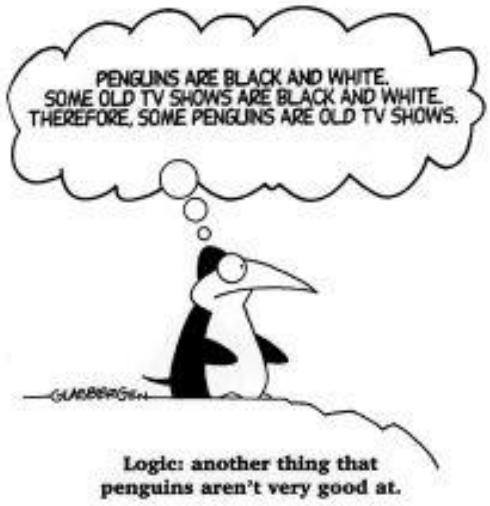
1B: Propositions and Truth Values

Group Activity

Have the reader in your group read each question and as a group, discuss your answer.



1. Discuss each item 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. (Note: not p can also be represented in symbols by ~p.)

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. Complete the truth table given the following propositions. Then explain what you ate for breakfast in each case.

p: I ate bacon for breakfast. *q:* I ate eggs for breakfast.

p	*q*	*p* ***and*** *q*	*Explanation – What did you eat for breakfast?*

5. Given the conditional statement, complete the truth table. Refer to your notes for help if needed. (Note: "if p, then q" can be written in symbols as p→q.)

"If I am elected, then I will reduce college tuition in Oregon."

p: I am elected *q*: I will reduce college tuition in Oregon

p	*q*	*if p, then q* $p \rightarrow q$	*Meaning – Have I told the truth?*

6. Pizza Truth Table

Let P represent pepperoni, H represent ham, and M represent mushrooms.

a. Complete each row by determining whether each statement is true or false. Don't worry about the meaning yet.

P	H	M	P and H	H or M	P and H and M	not P	not M	not P or not M
T	T	T						
T	T	F						
T	F	T						
T	F	F						
F	T	T						
F	T	F						
F	F	T						
F	F	F						

b. Now that you have the table filled in, Identify the row for each type of pizza given.

Pepperoni and Mushroom Pizza: Row _____

Cheese Pizza: Row _____

Veggie Pizza (peppers, onions, mushrooms, olives): Row _____

Supreme Pizza (ham, pepperoni, sausage, olives, mushrooms, onions, peppers): Row _____

c. Explain the result (T or F), in the context of the pizza and its toppings.

i. Row 8 Column 9

ii. Row 3 Column 4

1C: Sets and Venn diagrams

7. Draw a Venn diagram for each 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

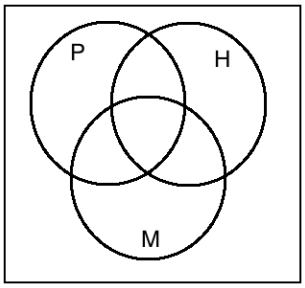
a. Some bikes are orange. _____

b. All bicycles have wheels. _____

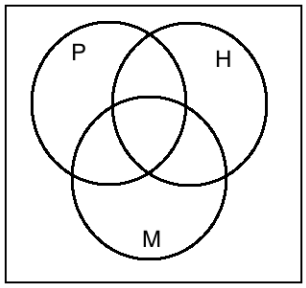
8. Pizza Venn Diagrams

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.

