Math 105, Edition 2.0
Course Packet 24785

Math In Society

Lead Instructor: Cara Lee

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1.5: Operations and Number Sense

Group Activity

Choose a reader for your group to read all the instructions and problems out loud.

This problem does not have a right or wrong answer. Show which calculations you could use to help you decide between the two offers.

1. You have two similar job offers. Which one would you choose and why?

    - Job A: $50K per year salary, 3 weeks of paid vacation per year, and a benefits package valued at $9K. The company will match 6% of retirement contributions.
    - Job B: $24 per hour, 40 hours per week, 2 weeks of paid vacation per year, and a benefits package valued at $10K per year. The company will match 5% of retirement contributions.

Job A **Job B**

What are some reasons you might choose Job A?

What are some reasons you might choose Job B?

Which job would you choose for yourself and why? (This may differ by group member)

Operation Sense

For the problem above, think about how you knew when to use each operation. You may have instinctively known what to do so we want to make that process more conscious.

2. What operation would you use in each situation?

    a. Finding the cost of buying 6 movie tickets.

    b. Find the number of boxes needed to pack 100 books if each box holds a certain number of books.

    c. Finding the distance you traveled on a road trip after driving on Saturday and Sunday.

    d. Calculating the amount you owe after making a payment on a credit card.

3. Fill in the chart with key phrases and some examples for each operation.

Operation – and what does it do with positive numbers	Key Phrases	Examples
Addition		
Subtraction		
Multiplication		
Division		

Number Sense and Estimation

4. Estimate a reasonable range of values for each situation including units.

    a. The number of books on the shelves in a small library.

    b. The weight of a fully loaded shopping cart at a grocery store.

    c. The amount of water in a backyard swimming pool.

    d. The number of spectators at a high school football game.

A Problem Solving Process

1. Identify the question(s) you're trying to answer. Do any research needed to understand the context.
2. Identify the information you have and any information you may need. Look up or estimate any missing information. Estimate the range of reasonable answers.
3. Brainstorm and try out different mathematical tools to see what might be helpful. Use manipulatives, visuals or tables whenever possible. All ideas are useful, even if they don't work out.
4. Choose one method to continue and get a potential solution.
5. Check whether your solution makes sense. Is it reasonable? Can you get there a different way to confirm your answer? Return to Steps 1-5 as needed. When finished, explain your conclusion.

Combining Operations

5. Show the steps and operations you use for each problem. Circle or highlight key words and phrases. Put units on each answer.

   a. A baker makes 15 batches of cookies for an order. Each batch makes 24 cookies. The cookies are packaged into boxes that hold 8 cookies each. How many boxes do they need for this order?

   b. You earn a weekly salary of $680 and $12 for each item after you sell 25 items in a week. How much will you earn if you sell 30 items this week?

   c. You ordered 50 shirts that you plan to sell for $25 each at an event. The cost was $11 per shirt. You sold 43 shirts and returned the rest but had to pay a $3 restocking fee on each shirt returned. What is your profit?

Order of Operations

6. For each question above, how did you know the order in which to do the operations?

Viral Math Problems

$$\mathbf{6 \div 2(1+2) =}$$

$$\mathbf{6 - 2(1+2) =}$$

1.3-1.4 Decimals, Percents and Proportional Reasoning

Rounding – May be Review

Step 1. Determine the place to which the number is to be rounded. Circle or underline it.

Step 2. If the digit to the right of the number to be rounded is less than 5, replace it and all the digits to the right of it by zeros. If the digit to the right of the underlined number is 5 or higher, increase the underlined number by 1 and replace all numbers to the right by zeros. If the zeros are decimal digits, you may eliminate them.

Place value chart

Ten thousands	Thousands	Hundreds	Tens	Ones	Decimal Point	Tenths	Hundredths	Thousandths	Ten Thousandths	Hundred Thousandths
10,000	1,000	100	10	1	.	.1	.01	.001	.0001	.00001

1. Round each number to the place value given:
   a. 126.745 inches to the nearest tenth

   b. 5.68932 feet to two decimal places

   c. 0.038594 to three decimal places

   d. $ 43.893 to the nearest cent

   e. 0.00125 to four decimal places

   f. 0.00199 to four decimal places

Converting Percentages to Decimals – May be Review

Percent means per 100, so depending on which way we are converting, we move the decimal 2 places to the left or to the right.

Percent to decimal

50% means 50/100. When we divide this we get 0.50 or 0.5. Notice how the decimal is now 2 places to the left.

Decimal to percent

0.25 is read as 25 hundredths, which can be written as 25/100. This is 25%. Notice how the decimal place is now 2 places to the right.

Memory aid

D **P**

2. Convert each percentage to a decimal:
   a. 31%
   b. 130%
   c. 3%
   d. 0.3%
   e. 1.3%
   f. 1.23%

Convert each decimal to a percentage:
   g. 0.97
   h. 0.09
   i. 0.009
   j. 2.41
   k. 0.3294
   l. 0.0354

Divide and round each proportion to four decimal places.

m. $\frac{9}{25}$

n. $\frac{5}{36}$

o. $\frac{9}{11}$

p. $\frac{\mathbf{19}}{\mathbf{570}}$

Operations with Percentages – May be Review

Finding the percentage of an amount

"of" is a key word that means multiply. First change the percentage into decimal form and then multiply.

3. A sweater that is normally priced at $59.99 is on sale for 20% off. What is the discount? What is the new price of the sweater?

Finding the percentage given a fraction

4. A pollster surveyed 320 people and 136 of them said they are planning to vote for candidate A in the next election. What percent of those surveyed are planning to vote for this candidate?

Absolute and Relative Change

Absolute change is the difference in two quantities and has the same units as the original quantities.

Relative change is the $\frac{\text{absolute change}}{\text{starting quantity}}$ and is written as a percentage increase or decrease.

The starting quantity is called the **base** of the percent change.

5. You bought a desktop computer three years ago for $1250. Today, it is worth about $350. Describe the absolute and relative change in the computer's value.

1.4: Proportional Reasoning

- Does a runner run a 5,000-meter race at the same rate they run a 100-meter race?
- Should the amount of taxes a person pays be related to their income?
- Should a state's representation in the U.S. government be related to the population of the state?

Proportional: When two quantities have the same relative size, or the same ratio or rate. In a proportional relationship, one quantity is always a constant multiple of the other.

1. Tax example. Julia makes $40,000 a year and pays $6,800 in taxes. Fabiana makes $400,000 a year and pays $50,000 in taxes. Are these ratios proportional?

2. Shopping example. Cans of chickpeas are $1.25 each or 4 for $5.00. Are these rates proportional?

Ratio: A comparison of two like quantities without units

Rate: A fraction of two unlike quantities (has units with "per")

Unit Rate: A rate where the denominator is one unit

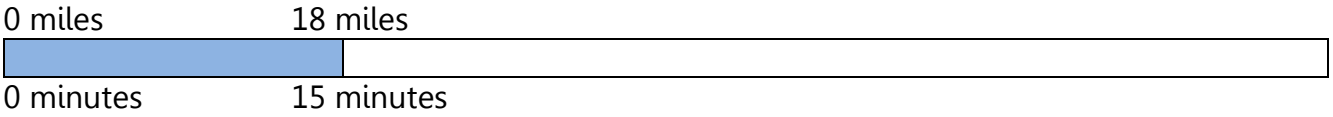
3. Identify each as a ratio, rate, or unit rate
    a. $19.99 per shirt

    b. $\frac{60\ miles}{5\ gallons}$

    c. 3:4

Solving proportion problems visually (scaling)

4. A car speeding on the highway in cruise control travels 18 miles every 15 minutes. How far will the car travel in 5 minutes? How far will it travel in one hour?



Solving proportion problems using a unit rate (constant multiple)

5. Bars of soap are on sale at the price of 3 bars for $2. How much would you pay for 7 bars of soap if the sale applies to all quantities at the same rate?

Solving proportion problems with an algebraic equation

6. A house valued at $480,000 has property taxes of $4,992 per year. In the same neighborhood, assuming the tax rate is proportional, what would the property taxes be for a house valued at $395,000?

1.3-1.4: Decimals, Percents and Proportional Reasoning

Group Activity

1. A TV originally priced at $799 is on sale for 30% off in Vancouver, WA. There is an 8.7% sales tax. Find the price after including the discount and sales tax.

2. Would you rather use a 30%-off coupon or a 20%-off coupon and then a 15%-off coupon? What percentage of an item would you pay under each option?

3. A laptop that usually sells for $1599.99 is on sale for $1349.99. What is the relative change in the cost? This sale is in Oregon so there is no sales tax.

4. The U.S. federal debt at the end of 2021 was $28.39 trillion, and grew to $30.84 trillion by the end of 2022. At the end of 2005 it was $7.91 trillion, and grew to $8.45 trillion by the end of 2006[1]. Calculate the absolute and relative changes for 2005-2006 and 2021-2022. Which year saw a larger absolute change and relative change in the federal debt?

Unit Rates

5. Would you rather buy a box of aluminum foil with 50 square feet for $2.99 or 75 square feet for $3.99? Find the unit price of each and explain your reasoning.

[1] https://fred.stlouisfed.org/series/FYGFD

Solving Proportion Problems

Use any method to solve these problems. Show your steps so we can follow your thinking.

6. Thai made $87,000 in gross income last year and paid $15,051 in taxes. If tax rates are proportional, how much should someone who makes $1,000,000 pay? Do you think tax rates are proportional?

7. A crepe recipe calls for 2 eggs, 3/4 cup of flour and 1 cup of milk. How much flour would you need if you use 5 eggs?

1.5: Formula Sheet

Unit Conversions

Unit Conversions for Length.

1 foot (ft) = 12 inches (in)

1 yard (yd) = 3 feet (ft)

1 mile (mi) = 5,280 feet (ft)

2.54 centimeters (cm) = 1 inch (in)

1000 millimeters (mm) = 1 meter (m)

100 centimeters (cm) = 1 meter (m)

1000 meters (m) = 1 kilometer (km)

Unit Conversions for Weight and Mass.

1 pound (lb) = 16 ounces (oz)

1 US ton = 2000 pounds (lbs)

1000 millgrams (mg) = 1 gram (g)

1000 grams (g) = 1 kilogram (kg)

1 kilogram (kg) ≈ 2.2 pounds (lbs) in Earth's gravity

Unit Conversions for Volume and Capacity.

1 gallon (gal) = 4 quarts (qt)

1 cup (c) = 8 fluid ounces (fl oz)

1 quart (qt) = 2 pints (pt)

1 cup (c) = 16 Tablespoons (T)

1 pint (pt) = 2 cups (c)

1 Tablespoon (T) = 3 Teaspoons (t)

1000 milliliters (ml) = 1 liter (L)

Note: Fluid ounces are a capacity measurement for liquids. 1 fluid ounce weighs about 1 ounce for water only.

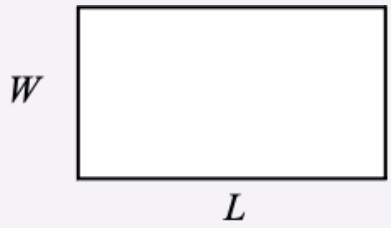
Geometry Formulas

Perimeter and Area.

Rectangle

Perimeter = $2L + 2W$ units

Area = $L \cdot W$ units^2



Circle

Circumference = $2\pi r$ units

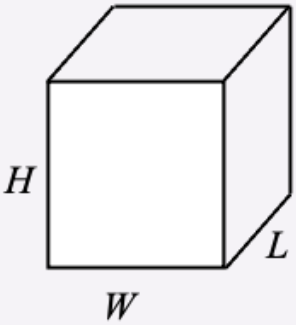
Area = πr^2 units^2



Volume.

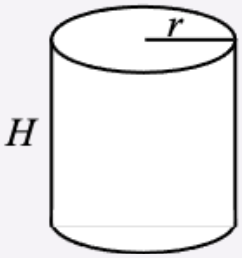
Rectangular Box

Volume = $L \cdot W \cdot H$ units^3



Cylinder

Volume = $\pi r^2 H$ units^3



1.5: Problem Solving with Units, Geometry and Proportions

Solving Problems with Unit Conversions

1. A medicine package gives a dosage of 0.65 mg/kg/day of a medication given in 2 doses. If the child weighs 40 pounds, how many milligrams do they need? If the chewable tablets come in either 3 or 5 mg, which ones should be purchased and how many tablets should be given?

Solving Problems with Geometry

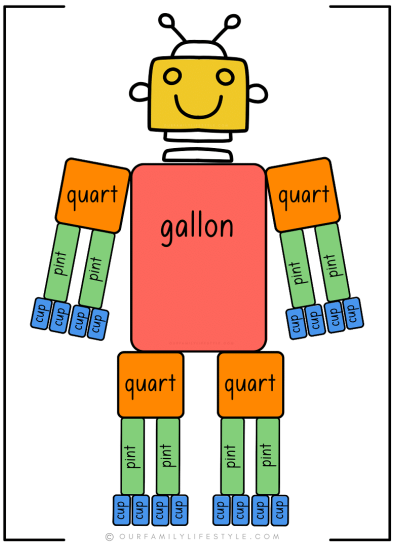
2. You're pouring a concrete patio with the shape of two overlapping squares as shown in the diagram. You want the concrete to be 6 inches thick. If each square is 12x12 feet and the overlap is about 3x4 feet, how many cubic yards of concrete should you order?



