Sales, Distribution, and Marketing Operations (52.1801) T-Chart

Use prediction models	=	Apply and extend the properties of exponents to solve problems with rational exponents

Program Task: Students will correctly staff and supply needs using the Order of Operation Business model.

PA Core Standard: CC.2.1.HS.F.1

Description: Apply and extend the properties of exponents to solve problems with rational exponents.

Program Associated Vocabulary:
FORMULA, ORDER OF OPERATIONS

Math Associated Vocabulary:
SIMPLIFY NUMERICAL EXPRESSION, TERM

Program Formulas and Procedures:
Understanding how to use the Order of Operations is an important tool for managers to use in the field of marketing and business. Using the Order of Operations model as a tool to predict the proper amount of supplies needed to operate a business is crucial to the success of a business. The proper application of this concept can help a manager evaluate the staffing needs of the business as well as the supply needs of the business that manufactures products for resale.

Formulas and Procedures:

P Do all operations in **PARENTHESIS**. Start with the innermost set.

E Evaluate all **EXPONENTS**.

M Do **MULTIPLICATION** and **DIVISION** in order from left to right.

D

A Do **ADDITION** and **SUBTRACTION** in order from left to right.

S

Example:
A concession vendor at Coca Cola Park® needs to know how much bottled water to order for Saturday's home game. The weather forecast for Saturday's game is a high temperature of 80 degrees. The park presold 2000 tickets. Calculate the number of bottles of water to order. The prediction formula for this scenario is:

$w = (.1(a - 65))^2 \times 1.05b + 500$
a = Predicted High Temp
b = Presold Tickets
w = number of bottles of water to order

One way to remember the order of operations is:

Please **E**xcuse **M**y **D**ear **A**unt **S**ally.

Remembering that <u>my</u> and <u>dear</u> go together since they both describe Aunt Sally who is one person.

Example:

$(7 + 3)^2 - 21 \div 7 + 10(2) =$
$10^2 - 21 \div 7 + 10(2)$ <u>P</u>arentheses
$100 - 21 \div 7 + 10(2)$ <u>E</u>xponents
$100 - 3 + 20$ <u>M</u>ultiplication and <u>D</u>ivision
$97 + 20$ <u>A</u>ddition and <u>S</u>ubtraction
$= 117$

Solution:

First, substitute in the given information:
a = 80
b = 2000
$w = (.1(80 - 65))^2 \times 1.05(2000) + 500$

Next, solve the problem using the order of operations:
$w = (.1(15))^2 \times 2100 + 500$
$w = (1.5)^2 \times 2100 + 500$
$w = 2.25 \times 2100 + 500$
$w = 4725 + 500$
$w = 5225$

If the temperature is predicted to be 80 degrees and the presold ticket amount is 2000, the concession vendor should order 5225 bottles of water for the game on Saturday.

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Instructor's Script - Comparing and Contrasting
Order of Operations is an essential skill for any student in a technical area that uses formulas. In addition to substituting values into the formula, the student must also apply the order of operations to reach a solution.

Common Mistakes Made By Students
Improper use of calculators: Students are usually very quick to use calculators when faced with formulas but if they are not proficient in using the order of operations, they will not insert parentheses where needed or press "=" at the wrong points and arrive at incorrect answers.

Familiarity with the calculator: In some calculators, you must enter the radical sign first and in some calculators the radical sign is entered after the number is entered. Some calculators automatically do some of the correct order of operations. You need to know your calculator. Calculators are great tools, but you need to know the correct way to use them.

When entering the square of a negative number in a calculator it is important to put it in parentheses. You need to enter $(-2)^2$ not -2^2. For the latter the calculator thinks you are saying the negative of 2 squared or -4, and not (-2) (-2) = 4.

When dealing with fractions students often will forget to put the numerator of the fraction and the denominator of the fraction in parentheses. If you enter (3 + 6)/9 into the scientific calculator, it recognizes that 3 + 6 is in the numerator and does this operation first, giving the answer 9/9 or 1. If you put 3 + 6/9 (without the parentheses) into a scientific calculator, it will give you an answer of 3.66…

CTE Instructor's Extended Discussion
In the field of Marketing and Business, there are times when managers have to predict staffing and product needs to satisfy the marketing concept for the business they operate. The mathematical concept, Order of Operations, is a useful tool for managers to implement to help with this process. A manager who is able to evaluate and assess these variances in their daily operations can use this mathematical concept to help them predict how nature, labor, supply and demand will affect their business models. This can help the manager plan inventory and labor needs to keep the business operating in a profitable manner.

