

Math 105, Edition 2.0

Course Packet 24674

Math In Society

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1.1: Logic in Everyday Language

Watch the videos on **Logic** and take notes on these pages.

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:

- Rabbits are fish and rattlesnakes have 4 legs
- Math 105 is a PCC class and Portland Community College is located in Oregon
- 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:

- Will you have the vegan or meat option at dinner?
- 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:

- Rabbits are fish or rattlesnakes have 4 legs.
- Math 105 is a PCC class or Portland Community College is located in Oregon
- 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.

- Hypothesis:
- 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 \rightarrow TRUE
- If TRUE, then FALSE \rightarrow FALSE
- If FALSE, then TRUE \rightarrow TRUE
- If FALSE, then FALSE \rightarrow 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.

1.2: Sets and Venn Diagrams

Watch the video on **Venn Diagrams** and take notes on this page.

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

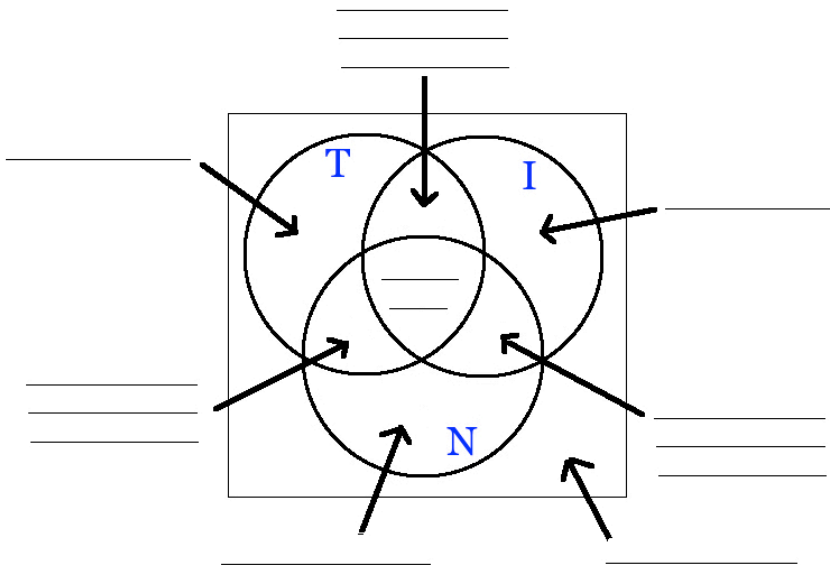
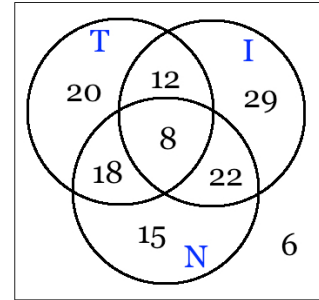
d. Some S are not P
Some college students are not athletes

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?

1.3 Decimals and Percents

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:

- 126.745 inches to the nearest tenth
- 5.68932 feet to two decimal places
- 0.038594 to three decimal places
- \$ 43.893 to the nearest cent
- 0.00125 to four decimal places
- 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. $\frac{9}{25}$

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

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

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

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

Watch the video on **Proportional Reasoning** and take notes on this page.

- 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

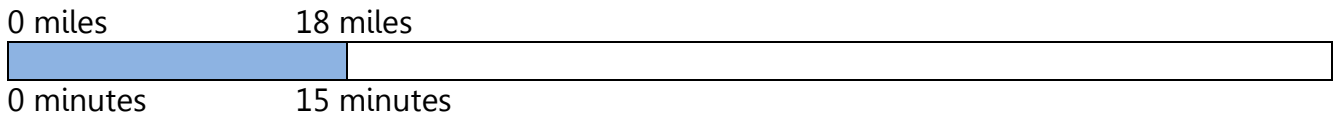
a. \$19.99 per shirt

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

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?

1.5: Problem Solving

Reflection: Give an example of a complex problem to solve in your life. How did you approach it?

Watch the videos on **Problem Solving** and take notes on these pages.

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.

Operation Sense

What would you use each operation for?

Addition –

Subtraction –

Multiplication –

Division –

Use the problem solving process to solve this problem. *Try solving it yourself first, then watch the video.*

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.

For the problem above, reflect on how you used your operation sense and number sense.

Solving Problems with Unit Conversions

2. 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

3. 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?



5.1: Apportionment

Apportionment is the problem of dividing up a fixed number of people or items among groups of different sizes. For example, we use apportionment to determine the number of representatives for each state in the US House of Representatives, or to divide school busses among districts.

Rules of Apportionment

1. The people/items can only be divided into _____.
2. We must use the _____ of people/items being divided.
3. Each group must get _____ of the people/items being divided up.
4. The number of people/items assigned to each group should be _____ to the size of the group. (Exact is rarely possible so get as close as possible).

Apportionment Methods and Steps

1. Divide the total population by the number of items to find the divisor: The number of people each person should represent (decimal).
2. Divide the population of each group by the divisor to get the standard quota.

Hamilton's Method (vetoed in 1792, used from 1850-1900): Cut off decimal to find the initial number. Then give any extra seats in order of the highest decimal remainders.

Jefferson's Method (used from 1792-1830): Cut off the decimal to find the initial number. Lower the divisor if needed so that there are no leftover seats. Uses trial and error.

Webster's Method (used in 1840): Instead of cutting off the decimal, round it to find the initial number. Then raise or lower the divisor if needed so there are no leftover seats.

Hill-Huntington Method (used 1941-present): Instead of rounding using 0.5 or higher, use the geometric mean $\sqrt{x(x+1)}$ to round the initial number. Then raise or lower the divisor if needed so there are no leftover seats.

It is important to acknowledge slavery in the U. S. when these methods were formed. In the textbook I encourage you to read about the 3/5 Compromise and Hamilton, Jefferson and Webster's relationship to slavery. In the 3/5 compromise, only 3/5 of the slave population was counted for representation. When the slaves were freed in 1863, they were counted as whole people. Black men were given the right to vote in 1869 and all women in 1920, however, there are still voter suppression measures for black people and other minoritized groups.

It is important to acknowledge this history and the racism that continues today so those with privileges can use them to work toward removing systemic oppression.

Example 1. PCC has four campuses and 45 full-time math instructors. The number of students at each campus is given in terms of full-time equivalency (FTE). How can we divide up the math instructors fairly?

2016-17 Academic Year Data: <https://www.pcc.edu/ir/factsheet/Factbook/201617/swr5yrt2012-2016.pdf>

Use Hamilton's method to apportion the math instructors.

<u>Campus</u>	<u>Students (FTE)</u>	<u>Standard Quota</u>	<u>Initial or Minimum</u>	<u>Final</u>
Sylvania	8871			
Cascade	4841			
Rock Creek	6797			
Southeast	2722			

Total

Divisor:

Use Jefferson's method to apportion the math instructors.

<u>Campus</u>	<u>Students (FTE)</u>	<u>Standard Quota</u>
Sylvania	8871	
Cascade	4841	
Rock Creek	6797	
Southeast	2722	

Total 23,231

Divisor:

Use Webster's method to apportion the math instructors.

<u>Campus</u>	<u>Students (FTE)</u>	<u>Standard Quota</u>
Sylvania	8871	
Cascade	4841	
Rock Creek	6797	
Southeast	2722	

Total 23,231

Divisor:

Use Hill-Huntington's method to apportion the math instructors.

<u>Campus</u>	<u>Students (FTE)</u>	<u>Standard Quota</u>
Sylvania	8871	
Cascade	4841	
Rock Creek	6797	
Southeast	2722	
Total	23,231	

Divisor:

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

Make a **Preference Schedule:**

1 st choice				
2 nd choice				
3 rd choice				

Plurality Method (only first choice counts)

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

Point System (Borda Count)

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

Condorcet Method (Pairwise Comparisons)

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

5.3: Representation, Electoral College and Popular Vote and Electoral Power

Watch the Video: U.S Elections – How do they work? For an overview.

Use your knowledge or look up this information on the internet.

1. How many senators are in the U.S. Senate? _____

Senators have a term of _____ years.

2. How many representatives are in the U.S. House of Representatives? _____

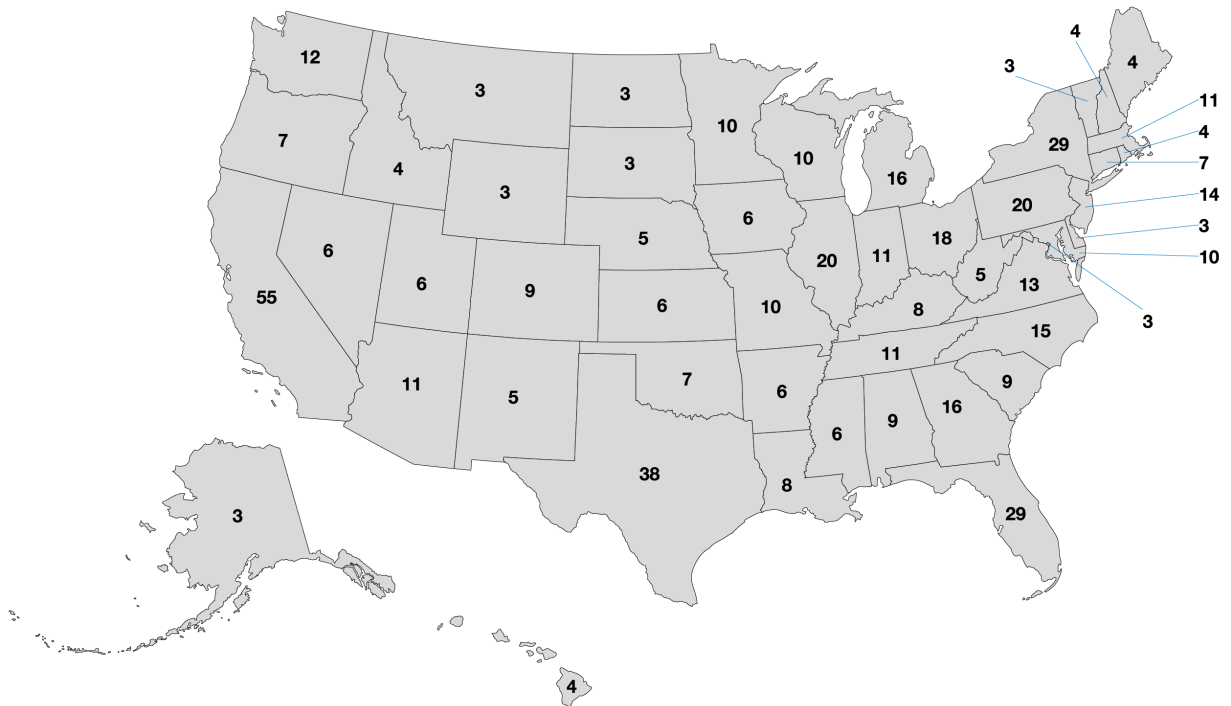
Representatives have a term of _____ years.