1.5: Problem Solving with Units, Geometry and Proportions

Group Activity

1. You are in charge of drinks for a neighborhood block party. You need at least 100 cups of beverages. So far, you have received enough mix to make 3 gallons of lemonade and 6 bottles of fruit juice that each contain are 32 fl. oz. How many cups of beverage do you have so far? Is this enough for the block party? How much extra do you have or how much more do you need?



2. Leo is building a fence around his garden which is 4 yards long and 7 feet, 6 inches wide. He plans to have one gate that is 42 inches wide. He gets a quote for a cedar fence that costs $40 per linear foot and $100 per gate. How much will this fence cost?

3. Sarina wants to fill her 2 rectangular raised garden beds, which are 6 feet long, 3 feet wide, and 16 inches deep. If bags of soil contain 1.8 cubic feet, how many bags does she need to buy?

4. A hiker walks 2.8 miles per hour for 2 hours 45 minutes. How far did the hiker travel in miles? In feet?

5. A homeowner wants to paint the outside of their rectangular 1-story house. One gallon of exterior paint covers 350 square feet. Paint is sold in 5-gallon cans. How many cans should the homeowner buy if they want to apply 2 coats?
   - The house measures 48 feet long, 32 feet wide, and 10 feet high.
   - There are 8 windows, each 3 ft x 4 ft
   - There are 2 doors, each 3 ft x 7 ft

6. Sally can paint a 10x10 foot wall in 2 hours. At the same rate, how long would it take her to paint a 30x8 foot wall? Do you think the rates would be the same? What are some factors that would affect this?

7. A Very Veggie Pizza at Pizzicato is available in 4 sizes with the prices shown in the table below. Find the price per square inch to determine whether the prices are proportional to the amount of pizza. If not, which is the best deal? Which is the worst deal?

Size	**Price**
Small, 10-inch	$17.25
Medium, 12-inch	$24.00
Large, 16-inch	$31.00
XL, 18-inch	$36.00

1.1: Logic in Everyday Life

A **Proposition** is a statement that makes a _____. It must be a complete sentence.

Which of the following are propositions?

a. Anka is sitting on the table.

b. Where are you going after class?

A proposition has two possible truth values: _____or _____.

A **negation** of a proposition makes the _____ claim.

Write a negation of the following statements:

a. Anka is sitting on the table.

b. The dog is not in the back yard.

A **double negation** is when a negated proposition is itself negated.

Turn each statement into a double negation:

a. I will not wash my hands

b. It is unlikely that there is an association.

Logical Connectors

Using **AND**, **OR**, or **IF…THEN** to connect two or more separate propositions into a single statement.

Examples:

- Ramesh has a cat AND Ramesh has a dog
- Ramesh has a cat OR a dog
- IF Ramesh has a cat, THEN Ramesh will get a dog

"AND" Statements - Conjunctions

An "AND" statement is true only when _____ of the statements connected by the "and" are _____. If either or both are false, the "and" statement is false.

Determine whether each AND statement is true or false:

a. Rabbits are fish and rattlesnakes have 4 legs

b. Math 105 is a PCC class and Portland Community College is located in Oregon

c. Oprah Winfrey and Bill Clinton were U.S. Presidents

"OR" Statements – Disjunctions

In everyday life, "or" statements can be interpreted as **inclusive** (meaning either or both) or **exclusive** (meaning either but not both).

Determine whether each OR statement is inclusive or exclusive:

a. Will you have the vegan or meat option at dinner?

b. We want to hire someone who knows spreadsheets or QuickBooks.

In logic and mathematics, the "or" is always inclusive unless specified otherwise.

An "OR" statement is true when _____ or _____ of the statements connected by the "or" are true. If both statements are false, the "or" statement is false.

Determine whether each OR statement is true or false:

a. Rabbits are fish or rattlesnakes have 4 legs.

b. Math 105 is a PCC class or Portland Community College is located in Oregon

c. Oprah Winfrey or Bill Clinton were U.S. Presidents

IF…THEN Statements – Conditional Statements

Example: if the animal is a bird, then the animal has a beak.

The "if" proposition is called the _____.

The "then" proposition is called the _____.

Determine the hypothesis and conclusion in the example below:

You'll be paid overtime if you work more than 10 hours today.

a. Hypothesis:

b. Conclusion:

When is an "IF…THEN" Statement True or False?

An If…then is false when the hypothesis is _____ and the conclusion is _____.

An If…then is true for all other situations, including when both the hypothesis and the conclusion are false.

Example: You make this statement. "If I get elected, I will reduce college tuition."

If the hypothesis is true – you get elected, there are two possibilities

- If you reduce college tuition, the statement is _____.
- If you don't reduce college tuition, the statement is _____.

Say the hypothesis is false – You don't get elected

- The entire statement is not false because you didn't say anything about what you would do if you weren't elected, so it's _____.

Summarize If…Then rules

- If TRUE, then TRUE → TRUE
- If TRUE, then FALSE → FALSE
- If FALSE, then TRUE → TRUE
- If FALSE, then FALSE → TRUE

Does it work to reverse an If…Then statement?

Original Conditional Statement: If A, then B
Converse: If B, then A
Inverse: If not A, then not B
Contrapositive: If not B, then not A

Which of these 4 statements are equivalent to each other?

a. Original: If you are not late, then you get coffee.

b. Converse: If you get coffee, then you are not late.

c. Inverse: If you are late, then you don't get coffee.

d. Contrapositive: If you don't get coffee, then you are late.

Logical Equivalence

The original statement and its contrapositive are logically equivalent.
The converse and inverse are logically equivalent.

1.1: Logic in Everyday Life

Group Activity

1. Discuss each statement and decide which are propositions. Circle or highlight them.

   a) Are you hungry?
   b) Janae was nominated for student council president.
   c) Four pounds less.
   d) 7 + 8 = 33
   e) I have two siblings.

2. A proposition is given, represented by the letter p. Write the wording for the negation and double negation.

   p: Hannah eats apples.

   not p:

   not not p:

3. More negations. Read the following and decide whether logging will continue. *"The House failed to overturn a veto on a bill that would stop logging."*

4. On this California ballot measure, what's the result of a "yes" vote?

   Ballot question title: Redistricting. State Senate Districts. Referendum.
   Ballot question text: A "Yes" vote approves, and a "No" vote rejects, new State Senate districts drawn by the Citizens Redistricting Commission. If the new districts are rejected, the State Senate district boundary lines will be adjusted by officials supervised by the California Supreme Court.
   (State Senate districts are revised every 10 years following the federal census.)

5. Negations of all or none: Write a negation of each statement. There is more than one right answer.

   a. All students like coffee.

   b. No students like to sing.

6. Determine whether each "and" statement is true or false.

   a. $25 + 30 = 55$ and $55 \div 11 = 6$.

   b. 16 is even and odd.

   c. Cats are mammals and geckos are reptiles.

7. Determine whether each "or" statement is inclusive or exclusive.

   a) Are you going to wear pants or a skirt tomorrow?

   b) Students can join the Music Club if they are in the choir or band.

8. Determine whether each "or" statement is true or false.

   a. $3 + 8 = 10$ or 6 is an odd number.

   b. Mexico is a country or a city.

   c. Mice are rodents or snakes are reptiles.

9. Identify the hypothesis and conclusion of each conditional statement.

   a. If you can see the stars, then it is night.

   b. You'll win big if you play the lottery.

   c. If elephants fly, then fish don't swim.

10. Determine whether each "if…then" statement is true or false.

   a. If a figure is a square, then it has four equal sides.

   b. If cows can fly then eagles can fly.

   c. If the sky is purple, dogs are not pets.

   d. If horses are mammals, then horses have two legs.

11. Write the converse, inverse, and contrapositive for the conditional statement:

   Original Statement: If you perform well tomorrow, then you get a cash bonus.

   a. Converse:

   b. Inverse:

   c. Contrapositive:

   d. Which pairs of statements are equivalent to each other?

12. Compound Statements: Some courses at PCC and other colleges have complex sets of prerequisites. For each class, list all the minimum ways a student could meet the prerequisites.

    a. ART275 Printmaking II.
    Prerequisites: ART 272 or ART 273 or ART 274

    b. AD256 Advanced Counseling and Addiction.
    Prerequisites: AD 160 or (AD 150 and AD 151)

    c. BA285 Human Relations-Organizations.
    Prerequisite: (WR 115 and RD 115) or IRW 115 and MTH 20 or equivalent placement. Note: IRW 115 is integrated reading and writing.

    d. CIS277A Data Analytics.
    Prerequisites: CIS 125D or CIS 275, and (WR 115 and RD 115) or IRW 115 and MTH 20 or equivalent placement. You can build off your last answer.

1.2: Sets and Venn Diagrams

Types of Relationships

Draw a Venn diagram for each situation and describe the relationships between the sets.

a. Insects and flies

b. Insects and cats

c. Athletes and Students

Four Categorical Propositions S: Subject Set P: Predicate Set

a. All S are P
All children are people

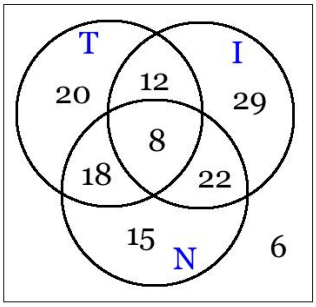
b. No S are P
No college students are cats

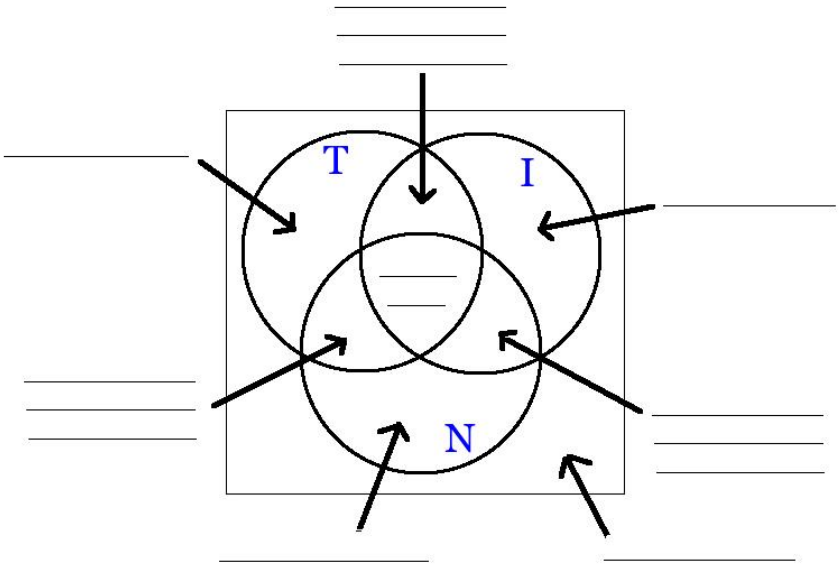
c. Some S are P
Some college students are athletes

d. Some S are not P
Some college students are not athletes

A Venn Diagram with Three Sets and Data

130 people were surveyed about the news sources that they used on a regular basis.
The results are given in the Venn diagram:
T represents television, I represents the Internet, and N represents newspapers





a) Write a description for each of the eight areas.

b) How many people used the Internet?

c) How many people used at least two of the three sources?

d) How many people didn't use newspapers?

Another Venn Diagram Example: How do you know when to subtract?

A survey was given asking whether people like espresso and/or chocolate. People could check one or both boxes. Use the results to draw a Venn diagram and determine how many people did not like either chocolate or espresso.

- 150 people were surveyed
- 132 people liked chocolate
- 96 people liked espresso
- 78 people checked both boxes

What is different in this problem than in the television, Internet and newspaper example? In other words, how will you know when to subtract?

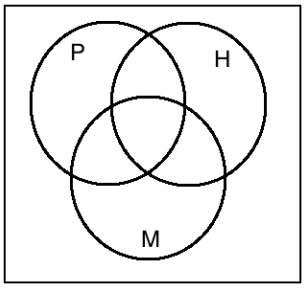
1.2: Sets and Venn Diagrams

Group Activity

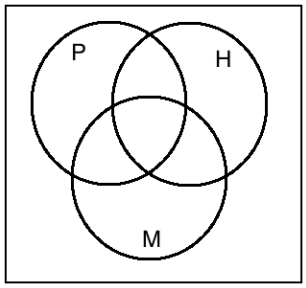
1. Pizza Venn Diagrams

Let's continue the last example with P representing pepperoni, H representing ham, and M representing mushrooms. Shade or color in the appropriate area(s) for each pizza on the Venn diagrams below.

