One definition of the word *formula* is a conventionalized statement expressing some fundamental principle. Adding the word mathematical to formula we can define a mathematical formula as a conventionalized equation using a group of symbols to express a fundamental numerical principle.

Two mathematical formulas that students at this level of mathematics are familiar with are:

- The Pythagorean Theorem: \( a^2 + b^2 = c^2 \), which discusses the length of sides of a right triangle.
- The Quadratic Formula: \( x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \), which we recently used to find x-intercepts of quadratic equations.

These formulas are very important in mathematics and will be used repeatedly if one continues further in mathematics. However, from the perspective of a business major, these formulas have a much more limited value. The unfortunate situation that occurs here is that too often only the actual value of the formula is considered and not the thought process skills that are developed from learning these formulas. As one goes through today’s activity, the ability to work with formulas will shine.

At this point in time, we will begin with a study of the compound interest formula. This equation is very useful in understanding personal finance and appears often in math courses. Thus, it is important that all students have some experience with this equation. From a standpoint of developing skills for education majors, it is another opportunity to work with a multitude of different letters.

\[
P_t = P_0 \left( 1 + \frac{r}{n} \right)^{nt}
\]

Where:

- \( P_t \) = the amount of money at time, \( t \)
- \( P_0 \) = the initial deposit ( Principle amount)
- \( r \) = annual interest rate (remember to change percents into decimal numbers)
- \( n \) = the number of times the account is compounded in a year
- \( t \) = the number of years the money is left in the account

Consider that you have $10,000 to deposit in a bank and plan to leave it in the bank for 10 years. Your bank choices are:

- Bank A is offering an interest rate of 7.02% and is compounding your money every six months.
- Bank B is offering an interest rate of 6.96% and is compounding your money every quarter.
- Bank C is offering an interest rate of 6.89% and is compounding your money every month.
Quickly, choose one bank and explain why it is the bank you desire to place your money in.

Next, use the simple interest formula to compute the exact amount that would be in each bank at the end of ten years. (Note: we will explain below that the amount should be approximately $20,000. If your answers are not close to $20,000 please reconsider how you are computing the answer.)

- Bank A =
- Bank B =
- Bank C =

How do the results compare to your initial guess?

Next let’s move to working on problems from a standpoint of STEM majors. STEM majors are often given formulas to work with and that work often requires the STEM major to rewrite the equation. As a future educator, you must recognize that many of your students will require these skills and ask yourself, “How would I develop the student’s ability to rewrite equations?”

Let’s begin by examining three equations.

<table>
<thead>
<tr>
<th>Equation 1</th>
<th>Solve for $g$;</th>
<th>Equation 2</th>
<th>Solve for $g$;</th>
<th>Equation 3</th>
<th>Solve for $g$;</th>
</tr>
</thead>
<tbody>
<tr>
<td>$h_t = 5 + 2(3) - \frac{1}{2}(g)(3)^2$</td>
<td></td>
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<td></td>
<td>$h_t = h_0 + vt - \frac{1}{2}(g)t^2$</td>
<td></td>
</tr>
<tr>
<td>$h_t = 5 + 6 - \frac{1}{2}(g)(9)$</td>
<td></td>
<td>$h_t - 5 = 2(3) - \frac{1}{2}(g)(3)^2$</td>
<td></td>
<td>$h_t - h_0 = vt - \frac{1}{2}(g)t^2$</td>
<td></td>
</tr>
<tr>
<td>$h_t - 5 = 6 - \frac{1}{2}(g)(9)$</td>
<td></td>
<td>$h_t - 5 - 2(3) = -\frac{1}{2}(g)(3)^2$</td>
<td></td>
<td>$2(h_t - h_0 - vt) = (g)\frac{t^2}{2}$</td>
<td></td>
</tr>
<tr>
<td>$h_t - 11 = -\frac{1}{2}(g)(9)$</td>
<td></td>
<td>$2(h_t - 5 - 2(3)) = (g)(3)^2$</td>
<td></td>
<td>$2(h_t - h_0 - vt) = (g)\frac{t^2}{2}$</td>
<td></td>
</tr>
<tr>
<td>$2h_t - 22 = (g)(9)$</td>
<td></td>
<td>$\frac{2(h_t - 5 - 2(3))}{(3)^2} = g$</td>
<td></td>
<td>$g$</td>
<td></td>
</tr>
<tr>
<td>$\frac{2h_t - 22}{9} = g$</td>
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</tbody>
</table>

Equation 1 and equation 2 start out as identical equations. What is the difference in working the problem?
Equation 3 is also the same except that equation three replaces 5 with $h_0$, 2 with $v$ and 3 with $t$. How are the solutions of equation 2 and equation 3 similar?

Equation 3 is actually the equation used to compute the height of an object which is thrown vertically into the air.

Here are three similar equations. In each equation solve for $h$. In the first box, solve with simplification. In the second box solve without simplification and in box three follow the steps in from the second box to solve for $h$ when only letters are involved.

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<td>Solve for $h$; $A = \frac{1}{2}ah + \frac{1}{2}bh$</td>
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</table>
Listed below are several more equations, using STEM notation for you to solve. If you need to, change the letters into numbers to figure out how to solve before working the problems with numbers only.

1) \[ P = 2l + 2w \] solve for \( w \)

2) \[ A = \frac{1}{2}ah + \frac{1}{2}bh \] solve for \( a \)

3) \[ A = \frac{1}{2}ah + \frac{1}{2}bh \] solve for \( h \)

4) \[ Q = \frac{p-q}{2} \] solve for \( q \)

5) \[ k_b = \frac{[NH_4^+][OH^-]}{[NH_3]} \text{ for } [OH^-] \]

6) \[ K = \frac{1}{2}mv^2 \] solve for \( v \)

7) \[ U_s = \frac{1}{2}kx^2 \] solve for \( k \)

8) \[ T_p = 2\pi \sqrt{\frac{I}{g}} \] solve for \( g \)
9) \[ F_g = -\frac{Gm_1m_2}{r^2} \text{ solve for } m_1 \]

10) \[ pV = nRT \text{ solve for } R \]

11) \[ \frac{1}{s_0} + \frac{1}{s_i} = \frac{1}{f} \text{ solve for } f \]

12) \[ \omega = \omega_0 + at \text{ solve for } \alpha \]

13) \[ F_s = -kx \text{ solve for } k \]

How did using numbers help you to understand how to solve these equations?

Students should be more familiar with working with numbers and only 2 variables as in the first equations above. By starting with where students are familiar and moving to the new skills, students should be able to better understand the new skills. Why?

How would you change this activity to obtain better learning outcomes? (Remember, this is a question you should be asking yourself every time you finish an assignment with your students so that you can grow and be better each year.)