3. How many electors are in the Electoral College? _____

How many electoral college votes are needed to win a U.S. presidential election? _____

Using the map of electors per state below, what is the minimum number of electors that a state can have? _____ Which state has the most electors? _____

Number of Electors per State using the 2010 Census and Apportionment



Watch the Video: Popular Vote vs. the Electoral College and take notes.

Consider a small country with 3 states. The rules for the number of senators and electors are the same as the U.S. government. Each state gets 1 representative for every 25,000 residents. Determine the number of electors for each state and the total for the country.

State	Population	Number of Representatives	Number of Senators	Number of Electors
Small	75,000			
Medium	350,000			
Large	500,000			

The total number of electors in the Electoral College is _____.

How many electoral votes are needed to win the presidential election? _____

There are 2 candidates for the president, Candidate A and Candidate B. When a candidate wins in a state, they get all the electoral votes for that state. Determine who wins the popular vote and who wins the electoral college vote.

State	Votes for Candidate A	Votes for Candidate B	Number of Electoral Votes for A	Number of Electoral Votes for B
Small	52,000	23,000		
Medium	280,000	70,000		
Large	236,000	264,000		
Total Votes				

The winner of the popular vote is _____.

The winner of the electoral college is _____.

Which method do you think is more fair and why?

Some states have passed a National Popular Vote bill which assigns a state's electoral votes based on the popular vote. <https://www.nationalpopularvote.com/>

Electoral Power

Electoral Power is

Let's calculate the electoral power of each state. Fill in the number of electors from the previous table. Then find the number of electoral votes per 25,000 people (you can ignore any remainder). Round to 2 decimal places.

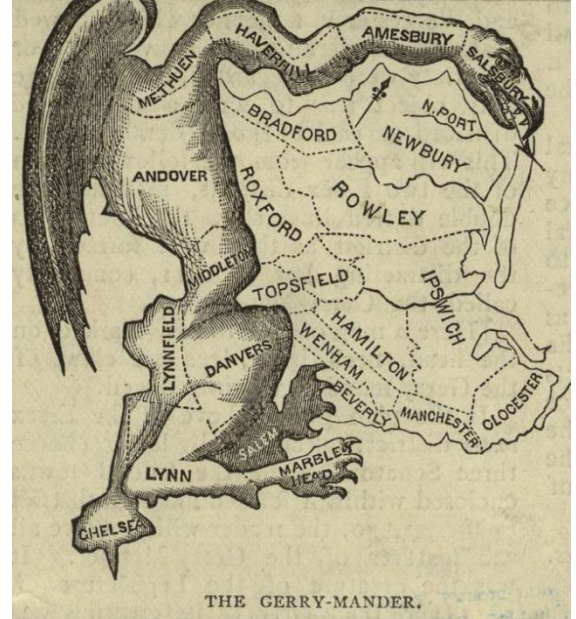
State	Population	Number of Representatives	Number of Senators	Number of Electors	Electoral Votes per 25,000 people
Small	75,000				
Medium	350,000				
Large	500,000				

5.4: Gerrymandering and Solutions

Apportionment determines how many representatives are given to each state. Then each state draws the districts that elect one representative each.

Watch the videos and look for the following information.

1. How often does redistricting happen?
2. What are the two rules for drawing district lines?
 - i.
 - ii.
3. Who determines where the district lines are drawn?
4. There are two types of gerrymandering.



What is cracking?

What is packing?

5. What is gerrymandering?



Proportionality and Fairness

There is nothing in our constitution or laws that says representation must be proportional, but that seems like a basic measure of fairness.

a. If a state with 10 districts is $\frac{3}{5}$ Democrats and $\frac{2}{5}$ Republicans, how many seats would each party get if the representation was proportional?

b. If a state with 9 districts is 42.3% Democrats and 57.7% Republicans, how many seats would each party get if the representation was proportional? It usually doesn't come out exactly so you can say what is closest to fair.

How to Measure Gerrymandering: The Efficiency Gap

Example 1. The votes are shown for five districts in a hypothetical state. Determine the number of seats won and calculate the efficiency gap.

Election Results:

	District	D Votes	R Votes	D Wasted Votes	R Wasted Votes
Democrats win	1	75	25		
_____ seats	2	60	40		
Republicans win	3	43	57		
_____ seats	4	48	52		
	5	49	51		
	Total				

Efficiency Gap = $\frac{\text{Party A Wasted Votes} - \text{Party B Wasted Votes}}{\text{Total Votes}}$ =

A maximum efficiency gap of _____% is currently being proposed.

Adapted from: https://www.brennancenter.org/sites/default/files/legal-work/How_the_Efficiency_Gap_Standard_Works.pdf

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:

Using Spreadsheet Formulas for Compound Interest

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

Future Value Formula
$$=FV(\text{rate}, \text{nper}, \text{pmt}, [\text{pv}], [\text{type}])$$
Present Value Formula
$$=PV(\text{rate}, \text{nper}, \text{pmt}, [\text{fv}], [\text{type}])$$

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.

$$A = Pe^{rt}$$

$$= P \cdot \exp(\text{rate} \cdot \text{years})$$

Effective Rate

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

$$= \text{effect}(\text{nominal rate, periods per year})$$

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

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

2.3: Savings Plans

You will need to use Microsoft Excel or Google Sheets while you watch these videos. 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])

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?

2.5: 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**

<p>If your withholdings are less than your taxes due, you will</p> <p>_____</p> <p>If your withholdings are more than your taxes due, you will</p> <p>_____</p>

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	

3.1: Fundamentals of Statistics

Watch the videos and take notes on this sheet

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](http://www.gallup.com/poll/216746/hourly-workers-unhappier-salaried-job-aspects.aspx?g_source=WWWV7HP&g_medium=topic&g_campaign=tiles) 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 $\pm 5\%$. Source: http://www.gallup.com/poll/216746/hourly-workers-unhappier-salaried-job-aspects.aspx?g_source=WWWV7HP&g_medium=topic&g_campaign=tiles

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?"

3.2: Describing Data – Upload Graphs with your notes**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.

Please print your graphs from the spreadsheet as a pdf or insert them into word docs and upload them with your notes. 😊

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.

3.3: Summary Statistics: Measures of Center

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: Summary Statistics: 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 \div 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

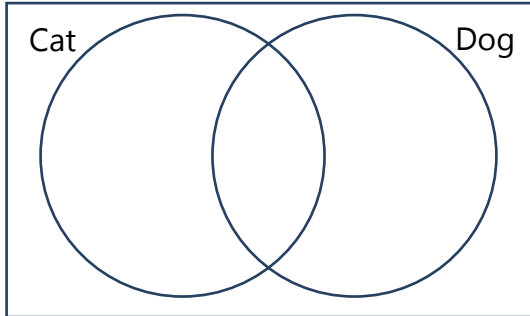
Data	Deviation from Mean	Squared Deviation
49		
49		
52		
58		
62		
66		
67		
71		
73		
74		
75		
78		
81		
82		
84		
85		
86		
91		
96		
Sum of the squared deviations:		

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

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

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 tablesMARGINAL

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

$$P(\text{cat}) =$$

AND

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

$$P(\text{cat AND dog}) =$$

OR

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

$$P(\text{cat OR no dog}) =$$

CONDITIONAL

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

$$P(\text{cat given dog}) =$$

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.

- a. Draw a tree to see the possible outcomes.
- b. Can you think of a way to multiply to find the number of outcomes? (Multiplication Principle)

- c. What is the probability of getting 3 heads?
- d. 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				

- e. What is the probability of getting 1 or 2 heads?
- f. What is the probability of getting fewer than 2 heads?
- g. What is the probability of not getting 2 heads (**Complement**)?
- h. 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 $P(A \text{ or } B) = P(A) + P(B)$	Add Be careful not to double count the intersection	Multiply $P(A \text{ and } B) = P(A) \cdot P(B)$	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?

4.3: 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	$\frac{1}{5}$	$\frac{1}{50}$	$\frac{1}{100}$	$\frac{1}{2000}$	$\frac{1539}{2000} = 0.7695$

- Find the expected value for this lottery ticket.
- 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				

- Find the expected value for the amount that Primo will pay per policy.
- What is the expected profit or loss per policy?

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1.1-1.2: Logic in Everyday Life, Sets and Venn Diagrams

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.
- All students like coffee.
 - No students like to sing.
6. Determine whether each "and" statement is true or false.
- $25 + 30 = 55$ and $55 \div 11 = 6$.
 - 16 is even and odd.
 - Cats are mammals and geckos are reptiles.
7. Determine whether each "or" statement is inclusive or exclusive.
- Are you going to wear pants or a skirt tomorrow?
 - Students can join the Music Club if they are in the choir or band.
8. Determine whether each "or" statement is true or false.
- $3 + 8 = 10$ or 6 is an odd number.
 - Mexico is a country or a city.
 - Mice are rodents or snakes are reptiles.

9. Identify the hypothesis and conclusion of each conditional statement.
- If you can see the stars, then it is night.
 - You'll win big if you play the lottery.
 - If elephants fly, then fish don't swim.
10. Determine whether each "if...then" statement is true or false.
- If a figure is a square, then it has four equal sides.
 - If cows can fly then eagles can fly.
 - If the sky is purple, dogs are not pets.
 - 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.
- Converse:
 - Inverse:
 - Contrapositive:
 - 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.