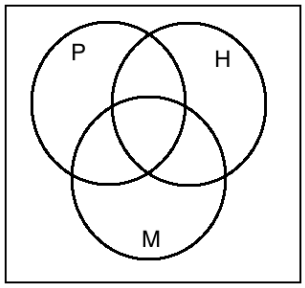
Pepperoni & Mushroom



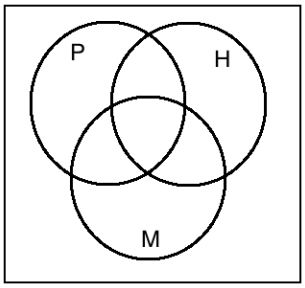
Cheese



Veggie



Supreme (everything on it)



Qualified Propositions

2. Draw a Venn diagram for each qualified or categorical proposition. Then write on the line whether the sets are disjoint, overlapping, or one is a subset of the other.

Relationship between the Sets

a. Some bikes are orange. _____

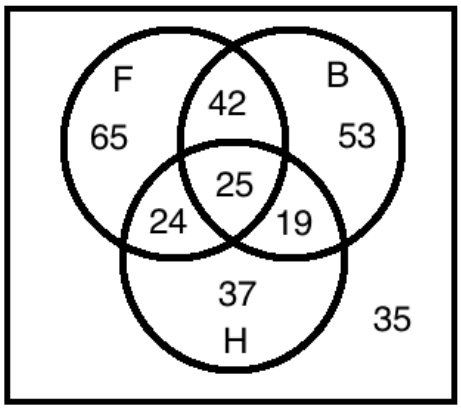
b. All bicycles have wheels. _____

c. No bikes are alive. _____

3. Interpreting values on a Venn diagram

A survey was taken to see which professional sports were watched by students. Let F represent football, B represent basketball, and H represent hockey.

Answer the following questions (use complete sentences). Show any calculations that were used.



a) How many students participated in the survey?

b) How many students watched basketball?

c) How many students watched only one of the sports?

d) How many students watched at least two sports?

e) How many students didn't watch hockey?

f) How many students watched football or hockey? Can you find this 2 different ways?

g) How many students watched football and hockey, but not basketball?

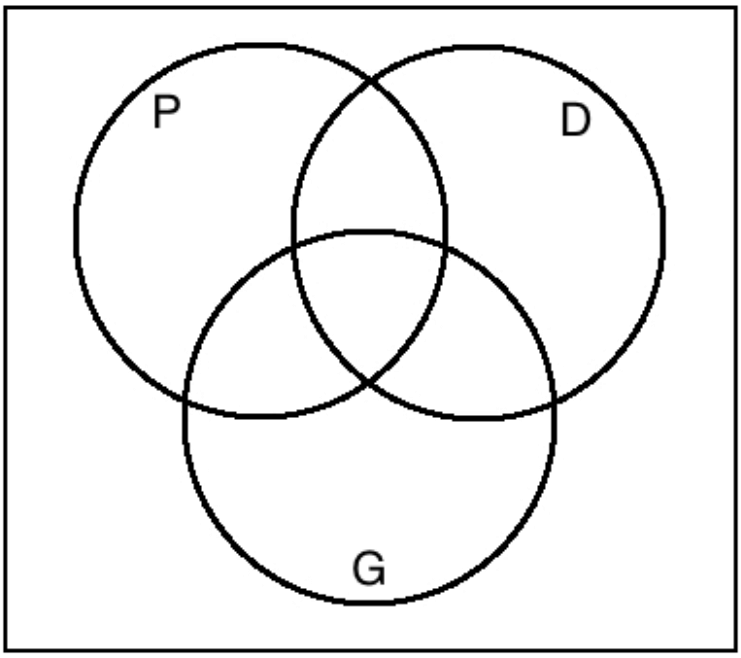
4. Challenge Problem – read the wording very carefully.

150 people attending a concert were asked if they played piano, guitar, or drums.

10 could play all three.
73 could play guitar.
18 couldn't play any of these instruments.
21 could play piano and drums.
49 could play at least two of the instruments.
13 could play piano and guitar but not drums.
69 could play drums or guitar but not piano.

Let P represent piano,
G represent guitar, and
D represent drums.

Calculate and fill in the values for all eight regions.



5.2: Voting Methods

Personal Reflection:
Do you think the U.S. presidential election system is fair? Explain why or why not.

Voting Methods

Ranked Choice Voting and the Preference Schedule

Example 1. Students are voting for their class president and the candidates are Omar (O), Ann (A), and Helen (H). They have ranked the candidates according to their preference.

	Vien	Ann	Marv	Tasha	Eve	Omar	Lupe	Dave	Helena	Jimmy
1st choice	A	A	O	H	A	O	H	O	H	A
2nd choice	O	H	H	A	H	H	A	H	A	H
3rd choice	H	O	A	O	O	A	O	A	O	O

Make a **Preference Schedule:**

1st choice				
2nd choice				
3rd choice				

Plurality Method (only first choice counts)

	1	3	3	3
1st choice	A	A	O	H
2nd choice	O	H	H	A
3rd choice	H	O	A	O

Example 2. Five candidates are running for office and labeled A, B, C, D and E for simplicity. Which candidate wins under each method?

Plurality Method

	3	4	4	6	2	1
1st choice	B	C	B	D	B	E
2nd choice	C	A	D	C	E	A
3rd choice	A	D	C	A	A	D
4th choice	D	B	A	E	C	B
5th choice	E	E	E	B	D	C

How many people voted?
How many votes are needed for a majority win?
How many votes are needed for a plurality win (at a minimum)?

Instant Runoff Method (Sometimes Called Sequential Runoff or Single Transferrable Vote)

	3	4	4	6	2	1
1st choice	B	C	B	D	B	E
2nd choice	C	A	D	C	E	A
3rd choice	A	D	C	A	A	D
4th choice	D	B	A	E	C	B
5th choice	E	E	E	B	D	C

Point System (Borda Count)

	3	4	4	6	2	1
1st choice	B	C	B	D	B	E
2nd choice	C	A	D	C	E	A
3rd choice	A	D	C	A	A	D
4th choice	D	B	A	E	C	B
5th choice	E	E	E	B	D	C

Condorcet Method (Pairwise Comparisons)

	3	4	4	6	2	1
1st choice	B	C	B	D	B	E
2nd choice	C	A	D	C	E	A
3rd choice	A	D	C	A	A	D
4th choice	D	B	A	E	C	B
5th choice	E	E	E	B	D	C

5.2: Voting Methods

Group Activity

1. Ranked Choice Voting Election. Our class will elect the best candy out of the three that are running for office: **R=Reese's Peanut Butter Cups, S=Skittles, M=M&Ms**

Please get ballot forms for your group and fill them out anonymously and turn them in. When all the results are tabulated, make a preference schedule.

Preference Schedule

Number of Voters						
1st choice	R	R	S	S	M	M
2nd choice	S	M	R	M	R	S
3rd choice	M	S	M	R	S	R

a. How many voters voted in this election?

b. How many votes are needed for a majority?

c. Find the winner under the plurality method.

d. Find the winner under the Instant Runoff Voting method.

e. Find the winner under the Borda Count method.

f. Find the winner under the Pairwise Comparisons method.

g. Which method do you think is the most fair in this situation and why?

2. A homeowners' association is deciding a new set of neighborhood standards for architecture, yard maintenance, etc. Four options have been proposed. The votes are:

Number of voters	**8**	**9**	**11**	**7**	**7**	**5**
1st choice	B	A	D	A	B	C
2nd choice	C	D	B	B	A	D
3rd choice	A	C	C	D	C	A
4th choice	D	B	A	C	D	B

a. How many voters voted in this election?

b. How many votes are needed for a majority?

c. Find the winner under the plurality method.

d. Find the winner under the Instant Runoff Voting method.

e. Find the winner under the Borda Count method.

f. Find the winner under the Pairwise Comparisons method.

g. Which method do you think is the most fair in this situation and why?

3. In the election shown below under the plurality method, explain why voters in the third column may feel they cannot vote for their first choice. How could it affect the outcome of the election?

Number of voters	**96**	**90**	**10**
1st choice	A	B	C
2nd choice	B	A	B
3rd choice	C	C	A

   a. How many voters voted in this election?

   b. How many votes are needed for a majority?

   c. Find the winner under the plurality method.

   d. Under the plurality method, explain why voters in the third column may feel they cannot vote for their first choice. How could that affect the outcome of the election?

   e. Find the winner under the Instant Runoff Voting method.

   f. Find the winner under the Borda Count method.

   g. Find the winner under the Pairwise Comparisons method.

   h. Which method do you think is the most fair in this situation and why?

2.1-2.2: Spreadsheets and Simple and Compound Interest

Personal Reflections:

1. Do you use a budget? Why or why not?

2. List some places in your finances where you might be able to save a few dollars or more per week or per month.

2.2: Simple and Compound Interest

Simple Interest
Definition: Interest is only earned (or paid) on the original amount.

Example: You invest $500 and you earn 6% interest every year for 5 years.

Year	Interest	Balance
Start		$500
1		
2		
3		
4		
5		

Compound Interest
Definition: Interest is earned on the original amount and any interest added to the account.

Example: You invest $500 at a rate of 6% interest compounded yearly for 5 years.

Year	Interest	Balance
Start		$500
1		
2		
3		
4		
5		

Formulas:

2.1-2.2: Using Spreadsheet Formulas for Compound Interest

You will need to use Microsoft Excel or Google Sheets while you take notes. You can use a computer, tablet or smart phone with the Google Sheets App.

Future Value Formula

=FV(rate, nper, pmt, [pv], [type])

Present Value Formula

=PV(rate, nper, pmt, [fv], [type])

Inputs:

rate =

nper =

pmt =

pv =

fv =

[type] =

Example 1. If you invest $500 at 6% interest, calculate the balance after 5 years for each compounding interval. Write the formula used and inputs in proper syntax.

- Simple Interest
- Compounded Yearly
- Compounded Quarterly
- Compounded Monthly
- Compounded Daily (365)
- Compounded Continuously

Compounding Continuously
If we let the number of compounding periods go to infinity, we get a base of e in our function.

$$A = Pe^{rt}$$

=P*exp(rate*years)

Effective Rate
The corresponding rate if compounded yearly. Used to compare different compounding options.

=effect(nominal rate, periods per year)

Example 2. Write the formula used and the inputs in proper syntax. Answer each question with a complete sentence, including units.

a. How much would you need to deposit in an account that pays 5.25% compounded monthly to have $20,000 in 20 years?

b. You get an inheritance of $15,000 and you decide to put it in an account that pays 7.1% interest compounded continuously. How much would it be worth in 25 years?

c. You decide to save your tax refund of $1000 in an account that pays 6.5% compounded quarterly. How much would you have in 15 years?

d. You are shopping for savings accounts and you find one with a rate of 3.25% compounded monthly and one with a rate of 3.15% compounded daily. Find the effective rates to determine which account has a better rate.

2.1-2.2: Simple and Compound Interest with Spreadsheets

Group Activity

Use a spreadsheet on a Chromebook, smartphone, laptop or tablet to work on these problems. Write down the spreadsheet syntax to show your work.
For example: =FV(.05/12, 2*12, 0, 1000).

Answer each question in a complete sentence.

1. Your uncle is giving you a simple interest loan of $500 for one year at 4% interest. What is the total amount you will owe him?

2. You borrowed $1500 from another relative. She charged you 5% APR, compounded monthly. If you paid her back 2 years later, how much money did you give her?

3. You got a bonus of $7,500 and you want to start a college fund for your child. You find an account paying 9.75% APR compounded quarterly. If your child just turned two years old, how much will you have when they turn 18? How much of that account balance is interest?

4. Calculate how much you would have in problem 3 above if it was compounded continuously instead of quarterly.

5. If you are considering a credit card with an APR of 27.49%, compounded daily, what annual rate are you effectively paying?

6. How much would you need to deposit today to have one million dollars if you can find an account that pays 10% interest compounded daily for 50 years?

7. Spreadsheet problem

Sage deposited $2498 into an account paying 7.05% APR, compounded quarterly. Dionne deposited $2994 into an account paying 5.19% APR, compounded monthly. How many years will it take for their balances to (nearly) match?

Write a spreadsheet formula for each person, using a cell reference for the year. Then you can copy the formula down using the fill-down feature.

Year	Sage	Dionne
1		
2		
3		

8. It's important to recognize which formula to use when they are mixed up. You will have these formulas given on the midterm. Decide which formula to use, write out your spreadsheet formula and solve the problem.

Financial Formulas

=principal + principal*rate*years

=FV(rate, nper, pmt, [pv], [type])

=PV(rate, nper, pmt, [fv], [type])

=principal*EXP(rate*years)

=EFFECT(nominal rate, periods per year)

   a. You deposit $2000 in an account earning 3% interest compounded monthly. How much will you have in the account in 20 years? How much interest will you earn?

   b. Which is better? An account that earns 7.25% compounded quarterly or an account that earns 7.15% compounded daily? Give the effective rate for each account.

   c. How much would you need to deposit in an account now in order to have $6,000 in the account in 8 years? Assume the account earns 6% interest compounded monthly.

   d. You deposit $4,500 in an account that earns 3.5% interest compounded continuously. How much will you have in 15 years?

   e. A friend lends you $200 for a week, which you agree to repay with 5% one-time simple interest. How much will you have to repay?

