MATH 00095
Statistics CoRequisite
LAB WORKBOOK

Fall 2018 edition

Department of Mathematical Sciences

Kent State University

Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

A Review of Fractions, Decimals, and Percents; Two-Way Tables

FRACTIONS, DECIMALS, PERCENTS

1. Complete the following table of equivalent fractions, decimals, and percents. Round to the hundredth's place if necessary. The first one is completed for you.

Simplified Fraction	Decimal	Percent
$\frac{1}{10}$	0.1	10%
	0.01	
$\frac{1}{5}$		
		50%
$\frac{1}{3}$		
	0.25	
		75%
$\frac{2}{3}$		
	0.6	

2. In your own words explain each of the following procedures:
   a) Converting a fraction to a decimal:

   b) Converting a decimal to a percent:

   c) Converting a percent to a fraction:

ROUNDING DECIMALS

3. Convert the following fractions into decimal value, round to the nearest hundredth

   a) $\frac{1}{3}$

   b) $\frac{4}{9}$

   c) $\frac{5}{11}$

   d) $\frac{7}{6}$

4. Convert the following fractions into decimal value, round to the nearest thousandth

   a) $\frac{2}{3}$

   b) $\frac{9}{13}$

   c) $\frac{7}{3}$

   d) $\frac{26}{9}$

READING TWO-WAY TABLES

Students in a certain class were asked to name their favorite color from the following choices: Red, Yellow, or Blue. The results are in the table below.

	Male	Female	Total
Red	30	20	
Blue	15	10	
Yellow	5	20	
Total			

5. Use the table to answer the following questions:
   a) What percent of the total class is Male?

   b) What percent of the total class is Female?

   c) What percent of the total class liked Blue as their Favorite Color?

   d) What percent of the total Class liked Red?

   e) What Percent of the total class liked Yellow?

   f) Considering only the males, what proportion of them liked Red as their favorite color?

   g) Considering only the Females of the classroom, what proportion of them liked Yellow as their favorite color?

   h) Of the people who liked Blue what fraction of them were male?

   i) Of the people who liked Red what fraction of them were female?

   j) What is the probability if we randomly selected a person that they would be Male AND like Yellow?

6. Fill in the missing information on the following two-way table. On the blank next to the number, write the relative frequency for each of the events on the table.

Students were randomly selected and asked to name their favorite class from the following: Science, English, and Math. This results of the survey are below.

	English	Math	Science	Total
Girls	20	13		50
Boys		15		
Total	38		40	

7. Use your table to answer the following questions:
   a) What percentage of the students said Math was their favorite subject?

   b) What percentage of the students said Science was their favorite subject?

   c) Suppose we are randomly selecting a girl from this group, what is the likelihood that her favorite subject is English?

   d) Suppose we are randomly selecting a person from the group that liked Science the most, what is the probability that the selected student is also a boy?

8. An ad campaign claims that a new diet pill will reduce weight by 150 percent. What is wrong with this statement?

Use this scenario to answer the following three questions.
A polling company reported that 65 percent of 2403 surveyed adults said that texting and driving was dangerous.

9. What is the exact value of 65% of 2403? Round to the nearest Hundredth spot.

10. Explain in your own words why this could not be the actual number of adults who answered that texting and driving was dangerous?

11. What could be the actual number that said that texting and driving was dangerous?

12. Among the 2403 respondents, 350 said texting and driving was not dangerous. What percentage of respondents said that texting and driving was not dangerous?

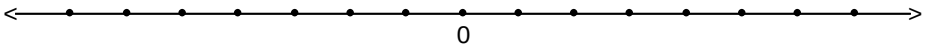
Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

Ordering Fractions and Decimals; Inequality Vocabulary

ORDERING NUMBERS ON THE NUMBER LINE and DISTANCE

1. Plot the following numbers on the number line below. Be sure to label the points with the given letters.
   $A=2$, $B=1$, $C=4$

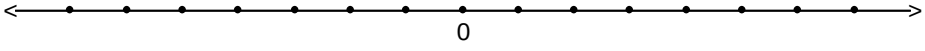


2. Using your number line above, find the distance between the following: (Show your calculations!)
   a) A and C

   b) B and C

   c) A and B

3. Plot the following numbers on the number line below. Be sure to label the points with the given letters.
   $A=-60$, $B=100$, $C=72$

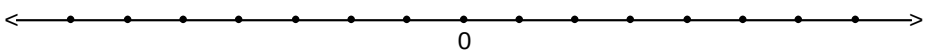


4. Using your number line above, find the distance between the following: (Show your calculations!)
   a) A and C

   b) B and C

   c) A and B

5. Plot the following numbers on the number line below. Be sure to label the points with the given letters.
   $A=0.5$, $B=0.9$, $C=1.2$, $D=-2.2$



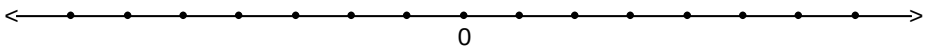
6. Using your number line, find the distance between the following: (Show your calculations!)
   a) A and D

   b) B and D

   c) D and C

   d) A and C

7. Plot the following numbers on the number line below. Be sure to label the points with the given letters.
$A=-1.1$, $B=2.3$, $C=-3.4$

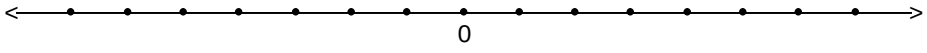


8. Using your number line, find the distance between the following: (Show your calculations!)
   a) A and C

   b) B and C

   c) A and B

9. Plot the following numbers on the number line below. Be sure to label the points with the given letters.
$A=400$, $B=2.3$, $C=-3.4$



10. Using your number line, find the distance between the following: (Show your calculations!)
   a) A and D

   b) B and C

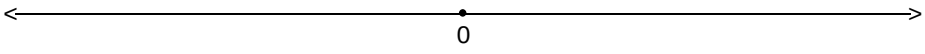
   c) A and C

   d) B and D

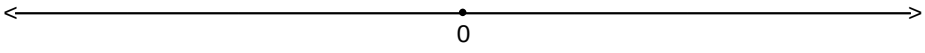
ORDERING NUMBERS ON THE NUMBER LINE PART B

For each set of four numbers, place the numbers in proper order on the given number line. Be sure to label your points.

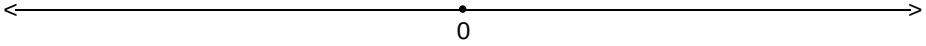
11. $\left\{0.5,\ \frac{1}{3},\ 0.6,\ \frac{7}{11}\right\}$



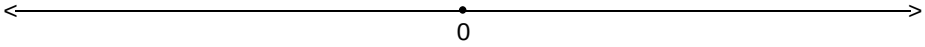
12. $\left\{\frac{1}{4},\ \frac{3}{8},\ 0.24,\ \frac{1}{5}\right\}$



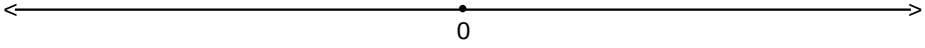
13. $\left\{\frac{1}{3},\ 0.31,\ \frac{3}{4},\ \frac{5}{6}\right\}$



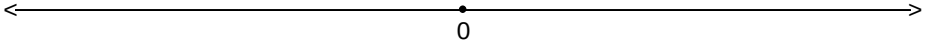
14. $\left\{0.11,\ -0.7,\ -\frac{3}{5},\ \frac{1}{9}\right\}$



15. $\left\{\frac{2}{3},\ -0.15,\ -\frac{2}{4},\ \frac{4}{7}\right\}$



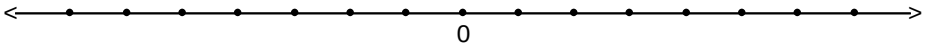
16. $\left\{0.82,\ \frac{8}{11},\ \frac{3}{2},\ 1.25\right\}$



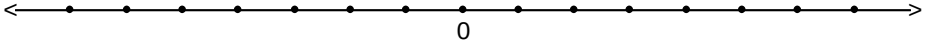
INEQUALITIES ON THE NUMBER LINE AND INTERVAL NOTATION

Plot each of the following inequalities on the given number line, then write each inequality as an interval below the number line.

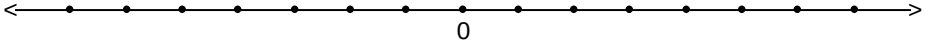
17. $x \geq 5$



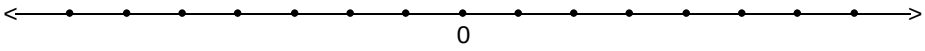
18. $1 < t$



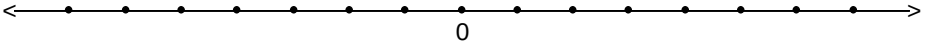
19. $0 < t \leq 4$



20. $3 < b \leq 7$



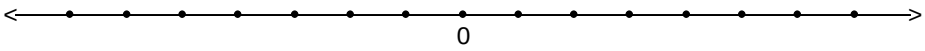
21. $-3 < x < 5$



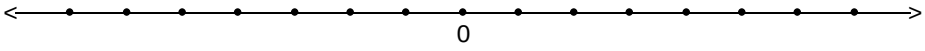
INEQUALITIES – PRACTICE READING THE WORDS!