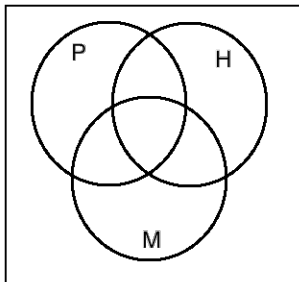
Prerequisites: CIS 125D or CIS 275, and (WR 115 and RD 115) or IRW 115 and MTH 20 or equivalent placement. You can build off your last answer.

1.2: Sets and Venn Diagrams

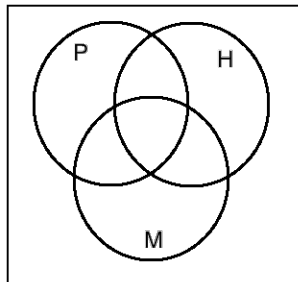
13. Pizza Venn Diagrams

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.

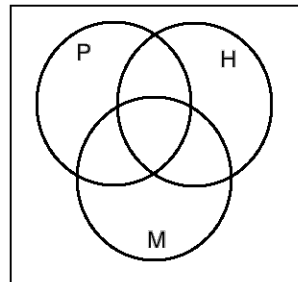
Pepperoni & Mushroom



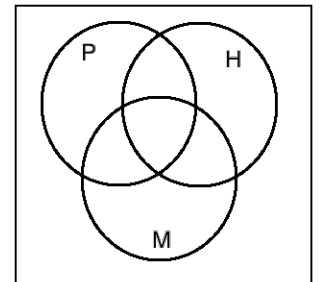
Cheese



Veggie



Supreme (everything on it)



Qualified Propositions

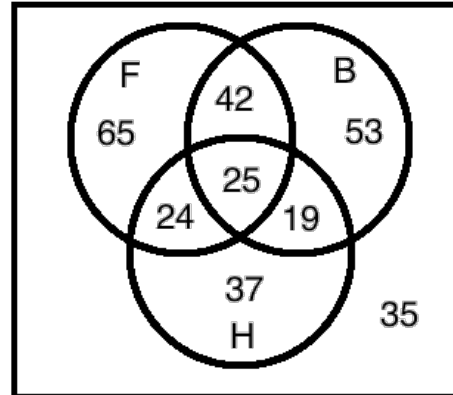
14. Draw a Venn diagram for each qualified or categorical proposition. Then write on the line whether the sets are disjoint, overlapping, or one is a subset of the other.

- | | Relationship between the Sets |
|------------------------------|-------------------------------|
| a. Some bikes are orange. | _____ |
| b. All bicycles have wheels. | _____ |
| c. No bikes are alive. | _____ |

15. 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.



- How many students participated in the survey?
- How many students watched basketball?
- How many students watched only one of the sports?
- How many students watched at least two sports?
- How many students didn't watch hockey?
- How many students watched football or hockey? Can you find this 2 different ways?
- How many students watched football and hockey, but not basketball?

16. 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.

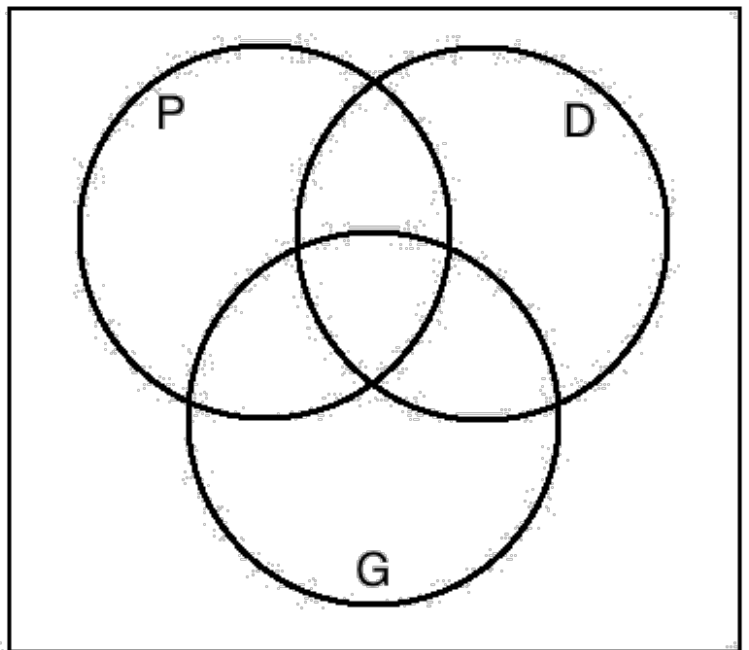
69 could play drums or guitar but not piano.

Let P represent piano,

G represent guitar, and

D represent drums.

Calculate and fill in the values for all eight regions.



1.3-1.5: Percents, Rates and Proportions and Problem Solving

Group Activity

1. Would you rather...

Work as a server at Restaurant A
OR
Work as a server at Restaurant B?

Restaurant A	Restaurant B
\$18 per hour No tipping allowed	\$10.50 per hour Tipping encouraged
(meals range from \$8 to \$25 each)	(meals range from \$8 to \$25 each)

wouldyourathermath.com

- Write down any assumptions you make.
- Write down any additional information you use.
- Write down your mathematical analysis.

d. Write out your conclusion with reasoning.

2. What would you say are the key steps to problem solving?

1.3 Percents

3. 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.

4. 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?

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. 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.

6. 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 2006¹. 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?

¹ <https://fred.stlouisfed.org/series/FYGFD>

1.4: Rates and Proportions

7. List 3 things in life that are generally proportional and 3 things that are not generally proportional.

Unit Rates

8. 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.

Solving Proportion Problems

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

9. 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?

10. A crepe recipe calls for 2 eggs, $\frac{3}{4}$ cup of flour and 1 cup of milk. How much flour would you need if you use 5 eggs?

1.5 Problem Solving

Problems with unit conversions

You can use the internet to look up any conversions you need. Please write down the conversions you use.

11. Would you Rather 500 pounds of pennies or 40 pounds of quarters?



- Write down any assumptions you make.
- Write down any additional information you use. This site can help: [Coin Specifications](#).
- Write down your mathematical analysis.

d. Write out your conclusion with reasoning.

Note: This is based on a true story. Did you get the same answer for the pennies as listed in the article? If not, why do you think they are different?

Problems with unit conversions and/or geometry

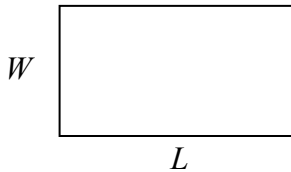
It may be helpful to recall some formulas for areas and volumes of a few basic shapes.

Areas

Rectangle

Area: $L \cdot W$

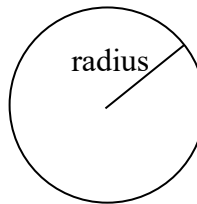
Perimeter: $2L + 2W$



Circle, radius r

Area: πr^2

Circumference = $2\pi r$



12. Painting a wall rates – scaling a ratio. 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?

13. A very veggie pizza at Pizzicato is available in 3 sizes with the prices shown in the table below. Are these prices proportional to the amount of pizza? If not, which is the best deal? Which is the worst deal?

Size	Price
Small, 10-inch	\$16.00
Medium, 12-inch	\$21.25
Large, 16-inch	\$30.50

5.1: Apportionment

Group Activity

1. A college offers tutoring in Math, English, Chemistry, and Biology. The number of students enrolled in each subject is listed below. If the college can only afford to hire 15 tutors, determine how many tutors should be assigned to each subject.

Add in any additional columns as you go.

a. Hamilton's Method

<u>Subject</u>	<u>Students</u>	<u>Standard Quota</u>
Math	330	
English	265	
Chemistry	130	
Biology	70	
Total		
Divisor		

b. Jefferson's Method

<u>Subject</u>	<u>Students</u>	<u>Standard Quota</u>
Math	330	
English	265	
Chemistry	130	
Biology	70	
Total		
Divisor		

c. Webster's Method

<u>Subject</u>	<u>Students</u>	<u>Standard Quota</u>
Math	330	
English	265	
Chemistry	130	
Biology	70	
Total		

Divisor

d. Hill-Huntington Method

<u>Subject</u>	<u>Students</u>	<u>Standard Quota</u>
Math	330	
English	265	
Chemistry	130	
Biology	70	
Total		

Divisor

Quota Rule

The Quota Rule says that the final number of representatives a state gets should be within one of that state's quota. Since we're dealing with whole numbers for our final answers, that means that each state should either go up to the next whole number above its quota, or down to the next whole number below its quota.

Do any of our examples violate the quota rule?

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?

More Practice

3. A small country consists of six states, whose populations are listed below. If the legislature has 200 seats, apportion the seats using each method.

A: 3,411 B: 2,421 C: 11,586 D: 4,494 E: 3,126 F: 4,962

a. Hamilton's Method

<u>State</u>	<u>Population</u>	<u>Standard Quota</u>
A	3,411	
B	2,421	
C	11,586	
D	4,494	
E	3,126	
F	4,962	
Total		

Divisor

b. Jefferson's Method

<u>State</u>	<u>Population</u>	<u>Standard Quota</u>
A	3,411	
B	2,421	
C	11,586	
D	4,494	
E	3,126	
F	4,962	
Total		

Divisor

c. Webster's Method

<u>State</u>	<u>Population</u>	<u>Standard Quota</u>
A	3,411	
B	2,421	
C	11,586	
D	4,494	
E	3,126	
F	4,962	
Total		

Divisor

d. Hill-Huntington Method

<u>State</u>	<u>Population</u>	<u>Standard Quota</u>
A	3,411	
B	2,421	
C	11,586	
D	4,494	
E	3,126	
F	4,962	
Total		

Divisor

4. 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?

5.3-5.4: Electoral College, Popular Vote, Electoral Power and Gerrymandering

Group Activity

5.3: Popular Vote vs. the Electoral College

1. Consider a small country with 4 states. The rules for the number of senators and electors are the same as the U.S. government. Each state gets 1 representative for every 20,000 residents (ignore any remainders).

a. Determine the number of electors for each state and the total for the country.

State	Population	Number of Representatives	Number of Senators	Number of Electors
Small	282,000			
Medium	365,000			
Large	480,000			
Huge	602,000			

b. The total number of electors in the Electoral College is _____.

c. How many electoral votes are needed to win the presidential election? _____

d. There are 2 candidates for the president, Candidate A and Candidate B. When a candidate wins in a state, they get all the electoral votes for that state. Determine who wins the popular vote and who wins the electoral college vote.