2.3-2.4: Savings Plans and Loan Payments

You will need to use Microsoft Excel or Google Sheets while you take notes. You can use a computer, tablet or smart phone with the Google Sheets App.

Future Value Formula	Present Value Formula
=FV(rate, nper, pmt, [pv], [type])	=PV(rate, nper, pmt, [fv], [type])

Saving with an initial deposit and/or monthly payments.

Example 1. Write the formula used and the inputs in proper syntax. Answer each question with a complete sentence, including units.

a. You want to save $100 per month at an annual rate of 8% interest. How much will you have after 15 years?

b. You want to save $1000 now and $50 per month for 10 years. How much will you have if you find an account with 7% interest?

Payment Formula

=PMT(rate, nper, pv, [fv], [type])

Example 2. Write the formula used and the inputs in proper syntax. Answer each question with a complete sentence, including units.

a. You want to save $30,000 for the down payment on a house in 5 years at an annual rate of 5% interest. How much do you need to set aside per month?

b. Your company needs $2,000,000 for an expansion project in 5 years. How much should be deposited quarterly in an account that earns 8% interest compounded quarterly?

2.4: Loan Payments, Credit Cards and Mortgages

Example 1. Write the formula used and the inputs in proper syntax. Answer each question with a complete sentence, including units.

1. You graduate with $25,000 in student loans and want to pay it off in 10 years. The interest is 4.45%. What is your monthly payment?

2. You have a credit card balance of $3,500 with 22% annual interest. If you want to pay it off in 3 years, how much do you need to pay per month? (Assuming you do not charge any more to the account.) How much interest would you have paid on this balance?

Down Payments

1. You are saving for your 3-year old child's college fund and you want to put in $2500 now and make payments of $50 per month for 15 years at 5.2% interest. How much will you have saved in 15 years? Show any calculations and Excel formulas used.

2. You want to buy a car for $11,000 and you trade in your old car for $1500, which acts as a down payment. The car loan interest rate is 2.74%. What will your monthly payments be if you choose a 2-year, 3-year or 4-year loan? Show any calculations and Excel formulas used.

   2-year: 3-year: 4-year:

Credit Card Minimum Payments

Azul's monthly minimum credit card payment is calculated by first applying a 16.99% APR which is compounded monthly to the outstanding credit card balance. Then they pay 2% of that figure or a minimum of $25. Currently, Azul has a balance of $2500.

a. What will their monthly payment be?

b. Assuming they only pay the minimum what will the new loan balance be?

c. How much did their credit card balance decrease by?

2.3-2.4 Savings Plans and Loan Payments

Group Activity

Use a spreadsheet to work on these problems. Write down the syntax to show your work. Answer each question in a complete sentence.

1. Jackie is 34 years old. She would like to have one million dollars in her retirement account when she is 65 years old.
    a. How much would she need to deposit every month into an account with an APR of 7.25%, compounded monthly, to achieve her goal?

    b. If she had started the account at age 21 (same APR), how much would she need to deposit every month to achieve her goal?

    c. If she had started the account at age 21 (same APR) and deposited the amount calculated in part (a) every month, what would the balance be when she retired at age 65?

    d. How much would she need to deposit as a lump sum at age 21 with the same APR (without making another payment) to have a million dollars at age 65?

2. Sam has a student loan of $30,000 at a fixed APR of 4.45%. If they want to pay it off in 15 years,
    a. How much would they pay per month?

    b. How much would they pay in total?

    c. What percentage of the total was paid toward the loan amount of $30,000 and what percentage was paid toward interest?

3. You want to buy a $350,000 home. You plan to put 10% down and take out a 30-year fixed mortgage on the rest.

    a. What will the loan amount be?

    b. What will your monthly payment be if the interest rate is 4.5%?

    c. If you make all the payments for 30 years, how much would you have paid for the house in total?

    d. In part b above, what number would you get if you switch the 0 and the 315,000? Why are the answers so different? Explain the difference between these two scenarios.

4. Tan has a balance of $1,650 on his credit card. His card has a 19.99% APR compounded monthly. His minimum payment is 3% of the balance after the interest is applied or $50, whichever is more. Calculate his minimum credit card payment for this month.

Car Loan Activity

1) Open the Car Loan Spreadsheet template from D2L. It has 8 cars in columns with different purchase prices and loan information. There is a copy on the next page.

   a. Write a formula using cell references in B5 for the loan amount. Then use the fill-across feature to copy the formula across the row.

   b. Write a formula using cell references in B8 for the monthly payment. Then copy the formula across the whole row.

   c. Which car would you choose and why?

2) You are checking out a special for a 2016 Nissan Pathfinder SL priced at $33,750. There are two offers to choose from (both with zero down):
   A. No rebate and 4.99% APR
   B. $3,000 rebate and 8.75% APR (The rebate reduces the loan by $3,000)

   a. Type in the principal values for options A and B in B15 and B19.

   b. Write a formula in cell C14 using cell references to calculate the monthly payment for option A. Copy the formula across.

   c. Write a formula in cell C18 using cell references to calculate the monthly payment for option b. Copy the formula across.

   d. Which is the best option, A or B? Explain.

3) For problem 2, option A, how much would you need for a down payment to keep your monthly payment less than $350 on a 7-year loan? (Can you do this in two different ways as a check?)

2.4: Car Loans

PROBLEM 1	1990 Acura NSX	2015 BMW M4	1963 Chevy II Nova	2013 Chevy Camaro SS	2015 Ford F-150 Super Crew	2015 Ford Mustang GT	2008 Tesla Roadster	2010 Toyota Tundra
Purchase Price	$34,525	$62,866	$32,150	$25,800	$27,936	$29,961	$62,950	$19,280
Down Payment	$5,000	$10,000	$5,000	$2,000	$4,000	$2,000	$7,000	$1,000
Amount loaned								
Term (yr)	6	7	5	5	6	7	6	4
APR	7.35%	6.95%	8.45%	4.95%	8.25%	3.99%	5.65%	6.75%
Monthly Payment								

PROBLEM 2	2016 Nissan Pathfinder SL	$33,750	COMPARE: Rebate vs. Better Rate (Zero down payment for both options)			
	Term (yr)	3	4	5	6	7
Option A monthly payment	**No Rebate** **P=** APR 4.99%					
Option B monthly payment	$3000 Rebate **P=** APR 8.75%					

PROBLEM 3	For Problem 2, Option A, how much would you need for a down payment to keep your monthly payment less than $350 on a 7-year loan?

2.5: Income Taxes

1. **Filing Status**. Search online and read about each tax filing status below. Write a short description in your own words.

Single -

Married Filing Jointly -

Married Filing Separately -

Head of Household (with qualifying person) -

Watch the videos and fill in the following information.

2. Tax Calculation Formula (2018 and later):

Gross Income

\- **Adjustments (Above the Line Deductions)**

=

\- **The higher of the standard deduction or itemized deductions**

=

(Use tables to calculate taxes due)

Tax Amount from Tables

\-

= **Taxes Due**

If your withholdings are less than your taxes due, you will

_____

If your withholdings are more than your taxes due, you will

_____

3. Tax Calculation Example: **(Using 2024 Tax Year Tables)**

	Jamie and Jordan (1 child)
Filing Status	Married Filing Jointly
Adjusted Gross Income (AGI)	$106,000
Itemized Deductions	$31,200
Standard Deduction	
Taxable Income	
Tax from Table	
Tax Credits	$2000
Tax Amount after Credits	
Federal Taxes Withheld from Paychecks	$7,120
Federal Tax Owed or Refund	

2024 Tax Tables

Standard deduction	
Single	$14,600
Head of household	$21,900
Married filing jointly and surviving spouses	$29,200
Married filing separately	$14,600

Single (other than surviving spouses and head of household)	
If taxable income is:	The tax is:
Not over $11,600	10% of the taxable income
Over $11,600 but not over $47,150	$1,160 plus 12% of the excess over $11,600
Over $47,150 but not over $100,525	$5,426 plus 22% of the excess over $47,150
Over $100,525 but not over $191,950	$17,168.50 plus 24% of the excess over $100,525
Over $191,950 but not over $243,725	$39,110.50 plus 32% of the excess over $191,950
Over $243,725 but not over $609,350	$55,678.50 plus 35% of the excess over $243,725
Over $609,350	$183,647.25 plus 37% of the excess over $609,350

Head of Household	
If taxable income is:	The tax is:
Not over $16,550	10% of the taxable income
Over $16,550 but not over $63,100	$1,655 plus 12% of the excess over $16,550
Over $63,100 but not over $100,500	$7,241 plus 22% of the excess over $63,100
Over $100,500 but not over $191,950	$15,469 plus 24% of the excess over $100,500
Over $191,950 but not over $243,700	$37,417 plus 32% of the excess over $191,950
Over $243,700 but not over $609,350	$53,977 plus 35% of the excess over $243,700
Over $609,350	$181,954.50 plus 37% of the excess over $609,350

Married filing jointly and surviving spouse	
If taxable income is:	The tax is:
Not over $23,200	10% of the taxable income
Over $23,200 but not over $94,300	$2,320 plus 12% of the excess over $23,200
Over $94,300 but not over $201,050	$10,852 plus 22% of the excess over $94,300
Over $201,050 but not over $383,900	$34,337 plus 24% of the excess over $201,050
Over $383,900 but not over $487,450	$78,221 plus 32% of the excess over $383,900
Over $487,450 but not over $731,200	$111,357 plus 35% of the excess over $487,450
Over $731,200	$196,669.50 plus 37% of the excess over $731,200

2024 Tax Tables Continued

Married filing separately	
If taxable income is:	The tax is:
Not over $11,600	10% of the taxable income
Over $11,600 but not over $47,150	$1,160 plus 12% of the excess over $11,600
Over $47,150 but not over $100,525	$5,426 plus 22% of the excess over $47,150
Over $100,525 but not over $191,950	$17,168.50 plus 24% of the excess over $100,525
Over $191,950 but not over $243,725	$39,110.50 plus 32% of the excess over $191,950
Over $243,725 but not over $365,600	$55,678.50 plus 35% of the excess over $243,725
Over $365,600	$98,334.75 plus 37% of the excess over $365,600

2.5 Federal Income Taxes

Group Activity

1. Using the tax tables, calculate the values for each household and determine the amount they owe or will be refunded. Show your steps in each box of the table.

2024 Tax Year	Dakota and Avery (no children)	Letitia (2 children)
Filing Status	Married Filing Jointly	Single (Single means she is not claiming her kids on her return, another parent is)
Adjusted Gross Income	$193,700	$61,000
Itemized Deductions	$31,500	$5,700
Standard Deduction		
Taxable Income		
Tax from Table		
Tax Credits	$0	$426
Tax Amount after Credits		
Federal Taxes Withheld	$26,585	$4,230
Federal Tax Owed or Refund		
Effective Rate (Tax amount after credits÷ taxable income)		

2024 **Tax Year**	Joshua (3 children)	Karalene (no children)
Filing Status	Head of Household	Married Filing Separately
Adjusted Gross Income	$68,200	$125,400
Itemized Deductions	$17,800	$18,500
Standard Deduction		
Taxable Income		
Tax from Table		
Tax Credits	$2,049	$0
Tax Amount after Credits		
Federal Taxes Withheld	$3,850	$16,490
Federal Tax Owed or Refund		
Effective Rate (Tax amount after credits÷ taxable income)		

2. Below is a portion of the 2017 tax year tax schedule from the form 1040 booklet.

   a. Find the tax amount for a single person with a taxable income of $39,890.

   b. Find the tax amount for a married couple filing jointly with a taxable income of $45,350.

   c. Find the tax amount for a single dad filing as head of household with a taxable income of $42,102.

