these four operations.
- Distribution: This is the process of multiplication acting across addition or subtraction, thereby giving us two or more products that can then be added or subtracted to get a final answer.

Materials Needed

- Paper
- Pencil

Example: Use the Distributive Property to simplify the following expression:

$$-2x(-3y + 4xy - 4x - 2)$$

Solution: Proceed as follows:

Step 1: From observing the question above, we note that one term is distributed across four terms inside parentheses in the expression. Hence we multiply this one term by each term inside the parentheses (watch your signs) to come up with the products as follows:

$$(-2x)(-3y) + (-2x)(4xy) + (-2x)(-4x) + (-2x)(-2).$$

Step 2: Multiply each of the products in Step 1 above (watch your signs ... remember negative times negative gives us positive, while negative times positive gives us negative and so on) to get

$$6xy - 8x^2y + 8x^2 + 4x.$$

Step 3: Combine like or similar terms (if any) in the result from Step 2 to get us our final simplified answer.

There are no like terms in the result from Step 2.

Hence our final answer is:

$$6xy - 8x^2y + 8x^2 + 4x.$$

Now Let's See you Practice Some on Your Own Using the Steps Outlined Above (Never Forget to Show All Your Work):

(a) Use the Distributive Property to simplify the expression (1-2x)(-3y+4xy-4x-2).

Hint: This problem is somewhat similar to the Example above. Start with distributing the 1 across the expression (-3y + 4xy - 4x - 2) and then proceed with distributing the (-2x) across the same expression (as in Example) and then combining everything

(b) Use the Distributive Property to simplify the expression

$$(4-y)(3x^2-2y^2).$$

(c) Suppose I wanted to multiply the numbers 4.95 and 5.01. How would I use the Distributive Property to get my answer? *Hint: Write 4.95 = 5 - 0.05 and 5.01 = 5 + 0.01 and go from there*.

Answers (To Check Your Work):

(a)

$$-3y+10xy-8x^2y+8x^2-2.$$

(b)

$$12x^2-8y^2-3x^2y+2y^3.$$

(c) 24.7995.