Show the numbers satisfying each of the following phrases on the number line given, then write the phrase as an inequality and also using interval notation.

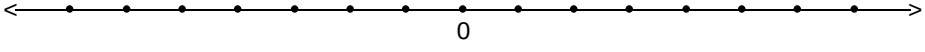
22. "x is more than 5"



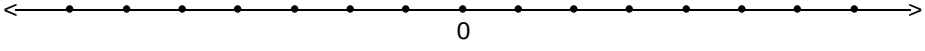
23. "x is less than or equal to 3"



24. "x is at least 2"



25. "x is no more than 1"



PRACTICE WITH HISTOGRAMS

The table below gives the salaries in thousands of dollars of the employees in a small company.

12	14	14	14	16	18
20	20	21	23	27	27
27	29	31	31	32	32
34	36	40	40	40	40
40	42	51	56	60	65

26. Count how many data points are located inside each class and complete the table below. **Remember, by the Right Hand Rule, to include the right endpoint in the **next larger** class.**

Classes	Frequency
12-21	
21-30	
30-39	
39-48	
48-57	
57-66	

27. Use the information from the table to help you create a histogram in the space below.

Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

Order of Operations; Use of the Calculator; Summation Notation

ORDER OF OPERATIONS

Consider each completed problem.

1.

a) On each line, write which operation was used to get to each step.

$4 + (6 + 1) \times 2^3 - 9$ _____

$4 + (6 + 1) \times 8 - 9$ _____

$4 - 7 \times 8 + 9$ _____

$4 - 56 + 9$ _____

$-52 + 9$ _____

-43 _____

b) Explain why the last two operations happened in that order.

2. Joe completed the problem in the following way. Find his mistake, then correct it and find the correct answer.

$90 \div 5 \times 9 - (3-2) + 1 \times 4$

$90 \div 5 \times 9 - 1 + 1 \times 4$

$90 \div 45 - 1 + 1 \times 4$

$2 - 1 + 1 \times 4$

$1 + 1 \times 4$

$1 + 4$

5

3. Natalie completed the problem in the following way. Is she correct? If not, fix her mistake.

$\{2 \times 5\} - 2 - 8 + 4 - 16 \div 2$

$\{10\} - 2 - 8 + 4 - 16 \div 2$

$\{10\} - 6 + 4 - 16 \div 2$

$4 + 4 - 16 \div 2$

$4 + 4 - 8$

$8 - 8$

0

Complete the following problems. Show your steps and write which operation was used in each step. Round your final answer to 2 decimal places.

4. $\dfrac{2-(3+4)}{18-8\cdot 2}$

5. $\dfrac{4.78-8.3}{1.4+5.4}$

6. $\dfrac{3(0.5-4)-(7-2)}{2.3+8.1}$

CALCULATOR PRACTICE

7. Use your calculator to compute the following.

   a) 18^2 b) 4^3 c) 3^4

8. Use the order of operations and your calculator to complete the following. Round your final answer to hundredths.

   a) $2+3\left(2+\dfrac{5}{7}\right)^2$

   b) $\sqrt{225}\ \ 5-(6-1.8)^2-9$

   c) $\dfrac{(5-4.3)^3}{2.3-0.1}$

9. Use your calculator to compute the following. Round your final answer to thousandths (if necessary).

   a) $\sqrt{225}$ b) $\sqrt{59}$

   c) $\sqrt{11.75}$ d) $\sqrt{0.005}$

10. Use the order of operations and your calculator to complete the following. Round your final answer to thousandths.

a) $5+\sqrt{2+15}-4$

b) $1.87-2\sqrt{7.89+2.3}$

c) $0.004+\sqrt{3.25+187\div 5}$

d) $\sqrt{\frac{(0.88)(1-0.12)}{458}}$

ORDER OF OPERATIONS IN FORMULAS

Consider the following formulas and values for each variable. Calculate the value of each indicated variable.

11. $\bar{X}=\frac{a_1+a_2+a_3}{n}$; $a_1=2.3$, $a_2=7.12$, $a_3=0.5$, $n=3$. Find the value of $\bar{x}$

12. $z=\frac{x-\bar{x}}{s}$; $x=57.5$, $\bar{x}=53.2$, $s=4.54$. Find the value of z.

13. $z=\frac{x-\mu}{\sigma}$; $x=1.07$, $\mu=1.25$, $\sigma=0.21$. Find the value of z.

14. $\sigma=\sqrt{\frac{p(1-p)}{n}}$; $p=0.75$, $n=1032$. Find the value of σ.

SUMMATION NOTATION

15. Jose earned the following test scores: 85, 72, 89, 65.

    a. Determine the average, or *arithmetic mean*, of his test scores.

    b. Write out the mathematical steps you took to calculate the mean.

To write the **mean** as a formula, we use the following notation:

$$\bar{x}=\frac{\sum_{i=1}^{n} a_i}{n},$$

where n numbers are given, and each number is denoted by a_i, where $i=1,2,\ldots n$. The symbol $\sum$ is the Greek letter, **sigma**, and is shorthand for telling us to "take the sum" or "add all these numbers together."

So for an arithmetic mean, we add up all of the values in a sequence, then divide by the number of values in the sequence.

16. For Jose's test scores above, what does n equal?

17. List the values of the a_i.

18. Suppose that $a_1 = 5,\ a_2 = 8,\ a_3 = 2,\ a_4 = 5,$ and $a_5 = 7.$ Determine $\sum_{i=1}^{5} a_i$.

Now suppose that instead of a list of numbers, we have a formula for a_i: $a_i = 2i + 3$

Then we can evaluate $\sum_{i=1}^{3} a_i$ (or in other notation, $\sum_{i=1}^{3} (2i + 3)$)

19.

a) Determine the values of a_1, a_2, a_3

b) Evaluate $\sum_{i=1}^{3} a_i$.

20. Determine the value of $\sum_{i=1}^{4} (3i - 1)$

SOLVING EQUATIONS

Solve each of the following equations for the indicated variable.

21. $3 = \frac{x - 7}{2}$; Solve for x.

22. $1.25 = \frac{x - 7.8}{0.5}$; Solve for x.

23. $-0.5 = \frac{x - 2.57}{0.31}$; Solve for x.

24. $2.15 = \frac{108.1 - 110}{s}$; Solve for s

25. $-1.1 = \frac{4.1 - \bar{x}}{0.21}$; Solve for $\bar{x}$

Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

A Review of Slope, Intercepts, and Linear Functions

Review: HOW TO FIND SLOPE

You may remember from your algebra class how to find the slope of the line between two points.

Given $(-3,4)$ and $(2,-1)$. We find the slope by taking the difference in the *y*-coordinates $(y_2 - y_1)$ divided by the difference in the *x*-coordinates $(x_2 - x_1)$ like this: $\frac{-1-4}{2-(-3)} = \frac{-1+-4}{2+3} = \frac{-5}{5} = -1$.

Find the slope of the line between each of the following pairs of points.

1. $(5,-3)$ and $(-4,8)$
2. $(-2.5,-7)$ and $(4,-3.5)$
3. $\left(\frac{1}{10},-9\right)$ and $\left(-\frac{1}{5},8\right)$

SLOPE IN CONTEXT

Now, suppose we had two quantities that are changing together, such that the change in one quantity depends upon the other. The two quantities might be number of toppings ordered on a pizza and the cost of the pizza. We can write them like this: $(\text{number of pounds of topings on a pizza, total cost of the pizza})$. Clearly the total cost of the pizza **depends upon** the number of toppings ordered. We say that the cost of the pizza is the ***dependent variable*** and the number of toppings is the ***independent variable***. Conventionally, we write the independent variable first, then the dependent variable.

Identify the dependent and independent quantity in each pair below.

4. Cost of chicken, the number of pounds of chicken purchased.
   Independent: _____ Dependent:_____

5. Number of credit hours a student takes during a semester, the total tuition in dollars a student pays that semester.
   Independent: _____ Dependent:_____

6. The number of gallons of gas in your car's gas tank while on a road trip; the number of miles driven on the road trip.

   Independent: _____ Dependent: _____

Consider the scenario in the introduction above: $(\text{number of toppings on a pizza, cost of the pizza})$.

7. What would the point $(1,7.75)$ mean?

8. What would the point $(3,9.25)$ mean?

9. Find the slope between these two points. Show your work below and write your answer here:_____

What does the slope mean in this context? Take a guess. *(Hint: Recall that slope is* $\frac{(y_2 - y_1)}{(x_2 - x_1)}$*, which we might now think of as* $\frac{(\text{Change in the dependent quantity})}{(\text{Change in the independent quantity})}$ *.*

10. Write your interpretation in a full sentence below.

Please note that a slope is a rate of ***change.*** So a correct interpretation of the above slope would be:

$\frac{(\text{Change in the cost of the pizza})}{(\text{Change in the number of toppings on the pizza})}$ or*, For each **additional** topping on a pizza, the cost of pizza **changes** (or increases by) $0.75*. Another correct statement would be, *For each **additional** topping on a pizza, the pizza costs $0.75 **more.*** It is NOT correct to say, *The pizza costs $0.75 per topping.* No it doesn't. It costs $0.75 **more** per topping. You need to include a statement of **change** in your interpretation.

Given each pair of quantities below and two sets of points, find the slope between the points and interpret it in the given context.