2017 Tax Table — *Continued*

If line 43 (taxable income) is—		And you are—			
At least	But less than	Single	Married filing jointly *	Married filing separately	Head of a household
		Your tax is—			
39,000					
39,000	39,050	5,495	4,921	5,495	5,186
39,050	39,100	5,508	4,929	5,508	5,194
39,100	39,150	5,520	4,936	5,520	5,201
39,150	39,200	5,533	4,944	5,533	5,209
39,200	39,250	5,545	4,951	5,545	5,216
39,250	39,300	5,558	4,959	5,558	5,224
39,300	39,350	5,570	4,966	5,570	5,231
39,350	39,400	5,583	4,974	5,583	5,239
39,400	39,450	5,595	4,981	5,595	5,246
39,450	39,500	5,608	4,989	5,608	5,254
39,500	39,550	5,620	4,996	5,620	5,261
39,550	39,600	5,633	5,004	5,633	5,269
39,600	39,650	5,645	5,011	5,645	5,276
39,650	39,700	5,658	5,019	5,658	5,284
39,700	39,750	5,670	5,026	5,670	5,291
39,750	39,800	5,683	5,034	5,683	5,299
39,800	39,850	5,695	5,041	5,695	5,306
39,850	39,900	5,708	5,049	5,708	5,314
39,900	39,950	5,720	5,056	5,720	5,321
39,950	40,000	5,733	5,064	5,733	5,329
40,000					
40,000	40,050	5,745	5,071	5,745	5,336

If line 43 (taxable income) is—		And you are—			
At least	But less than	Single	Married filing jointly *	Married filing separately	Head of a household
		Your tax is—			
42,000					
42,000	42,050	6,245	5,371	6,245	5,636
42,050	42,100	6,258	5,379	6,258	5,644
42,100	42,150	6,270	5,386	6,270	5,651
42,150	42,200	6,283	5,394	6,283	5,659
42,200	42,250	6,295	5,401	6,295	5,666
42,250	42,300	6,308	5,409	6,308	5,674
42,300	42,350	6,320	5,416	6,320	5,681
42,350	42,400	6,333	5,424	6,333	5,689
42,400	42,450	6,345	5,431	6,345	5,696
42,450	42,500	6,358	5,439	6,358	5,704
42,500	42,550	6,370	5,446	6,370	5,711
42,550	42,600	6,383	5,454	6,383	5,719
42,600	42,650	6,395	5,461	6,395	5,726
42,650	42,700	6,408	5,469	6,408	5,734
42,700	42,750	6,420	5,476	6,420	5,741
42,750	42,800	6,433	5,484	6,433	5,749
42,800	42,850	6,445	5,491	6,445	5,756
42,850	42,900	6,458	5,499	6,458	5,764
42,900	42,950	6,470	5,506	6,470	5,771
42,950	43,000	6,483	5,514	6,483	5,779
43,000					
43,000	43,050	6,495	5,521	6,495	5,786

If line 43 (taxable income) is—		And you are—			
At least	But less than	Single	Married filing jointly *	Married filing separately	Head of a household
		Your tax is—			
45,000					
45,000	45,050	6,995	5,821	6,995	6,086
45,050	45,100	7,008	5,829	7,008	6,094
45,100	45,150	7,020	5,836	7,020	6,101
45,150	45,200	7,033	5,844	7,033	6,109
45,200	45,250	7,045	5,851	7,045	6,116
45,250	45,300	7,058	5,859	7,058	6,124
45,300	45,350	7,070	5,866	7,070	6,131
45,350	45,400	7,083	5,874	7,083	6,139
45,400	45,450	7,095	5,881	7,095	6,146
45,450	45,500	7,108	5,889	7,108	6,154
45,500	45,550	7,120	5,896	7,120	6,161
45,550	45,600	7,133	5,904	7,133	6,169
45,600	45,650	7,145	5,911	7,145	6,176
45,650	45,700	7,158	5,919	7,158	6,184
45,700	45,750	7,170	5,926	7,170	6,191
45,750	45,800	7,183	5,934	7,183	6,199
45,800	45,850	7,195	5,941	7,195	6,206
45,850	45,900	7,208	5,949	7,208	6,214
45,900	45,950	7,220	5,956	7,220	6,221
45,950	46,000	7,233	5,964	7,233	6,229
46,000					
46,000	46,050	7,245	5,971	7,245	6,236

More Practice

3. Use the **2024 tax tables** to answer the questions and show your steps. The tables will be given to you with any test. Write your answers in complete sentences.

   a. Mariana is single and has $11,402 in itemized deductions. What is her standard deduction and should she claim the itemized deductions or the standard deduction?

   b. Vy has a gross income of $129,500 and he filed as the head of household with 2 kids. He had $6,500 in itemized deductions. Determine his deduction and calculate his taxable income.

   c. Alex and Jesse are married, filing jointly. Their taxable income is $96,210. Calculate the amount of tax they owe using the appropriate table.

   d. Tim had $8,420 deducted from his paychecks in withholdings. He calculated his taxes owed to be $7,952. Does he get a refund or owe money and what is the amount?

3.1: Overview of the Statistical Process

1. Researchers are interested in how many people have been evicted from their housing. Draw a diagram to represent the population, sample, parameter and statistic.

2. What is a representative sample?

Common Sampling Methods

Method	Description	Picture	Example
Simple Random Sample (SRS)			
Systematic Sample			
Stratified Sample			
Convenience Sampling			

3. What does it mean for a sample to be biased?

Basic Types of Statistical Studies

Observational Studies
Example: Researchers examined health records of thousands of males to determine whether there was a relationship between family history and heart attack.

Experiment
Example: Researchers want to investigate whether taking aspirin regularly reduces the risk of heart attack. Four hundred people who identify as men are divided randomly into two groups: one group will take aspirin, and the other group will take a sugar pill. At the end of the study, researchers count the number of men in each group who have had a heart attack.

Treatment group:

Control group:

Random Selection:

Placebo:

Placebo effect:

Single-blind:

Double-blind:

Observational Case-Controlled
Example: A group of disabled women aged 65 and older was tracked for several years, ending in 2010. Those who had a vitamin B12 deficiency were found to be twice as likely to suffer severe depression as those who did not.

Subjects were separated into two categories:

Caution:

Margin of Error and Confidence Intervals
Example: According to a gallup.com poll in 2017, 29% of hourly workers and 41% of salaried workers are completely satisfied with the amount of money they earn. The survey had a margin of error of ±5%. Source link

Write the confidence interval for each group:

Hourly Workers:

Salaried Workers:

Types of Bias in Statistical Studies

What is bias in general?

What is bias in a statistical study?

Sources of bias

Sampling bias – when the sample is not representative of the population
- **Voluntary response bias** – the sampling bias that often occurs when the sample is volunteers

Self-interest study – bias that can occur when the researchers have an interest in the outcome

Response bias – when the responder gives inaccurate responses for any reason
- **Perceived lack of anonymity** – when the responder fears giving an honest answer might negatively affect them
- **Loaded questions** – when the question wording influences the responses

Non-response bias – when people refusing to participate in the study can influence the validity of the outcome

In each situation, identify a potential source of bias

a. A survey asks how many sexual partners a person has had in the last year

b. A radio station asks readers to phone in their choice in a daily poll.

c. A substitute teacher wants to know how students in the class did on their last test. The teacher asks the 10 students sitting in the front row to state their latest test score.

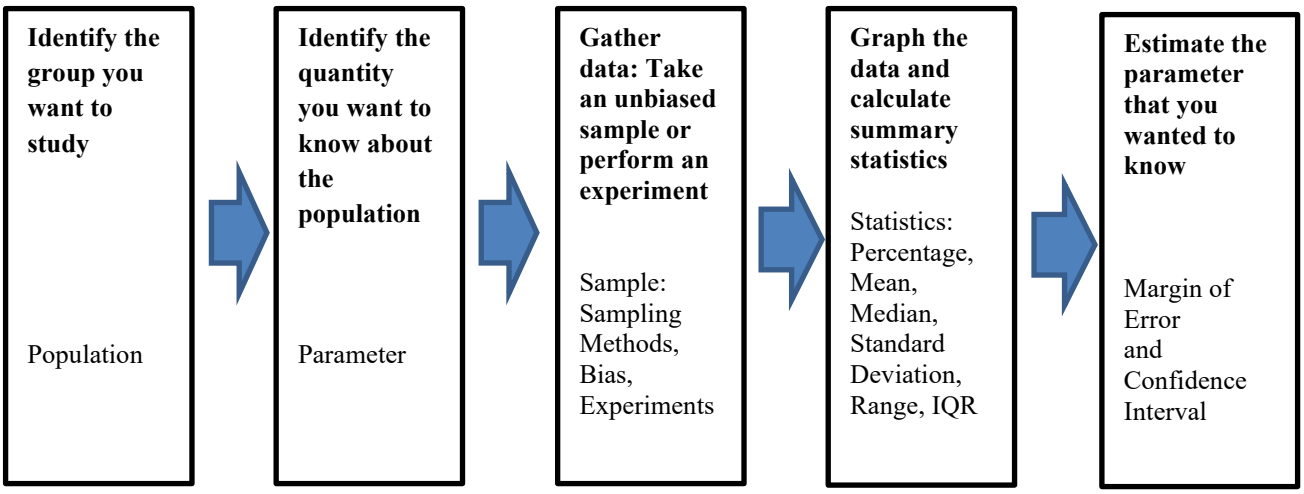
d. High school students are asked if they have consumed alcohol in the last two weeks.

e. The Beef Council releases a study stating that consuming red meat poses little cardiovascular risk.

f. A poll asks, "Do you support a new transportation tax, or would you prefer to see our public transportation system fall apart?"

Section 3.1 Overview of the Statistical Process

Group Activity



Identify the Population, Sample, Parameter and Statistic

1. For each scenario, a question or problem has been identified. Draw a diagram and describe the population, sample, parameter and statistic. Be specific with units for the parameter and statistic.

   a. An insurance company wants to know whether households have two cars. A survey of 976 American households found that 32% of households have two cars.

   b. A local toy store owner wants to know how much money kids in Portland aged 5-12 get as an allowance per week. They asked 100 kids from around Portland and found the average allowance to be $4.25 per week.

Sampling Methods

2. Identify the sampling method used:

    a. All the Redland High School students were assembled in the gym, and then separated into groups by grade. Each student was assigned a number, and 25 numbers were randomly drawn from the students in each grade. They were asked if they planned to go to college.

    b. You are standing outside of the grocery store and stop every third person leaving to ask if they purchased milk.

    c. At his book club meeting, Dan asked each member if they had seen the movie made from their current book.

    d. Instead of the method in part a, the administrator at Redland High School chose 100 student numbers randomly and asked those students to report to the office for the survey.

3. You are a statistical consultant and you have been hired to collect data on employee satisfaction. The company has 1000 employees at two buildings, East and West. There are 4 departments and 5 levels of employees. Identify the population, sample, parameter and statistic, then describe a sampling method to get a representative sample.

Types of Studies

4. For each scenario, determine the type of study and depending on the type, list the following items:
    i. If it is an observational study just write observational study
    ii. If it is a case-controlled observational study, write case-controlled and list the cases and control group
    iii. If it is an experiment, write experiment and list the control group, treatment group and type of blinding used (or no blinding).

Scenario	Identify the type of study, then list the items in i, ii, or iii above.
a. Over a 6-month period, among 100 people with bipolar disorder, patients given a high dose of omega-3 fats improved more than those given a placebo. Patients didn't know which they were given, but the experimenters knew.	
b. A National Cancer Institute study of 716 melanoma patients and 1014 cancer-free patients found that those having a single large mole had twice the risk of melanoma.	
c. Over the period of one-year, researchers determined which airline had the lowest percentage of canceled flights.	
d. 1000 people were randomly separated into two groups—one group was assigned to exercise for 45 minutes daily, and the other group was instructed not to exercise. The participants in the exercise group reported falling asleep within 15 minutes of going to bed, but those not exercising laid awake for at least 30 minutes.	
e. 500 patients with migraine headaches receive a shot to see if it helps reduce the frequency of the headaches. The nurses giving the shots write down the code on each syringe and the patient name. The syringes look identical, but half contain the new medicine and half contain saline.	

Confidence Intervals and Statistical Ties

5. Below are the results of some polls and their corresponding margin of error. Write the confidence interval for each one.

    a. 68% of Americans support Medicare-for-all with a margin of error of +/- 3%.

    b. 63% of Americans think the economy is in poor shape due to COVID-19 with a margin of error of 3.7 percentage points.

    c. 53% of Portland area residents support the Portland Parks levy with a margin of error of +/- 4.9 percentage points. Source link

6. Below are the results of some statistical polls – determine the confidence interval for each candidate and which is ahead or whether it is a statistical tie (if the confidence intervals overlap it is considered a statistical tie).

    a. 502 Registered voters were surveyed and Biden lead Trump in Pennsylvania 51% to 44% among highly likely voters with a margin of error of plus or minus 4.4 percentage points. Source link

    b. 400 likely voters were surveyed and Mingus Mapps lead Chloe Eudaly for Portland City Council by 35% to 26% with a margin of error of +/- 4 percentage points.

Types of Bias

7. In each situation, identify a potential source of bias. You will use each type from the class prep once.

    a. Trident gum did a survey of dentists to see how many would recommend their gum.

    b. A boss asks their employees if they have taken drugs in the last week.

    c. A researcher on a phone survey asks, "Do you plan to vote for the school district bond or would you rather see our schools crumble?"

    d. A survey was given to a random sample of students but three students didn't return the survey.

    e. A survey about PCC student's experiences in Math 105 was given to students at Rock Creek and Sylvania.

    f. A survey asks people for their weight.

    g. A broadcast email was sent to all PCC students with a satisfaction survey.

3.2: Describing Data

Two Types of Data

	Quantitative (Numerical)	Qualitative (Categorical)
Description		
Example		
Types of Graphs		

Graphing Qualitative Data

Example 1. A movie review website lists eight 5-star films, nineteen 4-star films, twelve 3-star films, seven 2-star films, and four 1-star films.

a. Make a frequency table for the data.

Movie Rating	Frequency	Relative Frequency	Cumulative Frequency
5-star	8		
4-star	19		
3-star	12		
2-star	7		
1-star	4		
Total			

b. Create the table in a spreadsheet, and then make a frequency bar graph and relative frequency bar graph. Label the axes and give the graph a meaningful title.

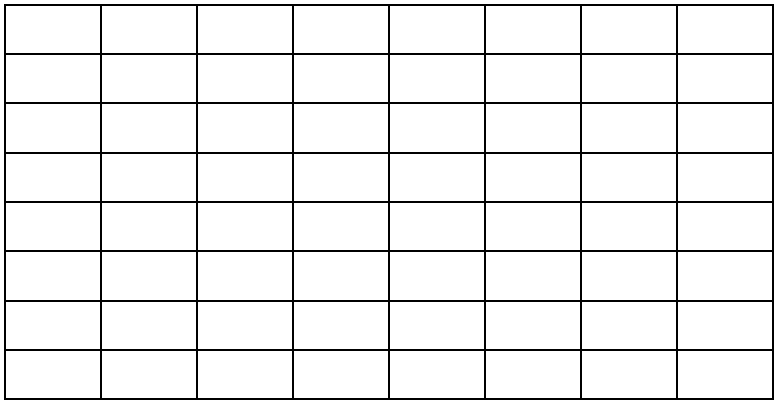
c. Make a frequency and relative frequency pie chart using a spreadsheet. Label the axes and give the graph a meaningful title.

Graphing One-Variable Quantitative Data

Example 2. Here is a set of 15 exam scores for a fictional MTH 105 class at PCC.

31, 62, 65, 70, 76, 81, 82, 82, 87, 88, 89, 94, 95, 98, 100

a. Make a Histogram using a bin-width of 10 points. Label the axes and give the graph a meaningful title.



b. Make the same histogram using technology and label it with a meaningful title.

Sections 3.2 Describing Data

Group Activity

Please complete the anonymous survey online. The link is in D2L. This will give our class some data to work with.

Types of Data

1. For each question in the survey, write whether the variable is qualitative or quantitative.

    a. How do you identify your gender?
    b. What is your age?
    c. How many credits are you taking this term?
    d. What is your main mode of transportation to campus?

Frequency Tables and Graphs of Qualitative Data

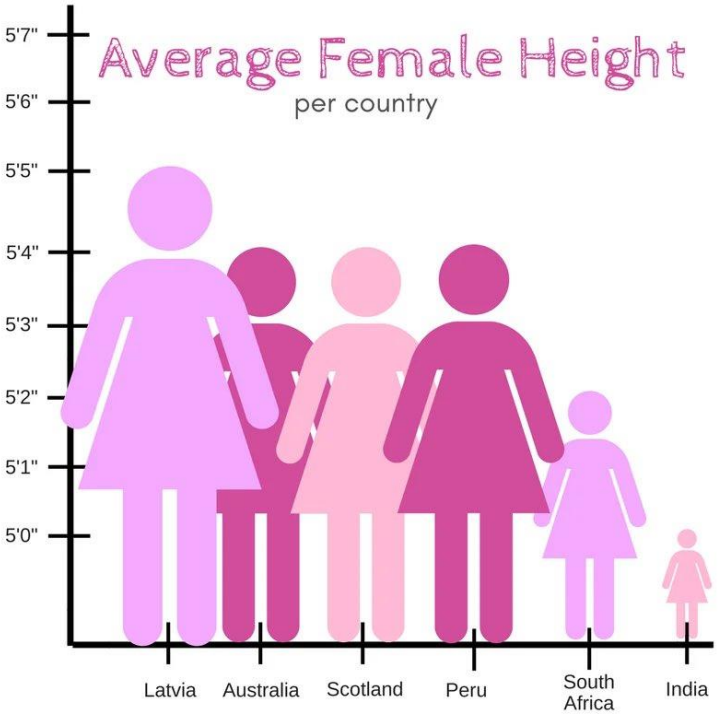
2. For each set of qualitative data, make a frequency table using a spreadsheet. Use your table to make a pie chart and a bar chart. Write a sentence or two about any patterns or observations you make from the graphs.

Quantitative Variables and Histograms

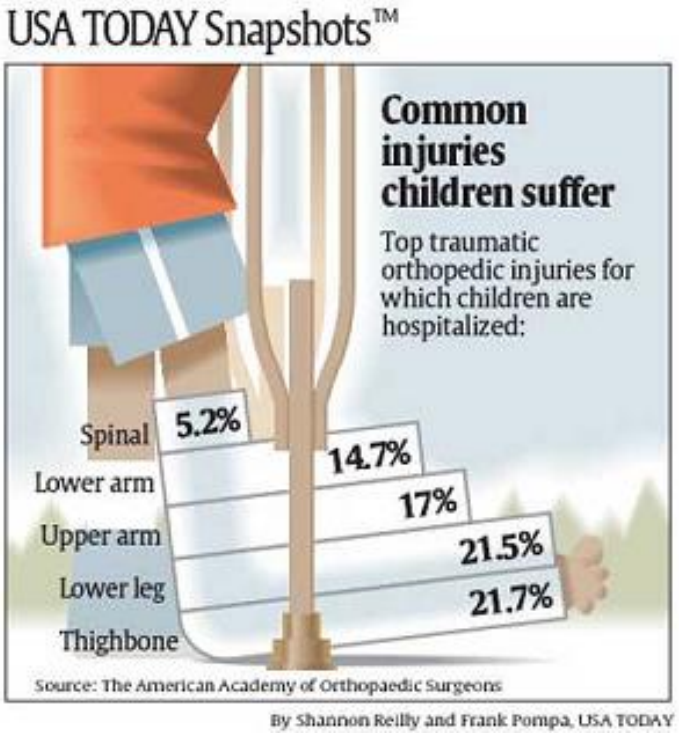
3. For the credit hour data, make a histogram by hand. Write a sentence or two about any patterns or observations you make from the graph. Label and title your graph.

4. What is misleading about these graphs?

   a. Average Female Height per country



   b. Common injuries children suffer. Top traumatic orthopedic injuries for which children are hospitalized.

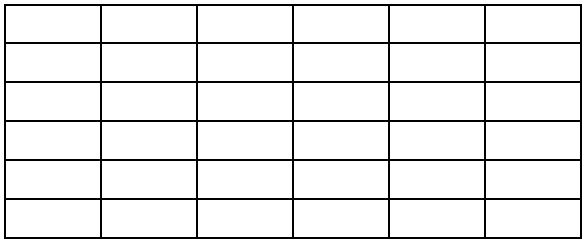


3.3-3.4: Summary Statistics: Measures of Center and Variation

We Describe Four Characteristics of Data: Shape, Center and Spread, and Outliers

Example. The grades on the third exam for a MTH 95 class were as follows:
82 74 67 81 49 84 52 91 66 75 96 73 71 78 49 86 85 62 58

a. Make a histogram of the data to determine its shape.



Shape of the Histogram:

Unimodal

Bimodal

Multimodal

Symmetric

Skewed to the Left
(Mean less than median)

Skewed to the Right
(Mean greater than median)

Measures of Center or Average

Mean:

Median:
odd number of values:
even number of values:

Mode:

b. Arrange the grades above in order:

c. Find the mean

d. Find the median

e. Find the mode(s), if any

3.4: Measures of Variation

Measures of Spread

Range:

Interquartile Range (IQR):

Standard Deviation:

Five-Number Summary and Boxplot: Minimum, Q_1, Median, Q_3, Maximum

Continuing with the test scores in order, find the following:

49, 49, 52, 58, 62, 66, 67, 71, 73, 74, 75, 78, 81, 82, 84, 85, 86, 91, 96

f. Five-number summary:

g. Range:

h. Interquartile Range (IQR):

i. Draw and label the boxplot:

Outliers

j. Are there any outliers in this data?

Which Measures to Use?
If the data is symmetric, use the mean and standard deviation
If the data is skewed, use the median and the IQR

Standard Deviation

Standard Deviation: The "average deviation from the mean." Can be approximated by the Range÷4 if the data is evenly spread without outliers.

$$s = \sqrt{\frac{\sum(x - \text{mean})^2}{n - 1}}$$

49, 49, 52, 58, 62, 66, 67, 71, 73, 74, 75, 78, 81, 82, 84, 85, 86, 91, 96

Data	Deviation from Mean	Squared Deviation
49		
49		
52		
58		
62		
66		
67		
71		
73		
74		
75		
78		
81		
82		
84		
85		
86		
91		
96		
Sum of the squared deviations:		

$$s = \sqrt{\frac{\sum(x - \text{mean})^2}{n - 1}}$$

Standard Deviation Approximation: Range/4. How do they compare in this case?

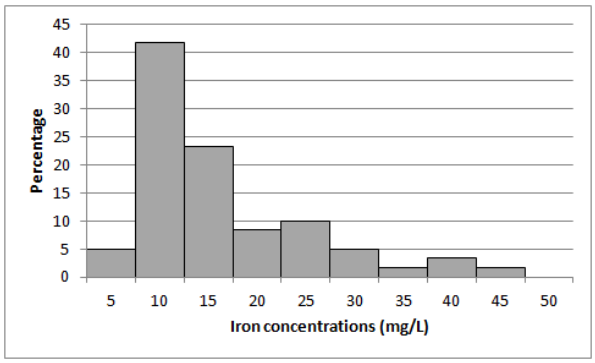
3.3-3.4: Summary Statistics: Measures of Center and Variation

Group Activity

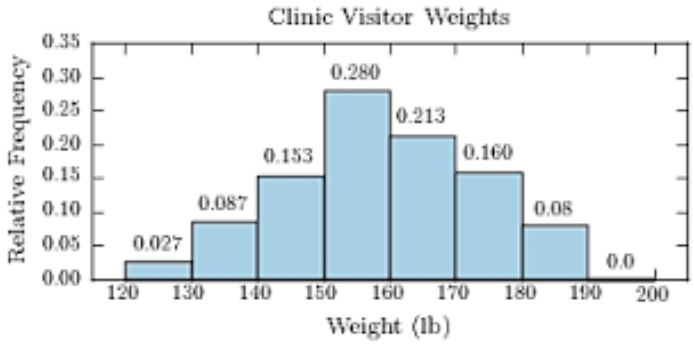
3.3: Shape

1. For each histogram, describe the shape and state the mode(s) with units. Then state the relationship between the mean and median. (Do not calculate the mean and median just look at the shape)

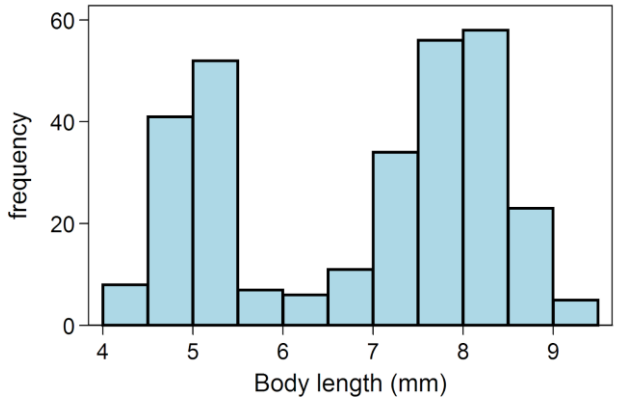
a.



b.



c.



3.3: Measures of Center

2. The following data are blood alcohol concentrations (BAC) of 12 drivers involved in fatal crashes (data from the U.S. department of justice). We will analyze the shape, center and spread of this data, and whether there are any outliers. Today we are just doing shape and center.

Blood alcohol level of drivers in fatal crashes: (.13 BAC means 13%)

0.27	0.17	0.17	0.16	0.13	0.24	0.29	0.24	0.14	0.16	0.12	0.16

a. Copy the row of data into technology and make a histogram with a bin width of .02. Label your graph with the variable.

b. What is the shape of the histogram? If you are not sure yet, compute and compare the mean and the median in the next question and use that to help you decide.

c. Use technology to find the summary statistics. Write the mean and median, including units.

3.3-3.4: Measures of Center and Variation

3. Below are fictitious student test scores from a Math 105 midterm in two different classes. You will be making a boxplot for each to compare their distributions.

   Class 1: 72, 86, 65, 99, 86, 71, 55, 86, 92, 73, 95, 71 points

   Class 2: 75, 94, 82, 81, 69, 71, 85, 92, 88, 78, 73, 65, 66 points

   a. Find the mean, 5-number summary, IQR and range for each class, including units.

      Class 1: Class 2:

   b. Use technology to draw a histogram and boxplot for each class using the same scale.

   c. What is the shape of the data for each class? How can you tell?

Calculating Standard Deviation, *s*

d. Using your means rounded to one decimal place, find the standard deviation for each class, including units. The symbol n refers to the sample size or number of data values.