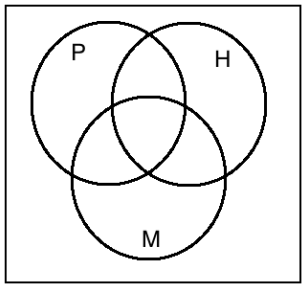
Pepperoni & Mushroom



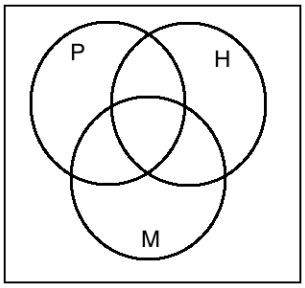
Cheese



Veggie



Supreme



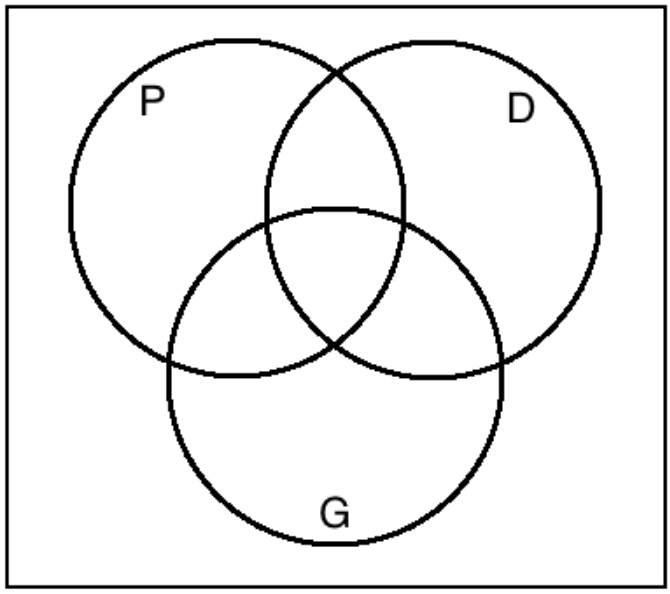
9. Finding values for regions on a Venn diagram

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 D: Analyzing Arguments

10. Determine whether each argument is inductive or deductive.

a. All cats have a keen sense of smell. Fluffy is a cat, so Fluffy has a keen sense of smell.

b. All brown dogs in the park are small dogs. Therefore, all small dogs are brown.

c. My friends who are in college eat pizza. Pizza is affordable. Therefore, all college students eat pizza.

11. Draw a Venn diagram for each deductive argument and determine whether it is valid and sound. (Problems adapted from David Lippman http://www.opentextbookstore.com/mathinsociety/index.html)

a. Premise: All cats are mammals
Premise: A tiger is a cat
Conclusion: A tiger is a mammal

The conclusion is valid/invalid
The conclusion is sound/not sound

b. Premise: If you live in Portland, you live in Oregon
Premise: Cara does not live in Oregon
Conclusion: Cara does not live in Portland

The conclusion is valid/invalid
The conclusion is sound/not sound

Here are a few more vocabulary words:

Related Statements	In Words	In Symbols
The original conditional is	"if p, then q"	$p \rightarrow q$
The converse is	"if q, then p"	$q \rightarrow p$
The inverse is	"if not p, then not q"	$\sim p \rightarrow \sim q$
The contrapositive is	"if not q, then not p"	$\sim q \rightarrow \sim p$

12. Here is a conditional statement: If you have finished your homework, then you get ice cream. Identify p and q to help you write each statement below.

a. Write the converse of the original statement.

b. Write the inverse of the original statement.

c. Write the contrapositive of the original statement.

d. If the original statement is true, which of the other three are also true?

1A: Logical Fallacies

A **logical fallacy** is a type of flawed or misleading argument.

We are going to study ten common fallacies (but there are many more that you can find on the internet).

The ten fallacies are listed on the yellow and red cards (like fútbol or soccer penalty cards) with their descriptions on the back. There are ten examples on white cards.

10 Common Logical Fallacies

13. Using the cards provided, match the example with the description and write the name of the fallacy.

Fallacy	Description	Examples
	Many people believe p is true; therefore, p is true.	"Everyone is buying these jeans, so they are the best."
	A came before B; therefore, A caused B.	"Today I wore a red shirt, and my team won! I will wear a red shirt every time they play to make sure they keep winning."
	There is no proof that p is true; therefore, p is false.	"No one has proven it isn't Bigfoot in the photo, so it must be Bigfoot."
	A and B are linked one or a few times; therefore, A causes B or B causes A.	"Months with high ice cream sales also have a high rate of deaths by drowning. Therefore, ice cream must be causing people to drown."
	p is false; Therefore, only q can be true.	"Either those lights in the sky were an airplane or aliens. There are no airplanes scheduled for tonight, so it must be aliens."
	p is associated with a positive emotional response; therefore, p is true.	"If you care enough to send the very best you will buy this brand of card."
	p is true; therefore, p restated in a different way is true.	"Only an untrustworthy person would run for office. The fact that politicians are untrustworthy is proof of this."
	p is related to q and I have an argument regarding q; therefore, p is true.	"We can't worry about the environment, we're in the middle of a war."
	I have an argument regarding an oversimplified or distorted version of p; therefore, I hope you will believe it is true about the real version of p.	"Senator Jones has proposed reducing military funding by 10%. Apparently, he wants to leave us defenseless against attacks by terrorists."
	I have a problem with the person or group claiming p; therefore, p is not true.	"Vote against the healthcare bill because 'Lying Laura' supports it."