11. (age of baby in weeks, weight of baby in pounds) $(4,9),(7,10.5)$ [Note: For the first 6 months]

12. (age of child in years, height of child in inches) $(7,59.5),(10,67)$ [Note: For ages 6 – 12 years]

13. (number of cars sold in a month, gross monthly income) $(4,2900),(7,3950)$

14. (number of minutes spent walking, distance walked) $(15,3960),(21,5544)$

15. (number of pizza toppings ordered, cost of pizza) $(2,8.5),(6,11.5)$

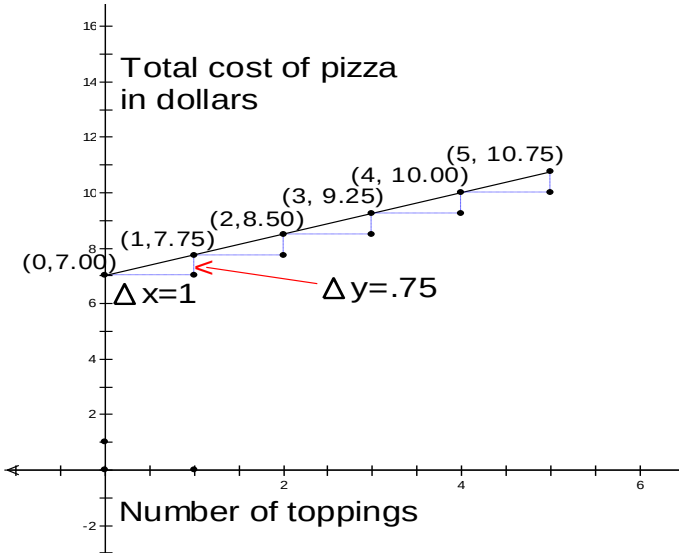
16. (number of tons of landscaping rock ordered, cost of the order) $(1.5,210.5),(3,371)$

17. (number of hours a candle is burning, height of candle in inches) $(1.5,6.7),(3.5,2.3)$

18. (seconds spent walking toward each other, distance in feet two friends are apart) $(8,68),(11,41)$

Review: WRITING EQUATIONS FOR LINES

You might notice that we are referring to the slope of **straight line. You may also remember that the slope between any two points on a line is the same.** Verify this fact all possible combination of two points using the points on the graph below.



We say that the rate of change of the cost per toppings on a pizza is **constant**. This means that for **any** added topping, the cost will **ALWAYS increase** \$0.75. For any two additional toppings, the cost will increase 2 times \$0.75; for any three additional toppings, the cost will increase 3 times \$0.75. In other words, the change in the cost is always \$0.75 times the number of additional toppings:

$$\text{Change in cost} = (0.75)\cdot\text{Change in number of toppings} \text{ or}$$

$$\Delta \text{cost} = (0.75)\Delta\text{number of toppings} \text{ or}$$

$$\Delta y = (0.75)\Delta x .$$

In general, when there is a constant rate of change, *m*, and *y* is the dependent variable and *x* is the independent variable, it is always the case that,

$$\Delta y = m\Delta x$$

Suppose we wanted now to predict the cost of pizza for **any** number of toppings. We know that $\frac{(y_2 - y_1)}{(x_2 - x_1)} = 0.75$. We can multiply both sides of this equation by $(x_2 - x_1)$ to obtain

$$(y_2 - y_1) = 0.75(x_2 - x_1).$$

Let's put in specific values for (x_1, y_1) , say $(1,7.75)$, and rewrite (x_2, y_2) as (x, y) so that it represents ***any*** point, (x, y). Now we have

$$(y - 7.75) = 0.75(x - 1).$$

Solving this equation for *y* gives

$$y = 0.75x + 7 \quad (1)$$

19. Substitute in the following values of *x* into (1), and interpret in words the meaning of your values:
    a. $x = 6$

    b. $x = 4$

    c. $x = 8$

    d. $x = 2.5$

    e. $x = 0$

Your answer for e) should be $y = 7$. Interpret the meaning in a full sentence.

INTERCEPT OF A LINEAR FUNCTION

When the input value, $x = 0$, the output value is called the ***initial value*** or the ***y-intercept,*** or the ***vertical intercept.*** In the above scenario, this is the cost of a pizza with no toppings.

20. Find the initial value, (the y-intercept) for each of the following linear functions and interpret its meaning in the context of the problem.
    a. Gallons of gas remaining $= 12 - \left(\frac{\text{miles driven}}{30}\right)$ or $y = 12 - \left(\frac{x}{30}\right)$

    b. Miles from home $= 5 + (12) \cdot$ hours spent bicycling or $y = 5 + (12) \cdot x$, assuming one is travelling on a straight path away from home.

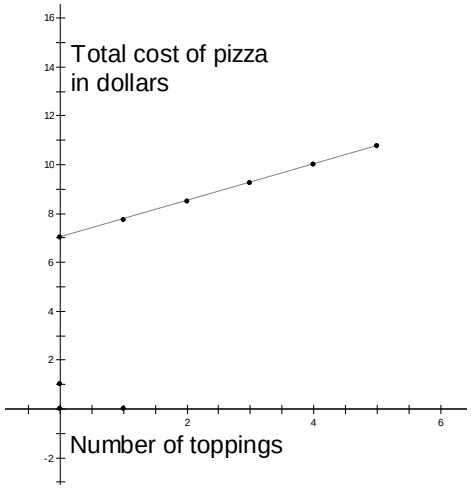
    c. Distance apart $= 140 - 9 \cdot$ number of seconds spent walking

    d. Monthly income $= 350 \cdot$ number of cars sold $+ 1500$

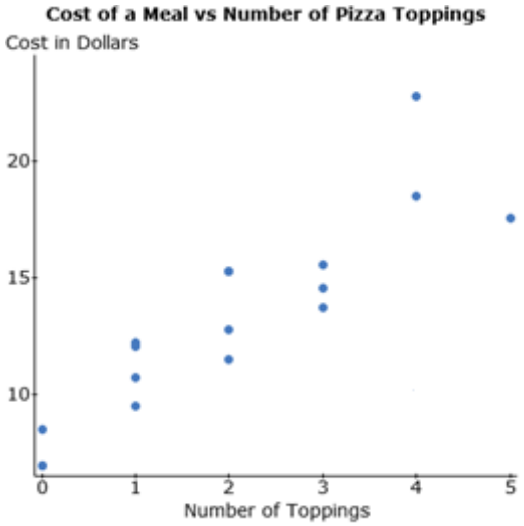
    e. Cost of a pizza $= 0.75 \cdot$ number of toppings $+ 7$

LINEAR FUNCTION VS LINE OF BEST FIT (REGRESSION LINE)

In the pizza example above, each of the points fit the equation of the line *exactly* and thus each point was on the line. Each number of topping had ***exactly one*** cost.



When data is collected, this is often not the case. Recall that given a scatterplot, points often have a ***linear trend***, but not all points fit on a line exactly. For example, if we were to relate the total cost of a meal that includes pizza and related that to the number of toppings ordered, we might obtain a scatterplot like the following.



Notice that the scatterplot has a linear trend, but not all points lie perfectly on a straight line. We will let technology construct a line of best fit, also called the regression line.

Interpretation of slope and y-intercept is the same as above, with the following exceptions:

- While interpreting slope of a regression line, we use the words, *on average.*
- The y-intercept does not always have a meaningful interpretation in context.

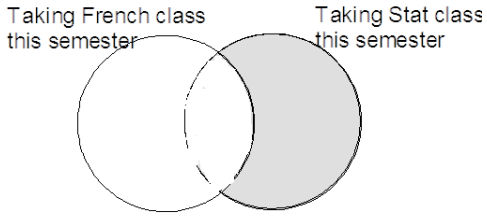
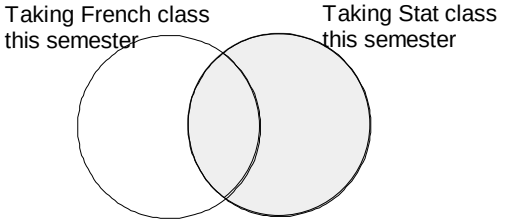
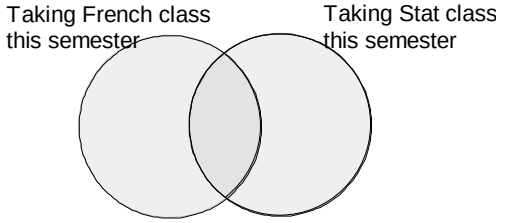
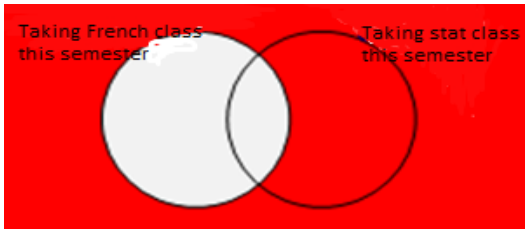
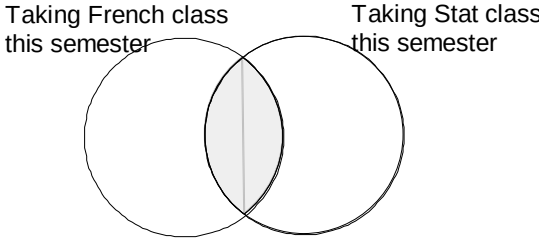
Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

Venn Diagrams, Complements, Two-way tables

REVIEW OF VENN DIAGRAMS

MATCH each statement with the correct Venn diagram. Then use proper set notation (intersection, union, complement) to symbolize the result. Let F = taking French and S = taking Stats.