Class 1:

Mean = _____, n = _____

Test Score (points)	Deviation from the mean	Squared deviation
72		
86		
65		
99		
86		
71		
55		
86		
92		
73		
95		
71		
Sum of the squared deviations (numerator)		

$$s = \sqrt{\frac{\sum(x - \text{mean})^2}{n - 1}}$$

Class 2:

Mean = _____, n = _____

Test Score (points)	Deviation from the mean	Squared deviation
Sum of the squared deviations (numerator)		

$$s = \sqrt{\frac{\sum(x - \text{mean})^2}{n - 1}}$$

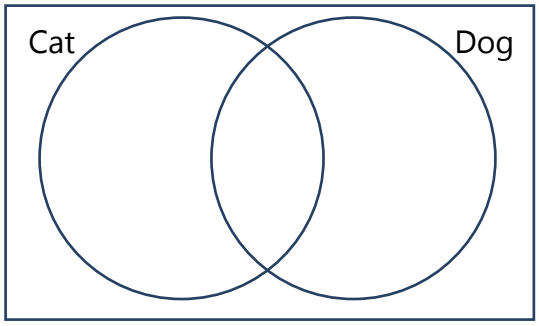
e. Write a few complete sentences summarizing the four characteristics of the distribution of class 1 (shape, center, spread and unusual features).

f. Which class did better on the test? Use the vocabulary and values for center and spread in your answer.

4.1: Contingency Tables

Relating Venn Diagrams to Contingency Tables:

250 households were surveyed and 180 said they have a cat, 95 said they have a dog, and 52 said they have a cat and a dog. Fill in the Venn diagram and the contingency table.



	Dog	No Dog	Total
Cat			
No Cat			
Total			

4 types of probabilities: Marginal, AND, OR, Conditional, using contingency tables

MARGINAL

Find the probability that a randomly selected person from the study has a cat.

P(cat) =

AND

Find the probability that a randomly chosen person from the study has a cat AND a dog.

P(cat AND dog) =

OR

Find the probability that a randomly chosen person from the study has a cat OR no dog.

P(cat OR no dog) =

CONDITIONAL

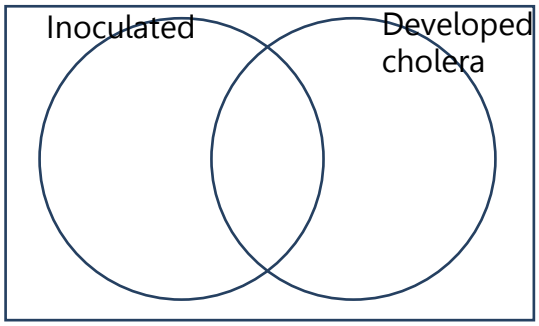
Given that a person from the study has a dog, what is the chance they have a cat?

P(cat given dog) =

4.1: Contingency Tables

Group Activity

Cholera Inoculation Study, 1894-96: A group of 818 people who were exposed to cholera in Calcutta, India in 1894-6 were studied. Of this group, 279 were inoculated with Haffkine's anti-cholera vaccine, while the remaining 539 had not been inoculated. Overall, 69 people developed cholera. Three of those who were vaccinated developed cholera. Use this information to complete the Venn diagram and the contingency table. (Source)



	Developed cholera	Did not develop cholera	Total
Inoculated			
Not inoculated			
Total			

1. Find the marginal, "and," and "or" probabilities. If a randomly selected person from the study was chosen, what is the probability they:

MARGINAL

a. were inoculated?

b. developed cholera?

AND

c. were inoculated and developed cholera?

d. were not inoculated and did not develop cholera?

OR

e. were inoculated or did not develop cholera?

f. were not inoculated or developed cholera?

CONDITIONAL

g. Given that a person was inoculated, what is the probability they developed cholera?

h. If a person was not inoculated, what is the probability they developed cholera?

i. Do you think the vaccine was effective? Why or why not?

2. The survey data below is from four classes of Math 105 students. Their gender identities and modes of transportation to PCC are summarized in a contingency table.

	Bike	Bus	Drive Self	Ride with Another	Walk	Total
Female	0	12	25	5	3	45
Non-binary or Genderqueer	0	3	2	0	0	5
Male	1	4	16	3	1	25
Total	1	19	43	8	4	75

Find the following marginal, "and", and "or" probabilities. If we were to randomly select a student who took the survey, what is the probability they:

a. identify as female?

b. identify as non-binary or genderqueer?

c. walk to PCC?

d. bus to PCC?

e. walk and identify as male?

f. identify as non-binary or genderqueer and drives themselves to PCC?

g. identify as female or ride with another?

h. identify as male or walk to PCC?

3. Calculate these conditional probabilities:

    a. Given that a student from the survey identifies as female, what is the probability they take the bus to PCC?

    b. If a student drives them self to campus, what is the probability they identify as non-binary or genderqueer?

    c. What is the probability that a student walks, given they identify as male?

    d. Of those students who identify as female, what is the probability they ride to campus with another?

4.2: Fundamentals of Probability

Three Types of Probabilities, Theoretical, Empirical, Subjective

Theoretical Probability– Based on counting equally likely outcomes

Example 1. You have a quarter, a dime, and a nickel. You toss them in the air, and record whether they land on heads or tails.

i. Draw a tree to see the possible outcomes.

ii. Can you think of a way to multiply to find the number of outcomes? (Multiplication Principle)

iii. What is the probability of getting 3 heads?

iv. exactly 1 head?

Theoretical Probability Model: We are interested in the number of heads, so we will list the possible outcomes for the number of heads, along with the probability of getting each.

Number of Heads				
Probability				

v. What is the probability of getting 1 or 2 heads?

vi. What is the probability of getting fewer than 2 heads?

vii. What is the probability of not getting 2 heads (**Complement**)?

viii. What is the probability of getting **at least one** head? (**Complement of none**)

Empirical Probability (Relative Frequency) – Based on observations or an experiment
15% of the parts sampled were found to be defective, so there is a 15% chance that a randomly selected part will be defective.

Subjective Probability – Based on intuition, experience or feeling
What's the chance you will go to the party on Friday?

Relationship between Odds and Probability

Example 2. A team is given odds of winning of 4:7. What is the chance they will win? Lose?

Gambling Odds: "odds on" means "odds against"

Example 3. At a horse race, the odds on My Little Pony are given as 8 to 1. What is the probability of My Little Pony winning and losing? The 8 to 1 odds mean that for every $1 you bet on My Little Pony, you get $8 if you win. If you bet $10 and My Little Pony wins, how much do you win?

Combining Probabilities

Example 4. You have 10 prizes in a bag and people are going to draw them at random. Two are yellow erasers, one is a yellow calculator, three are green calculators and four are red erasers. First, let's find the individual probabilities:

P(YE)= P(YC)= P(GC)= P(RE)=

P(Calculator)= P(Eraser)= P(Red)= P(Yellow)= P(Green)=

"Or" Events (Single Draw)		**"And" Events (Multiple Draws)**	
Add $\boldsymbol{P(A \text{ or } B) = P(A) + P(B)}$	**Add** Be careful not to double count the intersection	**Multiply** $\boldsymbol{P(A \text{ and } B) = P(A) \cdot P(B)}$	**Multiply** Change the probability for each draw

"Or" Events

a. What is the probability of drawing a yellow or green item?

b. What is the probability of drawing a red item or an eraser?

"And" Events

c. If we put the items back in each time, (draw with replacement), what is the probability of drawing three red erasers in a row?

d. If we do not put the marbles back in each time, (draw without replacement), what is the probability of drawing three red erasers in a row?

4.2: Theoretical Probability

Group Activity

1. **Empirical Probability.** In the video we looked at the theoretical probabilities for flipping a quarter, dime and nickel. Now we will do a class experiment to find empirical probabilities.

   a. Get a quarter, nickel and dime for your group. Take turns tossing them for a total of 10 trials. Record H or T for each coin in each trial.

Trial	1	2	3	4	5	6	7	8	9	10
Quarter										
Nickel										
Dime										

   b. From your 10 trials, count the number of times you got 0 heads, 1 head, 2 heads and 3 heads. Write the number in each column. They should add up to 10 trials.

Number of Heads	0	1	2	3
Group Count				

   c. **Combining the Class Data.** Record your totals on the class sheet on the document camera. Once all the data is added, write the totals in the next table. Number of trials____

Number of Heads	0	1	2	3
Total Class Count				

   d. **Empirical Probability Model.** Using the class totals, calculate the empirical probability of each outcome.

Number of Heads	0	1	2	3
Empirical Probability				

   e. 5. Compare these numbers to the theoretical outcomes on your notes. How do they compare?

   f. What would you expect if we repeated this experiment for 1000 trials?

2. **Theoretical Probability**

a. Using the prize wheel below, make a theoretical probability model and then use it to find the probabilities below.

	Sub	Drink	Cookies	Chips	BOGO	Mystery Prize
Probability						

b. If you spin the wheel once, what's the probability that you get

i. chips or a drink?

ii. not the mystery prize?

iii. a drink or not BOGO?



c. Find the following odds:

i. The odds of winning the mystery prize.

ii. The odds against winning the mystery prize.

iii. The odds on winning a sandwich.

d. If you get to spin the wheel repeatedly, would that be like drawing with or without replacement?

i. If you get to spin 3 times, what is the chance you would get 3 bags of chips?

ii. If you get to spin twice, what is the chance you will get two BOGO's?

3. The t-shirts for your school group just arrived: 5 red small, 5 orange small, 10 red medium, 10 orange medium, 15 red large, 15 orange large, 10 red extra-large, 10 orange extra-large.

If you grab one t-shirt at random, what is the probability that

a. it is a small or an extra-large?

b. it is extra-large or orange?

c. it is not small or medium?

d. it is not small or red?

If five people come up and you draw 5 shirts at random, what is the probability that

e. they are all red larges?

f. there is at least one orange extra-large?

4.3: The Law of Large Numbers and Expected Value

The Law of Large Numbers:
In an experiment with independent trials, as you increase the number of trials the relative frequency gets closer to the theoretical probability.

Example 1. Theo rolled a standard 6-sided die 1,000 times and recorded that the number 2 came up 100 times. He suspects that the die is not fair. Is he correct?

Gambler's Fallacy:
The mistaken belief that a streak or run of bad luck will make the opposite outcome more likely.

Expected Value:
The long run average or mean value for many repeated samples.

The expected value is an _____ that is weighted by the _____.

Example 2. A lottery ticket has five possible prize amounts and the chances of winning each are shown in the probability model.

Prize	$1	$10	$50	$1000	0
Probability	$\frac{1}{5}$	$\frac{1}{50}$	$\frac{1}{100}$	$\frac{1}{2000}$	$\frac{1539}{2000}=0.7695$

a. Find the expected value for this lottery ticket.

b. If the cost of the ticket is $2, what are your expected winnings?

Example 3. Primo Insurance sells an annual car insurance policy for $1,350. Based on past data collected, an average of 1 in 50 policyholders will file a $6,000 claim, an average of 1 in 100 policyholders will file a $15,000 claim, and an average of 1 in 300 policyholders will file a $33,000 claim.

Insurance Payout				
Probability				

a. Find the expected value for the amount that Primo will pay per policy.

b. What is the expected profit or loss per policy?

4.3: Expected Value

Group Activity

1. Beginning in October, 2015, **Powerball**® became an even larger combined large jackpot game and cash game. Every Wednesday and Saturday night at 10:59 p.m. Eastern Time, we draw five white balls out of a drum with 69 balls and one red ball out of a drum with 26 red balls. Source

Powerball - Prizes and Odds

Match	Prize	Odds
5 + Powerball	Grand Prize	1 in 292,201,338.00
5	$1,000,000	1 in 11,688,053.52
4 + Powerball	$50,000	1 in 913,129.18
4	$100	1 in 36,525.17
3 + Powerball	$100	1 in 14,494.11
3	$7	1 in 579.76
2 + Powerball	$7	1 in 701.33
1 + Powerball	$4	1 in 91.98
Powerball	$4	1 in 38.32

The overall odds of winning a prize are 1 in 24.87.
The odds presented here are based on a $2 play (rounded to two decimal places).

a. If the Powerball grand prize amount is $90 million, calculate the expected winnings per ticket:

b. Calculate the expected profit or loss for the ticket-holder per Powerball ticket:

2. Back to our Subway wheel from last time.

   a. Calculate the expected value of the Subway prize wheel. Let's say the mystery prize is a $20 gift card.

	Sub	Drink	Cookies	Chips	BOGO	Mystery Prize
Prize Value	$4.25	$1.60	$1.30	$0.99	$4.25	$20
Probability	$\frac{2}{13}$	$\frac{2}{13}$	$\frac{2}{13}$	$\frac{4}{13}$	$\frac{2}{13}$	$\frac{1}{13}$



   b. What does the expected value mean in this example? Explain it in a complete sentence.

3. Based on historical data, an auto insurance company estimates that a particular customer has a 1.5% likelihood of having an accident in the next year, with the average insurance payout being $10,000.

   If the company charges this customer an annual premium of $500, what is the company's expected value of this insurance policy?

   a. Make a probability table.

Possibilities	Accident	No Accident
Payout		
Probability		

   b. Calculate the expected value for the company.

4. A company estimates that 7% of their products will fail after the original warranty period but within 2 years of the purchase, with a replacement cost of $250.

   If they want to offer a 2-year extended warranty, what price should they charge so that they'll break even (in other words, so the expected value will be 0)

   a. Make a probability table.

   b. Calculate the expected value and answer the question.