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Problems	Career and Technical Math Concepts	Solutions
1. Calculate the number of employees needed for concessions and parking at the park for a game: Where one employee is needed in concessions for every 20 tickets sold and one employee is needed in parking for every 100 cars and on average there is one car for every two tickets sold. $E = .05\,b + .01(.5b)$ when $b = 2000$		
2. Calculate the number of bottles of water needed if the temperature is 95 degrees and the number of presold tickets for the game is 3000.		
3. There is a supply shortage of Coca-Cola®. A vendor needs to order Coca-Cola® for the weekend games. The amount of Coca-Cola the vendor is willing to supply is represented by the following formula: $y = 2x^2$ x = dollars/case and y = cases supplied How many cases is the supplier willing to deliver if the vendor is willing to pay \$6.00/case?		

Problems	Related, Generic Math Concepts	Solutions
4. Simplify $3(5 + 7)^2 - 10/5$		
5. Simplify $5(8 + 2) + (-5 + (2 + 3)(7 - 4))$		
6. Simplify $(5 + 8)^2 - (7 + 5)^2$		

Problems	PA Core Math Look	Solutions
7. Simplify $(5 + 7 + 3) \div (3 + 2)$		
8. Simplify $5 + 7 + 3 \div 3 + 2$		
9. Compare problem #7 with problem #8. Explain how someone may make the mistake of thinking they are the same problem.		

	Problems	Occupational (Contextual) Math Concepts	Solutions
1.	Calculate the number of employees needed for concessions and parking at the park for a game: Where 1 employee is needed in concessions for every 20 tickets sold and 1 employee is needed in parking for 100 cars and on average there is 1 car for every two tickets sold. $E = .05\,b + .01(.5b)$ when b = 2000	$E = 05(2000) + .01(.5(2000))$ $E = 100 + .01(1000)$ $E = 100 + 10$ If 2000 tickets are sold, they need 110 employees to operate the concessions and parking for the game.	
2.	Calculate the number of bottles of water needed if the temperature is 95 degrees and the number of presold tickets for the game is 3000.	$W = (.1(95 - 65))^2 \times 1.05(3000) + 500$ $W = (.1(30))^2 \times 3150 + 500$ $W = (3)^2 \times 3150 + 500$ $W = 9 \times 3150 + 500$ $W = 28350 + 500$ $W = 28{,}850$	
3.	There is a supply shortage of Coca-Cola®. A vendor needs to order Coca-Cola® for the weekend games. The amount of Coca-Cola the vendor is willing to supply is represented by the following formula: $y = 2x^2$ x = dollars/case and y = cases supplied How many cases is the supplier willing to deliver if the vendor is willing to pay $6.00/case?	$y = 2x^2$ $y = 2(6.00)^2$ $y = 2(36.00)$ $y = 72$	

	Problems	Related, Generic Math Concepts	Solutions
4.	Simplify $3(5 + 7)^2 - 10/5$	$3(5 + 7)^2 - 10/5 =$ $3(12)^2 - 10/5 =$ $3(144) - 10/5 = 432 - 2 = 430$	
5.	Simplify $5(8 + 2) + (-5 + (2 + 3)(7 - 4))$	$5(8 + 2) + (-5 + (2 + 3)(7 - 4)) =$ $5(8 + 2) + (-5 + (5)(3)) =$ $5(10) + (-5 + 15) =$ $5(10) + (10) = 50 + 10 = 60$	
6.	Simplify $(5 + 8)^2 - (7 + 5)^2$	$(5 + 8)^2 - (7 + 5)^2 =$ $13^2 - 12^2 =$ $169 - 144 = 25$	

	Problems	PA Core Math Look	Solutions
7.	Simplify $(5 + 7 + 3) \div (3 + 2)$	Following the order of operations, $(5 + 7 + 3) \div (3 + 2) =$ Parenthesis $15 \div 5 =$ Division 3	
8.	Simplify $5 + 7 + 3 \div 3 + 2$	Following the order of operations, $5 + 7 + (3 \div 3) + 2 =$ Division $5 + 7 + 1 + 2 =$ Addition 15	
9.	Compare problem #7 with problem #8. Explain how someone may make the mistake of thinking they are the same problem.	In problem #7 you are asked to add $5 + 7 + 3$ first, then add $3 + 2$, and finally divide the two answers $(5 + 7 + 3)/(3 + 2)$. In problem #8, the first thing to do is divide 3 by 3 and then add $5 + 7 + 1 + 2$.	