State	Votes for Candidate A	Votes for Candidate B	Number of Electoral Votes for A	Number of Electoral Votes for B
Small	126,900	155,100		
Medium	189,800	175,200		
Large	192,000	288,000		
Huge	307,020	294,980		
Total Votes				

e. The winner of the popular vote is _____.

f. The winner of the electoral college is _____.

- g. Write down all the possible combinations of states that would win you the election based on the electoral college.

- h. In the country above, what is the fewest number of votes you could win the electoral college with?

- i. What percentage of the population is that?

5.3: Electoral Power

- 2. Do you think each state has the same electoral power? Why or why not?
 - a. Explain why or why not.

 - b. Let's calculate the electoral power of each state. Fill in the number of electors from the previous table. Then find the number of electoral votes per 20,000 people (you can ignore any remainder). Round to 2 decimal places.

State	Population	Number of Representatives	Number of Senators	Number of Electors	Electoral Votes per 20,000 people
Small	282,000				
Medium	365,000				
Large	480,000				
Huge	602,000				

- c. Which states have more electoral power? Less electoral power?

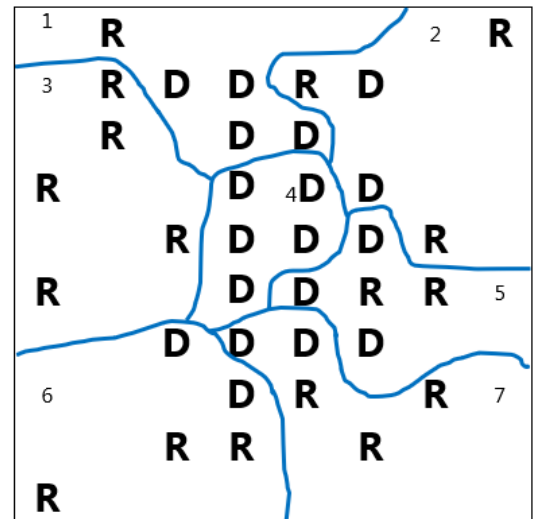
- d. Which states in the U.S.A. do you think have more electoral power? Less electoral power? Why?

5.4 Proportionality, Gerrymandering and Solutions

3. There is nothing in our constitution or laws that says representation must be proportional, but that seems like a basic measure of fairness.
 - a. If a state with 8 districts is 25% Democrats and 75% Republicans, how many seats would each party get if the representation was proportional?
 - b. If a state with 7 districts is 51.4% Democrats and 48.6% Republicans, how many seats would each party get if the representation was proportional? It usually doesn't come out exactly so you can say what is closest to fair.

4. You have just been hired as consultants to your state legislature in the re-districting of the state. To assess the current map below, tally the voters and calculate the efficiency gap.

- a. Using the map, fill in the number of votes in each district and determine the winner of each.



Election Results:		District	D Votes	R Votes	D Surplus Votes	R Surplus Votes
Democrats win	_____ seats	1				
		2				
		3				
		4				
Republicans win	_____ seats	5				
		6				
		7				
		Total				

b. Calculate the efficiency gap for this map.

$$\text{Efficiency Gap} = \frac{\text{Party A Surplus Votes} - \text{Party B Surplus Votes}}{\text{Total Votes}}$$

c. Calculate the percentage of voters that each seat represents. (Hint: take 100% and divide by the number of districts)

d. Compare the efficiency gap with the percentage for each seat. Is the efficiency gap worth less than one seat or more than one? How many seats?

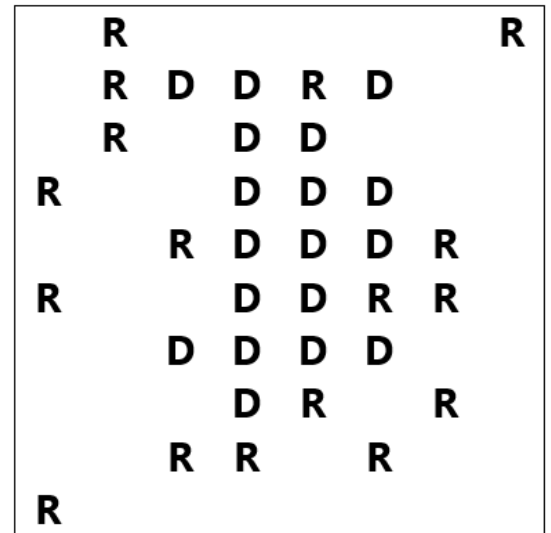
e. Is this a fair map? Why or why not?

5. Now it is time for re-districting, and you get to draw the lines. There are three rules:

Rules

1. All legislative districts must contain the same number of people.
2. Districts must not be drawn according to race or ethnicity.
3. District must be contiguous – no split districts allowed

a. Use packing and cracking to win as many seats as possible for the **Democrats** and fill in the table.



Election Results:

Democrats win

_____ seats

Republicans win

_____ seats

	District	D Votes	R Votes	D Surplus or Wasted Votes	R Surplus or Wasted Votes
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	Total				

b. Calculate the efficiency gap for this map.

$$\text{Efficiency Gap} = \frac{\text{Party A Surplus Votes} - \text{Party B Surplus Votes}}{\text{Total Votes}}$$

c. Calculate the percentage of voters that each seat represents. (Hint: take 100% and divide by the number of districts)

d. Compare the efficiency gap with the percentage for each seat. Is the efficiency gap worth less than one seat or more than one? How many seats?

e. Is this a fair map? Why or why not?

6. Use packing and cracking to win as many seats as possible for the **Republicans** and calculate the efficiency gap.

f. Fill in the table and see how many seats each party wins.

	R					R
	R	D	D	R	D	
	R		D	D		
R			D	D	D	
		R	D	D	D	R
R			D	D	R	R
		D	D	D	D	
			D	R		R
		R	R		R	
R						

Election Results:	District	D Votes	R Votes	D Surplus or Wasted Votes	R Surplus or Wasted Votes
Democrats win	1				
_____ seats	2				
	3				
Republicans win	4				
_____ seats	5				
	6				
	7				
	Total				

g. Calculate the efficiency gap for this map.

$$\text{Efficiency Gap} = \frac{\text{Party A Surplus Votes} - \text{Party B Surplus Votes}}{\text{Total Votes}}$$

h. Calculate the percentage of voters that each seat represents. (Hint: take 100% and divide by the number of districts)

i. Compare the efficiency gap with the percentage for each seat. Is the efficiency gap worth less than one seat or more than one? How many seats?

j. Is this a fair map? Why or why not?

If you'd like to learn more:

7. Azavea, a data analytics organization calculated the efficiency gap for all 50 states in 2017. <https://www.azavea.com/blog/2017/07/19/gerrymandered-states-ranked-efficiency-gap-seat-advantage/>

2.1-2.2: Simple and Compound Interest with SpreadsheetsGroup 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?

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)

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?

2.3-2.4 Savings Plans and Loan PaymentsGroup 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%?

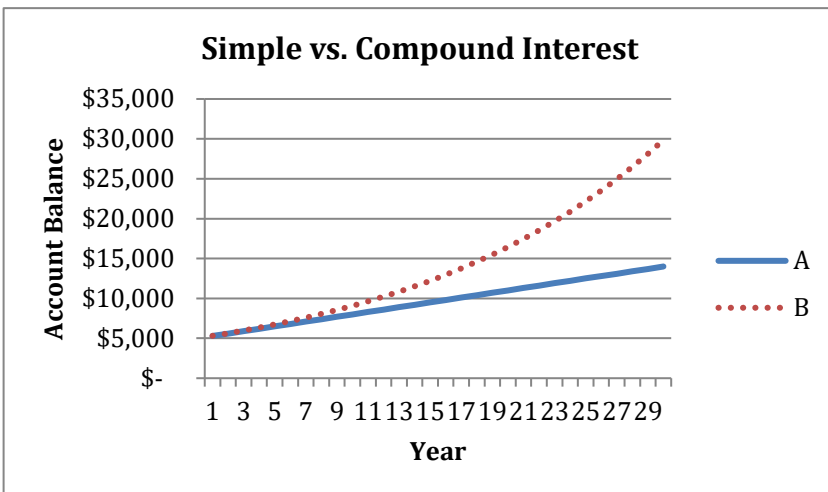
- c. If you make all the payments for 30 years, how much would you have paid for the house in total?
- d. In part b above, what number would you get if you switch the 0 and the 315,000? Why are the answers so different? Explain the difference between these two scenarios.

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.

Write the letter of the graph that matches the type of interest.

1. Simple Interest _____

2. Compound Interest _____



3. Write the letters in order from the type of compounding that would give the lowest amount to the type that would give the highest amount (assuming the same interest rate).

_____ / _____ / _____ / _____ / _____
 A. Quarterly B. Continuously C. Daily D. Monthly E. Annually

Use the spreadsheet formulas to solve each problem and show your formula and any other steps you use.

4. a. You deposit \$10,000 into an account that earns 5% interest, compounded quarterly. How much will you have in 20 years?

b. What percentage of your total balance is from interest?

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)

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

5. You loan a friend \$1,000 for 2 years at 3% simple interest. How much will they pay you back?

6. a. You are buying a condo for \$282,500 and putting 13% down. You will take out a conventional 30-year mortgage for the rest with an interest rate of 5%. How much will your monthly payment be?

b. If you stay there for 30 years, how much in total would you spend on the condo?

7. You want to compare an account that earns 6.1% interest compounded daily with an account that earns 6.2% compounded quarterly. Find each effective rate. Which account earns more?

8. You deposit \$7,000 into an account that earns 8% interest compounded continuously. How much will you have in 10 years?

b. How much interest would you earn?

9. If you want to have 500,000 in 25 years and you find an account with a 7.5% interest rate compounded daily, how much would you need to deposit now?

10. a. If you put \$200 per month in a savings account with a 6.2% interest rate compounded monthly, how much will you have in 35 years?

b. How much interest would you have earned?

These are sample problems to help you prepare for the midterm. The midterm will be given in MyOpenMath. Study all class materials and feedback. You'll be using a spreadsheet on the test and you may also use a calculator.