Math 105 **Midterm Practice Problems (Chapters 1, 5.2, 2)**

These are sample problems to help you prepare for the midterm. Study all class materials and feedback. You'll be able to use a spreadsheet and a calculator on the test.

Show all of your steps and thinking. Use any method for problems 1-7.

1. During a food drive, volunteers collect 325 cans of food on Monday, 418 cans on Tuesday and 267 cans on Wednesday. They pack the cans equally into boxes that hold 25 cans each. How many full boxes do they have? How many cans are left over?

2. Jordan works 28 hours per week for 6 weeks and earns $21.50 per hour. They had $614 taken out for taxes and they spent $240 on a bike. How much do they have left?

3. Your restaurant bill is $67. You want to leave a 20% tip. How much is the tip? How much is the total bill?

4. The value of a car dropped from $7500 to $6800 over the last year. How much did the car decrease by? What percent decrease is this?

5. A map scale indicates that ½ inch on the map corresponds with 3 real miles. How many miles apart are the two cities that are $3\frac{1}{4}$ inches apart on the map?

6. A recipe uses 3 cups of flour for every 24 ounces of dough. If you need to make 5 pounds of dough for a pizza party, how many cups of flour will you need?

7. You just got a circular above ground pool with a 15-foot diameter and a height of 48 inches. You want to know the cost of the water to fill it up to 6 inches from the top and how much chlorine to put in. The package says to use two 3-inch tablets per 10,000 gallons of water. City of Portland water is measured and billed at a rate of $7.559 per 100 cubic feet (ccf). One ccf is 748 gallons.

8. Write whether each statement is true or false.

   a. Portland is in Oregon or San Francisco is in New York.

   b. Portland is in Oregon and San Francisco is in New York.

   c. If cats meow, then dogs bark.

   d. If 1 + 6 = 7, then 1 + 5 = 7.

9. Use this if-then statement to write the following: If I have a cat then I am happy.

   a. the converse

   b. the inverse

   c. the contrapositive

   d. Which of the statements are equivalent to each other?

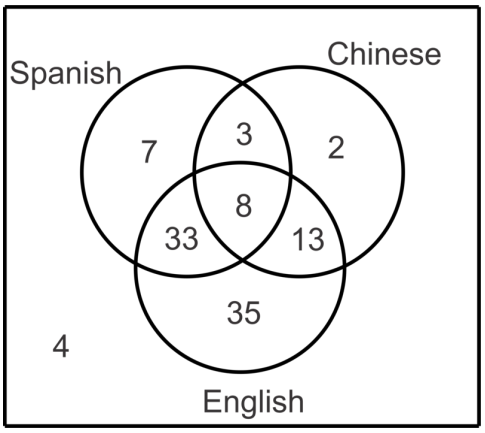
10. Draw and label a Venn diagram for each scenario and write whether the sets are disjoint, overlapping or one is a subset of the other.

    a. All cars have wheels.

    b. Some houses have two stories.

    c. No cows can fly.

11. Students at a local school were surveyed about which languages they speak. Use the Venn diagram to answer the questions.



a. How many students were surveyed?

b. How many students speak English and Chinese?

c. How many students speak at least two of the languages listed?

d. How many students speak only Spanish out of the languages listed?

e. How many students speak Spanish, Chinese and English?

12. Consider a city council election where there are two Democrats: Don and Key, and two Republicans, Elle and Fant. Answer the questions below and determine the winner under each type of voting.

	300	219	281	210
1st choice	Elle	Don	Key	Fant
2nd choice	Fant	Key	Don	Don
3rd choice	Don	Elle	Fant	Elle
4th choice	Key	Fant	Elle	Key

a. How many people voted?

b. How many votes are needed for a majority win?

c. Find the winner of the Plurality Method.

d. Find the winner of the Instant Runoff Method.

e. Find the winner of the Point System or Borda Count Method.

f. Find the winner of the Condorcet Method or Pairwise Comparisons Method.

13. Use a spreadsheet to calculate the value for each problem. Write the syntax and your answer rounded to the nearest cent.

=principal + principal*rate*years

=FV(rate, nper, pmt, [pv], [type])

=principal*EXP(rate*years)

=PV(rate, nper, pmt, [fv], [type])

=EFFECT(nominal rate, periods per year)

=PMT(rate, nper, pv, [fv], [type])

a. Abbie is buying a used car priced at $16,735. She gets $4,000 for her trade-in vehicle, and finances the remainder at 10.7% APR, compounded monthly, for five years. Find her monthly car payment.

b. Batula deposits $325 every quarter into an account paying 3.86% APR, compounded quarterly. Find her account balance after ten years.

c. Cristian deposited $800 into a savings account paying 5.2% APR, compounded continuously. Find his account balance after 15 years.

d. Danny wants to have a retirement account balance of one million dollars in 47 years. Find how much he needs to deposit every month, if the account pays 8.42% APR, compounded monthly.

e. Elisa is comparing two different savings accounts. One is 5.25% compounded monthly and the other is 5.10% compounded daily. Calculate the effective rate of each, and state which account will earn more money.

f. Fatima wants to start saving for her kid's college fund. She wants to know how much she needs to invest now to have $100,000 in 18 years, if she finds an account that pays 5.75% compounded monthly.

14. Use the **2024 tax tables** to answer the tax questions. The tables will be given with the test. Write your answers in complete sentences.

    a. Alicia is filing as single and has $11,800 in itemized deductions. Should she claim the itemized deductions or the standard deduction? How much would her deduction be?

    b. Marcus and Renee are married filing jointly. They have a gross income of $92,450 and $28,600 in itemized deductions. Determine their deduction and calculate their taxable income.

    c. DeShawn is filing as head of household with a taxable income of $57,800. Calculate the amount of tax owed using the table.

    d. Sofia had $4,980 deducted from her paychecks in withholdings. After completing her tax return, she finds that her total tax is $5,430. Does Sofia get a refund or owe money and what is the amount?

Math 105 **Final Practice Problems**

Note: This is a sample of possible problems, not the population. Study all class materials and MyOpenMath problems. You may use a calculator, a spreadsheet and Stapplet for statistics.

1. A gallon of paint covers a 35 ft x 10 ft area. A homeowner needs to paint 2,000 square feet. Each gallon costs $42. How many gallons should they buy and what is the cost?

2. Students sold 145 boxes of cookies for a fundraiser. Each box sold for $8. The club had to buy each box for $3.25 and they spent $75 on supplies. How much money did the club get to keep?

3. You recently put down new floors in part of your house, and you need to buy the baseboard that goes around the edge. You have 3 rooms, one is 12x12 feet, one is 10 feet, 4 inches by 10 feet 6 inches, and one is 15x18 feet. There are 5 doors that are each 32 inches wide. How many 12-foot lengths will you need to buy?

4. Would you rather have 3500 Mexican Pesos or 210 Euros? Justify your answer. The current exchange rates are 1 Euro to 1.08 US dollars and 1 Peso to 0.057 US dollars.

5. A certain shade of green paint is made from 5 parts yellow mixed with 2 parts blue. If you have 2 cans of yellow paint, how much blue paint do you need?

6. Determine whether each statement is true or false.

    a. If dogs can fly, then cats can swim.

    b. Dogs can't fly or cats can't swim.

    c. Dogs can't fly and cats can swim.

7. Write the converse, inverse and contrapositive of the statement: "If you go to the store, then you will have food for dinner."

    a. Converse:

    b. Inverse:

    c. Contrapositive:

8. The school board is electing a new chair of the board. The candidates are labeled W, X, Y, and Z for simplicity. The votes are shown below.

Number of voters	**25**	**18**	**16**	**22**	**19**
1st choice	W	Z	Z	X	Y
2nd choice	X	W	Y	Y	X
3rd choice	Y	Y	W	W	W
4th choice	Z	X	X	Z	Z

    a. How many voters voted in this election?

    b. How many votes are needed for a majority?

    c. Find the winner under the plurality method.

    d. Find the winner under the Instant Runoff Voting method.

    e. Find the winner under the Borda Count method (Point System).

    f. Find the winner under the Pairwise Comparison or Condorcet method.

9. Finance problems. Use Excel to calculate the value for each problem. Write the Excel syntax and your answer rounded to the nearest cent. Write each answer in a complete sentence.

Financial Formulas Provided

=principal + principal*rate*years

=FV(rate, nper, pmt, [pv], [type])

=principal*EXP(rate*years)

=PV(rate, nper, pmt, [fv], [type])

=EFFECT(nominal rate, periods per year)

=PMT(rate, nper, pv, [fv], [type])

   a. Luisa needs to start saving for retirement. She can afford to deposit $90 every month, into an account paying 5.36% APR, compounded monthly. Find the balance in the account after 29 years.

   b. Jonah is purchasing a 2016 Dodge Challenger for $32,750. He plans to put $4,500 cash down, and finance the remainder at 9.35% APR, compounded monthly, for seven years. Find his monthly car payment. How much will Jonah pay in total for the car?

   c. Charles deposited $2,800 into an account paying 7.15% APR, compounded daily. Find the balance in this account after 15 years.

   d. Trung deposited $1200 into a savings account paying 6.5% APR, compounded continuously. Find his account balance after 15 years. What percentage of that is interest?

   e. May is comparing two different accounts. One is 6.3% compounded quarterly and the other is 5.5% compounded daily. Calculate the effective rate of each, and state which account will earn more money.

10. Use the **2024 tax tables** to answer the tax questions. The tables will be given with the test. Write your answers in complete sentences.

    a. Manuel is filing as head of household and has $22,500 in itemized deductions. Should he claim the itemized deductions or the standard deduction? How much would his deduction be?

    b. Jessie and Sam are married filing jointly with two kids. They have a gross income of $104,100 and $21,000 in itemized deductions. Determine their deduction and calculate their taxable income.

    c. Bill is single with a taxable income of $35,100. Calculate the amount of tax owed using the table.

    d. Kole had $6,210 deducted from their paychecks in withholdings. Their taxes owed came out to be $5,598. Does Kole get a refund or owe money and what is the amount?

11. Identify the sampling method:
    a. Researchers select every 5th customer who walks into the store to take a survey.

    b. Raffle tickets are distributed and collected in a bag, where they are mixed and ten are drawn for prizes.

    c. I asked the shoppers near me in the shoe department what size they wear.

    d. An IRS auditor randomly selects 25 taxpayers in each filing status (single, head of household, married filing jointly, and married filing separately).

12. Write the type of study, describe the control group (if any), the treatment group and whether there is any blinding and the type.

    a. A study was done on a new heart medication, where some patients would receive the medication and others would receive a placebo, without knowing to which group they belonged. The nurse who was dispensing the pills was given the pills for each patient and couldn't tell the difference.

    b. A study assigned one group of participants to try a new moisturizing cream on their hands, and the other group was instructed not to use any cream. This new cream was predicted to help extremely dry skin.

    c. A study was done to find the average height of each NBA team's players.

    d. A study was done to try a new dog food, and the dog owners were given cans with the labels removed. The person handing out the dog food knew which type was given.

13. In a CNN poll of 500 adults nationwide, 62% of those surveyed answered yes to the following question, "Do you favor a law to ban the sale of assault weapons and semiautomatic rifles?" The margin of error was 4.4%. Write the confidence interval. Would you claim that a majority of Americans support such a law?

14. List the type of bias in each study.

    a. PCC students were sent an email survey to determine how long to keep the computer lab open in the evenings.

    b. Campus officials want to know how many PCC students have experienced housing insecurity so they poll students at Sylvania and Rock Creek campuses.

15. Old Faithful (geyser in Yellowstone Park) typically erupts nearly 20 times per day for about 1.5 to 5 minutes in duration each time. The amount of time between eruptions varies but is fairly regular. For May 30, 2016, the time between eruptions was recorded (in minutes):

    97, 88, 91, 95, 90, 100, 107, 85, 93, 103, 99, 107, 90, 94, 90

    a. Use Stapplet to create a histogram and boxplot with label and units. Practice taking a screenshot for the final.

    b. Use Stapplet to find the mean, standard deviation, and 5-number summary, including units.

16. There are 20 prize items in a box:

5 pink phone cases	2 yellow calculators	2 green erasers	1 purple phone case
2 pink erasers	4 yellow phone cases	3 green journals	1 purple calculator

If you grab one prize at random, what is the probability that

a. it is a calculator?

b. it is not green?

c. it is pink or purple?

d. it is yellow or a phone case?

e. If you draw three prizes in a row, putting them back in each time, what is the probability that they are all green journals?

f. If three people draw prizes in a row (they get to keep them, so they do not put them back), what is the probability that they are all yellow phone cases?

g. What are the odds against getting a pink eraser?

17. The probability distribution for the amount of money an insurance company pays in claims per customer per year is given below.

a. Fill in the missing value and calculate the expected payout for the insurance company per customer, including units.

Payout	$20,000	$15,000	$1,000	$500	$0
Probability		0.003	0.09	0.05	0.856

b. If the insurance policy sells for $599 per year, what is the expected profit or loss for the company? Write your answer in a complete sentence.