More Practice
These problems can be used to check your understanding, help with online homework and study for tests. The answers can be found on my website.

1B Truth Values

1. The following proposition has the form p and q. Decide whether each part is true or false and whether the entire proposition is true or false.

$25+30=55$ *and* $55\div 11=6$

2. Complete the truth table.

r	s	t	r and t	s or t	not (s or t)	If s then (r and t)	not r	If s then not r
T	T	T						
T	T	F						
T	F	T						
T	F	F						
F	T	T						
F	T	F						
F	F	T						
F	F	F						

1C Sets and Venn Diagrams

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

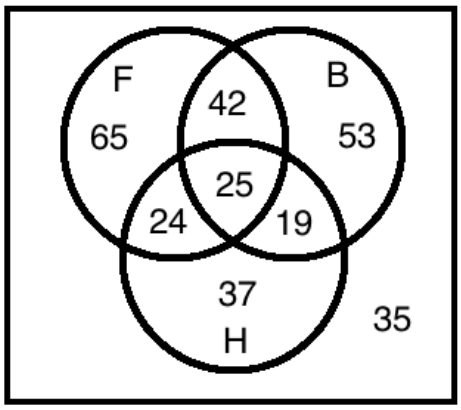
Relationship between the Sets

a. No cars are airplanes. _____

b. Some college students don't take psychology. _____

4. Interpreting values on a Venn diagram

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



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

a. How many students participated in the survey?

b. How many students watched basketball?

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

d. How many students watched at least two sports?

e. How many students didn't watch hockey?

f. How many students watched football and hockey, but not basketball?

1D Analyzing Arguments

5. Draw a Venn diagram for each deductive argument and determine whether it is valid and sound. (Problems adapted from David Lippman http://www.opentextbookstore.com/mathinsociety/index.html)

a. Premise: Some cows are brown
Premise: Fido is not a cow
Conclusion: Fido is brown

The conclusion is valid/invalid
The conclusion is sound/not sound

b. Premise: All PCC Students Live in Portland
Premise: Trung is a PCC Student
Conclusion: Trung lives in Portland

The conclusion is valid/invalid
The conclusion is sound/not sound

c. Premise: All firefighters know CPR
Premise: Juliana knows CPR
Conclusion: Juliana is a firefighter

The conclusion is valid/invalid
The conclusion is sound/not sound

6. Here is a conditional statement: If I go to the party, I will see Shonda.

Identify whether each statement is using the original, converse, inverse or contrapositive. Which two of these arguments are valid?

a. I did not see Shonda; therefore, I did not go to the party.

b. I saw Shonda; therefore, I went to the party.

c. I went to the party; therefore, I saw Shonda.

d. I did not go to the party; therefore, I did not see Shonda.

7. Here is a conditional statement: If it is raining, there are clouds in the sky.

Identify whether each statement is using the original, converse, inverse or contrapositive. Which two of these arguments are valid?

a. It is not raining; therefore, there are no clouds in the sky.

b. There are no clouds in the sky; therefore, it is not raining.

c. There are clouds in the sky; therefore, it is raining.

d. It is raining; therefore, there are clouds in the sky.

8. Given your answers to problems 4, 5, and 6, which of the four types of statements are equivalent to each other? Challenge problem: prove it with a truth table.

1D Identifying Premise(s) and Conclusions
1A Logical Fallacies

9. The conclusion is typically written after the premise(s), but that is not always the case. In each problem, highlight or circle each premise(s) and label them. Underline the conclusion and label it. Then write the type of fallacy.

Example:
The poll shows that Mr. Burke is leading by a 2-to-1 margin, so you should vote for Mr. Burke.

Fallacy:

a. Coyotes must be extinct, since I haven't seen any for five years.

Fallacy:

b. "You don't drink Coke, so you must not consume caffeinated drinks."

Fallacy:

c. People should avoid seeing the movie "Star Wars" because Jan was diagnosed with strep throat the next day after she saw it, and I got the flu a few days after seeing that same movie.

Fallacy:

d. "Ms. Cheng is the most successful mayor of Bay City because she is the best mayor in the history of Bay City."

Fallacy: