Purpose: Use order of operations to determine the monthly payment for an auto loan.

Outline: You will be introduced to the idea of order of operations, and will use these methods to determine the monthly payment of an auto loan.

Content Objectives: Order of operations.

Materials Needed: None (calculator optional).

Instructions: Go through the following exercises, and answer the given questions completely. You must show all work.

The Standard Order of Operations Are:

- Parentheses (and groupings)
- Exponents
- Multiplication/Division
- Addition/Subtraction
- Within each grouping (or level) it is customary to work left to right
- Often times, groups are not given parenthesis, but they are implied. For example
  - $\frac{2}{6-3}$ is considered to be $\frac{2}{(6-3)}$
  - $\sqrt{25-16} - 2$ is considered to be $\sqrt{(25-16)} - 2$

- Examples:
  - Calculate $12 + 5^2 - 2 \cdot (21 + 4)$
    Solution: -13
  - Calculate $\frac{1}{3} - (2 + 5)^2 - 21 \div 3$
    Solution: -55.66
  - Calculate $\frac{-3 + \sqrt{3^2 + 4(2)(10)}}{2(2)}$
    Solution: 1.61
  - Calculate $1 + \left(\frac{45 + (2^3 - 4)}{7 - 2(3)}\right)^{1/2}$
    Solution: 8
Auto Payment:

- The formula for the monthly payment of an automobile is calculated with the formula:

\[
mo. \text{ payment} = \frac{P \left( \frac{r}{12} \right)}{1 - \frac{1}{\left(1 + \frac{r}{12}\right)^m}}
\]

where \( r \) is the monthly interest rate (as a percentage), \( P \) the amount of principal (what is financed), and total number of monthly payments, \( m \).

- Question: How much would be the monthly payment if you were financing $15,000 at 7% interest for 3 years (36 months)?

Solution:

\[
\begin{align*}
15000 \left( \frac{0.07}{12} \right) & = 15000 \cdot (0.005833) \\
& = 87.495 \\
& = \frac{87.495}{1 - 0.994201^{36}} \\
& = \frac{87.495}{0.188906} \\
& = 463.1669
\end{align*}
\]

- Question: Compute the monthly payment for an automobile that cost $24,000 with an interest rate of 2.25% for 72 months.

Solution \( $356.65 \) \]

- Question: An auto dealer is offering 0% financing for those who qualify. Will our formula work? Why or why not?

Solution \( \text{no. } r = 0, \text{ and you can’t divide by } 0. \) \]

- The formula above can be solved for \( P \), to yield

\[
P = \frac{mo. \text{ payment}}{r} \cdot \left( \frac{1}{1 - \left(1 + \frac{r}{12}\right)^m} \right).
\]

- Question: If your monthly payment was $345 and you financed it at 3.2% for 5 years, what was the amount financed?

Solution: \( \begin{align*}
P & = \frac{345 \cdot 0.032}{12} \cdot \left(1 - \frac{1}{\left(1 + \frac{0.032}{12}\right)^{5 \cdot 12}} \right) \\
& = 19,105.42
\end{align*} \]

Can you use your calculator to determine this value? \( \text{Yes. } 139375 \left(1 - \frac{1}{1.17326} \right) = 129375(0.14767) \)
• Question: If you recall an interest rate, monthly payment and number of payments (and are willing to share), determine the original amount financed. If you do not recall or do not wish to share this information, feel free to estimate interesting values.

Answers will vary

Solution \( r = \) \( \text{mo. payment} = \) \( m = \) \( P = \)