	Write letter of the correct diagram below	**Symbolic Notation**
A. 	1. Taking French class and Stat class	1.
B. 	2. Not taking French class (the complement of taking French)	2.
C. 	3. Taking Stat class	3.
D. 	4. Taking Stat class and not French	4.
E. 	5. Taking French class or Stat class	5.

PRACTICE WITH SET NOTATION

Suppose the events A, B, and C are defined as follows, where the experiment involves choosing a random integer from 1 to 12 inclusive. Let $A=\{1,2,3,4,5,6,7,8\}$, Let $B=\{6,7,8,9,10,11,12\}$, and Let $C=\{11,12\}$ where the sample space (universal set) is $U=\{1,2,3,4,5,6,7,8,9,10,11,12\}$. List the elements of each of the following.

1. $A \cap B$
2. $A \cup B$
3. A or B
4. not A
5. B^C
6. B and C
7. $(B \cap C)^C$
8. $(A \cup B)^C$
9. $B \cap A^C$
10. $B^C \cup C^C$
11. Are any two events mutually exclusive? If so, which?
12. Are any two events complementary? If so, which?

SKETCH A VENN DIAGRAM TO ILLUSTRATE THE GIVEN FACTS ABOUT A GROUP OF 90 MUSICIANS.

a) 12 musicians played in the marching band and played the trumpet;
b) 18 musicians played the trumpet;
c) 75 musicians played in the marching band.

- How many musicians were neither in the marching band nor played the trumpet?
- How many musicians were not in the marching band?

PRACTICE READING TWO-WAY TABLES

Students at a local high school were surveyed about their most frequent method of transportation to school. The results are given in the table below.

	Freshman	Sophomore	Junior	Senior	
Walk to school	38	10	54	10	
Bike to school	80	94	35	66	
Drive to school	75	150	125	170	
Take a bus to school	194	85	60	4	
Other	13	11	26	0	

1. Name a pair of mutually exclusive events.
2. How many sophomores drive to school?
3. How many juniors participated in the survey?
4. How likely is it that a randomly selected person who took the survey is a junior and bikes to school?
5. How likely is it that a sophomore drives to school?
6. How many students in the survey walk to school?
7. How many students are freshman or take a bus to school?
8. How many students are juniors and bike to school?
9. How many students from the survey walk to school or are seniors?
10. How many students from the survey are freshman or seniors?
11. Are any TWO of the events in the table complementary? If so, which?
12. What is the complement of “is a sophomore or is a junior?”
13. What is the complement of “takes a bus to school” or “bikes to school?”
14. How many students participated in the survey?
15. How likely is it that a student who drives to school is a freshman?
16. How likely is it that a randomly selected person from the survey drives to school and is a freshman?
17. How likely is it that a randomly selected person from the survey is a sophomore?
18. How likely is it that a randomly selected person from the survey takes a bus to school?
19. How likely is it that a randomly selected person is a junior or senior?
20. How likely is it that a randomly selected person drives to school or is a sophomore?

Table Number: _____ Group Name: _____

Group Members: _____ _____ _____

Sample Spaces, Probability, and Mutually Exclusive vs Independence

PRACTICE WITH SAMPLE SPACES

For each of the situations listed below, determine the sample space. Write your answer using set notation.

1. Two fair coins (one dime and one penny) are tossed and the outcomes (Heads or Tails) on each are recorded.

2. Suppose a container has 14 marbles: 2 yellow, 4 white, and 8 blue. An experiment consists of drawing one marble and noting its color.

3. An unprepared student takes a short three question true or false quiz in which he guesses the answers to all three questions.

4. Ann (A), Ben (B), Carla (C), Dave (D), and Eugene (E) are five members of a student club. They decide to choose the two members of the club to serve on a committee by random drawing. Five slips of paper are marked with the five student names and are placed in a box. After mixing, two slips of paper are drawn.

5. When a button is pressed, a computer program outputs a random odd number greater than 1 and less than 9. An experiment requires you to press the button twice.

6. Suppose a container has 6 marbles: 3 white, 2 green, and 1 yellow. An experiment consists of drawing one marble noting its color and then drawing a second marble and noting the color <u>with</u> replacement.

7. Suppose a container has 6 marbles: 3 white, 2 green, and 1 yellow. An experiment consists of drawing one marble noting its color and then drawing a second marble and noting the color <u>without</u> replacement.

8. Two fair 4-sided dice, each labeled 1, 2, 3, and 4, are rolled and the outcomes on each are recorded.

PROBABILITY NOTATION

Suppose a survey is administered to a group of individuals about their Twitter usage. Let A and B represent the following events.

A: The selected person is a teenager (12 to 17 years old)
B: The selected person uses Twitter daily.

Assume that every individual is at least 12 years old. Translate the following statements symbolically using probability notation.

9. The probability that a randomly selected respondent is a teenager and uses Twitter daily.	
10. The probability that a randomly selected teenager will use Twitter daily.	
11. The probability that a randomly selected respondent is an adult.	
12. The probability that a randomly selected respondent is a teenager or will use Twitter daily.	
13. The probability that a randomly selected respondent uses Twitter daily given that they are a teenager.	
14. The probability that a randomly selected respondent who uses Twitter daily is a teenager.	
15. The probability that a randomly selected respondent is not a daily Twitter user.	
16. The probability that a randomly selected respondent is not a daily Twitter user and is not a teenager.	
17. The probability that a randomly selected respondent is a teenager or is not a daily Twitter user.	
18. The probability that a randomly selected daily Twitter user is a teenager.	

PROBABILITIES FROM TWO-WAY TABLES

The following represents the make of car owned by a random sample of college students from three different universities. Find the following probabilities and round answers to the nearest thousandths.

	Chevrolet	Ford	Honda	Toyota	Totals
Kent State University	125	66	70	95	356
Ohio State University	75	46	85	116	322
University of Akron	80	50	71	61	262
Totals	280	162	226	272	940

19. What is the probability that a randomly selected student is an Ohio State University student and owns a Honda?

20. What is the probability that a randomly selected student owns a Ford or attends Kent State University?

21. What is the probability that a randomly selected student owns a Chevrolet given that the student attends Ohio State University?

22. What is the probability that a randomly selected Kent State University student owns a Chevrolet?

23. What is the probability that a randomly selected student does not attend the University of Akron?

24. What is the probability that a randomly selected student owns a Toyota or a Chevrolet?

25. What is the probability that a randomly selected Toyota owner is a University of Akron student?

26. What is the probability that a randomly selected student who owns a Ford attends Ohio State University?

27. What is the probability that a randomly selected student attends either Kent State University or the University of Akron?

28. Suppose that events A and B are mutually exclusive. If P(A) = 0.27 and P(B) = 0.51, find the following. Round answers to the nearest hundredths, if necessary.
    a) P(A AND B) =

    b) P(A OR B) =

    c) P(B^C) =

29. Suppose that events A and B are independent. If P(A) = 0.63 and P(B) = 0.19, find the following. Round answers to the nearest ten thousandths, if necessary.
    a) P(A AND B) =

    b) P(A OR B) =

    c) P(A^C) =

30. Suppose that events A and B are complementary. If P(A) = 0.23, find the following.
    a) P(B) =

    b) P(A AND B) =

    c) P(A OR B) =

31. Suppose that events A and B are such that P(A) = 0.25, P(B) = 0.42, and P(A AND B) = 0.15. Answer the following. Round answer to the nearest hundredth, if necessary.
    a) P(A OR B) =

    b) P(A|B) =

    c) P(B|A) =

    d) P(A^C) =

    e) P(B^C) =

    f) Are events A and B mutually exclusive? Explain why or why not.

    g) Are events A and B independent? Explain why or why not.

    h) Are events A and B complementary? Explain why or why not.

MUTUALLY EXCLUSIVE, COMPLEMENTARY, AND INDEPENDENT EVENTS

For the situations below, determine if events A and B are mutually exclusive, complementary, independent, or associated. Choose the ***BEST*** answer. Explain how you know.

32. Suppose A and B are events such that P(A) = 0.5; P(B) = 0.6, and P(A AND B) = 0.21.

33. Suppose you randomly select one Ohio voter. Suppose A = selecting a Democrat and B = selecting a Republican.

34. One card is randomly selected from a standard deck of playing cards. Suppose A = selecting a diamond and B = selecting a face card.

35. One card is randomly selected from a standard deck of playing cards. Suppose A = selecting a spade and B = selecting a red card.

36. Suppose you roll one fair six-sided die and record the outcome. Suppose A = rolling an even number and B = rolling a number greater than 3.

37. Suppose you roll one fair six-sided die and record the outcome. Suppose A = rolling a number at least 4 and B = rolling a number at most 3.

38. Suppose you roll one fair six-sided die twice and record each outcome. Suppose A = rolling a 6 on the first roll and B = rolling a 6 on the second roll.

