Percent Change

Formula:
((y2 - y1) / y1)*100 = your percentage change
Alternatively,
((current amount - original amount) / original amount) * 100 = percent change
Alternatively,
(amount of change / original amount) * 100 = percent change

The following questions ask you to find the percent changes in given scenarios. First, take 10-15 minutes to work through these practice problems on your own. Next, work with 1-2 partners to discuss the answers and complete the section. We will circulate through the room and assist on an ad-hoc basis!

1. The budget of a government agency increased from $1.75 million to $2 million. What percentage increase does this represent?

((2 - 1.75) / 1.75)*100 = your percentage change
((0.25) / 1.75)*100 = **14%**

2. The staff of that agency changed from 90 to 72. What percentage decrease does this represent?

((72 - 90) / 90)*100 = your percentage change
((-18) / 90)*100 = **-20%**

3. A local nonprofit held a 5K to raise awareness and money for its cause. Last year, the event raised $6,950. This year, the event raised $10,092. What is the percent of increase in money raised from this event?

((10,092-6,950) / 6,950)*100 = your percentage change
((3,142) / 6,950)*100 = **45%**

4. The increase in donations likely stems from increased participation in the event. Last year, 60 people participated in the event. This year, 87 people participated. What is the percent increase in 5K participation?

((87-60) / 60)*100 = your percentage change
((27) / 60)*100 = **45%**

5. Your unit's operating budget is $19,500. Due to positive performance and improved economic conditions, your operating budget is set to increase 15% heading into next year. If this holds, what do you expect your operating budget to be?

100% of original amount + 15% of original amount = 115% of original amount
Final amount = 115% of 19,500
1.15 * 19,500
Final amount = **$22,425**

6. After informing you of the expected budget increase, your supervisor is curious about how performance improved. You cite emphasizing LEAN management principles over the past few months as an explanation for more efficient unit performance. It used to take 16 hours and 47 minutes to make a final determination on applications – now it only takes 7 hours and 20 minutes. What percentage improvement in efficiency does this represent?

7h20m = 440 minutes
16h47m = 1,007 minutes
((440 – 1,007) / 1,007)*100 = your percentage change
((-567) / 1,007)*100 = -56%
56% faster process!

Rearranging and Solving Equations
Write x in terms of y.

1. $y = 7x + 10$

y – 10 = 7x
(y-10) / 7 = x

Solve for t.

2. $2t^2 - 11 = 0$

2t^2 = 11
t^2 = 5.5
$t = \sqrt{5.5}$

3. $3t^2 - 75 = 0$

3t^2 = 75
t^2 = 25
t = 5

4. $12 = -4(-6t - 3)$

12 = 24t + 12
0 = 24t
0/24 = t
0 = t

5. $3t - 5 = -8(6 + 5t)$

3t – 5 = -48 – 40t
43 = -43t
t = -1

Systems of Equations

In this section, you will find the solutions set to the following systems of equations (i.e., you will find the *(x, y)* coordinate pair that simultaneously makes both equations "true."). Again, work on your own for 10-15 minutes on the following problems. After that, work with your partner or group to discuss and confirm solutions.

Solve using Substitution.

Follow these four steps

1. Isolate a variable.

2. Plug the result of Step 1 into the other equation and solve for one variable.

3. Plug the result of Step 2 into one of the original solutions and solve for the other variable.

4. State the solution

1. $\begin{cases} 2x + y = 5 \\ 3x + 5y = 4 \end{cases}$

Let's start by putting y in terms of x: y = 5 – 2x

Then, we plug into the second equation: 3x + 5(5 – 2x) = 4

3x + 25 – 10x = 4

-7x = -21

x = 3

2(3) + y = 5

6 + y = 5

y = -1

(3, -1)

2. $\begin{cases} y = 2 \\ -x - 8y = -12 \end{cases}$

-x – 8(2) = -12

-x – 16 = -12

-x = 4

x = -4

-(-4) – 8y = -12

-8y = -16

y = 2

(-4, 2)

3. $\begin{matrix} 3x - 4y = 5 \\ 2x + y = 7 \end{matrix}$

Let's start by putting y in terms of x: y = 7 – 2x

Then, we plug into the first equation: 3x – 4(7 – 2x) = 5

3x – 28 + 8x = 5

11x = 33

x = 3

2(3) + y = 7

6 + y = 7

y = 1

(3, 1)

Solve using Elimination (There are excellent resources online if you are not familiar with Elimination). Follow these four steps

1. Make sure the equations have opposite x terms or opposite y terms
2. Add to eliminate one variable and solve for the other
3. Plug the result of Step 2 into one of the original equations and solve.
4. State the solution

4. $\begin{cases} -2x - 4y = 18 \\ 10x + 4y = 6 \end{cases}$

Here, we still want to solve for either x or y first. In this case, if we add the second equation to the first, the y's cancel out (-4y + 4y = 0). This is the first step in the elimination technique. By eliminating the y's, we are able to solve for x. After solving for x, we plug the number back into the equations to find y, just as we did in other systems of equations problems.