1. Write whether the following statements are 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 $1 + 5 = 7$.

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

 - b. the inverse

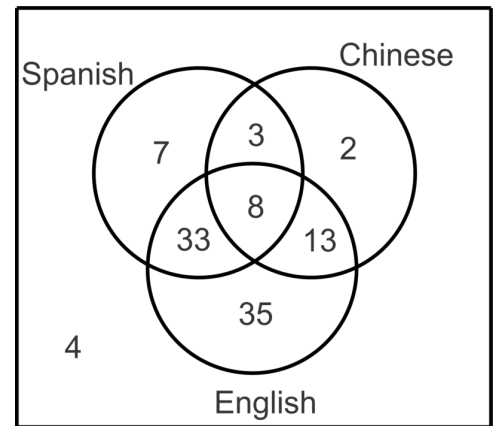
 - c. the contrapositive

3. 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.

4. 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?

Show all of your steps and thinking. Use any method for problems 5-10.

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

6. 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?

7. A line of coats was marked up by 200% and then placed on sale for 30% off. If the owner of the store purchased the jackets wholesale for \$70 each, find the sale price and the combined relative change from the wholesale price.
8. A map scale indicates that $\frac{1}{2}$ 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?
9. Keila receives a weekly salary of \$330. In addition, she gets paid \$15 for every item sold in excess of 100 items. How much will Keila earn for the week if she sold 195 items?
10. 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.

11. A small country has four states whose populations are listed below. Their legislature has 116 seats. Determine the number of seats that each state would get using the methods below.

a. Hamilton's Method

<u>State</u>	<u>Population</u>	<u>Standard Quota</u>	<u>Initial or Minimum</u>	<u>Final</u>
North	33,700			
South	559,500			
East	141,300			
West	89,100			
Total				

Divisor

b. Hill-Huntington Method

<u>State</u>	<u>Population</u>	<u>Quota</u>	<u>Geo Mean</u>	<u>Initial</u>	(trials)	<u>Final</u>
North	33,700					
South	559,500					
East	141,300					
West	89,100					
Total						

Divisor

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
1 st choice	Elle	Don	Key	Fant
2 nd choice	Fant	Key	Don	Don
3 rd choice	Don	Elle	Fant	Elle
4 th 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. A State map is shown below. Tally the voters and use the information to answer the questions below.

a. Calculate the results of an election and the efficiency gap.

Election Results:

Democrats win

_____ seats

Republicans win

_____ seats

District	D Votes	R Votes	D Surplus or Wasted Votes	R Surplus or Wasted Votes
1				
2				
3				
4				
5				
6				
Total				

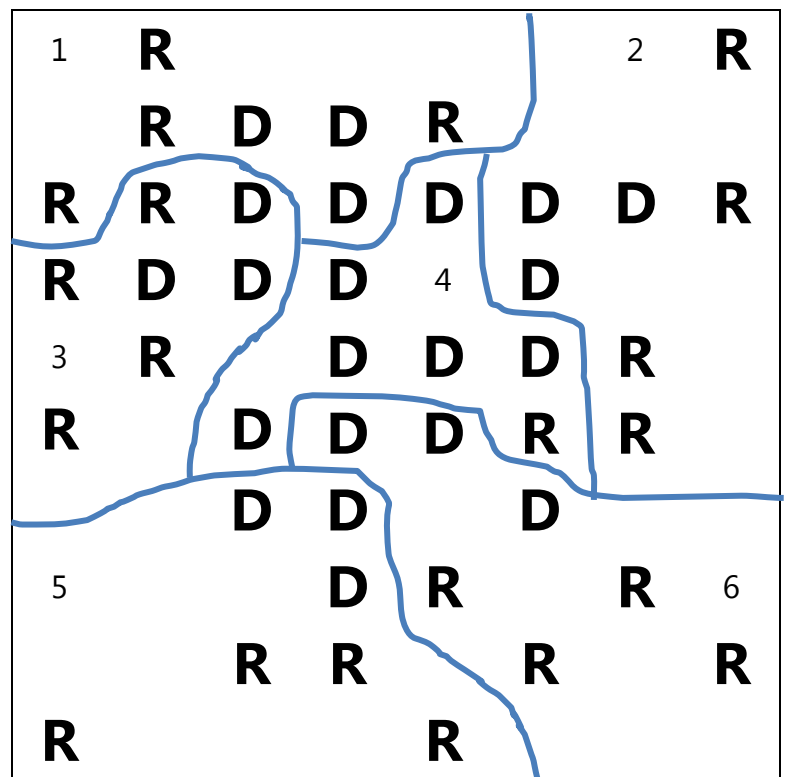
Efficiency Gap

$$\frac{\text{Party A Wasted Votes} - \text{Party B Wasted Votes}}{\text{Total Votes}}$$

b. Calculate the percentage of voters that each seat represents.

c. Compare the efficiency gap with the percentage for each seat. How many seats is the efficiency gap worth?

d. Is this a fair map? Why or why not?



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

- 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.

=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])

- 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.

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)		

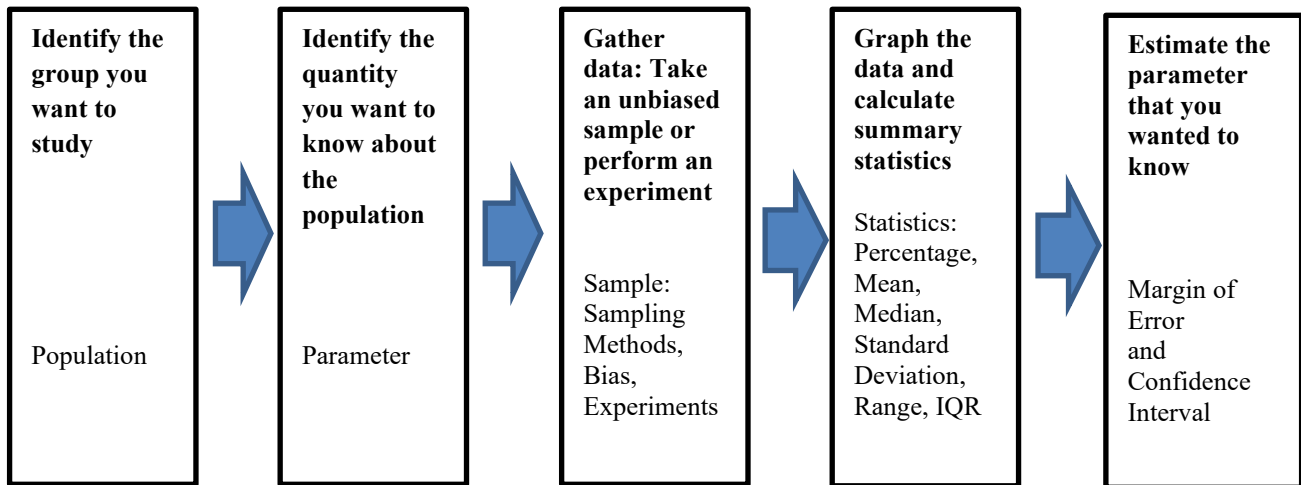
2. Below is a portion of the 2017 tax year tax schedule from the form 1040 booklet.

2017 Tax Table — Continued

If line 43 (taxable income) is—		And you are—				If line 43 (taxable income) is—		And you are—				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	At least	But less than	Single	Married filing jointly *	Married filing separately	Head of a household	At least	But less than	Single	Married filing jointly *	Married filing separately	Head of a household
Your tax is—		Your tax is—				Your tax is—		Your tax is—				Your tax is—		Your tax is—			
39,000						42,000						45,000					
39,000	39,050	5,495	4,921	5,495	5,186	42,000	42,050	6,245	5,371	6,245	5,636	45,000	45,050	6,995	5,821	6,995	6,086
39,050	39,100	5,508	4,929	5,508	5,194	42,050	42,100	6,258	5,379	6,258	5,644	45,050	45,100	7,008	5,829	7,008	6,094
39,100	39,150	5,520	4,936	5,520	5,201	42,100	42,150	6,270	5,386	6,270	5,651	45,100	45,150	7,020	5,836	7,020	6,101
39,150	39,200	5,533	4,944	5,533	5,209	42,150	42,200	6,283	5,394	6,283	5,659	45,150	45,200	7,033	5,844	7,033	6,109
39,200	39,250	5,545	4,951	5,545	5,216	42,200	42,250	6,295	5,401	6,295	5,666	45,200	45,250	7,045	5,851	7,045	6,116
39,250	39,300	5,558	4,959	5,558	5,224	42,250	42,300	6,308	5,409	6,308	5,674	45,250	45,300	7,058	5,859	7,058	6,124
39,300	39,350	5,570	4,966	5,570	5,231	42,300	42,350	6,320	5,416	6,320	5,681	45,300	45,350	7,070	5,866	7,070	6,131
39,350	39,400	5,583	4,974	5,583	5,239	42,350	42,400	6,333	5,424	6,333	5,689	45,350	45,400	7,083	5,874	7,083	6,139
39,400	39,450	5,595	4,981	5,595	5,246	42,400	42,450	6,345	5,431	6,345	5,696	45,400	45,450	7,095	5,881	7,095	6,146
39,450	39,500	5,608	4,989	5,608	5,254	42,450	42,500	6,358	5,439	6,358	5,704	45,450	45,500	7,108	5,889	7,108	6,154
39,500	39,550	5,620	4,996	5,620	5,261	42,500	42,550	6,370	5,446	6,370	5,711	45,500	45,550	7,120	5,896	7,120	6,161
39,550	39,600	5,633	5,004	5,633	5,269	42,550	42,600	6,383	5,454	6,383	5,719	45,550	45,600	7,133	5,904	7,133	6,169
39,600	39,650	5,645	5,011	5,645	5,276	42,600	42,650	6,395	5,461	6,395	5,726	45,600	45,650	7,145	5,911	7,145	6,176
39,650	39,700	5,658	5,019	5,658	5,284	42,650	42,700	6,408	5,469	6,408	5,734	45,650	45,700	7,158	5,919	7,158	6,184
39,700	39,750	5,670	5,026	5,670	5,291	42,700	42,750	6,420	5,476	6,420	5,741	45,700	45,750	7,170	5,926	7,170	6,191
39,750	39,800	5,683	5,034	5,683	5,299	42,750	42,800	6,433	5,484	6,433	5,749	45,750	45,800	7,183	5,934	7,183	6,199
39,800	39,850	5,695	5,041	5,695	5,306	42,800	42,850	6,445	5,491	6,445	5,756	45,800	45,850	7,195	5,941	7,195	6,206
39,850	39,900	5,708	5,049	5,708	5,314	42,850	42,900	6,458	5,499	6,458	5,764	45,850	45,900	7,208	5,949	7,208	6,214
39,900	39,950	5,720	5,056	5,720	5,321	42,900	42,950	6,470	5,506	6,470	5,771	45,900	45,950	7,220	5,956	7,220	6,221
39,950	40,000	5,733	5,064	5,733	5,329	42,950	43,000	6,483	5,514	6,483	5,779	45,950	46,000	7,233	5,964	7,233	6,229
40,000						43,000						46,000					
40,000	40,050	5,745	5,071	5,745	5,336	43,000	43,050	6,495	5,521	6,495	5,786	46,000	46,050	7,245	5,971	7,245	6,236

- Find the tax amount for a single person with a taxable income of \$39,890.
- Find the tax amount for a married couple filing jointly with a taxable income of \$45,350.
- Find the tax amount for a single dad filing as head of household with a taxable income of \$42,102.

3.1 Overview of the Statistical Process



Identify the Population, Sample, Parameter and Statistic

3. 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 US insurance company wants to know whether households have two cars. A survey of 976 US households found that 32% of households have two cars.

Sampling Methods

4. 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.

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 $\pm 3\%$.
 - 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.

Types of Studies

6. 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 describe the cases and control group
 - iii. If it is an experiment, write experiment and describe 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.
<p>a. Over a 6-month period, among 100 people with bipolar condition, 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.</p>	
<p>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.</p>	
<p>c. Over the period of one-year, researchers determined which airline had the lowest percentage of canceled flights.</p>	

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.

Sections 3.2-3.3 Describing Data and Measures of CenterGroup Activity**3.2 Describing Data**

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/categorical or quantitative/numerical. You can use either set of words.
 - 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?

Here is the [spreadsheet](#) with our class data and the link is also in D2L. Please have 1 group member open and make a copy and share it with all of your group members. Use this spreadsheet to make your graphs for questions 2 and 3.

Frequency Tables and Graphs of Qualitative Data - Spreadsheets

2. Pick one of qualitative variables above and make a frequency table using a spreadsheet. Use your frequency table to make a pie chart and a bar chart. Add meaningful labels. Write a sentence or two about any patterns or observations you make from the graph.

Quantitative Variables and Histograms - GeoGebra

3. For the credit hour data, follow the instructions below to make a histogram in GeoGebra. You might need to clean up the data if there are any values that aren't a single number. Then write a sentence or two about any patterns or observations you make from the graph.

Use **GeoGebra** to make a histogram: Go to Geogebra.org and select GeoGebra Classic.

In the menu on the right side click on **spreadsheet**, or click on the 3 bars, **View** > **Spreadsheet**, and uncheck other items

Enter your data (copy and paste is best to avoid typos)

Select your data > Click on the histogram for **One Variable Analysis** > Click **Analyze**

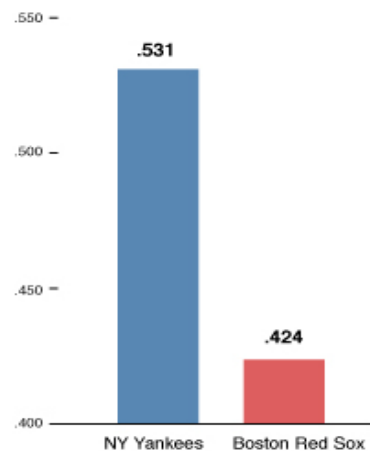
Use the dropdown menu to select **Histogram** if it didn't come up that way. Change the **options** using the icon in the upper right corner. Use the **export** button to save the file. Then insert into a word or google doc. Type labels above and below.

4. What is wrong with these graphs?

a. Ticket Prices



b. Percentage of Victories

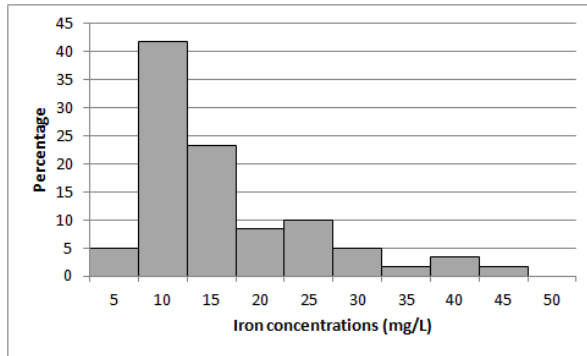


3.3: Shape and Center

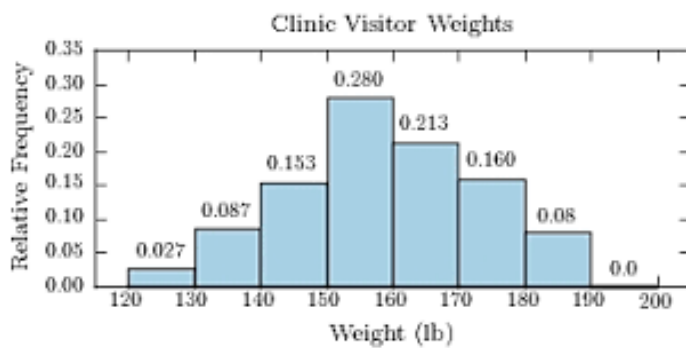
Shape

5. 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)

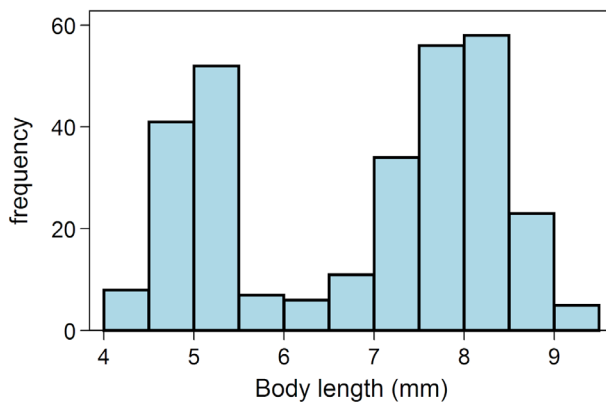
a.



b.



c.



Measures of Center

6. 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 the GeoGebra spreadsheet and make a histogram with a bin width of .02. Use the export button and insert the image into a word or google document. Type your title and labels above and below the graph.
- 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 **GeoGebra** to calculate the measures of center. Click on the $\sum x$ button to show **summary statistics**. Write the mean and median, including units.

7. The US Census Bureau, in addition to counting the population of the US every 10 years, conducts yearly informational surveys, such as the American Community Survey (ACS). For the 2012 ACS, a randomly chosen group of 21 respondents gave their yearly income and gender identity.

Find the mean and median income for each group with units. Find by hand first, then use GeoGebra to check your answers.

- People who identify as male:

53000
70000
12800
30000
4500
42000
48000
60000
108000
11000

- People who identify as female:

1600
1200
20000
25000
670
29000
44000
30000
5800
50000
20000

We will continue with these data sets next time and calculate measures of spread/variation.

3.4, 4.1: Summary Statistics for Spread and Contingency Tables

Group Activity

Choose a reader for the day. You can switch it up at any time. Work through these items together as a team. Have your video notes handy to refer to and you can also use the book to help you.

3.4 5-number summary and boxplots

GeoGebra Instructions: to get summary statistics: Go to Geogebra.org and select GeoGebra Classic.

- In the menu on the right side click on **spreadsheet**, or click on the 3 bars, **View > Spreadsheet**, and uncheck other items
- Enter your data (copy and paste is best to avoid typos)
- Select your data > Click on the histogram for **One Variable Analysis > Click Analyze**
- Click on the $\sum x$ button to show **summary statistics**. Write the mean and median, including units.

The US Census Bureau, in addition to counting the population of the US every 10 years, conducts yearly informational surveys, such as the American Community Survey (ACS). For the 2012 ACS, a randomly chosen group of 21 respondents gave their yearly income and gender identity.

1. Enter the data into GeoGebra: Data for people who identify as male:

a. Use GeoGebra to find the 5-number summary (with units)

b. Calculate the IQR (with units)

c. Find the standard deviation from GeoGebra (S for a sample), with units

d. Once you have your histogram, use the "show 2nd plot" button that looks like two rectangles or an equal sign to create a boxplot. Export and insert your boxplot from GeoGebra and type a label underneath:)

53000
70000
12800
30000
4500
42000
48000
60000
108000
11000

2. Enter the data into GeoGebra: Data for people who identify as female:

a. Use GeoGebra to find the 5-number summary (with units)

b. Calculate the IQR (with units)

c. Find the standard deviation from GeoGebra (S for a sample), with units

d. Once you have your histogram, use the "show 2nd plot" button that looks like two rectangles or an equal sign to create a boxplot. Export and insert your boxplot from GeoGebra and type a label underneath:)

1600
1200
20000
25000
670
29000
44000
30000
5800
50000
20000

3. Which group has higher salaries overall? Which group has more variation?

Calculating Standard Deviation, s

4. The salary numbers are really big to practice calculating the standard deviation by hand, so let's go back to the blood alcohol content data. Calculate the mean rounded to two decimal places, then use it to find the standard deviation, including units. The variable n refers to the number of data values.

Mean = _____, n = _____

Blood alcohol level of drivers in fatal crashes	Deviation from the mean	Squared deviation
0.27		
0.17		
0.17		
0.16		
0.13		
0.24		
0.29		
0.24		
0.14		
0.16		
0.12		
0.16		
Sum of the squared deviations (numerator)		

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

$$= \sqrt{\frac{\quad}{-1}}$$

4.1: Contingency Tables and Probability

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

5. 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:

- identify as female?
- identify as non-binary or genderqueer?
- walk to PCC?
- bus to PCC?
- walk and identify as male?
- identify as non-binary or genderqueer and drive them self to PCC?
- identify as female or ride with another?
- identify as male or walk to PCC?

6. 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 themselves 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?

4.2-4.3: Theoretical Probability and Expected Value

Group Activity

Types of Probability

1. Write the type of probability described by each scenario:
 - a. You flip a coin 1000 times and find that 495/1000 came up tails.
 - b. You know that from prior experience there is a 97% chance that you will have to wait more than an hour at the DMV.
 - c. You calculate the probability of getting heads on three coin flips is $(.50)^3 = .125$.

Theoretical Probability

2. Using the prize wheel below, make a theoretical probability model and then use it to find the probabilities below. Note: Look at the question mark spaces very carefully.

	Sub	Drink	Cookies	Chips	BOGO	Mystery Prize
Probability						

3. If you spin the wheel once, what's the probability that you get
 - a. chips or a drink?
 - b. not the mystery prize?
 - c. a drink or not BOGO?



4. Using the Subway wheel and table, find the following odds:
- The odds of winning the mystery prize.
 - The odds against winning the mystery prize.
5. If you get to spin the Subway wheel repeatedly, ...
- Would that be like drawing with or without replacement?
 - If you get to spin 3 times, what is the chance you would get 3 bags of chips?
6. 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
- it is a small or an extra-large?
 - it is extra-large or orange?
 - it is not small or medium?
 - it is not small or red?
- e. If five people come up and you draw 5 shirts at random, what is the probability that they are all red larges?










4.3: Expected Value



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: http://www.powerball.com/powerball/pb_prizes.asp

Powerball - Prizes and Odds

Match	Prize	Odds
	Grand Prize	1 in 292,201,338.00
	\$1,000,000	1 in 11,688,053.52
	\$50,000	1 in 913,129.18
	\$100	1 in 36,525.17
	\$100	1 in 14,494.11
	\$7	1 in 579.76
	\$7	1 in 701.33
	\$4	1 in 91.98
	\$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).

7. a. If the current Powerball grand prize amount is \$90 million, calculate the expected winnings per ticket (you can use a spreadsheet if you wish):

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

8. 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. Fill in the probability model.

Possibilities	Accident	No Accident
Payout		
Probability		

- b. Calculate the expected value for the company.

9. 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**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 [GeoGebra](#) or [Stapplet](#) for statistics.

1. 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.
2. 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?
3. 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.

4. 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.

5. The number of salespeople assigned to work during a shift is apportioned based on the average number of customers during that shift. Apportion 20 salespeople given the information below. Adapted from David Lippman, <http://www.opentextbookstore.com/mathinsociety/index.html>

a. Hamilton's Method

<u>Subject</u>	<u>Customers</u>	<u>Standard Quota</u>	<u>Initial or Minimum</u>	<u>Final</u>
Morning	95			
Midday	275			
Afternoon	415			
Evening	515			
Total				
Divisor				

b. Jefferson's Method

<u>Subject</u>	<u>Customers</u>	<u>Standard Quota</u>	<u>Initial</u>	(trials)	<u>Final</u>
Morning	95				
Midday	275				
Afternoon	415				
Evening	515				
Total					
Divisor					

6. 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.

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.

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])

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.

7. 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?

8. 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).
9. 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.

10. 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?

11. 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.

12. 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 GeoGebra or Stapplet to create a histogram and boxplot with label and units. Practice taking a screenshot for the final.
- b. Use GeoGebra or Stapplet to find the mean, standard deviation, and 5-number summary, including units.

13. 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?

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

- a. Calculate the expected payout for the insurance company per customer, including units.

Payout	\$20,000	\$15,000	\$1,000	\$500	\$0
Probability	0.001	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.

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Section 1.2: Sets and Venn Diagrams

4. Create a Venn Diagram to illustrate the results of this survey: A survey asked buyers whether color, size, or brand influenced their choice of cell phone. The results are below. Draw a Venn diagram and use it to answer the question below. [4 points]
- 5 said only color, 8 said only size, 16 said only brand.
 - 20 said only color and size, 42 said only color and brand, 53 said only size and brand.
 - 102 said all three, 20 said none of these.

How many people altogether were influenced by the brand?

5. Create a Venn Diagram to illustrate the results of this survey: 100 pet owners were asked whether they like fish and/or rabbits. The results are below. Draw a Venn diagram and use it to answer the question below. [4 points]
- 43 said they like fish in general, 75 said they like rabbits.
 - 32 people said they like both fish and rabbits.

How many people in the survey did not like fish or rabbits?

Section 1.3-1.4 Percents and Proportional Reasoning

6. Safa managed a company to reduce its carbon emissions by 18.3%. The company originally emitted 920 tons of carbon dioxide annually. How much was the reduction and what are the new emissions? [4 points]
7. Find the unit rates and determine which you would rather buy. Explain your reasoning. [2 points each]
- a. A 10-pound bag of potatoes for \$6. Or a 1.5-pound bag of potatoes for \$1.15. Which would you rather buy and why?
- b. 90-count zipper sandwich bags for \$1.79, 150-count zipper sandwich bags for \$2.79, or 280-count zipper sandwich bags for \$5.69. Which would you rather buy and why?
8. Asanji took a trip to Mexico. Upon leaving he decided to convert all of his Mexican Pesos back into U.S. dollars. How many dollars did he receive if he exchanged 72.5 Pesos at a rate of $\$5.83 = 100$ Pesos? [4 points]

Section 1.5 Problem Solving

9. You are organizing a large dinner event. One venue charges \$950 per table of 12. Another venue charges a setup fee of \$1500 and \$40 per person. Which venue is more cost effective? Write out the steps of the problem solving process and any assumptions you make. [8 points]

10. Sidiki wants to fill a circular sandbox with a diameter of 5 feet and a depth of 1.5 feet. If bags of sand contain 3 cubic feet each, how many bags does he need to buy? [4 points]

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Homework Write-up Chapter 5**Name** _____**Section 5.1: Apportionment**

It's very important to acknowledge that when Hamilton, Jefferson and others were making the rules for apportionment, black people were owned and enslaved in the United States. The 3/5 rule counted the black population as only 3/5 of the white population. We need to remember why we still have racism and systemic inequality now and continue to make our systems fair for everyone.

1. A country with 5 states conducts a census and needs to determine how many representatives each state will get based on its population. There must be a total of 26 representatives. Determine how many representatives each state will receive.

- a. **Hamilton's Method** [4 points]

<u>State</u>	<u>Population</u>	<u>Standard Quota</u>
East	351,000	
West	180,300	
North	223,500	
South	101,450	
Middle	403,372	
Total		
Divisor		

- b. **Jefferson's Method** [4 points] Show some of the divisors you tried until you got the right one.

<u>State</u>	<u>Population</u>	<u>Standard Quota</u>
East	351,000	
West	180,300	
North	223,500	
South	101,450	
Middle	403,372	
Total		
Divisor		

c. **Webster's Method** [4 points]

<u>State</u>	<u>Population</u>	<u>Standard Quota</u>
East	351,000	
West	180,300	
North	223,500	
South	101,450	
Middle	403,372	
Total		
Divisor		

d. **Hill-Huntington Method** [4 points]

<u>State</u>	<u>Population</u>	<u>Standard Quota</u>
East	351,000	
West	180,300	
North	223,500	
South	101,450	
Middle	403,372	
Total		
Divisor		

Section 5.2 Voting Methods

2. Union representatives are deciding on a bargaining platform for employee pay, benefits and working conditions. Four options have been proposed and voted on. Here is the preference schedule:

Number of voters	6	3	8	6	6	2
1st choice	B	A	D	A	B	C
2nd choice	C	B	C	D	A	D
3rd choice	A	C	A	B	C	A
4th choice	D	D	B	C	D	B

- How many voters voted in this election? [1 point]
- What is the minimum number of votes needed for a majority win? [1 point]
- What is the minimum number of votes needed for a plurality win? [1 point]
- Find the winner under the plurality method. [1 point]
- Find the winner under the Instant Runoff Voting method. [2 points]
- Find the winner under the Borda Count method. [2 points]
- Find the winner under the Pairwise Comparisons method. If there is a tie, state which candidates are tied. [2 points]
- Which method do you think is the most fair in this situation and why? [1 point]

Section 5.3: The Popular Vote vs. the Electoral College and Voting Power

3. Consider a small country with 3 states. The rules for the number of senators and electors are the same as the U.S. government. Each state gets 1 representative for every 40,000 residents.

a. Determine the number of electors for each state and the total for the country. [2 points]

State	Population	Number of Representatives	Number of Senators	Number of Electors
Red	200,000			
Blue	160,000			
Purple	400,000			

b. The total number of electors in the Electoral College is _____. [1 point]

c. How many electoral votes are needed to win the presidential election? _____ [1 point]

4. There are 2 candidates for the president, Candidate A and Candidate B. When a candidate wins in a state, they get all the electoral votes for that state. Determine who wins the popular vote and who wins the Electoral College vote. [2 points]

State	Votes for Candidate A	Votes for Candidate B	Number of Electoral Votes for A	Number of Electoral Votes for B
Red	96,000	104,000		
Blue	70,400	89,600		
Purple	248,000	152,000		
Total Votes				

a. The winner of the popular vote is _____. [1 point]

b. The winner of the electoral college is _____. [1 point]

c. Which method do you think is more fair and why? [1 point]

Section 5.4: Gerrymandering and the Efficiency Gap

5. You have just been hired as consultants to your state legislature in the re-districting of the state.
- a. To assess the current map below, tally the votes, seats won, and surplus votes. [4 points]

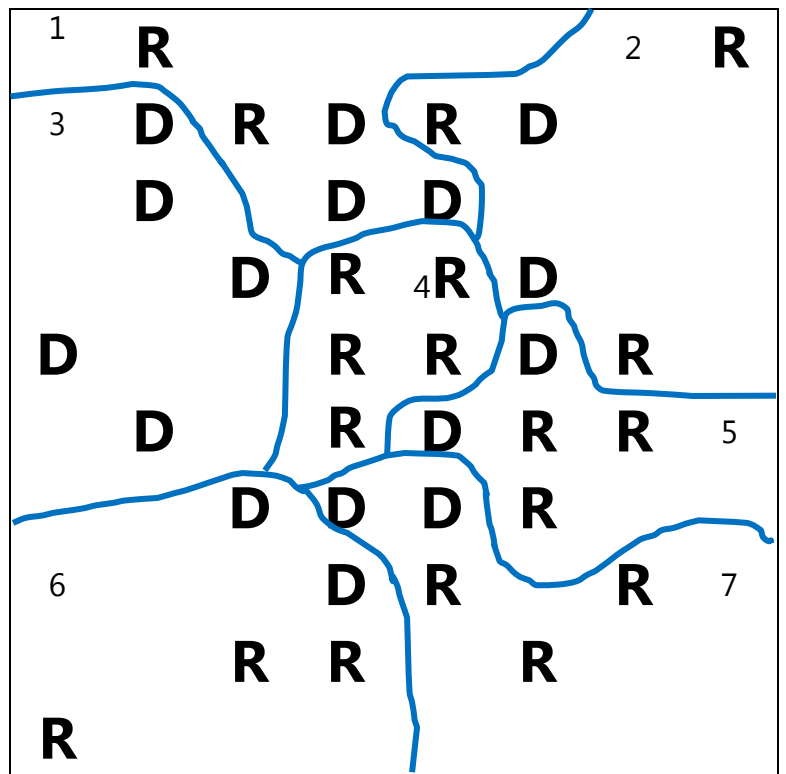
Election Results:	District	D Votes	R Votes	D Surplus or Wasted Votes	R Surplus or Wasted Votes
	1				
Democrats win	2				
_____ seats	3				
	4				
	5				
Republicans win	6				
_____ seats	7				
	Total				

Efficiency Gap

- b. Calculate the efficiency gap using this formula: [2 points]

$$\frac{\text{Party A Wasted Votes} - \text{Party B Wasted Votes}}{\text{Total Votes}}$$

- c. Since there are 7 districts, each district represents about 14% of the state (100%/7). Compare the efficiency gap with that percentage. Is the efficiency gap worth less than one seat or more than one? How many seats? [2 points]



- d. Is this a fair map? Why or why not? [1 point]

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Homework Write-up Chapter 2.1-2.4

Name _____

Section 2.1-2.2 Spreadsheets and Simple and Compound Interest

1. Show all your steps and include any spreadsheet formulas you use, written in proper spreadsheet form. Answer each question using a complete sentence.

- a. How much will you have in 20 years if you invest \$4000 now with an APR of 6% and it is compounded monthly? [2 points]

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)

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

- b. A friend lends you \$500 for 2 years at 4% simple interest per year. How much will you pay them back at the end of the loan? [2 points]

- c. How much would you need to deposit now in order to have \$100,000 in 25 years at 8.5% compounded daily? [2 points]

Sections 2.1-2.4 Mixed

4. It's important to know when to use each formula so these questions are all mixed up. Show all of your steps and include any spreadsheet formulas you use, written in proper spreadsheet form. [2 points each]
- Keisha received an inheritance of \$20,000 and invested it at 6.9% interest, compounded continuously. How much will she have for college in 8 years?
 - Paul wants to buy a new car. Rather than take out a loan, he decides to save \$200 a month in an account earning 3.5% interest compounded monthly. How much will he have saved up after 3 years?
 - Sol is managing investments for a non-profit company. They want to invest some money in an account earning 5% interest compounded annually with the goal to have \$30,000 in the account in 6 years. How much should Sol deposit into the account?
 - How much would you need to save every month in an account earning 4.1% interest to have \$5,000 saved up in two years.
 - Terry and Jess are buying a house for \$405,000 and they can afford to put 10% down. Their interest rate is 4.3% for 30 years. What will their monthly mortgage payment be?
 - Zahid starts saving \$150 per month in an account that pays 4.8% compounded monthly. If he continues for 20 years, how much will he have? If he waited 10 years instead and put in \$300 per month for 10 years with the same interest, how much would he have?

- f. What is the confidence interval and how should it be interpreted? [2 points]

- g. How would you respond to someone who claims *the majority of US adults are in favor of lowering the drinking age?* [2 points]

- h. Is this an experiment or observational study? Explain. [2 points]

- i. Name and describe one type of bias that could be present in this study. [2 points]

Section 3.2: Describing Data

- 3. In one of my stats classes I asked students, "If you could have one superpower, what it would be?" The response of each student is given below.

Mind Read	Fly	Fly	Fly	Other	Telekinesis	Fly
Other	Teleport	Other	Other	Telekinesis	Fly	Teleport
Mind Read	Teleport	Fly	Other	Invisible	Fly	Other
Telekinesis	Fly	Other	Invisible	Mind Read	Other	Fly

- j. Complete the following table for the data. Show all work. [2 points]

Super Power	Frequency	Relative Frequency
Mind Read		
Fly		
Telekinesis		
Invisible		
Teleport		
Other		

p. Considering the mean and the median, is the distribution more likely to be left skewed, right skewed, or symmetric? Explain. [2 points]

q. Calculate the standard deviation of the data, including units. [4 points]

Data	Deviation from Mean	Squared Deviation
62		
62		
63		
64		
65		
65		
66		
67		
68		
68		
69		
70		
71		
73		
Sum of the squared deviations:		

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

(You can use the equation editor to show your steps. Select Insert > Equation.)

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Homework Write-up Chapter 4**Name** _____**Section 4.1 Contingency Tables**

1. The 117th US Congress (2021-2022) is the most diverse yet, but how diverse is it? Below are some contingency tables.

a. Complete each table below. [4 points]

	Openly LGBTQ+	Straight or not out	Total
House Democrats	9		221
Senate Democrats	2		50
House Republicans	0		211
Senate Republicans	0		50
Total			

	Black	Latinx	Native American	Asian or Pacific Islander	White	Total
House Democrats	54	30	3	14	125	221*
Senate Democrats	2	4	0	2	42	50
House Republicans	2	10	3	2	194	211
Senate Republicans	1	2	0	0	47	50
Total						

Note that racial categories have been socially constructed and have many limitations. The US Census does not have a category for people from the Middle East, who have been traditionally categorized as white. This may not feel representative to them (about 3 million people).

*Multiracial was not a category so people may be listed in more than one category. That's why the total is more than 221 people.

Source: <https://www.dailykos.com/stories/2021/2/24/2011804/-Daily-Kos-Elections-presents-our-comprehensive-guide-to-the-117th-Congress-members-and-districts>

Use the tables to answer the questions. Show your steps and answer questions in a complete sentence.

b. What percentage of congress is out as LGBTQ+? [1 point]

c. If a member of congress is chosen at random, what is the probability they are Republican and out as LGBTQ+? [1 point]

- d. If a member of congress is selected, what is the probability they identify as a person of color (Black or Latinx or Native American or Asian or Pacific Islander)? [1 points]

- e. Given that a person in congress identifies as Black, what is the probability they are a Democrat? [2 points]

- f. Given that a person in congress is a Republican, what is the probability they are White? [2 points]

- g. Calculate the percentage of each race/ethnicity in congress. Then compare your percentages with the overall US demographics using this link. [4 points]
<https://www.census.gov/quickfacts/fact/table/US/PST045218>

	Black	Latinx	Native American	Asian or Pacific Islander	White
Percentage of Congress					
Percentage of US Population					

- h. Do you think the representation in congress is fair? Explain why or why not. [2 points]

Section 4.2: Theoretical Probability

2. Toma Todo, or Pirinola, is a game of chance from Mexico. Children as well as adults play toma todo with a pirinola, which is a six-sided top. Each of six possible outcomes on the pirinola is equally likely to occur. To win, each player must acquire all the beans from the other players.

To begin the game, each player has 10 beans and places 1 bean in a center pile. Turns are taken. A turn consists of spinning the pirinola and following the directions on the side that is faceup after the spin.



The sides of the Pirinola contain this information:



- pon 1 (put in 1 bean)
- pon 2 (put in 2)
- toma todo (take all)
- toma 1 (take 1)
- toma 2 (take 2)
- todos ponen (each player puts 1 in the pile)



If the toma todo side lands faceup, then to continue the game, each player must place 1 bean in a center pile again. Play continues until one player has all the beans. Source: <https://www.uccs.edu/Documents/pipes/mccoyprob-games.pdf>

- What is the probability of the pirinola landing on each side? [1 point]
 - What are the odds of spinning toma todo? [1 point]
 - What are the odds against spinning toma todo? [1 point]
 - What is the probability of spinning pon 2 three times in a row? [2 points]
 - What is the chance of spinning toma todo 10 times in a row? [2 points]
3. In your sock drawer you have 2 types of socks (short and long) in different colors:
- Blue short: 2 Black short: 3 Black long: 5 Brown short: 4 Pink long: 1
- What is the probability of drawing a black pair of socks at random? [1 point]
 - What are the odds of drawing the pink socks? [1 point]
 - What is the probability of drawing a blue or short pair of socks at random? [1 point]
 - If you draw socks at random for 4 days in a row (without doing laundry), what is the chance of getting all 4 brown short socks? [2 points]

Section 4.3: Expected Value

4. The Gone Squatchin' Lottery ticket can be purchased for \$1 and has a top prize of \$1,200. If you reveal a sasquatch symbol  you win that amount. If you reveal binoculars,  you also get \$10. Using the prize table at <https://www.oregonlottery.org/games/scratch-its/details/1283>, here is the probability of winning each prize.

Prize	Probability
\$1200	$\frac{10}{2,160,000}$
\$500	$\frac{14}{2,160,000}$
\$200	$\frac{80}{2,160,000}$
\$100	$\frac{150}{2,160,000}$
\$50	$\frac{600}{2,160,000}$
\$30	$\frac{2,000}{2,160,000}$
\$15	$\frac{8,100}{2,160,000}$
\$10	$\frac{10,800}{2,160,000}$
\$6	$\frac{13,500}{2,160,000}$
\$5	$\frac{13,500}{2,160,000}$
\$3	$\frac{94,500}{2,160,000}$
\$2	$\frac{135,000}{2,160,000}$
\$1	$\frac{267,300}{2,160,000}$
\$0	$\frac{1,614,446}{2,160,000}$



a. Calculate the expected winnings for this type of ticket. Use the entire probability table and show your steps. [5 points]

b. What is the expected profit or loss for this ticket? [2 points]