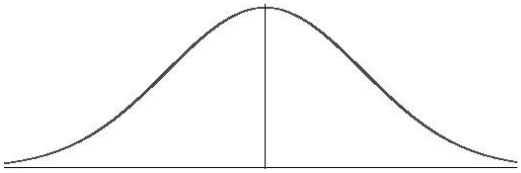
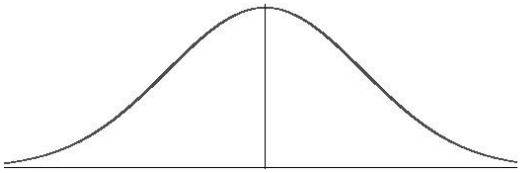
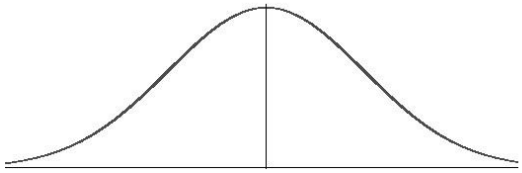
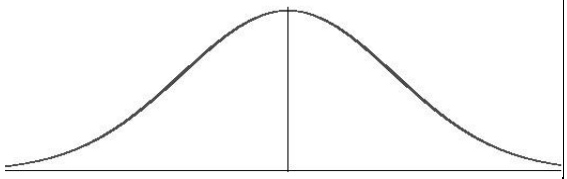
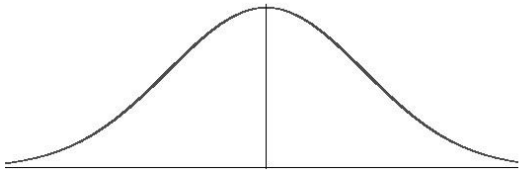
Table Number: _____ Group Name: _____

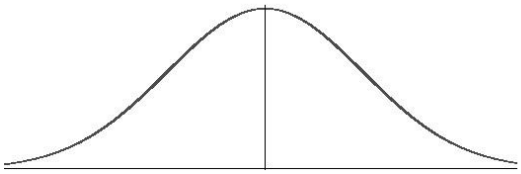
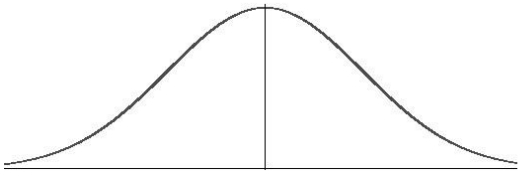
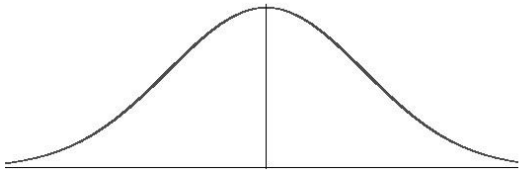
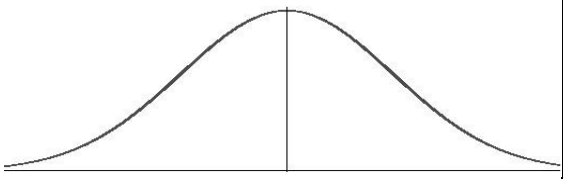
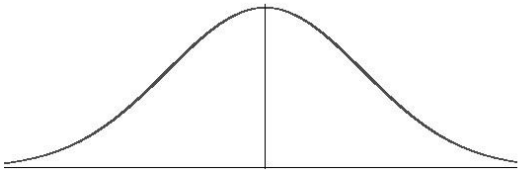
Group Members: _____ _____ _____

Areas and Z-scores

AREAS

For each of the following problems, shade the area represented by the problem stated in the first column. Be sure to label your horizontal axis. In the last column, identify the interval represented by each area.

1. The area under the standard normal curve where the z-score is between z = -1.25 and z = 2.08.		Lower bound: Upper bound: Interval Notation:
2. The area under the standard normal curve where the z-score is at least z = 0.75.		Lower bound: Upper bound: Interval Notation:
3. The area under the standard normal curve where the z-score is at most z = 1.15.		Lower bound: Upper bound: Interval Notation:
4. The area under the standard normal curve where the z-score is more than z = -0.65.		Lower bound: Upper bound: Interval Notation:
5. The area under the standard normal curve where the z-score is less than z = -0.5.		Lower bound: Upper bound: Interval Notation:

6. The area under the standard normal curve to the right of z = 1.95.		Lower bound: Upper bound: Interval Notation:
7. The area under the standard normal curve to the left of z = -1.13.		Lower bound: Upper bound: Interval Notation:
8. The area under the curve where the z-score is more than z=1.25 or is less than z = -1.75.		Interval Notation:
9. The area under the standard normal curve where the z-score is within one standard deviation of the mean.		Lower bound: Upper bound: Interval Notation:
10. The area under the standard normal curve where the z-score is more than two standard deviations from the mean.		Interval Notation:

Using the equation $z = \frac{x-\mu}{\sigma}$, complete the following problems**.**

11. An intelligence test has a normal distribution with mean 100 and standard deviation of 15. Find the z-score corresponding to each of the following intelligence test scores.

    a) Roger scored 85.

    b) Sally scored 120.

    c) Steve scored 135.

12. Women's heights are normally distributed with a mean of 63.7 inches and a standard deviation of 2.5 inches. Find the z-score corresponding to each of the following women's heights. Determine if any of the given heights are unusual.

    a) Height = 60 inches

    b) Height = 72 inches

    c) Height = 68 inches

13. A standardized test is normally distributed with a mean of 75 and a standard deviation of 12. Find the raw score that corresponds with the following z-scores. Round answers to the nearest tenth, if necessary.

a) z = -1.25	b) z = 1.34
c) z = 2.05	d) z = -2.25

14. A standardized test is normally distributed with a mean of 85. If Brenda's score of 103 resulted in a z-score of 1.65, what is the standard deviation for this distribution? Round answer to the nearest tenth.

15. The heights of men in the U.S. are normally distributed with a mean of 69.1 inches. If Jeff's height of 70 inches has a z-score of 0.31, what is the standard deviation for this distribution? Round answer to the nearest tenth.

16. Assume that the resting pulse rates for a group of individuals are normally distributed with a standard deviation of 15 beats per minute (bpm). If Karen's resting pulse rate of 57 bpm resulted in a z-score of -0.87, what is the mean of resting pulse rates for this group? Round answer to the nearest whole number.

17. The ages of the employees at the public library are normally distributed with a standard deviation of 4.75 years. If Barbara's age of 55 years old resulted in a z-score of 2.74, what is the mean age at the public library? Round answer to the nearest whole number.

18. The monthly income of the employees at the local manufacturing plant are distributed normally distributed with a mean monthly income is $2,750 and a standard deviation of $250. If John's monthly income has a z-score of 1.64, what is John's monthly income?

INEQUALITY VOCABULARY REFRESHER

An exam consists of 15 multiple choice questions. Each of the answers is either right or wrong. Suppose we consider the number of correct answers as the outcome of interest. LIST ALL the possible outcomes for each of the following situations.

19. The student answers more than 10 questions correctly.	
20. The student answers less than 9 questions correctly.	
21. The student answers at most 7 questions correctly.	
22. The student answers greater than 7 questions correctly.	
23. The student answers between 7 and 14 questions correctly.	
24. The student answers at least 5 questions correctly.	
25. The student answers no more than 10 questions correctly.	
26. The student answers between 5 and 12 (inclusive) questions correctly.	
27. The student answers fewer than 6 questions correctly.	
28. The student answers no less than 11 questions correctly.	

Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

PROBABILITY NOTATION AND VOCABULARY REVIEW

BINOMIAL PROBABILITIES STEP-BY-STEP

1. Write each statement in probability notation.
   For example, the probability that less than 5 students wear glasses would be written as: P(x<5)

   a) the probability that at least 23 students wear glasses

   b) the probability that exactly 25 students wear glasses

   c) the probability that 10 or more students wear glasses

   d) the probability that more than 17 students wear glasses

   e) the probability that less than 25 students wear glasses

   f) the probability that at most 20 students wear glasses

2. Now go back to each statement above and re-write the probability using only an **equal sign** or a **less than or equal to sign (≤**) and **properties of the complement**, if needed.

   a)

   b)

   c)

   d)

   e)

   f)

3. Now suppose that the class has 30 people, and that 61% of Americans wear glasses. Write the command you would use on your calculator, binompdf or binomcdf, to calculate the above probabilities, then calculate them.

   a)

   b)

   c)

   d)

   e)

   f)

BINOMIAL PROBABILITIES PRACTICE

4. In a school survey 68% of the students have an Android device. For each of the following problems, calculate the following. Round to 2 decimals if needed.

   a) What is the probability that exactly 11 students of a selection of 20 have Android devices?

   b) What is the probability that out of 20 classmates, 12 or fewer have an Android device?

   c) What's the probability that out of 20 classmates, at least 12 have an Android?

   d) What is the probability that less than 10 have an Android?

   e) What is the probability that more than 12 have an Android?

VOCAB: POPULATION, SAMPLE, PARAMETER, STATISTIC

For each of the following scenarios, describe the population, sample, statistic, and parameter (if applicable).

Example: Sunnyvale has 13,567 residents. In a survey of 50 likely voters conducted the week before the election, 67% said that they were planning on voting for Candidate A.

Population: All of the voters in the election
Sample: the 50 likely voters
Parameter: the percent of voters who actually voted (or will vote) for Candidate A
Statistic: the 67% of those sampled who said they would vote for Candidate A

5. A survey of 1353 American households found that 18% of the households own a computer.

   Population:

   Sample:

   Parameter:

   Statistic:

6. The average weight of every sixth person entering the mall within a 3-hour period was 146 pounds.

   Population:

   Sample:

   Parameter:

   Statistic:

7. The average salary of all assembly-line employees at a certain car manufacturer is $33,000.

   Population:

   Sample:

   Parameter:

   Statistic:

8. The average late fee for 360 credit card holders was found to be $56.75.

   Population:

   Sample:

   Parameter:

   Statistic:

9. A researcher caught and weighed 20 ring-tailed lemurs before releasing them and found their average weight to be 2.05 kg.

   Population:

   Sample:

   Parameter:

   Statistic:

10. 42% of students in a Statistics class last spring earned a grade of 90% or better on the first Exam.

    Population:

    Sample:

    Parameter:

    Statistic:

Fill in the blanks for the given scenarios.

11. The mean GPA of all 5000 students at a college is 2.25. A sample of 75 GPAs from this school has a mean of 2.27.

    μ=_____ $\bar{x}$ = _____

12. There are 10,000 people in a particular city. The 2010 census reported that 25% of the community was African-American. A newspaper conducts a poll of 118 people in the city and finds that 37 of them are African-American.

    p =_____ $\hat{p}$ = _____

For each of the following, determine whether the **bolded value** is a parameter or statistic. Then give the correct notation (μ or $\bar{x}$ or p or $\hat{p}$) for the quantity described and its value.

13. The average age of Members of the House of Representatives at the beginning of the 113th Congress was **57.0 years**.

    Parameter statistic

    13._____

14. A 2018 Pew Research study found that **78%** of respondents age 18-24 used Snapchat daily.

    Parameter statistic 14._____

15. The average lifespan of 100 lightbulbs tested from a certain factory was **1,180** hours.

    15._____

    Parameter statistic

16. According to the 2015 National Survey on Drug Use and Health (NSDUH), **86.4** percent of people ages 18 or older reported that they drank alcohol at some point in their lifetime.

    Parameter statistic 16._____

17. Voter records showed that **58 percent** of eligible voters went to the polls during the 2016 election.

    Parameter statistic 17._____

18. In a study conducted for the *Journal of the American Academy of Nutrition and Dietetics,* researchers ordered takeout from 123 restaurants in Boston, San Francisco and Little Rock, Arkansas. These restaurant meals contained an average of **1,205** calories.

    Parameter statistic

    18._____

19. In the 2015-16 academic year, **91%** of classes at Kent State University had 50 or fewer students.

    Parameter statistic

    19.._____

20. The Fall 2015 Freshman class at Kent State had a mean high school cumulative GPA of **3.36.**

    Parameter statistic

    20.._____

Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

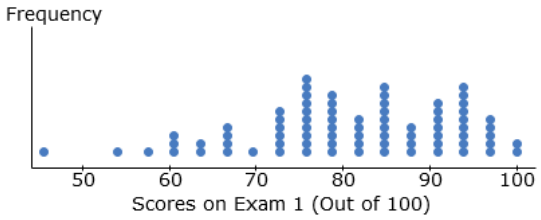
SAMPLING DISTRIBUTIONS VS DISTRIBUTION OF A SAMPLE; PROBABILITIES USING THE NORMAL DISTRIBUTION

Recall what a **sampling distribution** is.

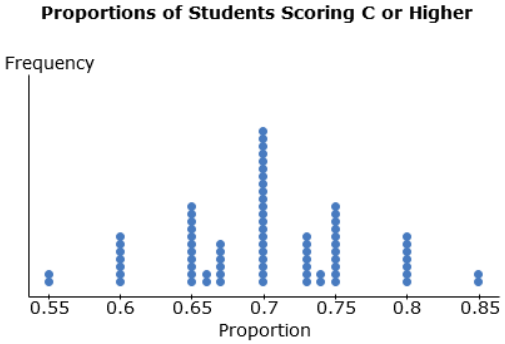
When we generate all possible samples of a certain size from a given population and find the proportion of the desired characteristic in each sample, we are generating a ***sampling distribution***, or a distribution of **sample proportions**. They look like other distributions we have seen of data.

Analyze the following scenarios and graphs. Label each as being a **data distribution** or an estimate of a **sampling distribution**. Explain your reasoning.

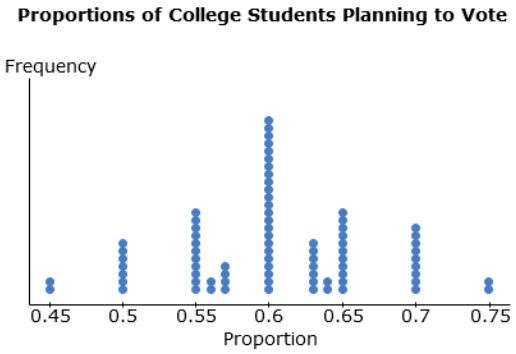
1. A statistics instructor records each student's Exam 1 score and makes the following dotplot. *(Hint: Think about what **each dot** represents.)*



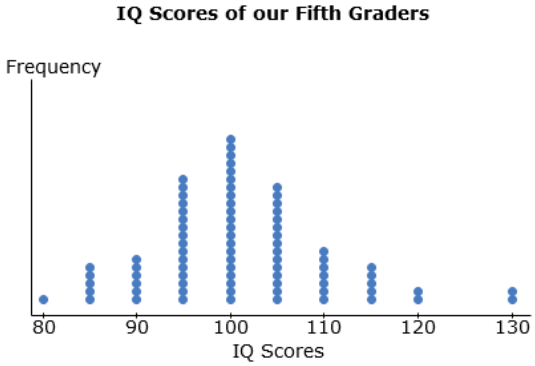
2. A school district consists of 78 statistics classes, each having the same number of students. After Exam 1, each instructor reported to the School Board the proportion of students that passed Exam 1 with a grade of C or better. The School Board made the following dotplot to show parents. *(Hint: Think about what **each dot** represents.)*



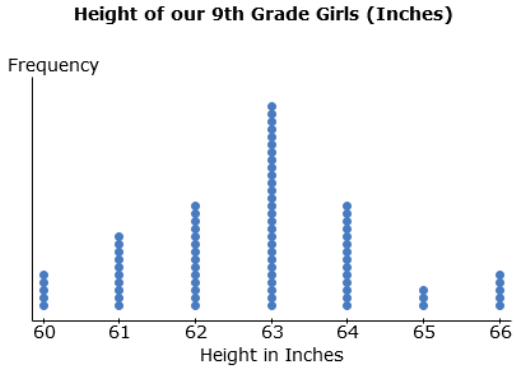
3. A pollster took 80 random samples of 100 college students and asked them if they planned to vote in the upcoming election. She recorded the proportion in each sample that planned to vote in the upcoming election. *(Hint: Think about what **each dot** represents.)*



4. A school superintendent recorded the IQ scores of all fifth grades in the district and made the following dotplot. *(Hint: Think about what **each dot** represents.)*



5. The school's athletic director was trying to recruit 9th grade girls to play on the basketball team, so he recorded the height, in inches, of each of the 9th grade girls in the district and made the following dotplot. *(Hint: Think about what **each dot** represents.)*



Given the scenarios below, find the desired probability. Remember, if you are dealing with a **sampling distribution** (of sample proportions or sample means), you need to check the conditions for the Central Limit Theorem and use the *standard error* while using the normalcdf( ) command on your calculator. If you are dealing with a **data distribution,** use the *standard deviation*. Please show all work, including your calculation of the standard error when needed, and write the full command you used on your calculator.

6. Suppose that the age of Kent State University students is normally distributed, with an average of 21.5, with a standard deviation of 0.75. What is the probability that a randomly selected student is older than 24?

7. A fifth teacher believes that 10% of her students are late for class. If the teacher is right, what is the probability that the proportion of late students in a sample of 50 students would be less than 9%?

8. The weights of steers in a herd are distributed normally. The standard deviation is 100 lbs and the mean steer weight is 1300 lbs. Find the probability that the mean weight of a sample of 30 randomly selected steers is between 1269 and 1320 lbs.

9. A soft drink machine outputs a mean of 27 ounces per cup. The machine's output is normally distributed with a standard deviation of 4 ounces. What is the probability of filling a cup between 21 and 31 ounces?

10. The time spent waiting in the line is approximately normally distributed. The mean waiting time is 4 minutes and the standard deviation of the waiting time is 2 minutes. Find the probability that a person will wait for more than 1 minute.

11. According to the Regional Bar Association, approximately 60% of the people who take the bar exam to practice law in the region pass the exam. Find the approximate probability that more than 63% of 200 randomly sampled people taking the bar exam will pass.

12. Suppose that the average country song length in America is 4.75 minutes with a standard deviation of 1.75 minutes. It is known that song length is not normally distributed. Suppose a sample of 49 songs is taken from the population. What is the approximate probability that the average song length will last more than 5.25 minutes? Round to the nearest thousandth.

13. According to the Regional Teachers' Association, approximately 69% of people who take the licensure exam to teach high school in the region pass the exam. Find the approximate probability that at least 72% of 200 randomly sampled people taking the licensure exam will pass.

Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

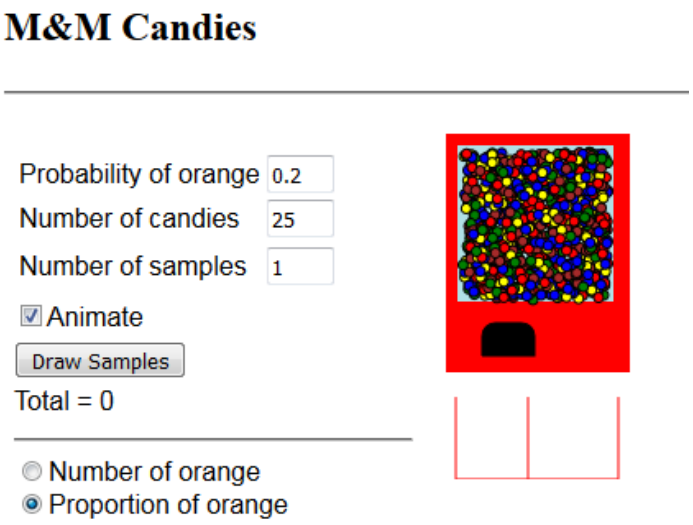
M&M Simulations

Scenario: Suppose you are throwing an Ohio NFL themed party and need to get orange M&Ms to show your support for your team. We are going to do some simulations using an applet to try to determine the proportion of orange M&Ms in the population of ALL M&Ms available.

You will now simulate taking samples of M&Ms by using an online app available at
http://www.rossmanchance.com/applets/OneProp/OneProp.htm?candy=2

WHAT YOU SEE ON THE APPLET:

A big container of colored candies represents the POPULATION of M&M candies. Be sure you check the "Animate" box and also the "Proportion of Orange" button at the bottom.



1. What is the proportion (*p*) of orange candies in the given population? _____ (Note: Normally, we didn't know the parameter value but one catch in running a computer simulation is that we have to assume a value for the simulation to work.)

Be sure the probability of obtaining an orange candy is set to be 0.20. This is the ***population proportion, or parameter, p***. (People who have counted lots of M&Ms, like we did the past couple days, came up with this number.)

Simulation

- Click on the "*Draw Samples*" button in the applet. One sample of 25 candies will be taken and the proportion of orange candies for this sample is plotted on the graph.
  - What is the sample proportion ($\hat{p}$) of orange candies? _____
    (Note: Note the difference in the symbols used for the sample proportion and the population proportion.)
- Repeat this again. (Draw a second sample.)
  - What is the sample proportion ($\hat{p}$) of orange candies in this sample? _____
    (Note: Note again the difference in the symbols used for the sample proportion, $\hat{p}$, and the population proportion, p.)

2. Do you get the same or different values for each sample proportion ($\hat{p}$)? Why do you think that is?

3. How close is each ***sample statistic*** ($\hat{p}$) (sample proportion) to the ***population parameter*** (p)?

Further Simulation

- Uncheck the "*Animate"* box.
- Check the "*Summary Stats*" box.
- Change the "Number of samples" to 500.
- Click on the "*Draw Samples*" button, and see the distribution of sample statistics (in this case proportions) build.

4. Describe the shape, center and spread of the distribution of sample proportions. These sample proportions are called **statistics**.

   Shape:

   Center:

   Spread:

5. How does this distribution compare to the one our class constructed on the board in terms of shape? Center? Spread?

6. Use the sampling distribution to answer the following. If we ran the simulation and obtained a sample of 0.4 (40% of our candies were orange), would that result be unusual based on the distribution? Interpret what that means for our distribution.

   a) List the mean and standard deviation of the sampling distribution:

      Mean (μ):

      Standard deviation (σ):

   b) Approximate the probability that the proportion of orange candies in a random sample of 25 Reese's pieces will be less than 0.2. Explain your reasoning and reference the sampling distribution.

When we generate sample statistics and graph them, we are generating an estimated ***sampling distribution***, or a distribution of the sample statistics. It looks like other distributions we have seen of raw data.

Make a Conjecture

7. What do you think will happen to the distribution of sample proportions if we change the sample size to 50? Explain.

8. What do you think will happen if we change the sample size to 500? Explain.

Test your conjecture. Set the number of samples (*num samples*) in the applet to 50. Complete the table below

Sample Size	Mean of the Sampling Distribution	Standard Deviation of the Sampling Distribution
$n = 25$		
$n = 50$		
$n = 500$		
$n = 5$		

9. As the ***sample size*** increases, what happens to the spread of the distribution?

10. Now, describe the effect of sample size on the distribution of sample statistics in terms of shape, center and spread.

Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

Calculating and Interpreting Confidence Intervals

WHAT IS A SUCCESS?

For each of the following scenarios:

Describe what represents a successful trial and state the number of expected successes

a) Describe what represents a failed trial and state the number of expected failures.

1. According to Wikipedia, roughly 7% of American households are considered millionaires. Suppose you take a random sample of 833 Americans. Answer the provided questions.

    a) A success is

    b) A failure is

2. According to a census study, 33% of American adults have earned a bachelor's degree or higher. Given a random sample of 25 American adults, answer the provided questions.

    c) A success is

    d) A failure is

3. According to the World Health Organization, the Ebola virus has a 50% fatality rate. If a random sample of 44 contractors of the Ebola virus is taken, answer the provided questions.

    e) A success is

    f) A failure is

FINDING AND INTERPRETING CONFIDENCE INTERVALS

In a poll of 545 incoming KSU freshman, only 45% felt prepared for their first college mathematics course. Assuming the participants were chosen randomly, create a 95% confidence interval for the proportion of ALL incoming KSU freshmen that felt prepared for their first college mathematics course using the following steps:

1.
   a) Does this poll provide enough expected students that **feel prepared**? Explain how you know.

   b) Does this poll provide enough expected students that **do not** feel prepared? Explain how you know.

   c) What criteria of the Central Limit Theorem Conditions is being satisfied by the two previous question?

2. State the sample size, n, and the sample proportion, $\hat{p}$.

3. Find the standard error

4. State the critical z-value for a 95% confidence interval for proportions and use it to calculate the margin of error, m.

5. Use the previous found values to state the 95% confidence interval in interval notation.

6. In your own words, write an interpretation of the confidence interval found in the previous question.

7. What is the difference between interpreting a confidence INTERVAL and a confidence LEVEL?

8. Write an interpretation of the confidence LEVEL in the context of the scenario.

EFFECTS OF SAMPLE SIZE ON STANDARD ERROR AND CONFIDENCE INTERVALS

Suppose that when reporting the information from the previous scenario, a typo was missed and the number of incoming freshmen was reported as 54 (not 545).

9. If you tried to test the Central limit theorem conditions from the previous question using only 54 people, would any Central Limit Theorem conditions fail?

10. Calculate a new standard error based on the typo. Describe the effect that making the sample size smaller has on the standard error.

11. Calculate the margin of error based on the typo. Describe the effect that making the sample size smaller has on the margin of error.

12. State the confidence interval in interval notation. Describe the effect that making the sample size smaller has on the confidence interval.

Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

Interpreting Confidence Intervals

1. Three different newspapers conducts polls of people in the community regarding their support of Issue X. A 95% confidence interval is shown for each poll below. Determine whether each interval supports or refutes the claim that the majority of people support Issue X.

    a) Newspaper 1: (42.7%, 60.6%)

    b) Newspaper 2: (52.7%, 62.8%)

    c) Newspaper 3: (48.7%, 65.5%)

2. A health administrator is concerned about student obesity in her community. Suppose a random sample of 200 public school children is taken from the community and 31% are found to be obese or overweight. A 95% confidence interval for the percentage of students who are overweight or obese was found to be (.2459, .3741). According to the 2015 Youth Risk Behavior Surveillance System (YRBSS), 29.9 percent of high school students were obese or overweight. Does this confidence interval support or refute the claim that the percentage of students in this community who are overweight or obese is higher than the national average? Explain.

3. When asked whether they support the death penalty, 987 out of 1952 (approximately 50.5%) of randomly selected adults who responded to a poll said yes. A confidence interval for this proportion is calculated and found to be (.48346,.52781). Is it plausible to claim that a majority support the death penalty? Why or why not? Explain.

4. A 2015 Gallup poll asked whether Americans support stricter gun control laws and found 56% support with a 5% margin of error at the 95% confidence level. Does this poll support or refute the statement that the majority of Americans support stricter gun control? Explain.

5. A random sample of likely voters showed that 54% planned to vote for Candidate A, with a margin of error of 3 percentage points and with 95% confidence. Is there evidence that Candidate A could lose? Why or why not? Explain.

6. A random sample of likely voters showed that 52% planned to vote for Issue 17 with a margin of error of 3 percentage points and with 95% confidence. Is there evidence that Issue 17 could fail? Why or why not? Explain.

Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

Scientific Notation

THE BASICS

Scientific Notation is used to simplify the writing of either very large or very small numbers. For example, in physics, the speed of light can be stated many different ways, depending on the rate of a person is concerned with. In miles per second, the speed of light is 186,000 mps or 1.86×10^5 mps in scientific notation.