See below:

-2x – 4y = 18
+ (10x + 4y = 6)
= 8x + 0y = 24
8x = 24
x = 3

-2(3) – 4y = 18
-6 – 4y = 18
-4y = 24
y = -6

(3, -6)

5. $\begin{cases} -6x + 7y = -11 \\ 6x - 3y = -9 \end{cases}$

Again, we see that adding the equations together can leave us with an isolated variable. In this case, the x's will cancel out (-6x + 6x = 0). After isolating y, we solve for y, and plug back into other equations to solve for x. See below:

-6x + 7y = -11
+ (6x – 3y = -9)
= 0x + 4y = -20
4y = -20
y = -5

6x – 3(-5) = -9
6x – 15 = -9
6x = 6
x = 1

(1, -5)

Slope-Intercept and Graphing

1. Plot the points (2, 9), (-2, -5), (-4, 10), (3, 7), (9, 0), (-5, 0), (5, -7) and (10, 3) on a graph.

If they are not already in this form, write the following equations in the form y = mx + b and identify a) the slope and b) the y-intercept.

2. $3y + 15x - 9 = 0$

3y = -15x + 9
y = -5x + 9

slope: -5 (this could also be thought of as -5/1)
y-int.: 9

3. $7x + \frac{1}{3}y = -4$

1/3y = -7x – 4
y = -21x – 12

slope: -21
y-int.: -12

4. $y = -1$

slope: 0
y-int.: -1

5. $-30 + 10y = -2x$

10y = -2x + 30
y = -2/10x + 3
y = -1/5x + 3

slope: -1/5
y-int.: 3

Graph the above equations.

2graph.
3graph.
4graph.
5graph.

6. Find an equation of the line through the given point and with the given slope.
(0, 4), $m = -\frac{1}{4}$.

y = mx + b
We have m, so we plug it in.
y = -1/4x + b
We also have (x, y), so we plug them in to solve for b.
4 = -1/4(0) + b
b = 4-(1/4)(0)
b = 4

y = -1/4x + 4

Find the intersection between these two lines.

7. $\begin{cases} y = 4x - 1 \\ y = -x + 19 \end{cases}$

The two equations above each represent a single line. For example, for the first equation, we know that the slope is 4/1 and the y-intercept is -1. Because we know (or, are told) that the two lines have an intersection point, we know that there is a point where the y coordinates are equal, and are thus able to set the equations equal to one another to solve for x. This should look familiar to what we did above – find the coordinates (x, y) that makes both equations true.

4x – 1 = -x + 19
5x – 1 = 19
5x = 20
x = 4

y = 4(4) – 1
y = 15
Alternatively,
y = -(4) + 19
y = 15

(4, 15)

8. $y = -2x + 2$
$3x + 2y = 1$

The substitution method to solve a system of equations can be useful, as well. See below:

3x + 2(-2x + 2) = 1
3x – 4x + 4 = 1
-1x = -3
x = 3

y = -2(3) + 2
y = -4

(3, -4)

Extra Practice

Our next session is Economics preparation. We encourage you to stick around and discuss core economic concepts. In the meantime, feel free to work through this final set of practice questions, either on your own or with a partner. Let us know if you have any questions! Thank you for your attention and hard work!

1. You typically drink 16 ounces of coffee per weekday. Starting on the first day of classes, you plan to increase daily coffee consumption by 35% (not compounded – just increasing your average daily intake by 35%). How many ounces of coffee will you consume this week?

135% of 16
16 * 1.35
21.6 ounces of coffee
Classes begin on Tuesday August 22, so we have 4 weekdays this week:
4 weekdays * 21.6 ounces of coffee per day = 86.4 ounces this week.

2. $\begin{cases} y = 10 \\ -10x + 4y = -10 \end{cases}$

-10x + 4(10) = -10
-10x = -50
x = 5
Plug in:
-10(5) + 4y = -10
-50 + 4y = -10
4y = 40
y = 10

(5, 10)

3. Sketch the graph of the line 12x + 4y + 20 = 0
4y = -12x – 20
y = -3x -5

4. Sketch the graph of the line y = -5

5. Write the slope-intercept equation of a line that passes through point (3, 8) and has a slope of -2.
Keep in mind that we have some of the elements of the y = mx + b form. Specifically, we have 'm'. We know that m, the slope, is -2. We plug that in, and then use the given x and y coordinates to solve for the y-intercept (b). See below:

y = mx + b
y = -2x + b
8 = -2(3) + b
8 = -6 + b
14 = b
y = -2x + 14

Economics Next…

A retail store faces a demand equation for Roller Blades given by: Q = 220 – 2P, where Q is the number of pairs sold per month and P is the price per pair in dollars.

a. The store currently charges P = $80 per pair. At this price, determine the number of pairs sold (Q).

$$q = 220 - 2p$$
$$q = 220 - 2(80)$$
$$q = 220 - 160$$
$$q = 60$$

b. If management were to raise the price to $100, how many pairs would the store sell?

$$Q = 220 - 2P$$
$$Q = 220 - 2(180)$$
$$Q = 220 - 360$$
$$Q = -140$$
$$\text{So, } Q_{sold} = 0$$