Mechanically, the process involves moving the decimal point as many places it needs to move until there is only one value to the left of the decimal. From the example above, the decimal moves 5 positions, leaving only a 1 on the left of the decimal and the power on 10 becomes equivalent to the number of movements. As a point of fact, moving a decimal to the left represents a positive exponential value and moving the decimal point to the right represents a negative decimal value. Moving the decimal point to the left is equivalent to dividing by a power of 10 and moving the decimal point to the right is equivalent to multiplying by a power of 10.

Now you practice:

1. The speed of light in miles per HOUR is 671,000,000. Rewrite this in scientific notation.

2. The probability of getting a royal flush in a five card poker hand is .000000154. Rewrite this in scientific notation.

SCIENTIFIC NOTATION AND THE GRAPHING CALCULATOR

Graphing calculators (TI-83/84 to be specific) have a hard time writing scientific notation. As a "work around," the value E (the button actually reads EE above the ",") is used to represent "times ten to the". For example:
(Note: Statcrunch will also use this notation for sufficiently small values)

a) Scientific Notation: 3.897×10^{11}
Calculator: 3.897E11

b) Scientific Notation: 4.9834×10^{-5}
Calculator: 4.9834E–5

Rewrite the scientific notations above in standard form.

a)

b)

3. Rewrite 8.92E–4 in true scientific notation and standard form.

EXTRA PRACTICE

4. Complete the following table of scientific notation. The first one is done for you

Actual Value	Scientific Notation	Calculator Notation
440,000,000	4.4×10^{8}	4.4E8
	3.75×10^{6}	
		5.834E11
46,800,000,000		
		4.382E–5
	1.2368×10^{-8}	
.00003555		

Table Number: _____ Group Name: _____

Group Members: _____ _____ _____

HYPOTHESIS TESTING VS CONFIDENCE INTERVALS

The Pew Research Center took a random sample of 2928 adults in the United States in September 2008. In this sample, 53% of 2928 people believed that reducing the spread of acquired immune sample deficiency disease (AIDS) and other infectious diseases was an important policy goal for the U.S. government.

1. What are the three conditions for the Central Limit Theorem (CLT)? Check if the CLT is applied in this situation.

2. Find a 95% confidence interval for the percentage of all Americans who believe that reducing the spread of AIDS and other infectious diseases was an important policy goal for the government.

3. How would interpret this confidence interval? Please use a complete sentence.

4. Some one claimed that more than half (50%) of all Americans who believe that reducing the spread of AIDS and other infectious diseases was an important policy goal for the government. If we are constructing a hypothesis test to test the claim, what are the null hypothesis (H_0) and the alternative hypothesis (H_α)? State the hypotheses both in words and in symbols.

   H_o :

   H_a :

5. Use this following formula to calculate the Z-statistic. $z = \frac{p - p_o}{SE}$ where $SE = \sqrt{\frac{p_o(1-p_o)}{n}}$. Please show your work.

6. Is the hypothesis test we are constructing a two-tailed hypothesis test or a one-tailed hypothesis test? Using technology and the Z-statistic you found in the previous question to find a p-value.
   ONE TAIL? TWO TAIL? P-VALUE =

7. If the significance level α=0.05, should we reject or fail to reject the null hypothesis? How would you interpret your results of hypothesis testing? REJECT H_O DO NOT REJECT H_O
   INTERPRET:

8. Based on the above questions, what is the difference between confidence interval and hypothesis testing? When should we use confidence interval and when should we use hypothesis testing?

For each of the following hypothesis tests, state the conclusion **in context** in a full sentence given the result.

9. H_o : The proportion of those who report dreaming in color in the population is the same as it has historically been 0.29
   H_a : The proportion of those who report dreaming in color has increased.

   The null hypothesis is **rejected.** CONCLUSION IN A FULL SENTENCE:

10. H_o : People have the same sense of smell when they are sitting up or lying down.
    H_a : People have a different sense of smell when they are sitting up or lying down.

    The null hypothesis is **rejected.** CONCLUSION IN A FULL SENTENCE:

11. H_o : People on the Weight Watchers diet do not tend to lose weight.
    H_a : People on the Weight Watchers diet tend to lose weight.

    The null hypothesis is **not rejected**. CONCLUSION IN A FULL SENTENCE:

12. H_o : The mean Calcium levels for men and women are the same.
    H_a : The mean Calcium levels for men and women are not the same.

    The null hypothesis is **rejected**. CONCLUSION IN A FULL SENTENCE:

13. H_o : The standard deviation in the pressure required to open a certain valve is not change.
    H_a : The standard deviation in the pressure required to open a certain value is reduced.

    The null hypothesis is **not rejected.** CONCLUSION IN A FULL SENTENCE:

14. H_o : The average grade of a standard test for a specific college course is not changed.
    H_a : The average grade of a standard test for a specific college course is increased.

    The null hypothesis is **not rejected.** CONCLUSION IN A FULL SENTENCE:

Table Number: _____ Group Name: _____

Group Members: _____ _____ _____

HYPOTHESIS TESTING

A milk producer claims that less than 32% of its customers drink another brand of milk on a regular basis. A random sample of 100 customers yielded 21 who did in fact drink another brand of milk on a regular basis. Do these sample results support the producer's claim? (Use a level of significance of 0.05.)

1. Check if the CLT conditions are satisfied in this situation.

2. What are the null and alternative hypotheses? State the hypotheses using the proper notation.
   H_o :
   H_a :

3. Find the standard error (SE) and compute the Z-statistic. Please show your work!

   $SE =$ $z =$

4. Using the technology to calculate the p-value.

   $p =$

5. Should we reject or fail to reject the null hypothesis? Write a sentence of two to interpret your conclusion.

   REJECT THE NULL HYPOTHESIS DO NOT REJECT THE NULL HYPOTHESES (Circle one)

   Interpret conclusion:

The NCHS report indicated that in 2002 the prevalence of cigarette smoking among American adults was 21.1%. Data on prevalent smoking in n=3,536 participants who attended the seventh examination of the Offspring in the Framingham Heart Study indicated that 482/3,536 = 13.6% of the respondents were currently smoking at the time of the exam. Suppose we want to assess whether the prevalence of smoking is lower in the Framingham Offspring sample given the focus on cardiovascular health in that community. Is there evidence of a statistically lower prevalence of smoking in the Framingham Offspring study as compared to the prevalence among all Americans?

6. Check if the CLT conditions are satisfied in this situation.

7. What are the null and alternative hypotheses? State the hypotheses using the proper notation.
   H_o :
   H_a :

8. Find the standard error (SE) and compute the Z-statistic. Please show your work!

   $SE =$ $z =$

9. Using the technology to calculate the p-value.

   $p =$

10. Should we reject or fail to reject the null hypothesis? Write a sentence of two to interpret your conclusion.

    REJECT THE NULL HYPOTHESIS DO NOT REJECT THE NULL HYPOTHESES (Circle one)

    Interpret conclusion:

Table Number:_____ Group Name: _____

Group Members:_____ _____ _____

GUESS MY PARAMETER

CONFIDENCE INTERVAL vs HYPOTHESIS TEST vs PROBABILITY

For each of the following scenarios answer the following:

a) What is the population parameter of interest? Proportion or mean (p or μ)? How do you know?

b) What is the most appropriate approach to answer the given question? Your options are (1) finding a confidence interval, (2) performing a hypothesis test, and (3) finding a probability involving sampling distributions. Explain your reasoning.

1. In 2010, a survey found that the typical attention span of a university student is 10 minutes (http://news.bbc.co.uk/2/hi/uk_news/education/8449307.stm). A university professor claims that this has decreased over the years. How may she support her claim?

   a) Proportion or Mean? How do you know?

   b) Confidence Interval? Hypothesis test? Probability? Explain.

2. In a survey of 450,000 U.S. adults, the CDC found that 80% of those surveyed did not get the recommended amount of exercise (https://www.cbsnews.com/news/cdc-80-percent-of-american-adults-dont-get-recommended-exercise/). Attempting to convince his students to keep up with their exercise outside of class, a gym instructor claims that 90% of adults do not get enough exercise and have health problems. Is his claim plausible?

   a) Proportion or Mean? How do you know?

   b) Confidence Interval? Hypothesis test? Probability? Explain then do it:

3. When a new restaurant opens, the owners know that most restaurants of their size need to earn more than $30000 per week for the first year of operation. Other restaurants in their vicinity earn $29,203.48 per week on average with a standard deviation of $2534.68. Six months after opening, the owners take a sample of weekly revenue from nine randomly chosen weeks. What is the probability that the average weekly revenue for these 9 weeks will be above $30,000. Assume that weekly revenue for the region is normally distributed.

   a) Proportion or Mean? How do you know?

   b) Confidence Interval? Hypothesis test? Probability? Explain then do it:

4. The acceptance rate to The Ohio State University is 49%. If 100 students from a certain high school in all apply to OSU, what is the probability that no more than 40 of those students will be accepted?

   a) Proportion or Mean? How do you know?

   b) Confidence Interval? Hypothesis test? Probability? Explain then do it:

5. A study in 2010 reported that 62% of personal bankruptcy filings were due to medical reasons and the bills attached to them. An economist believes that this percentage has changed. How may the economist support their claim?
   a) Proportion or Mean? How do you know?

   b) Confidence Interval? Hypothesis test? Probability? Explain then do it: