

Do you have a dog or a cat or neither?
Place your initials in the appropriate column.

Dog (D)	Cat (C)	Neither (N)

Record your preference in the two-way frequency table. Use a tally.

	Snapchat (S)	Instagram (I)
Born in Tracy (T)		
Not Born in Tracy (N)		

21.1 Set Theory

1/12/23

Venn Diagram: a picture that illustrates the relationship between two or more sets.

set: a collection of distinct objects

elements: the objects in a set

empty set: a set with no elements, denoted by \emptyset or $\{ \}$

universal set: set of all elements involved in the problem under consideration, denoted by U .

For our example:

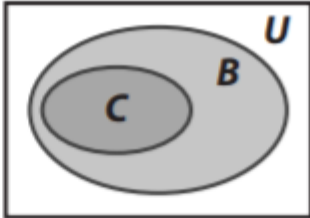
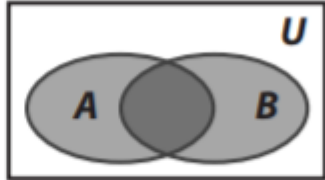
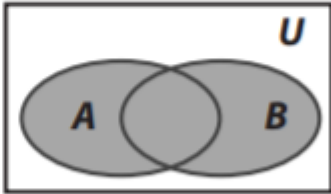

set A is the set of prime numbers less than 10 $A = \{2, 3, 5, 7\}$

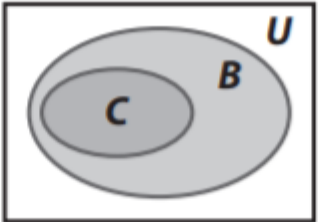
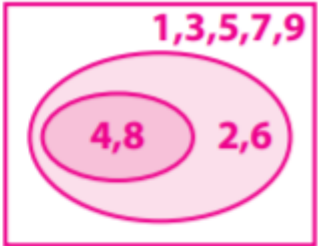
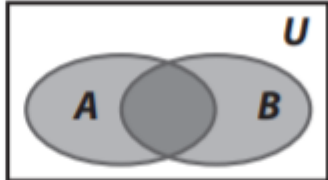
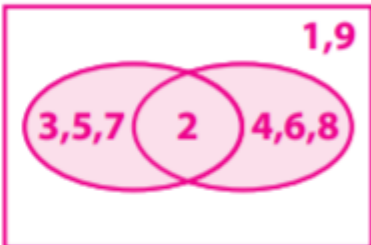

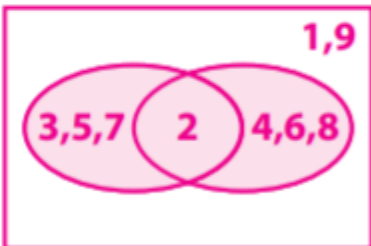
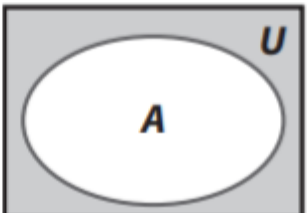

set B is the set of even numbers less than 10 $B = \{2, 4, 6, 8\}$

set C is the set of multiples of 4 less than 10 $C = \{4, 8\}$

set U is the universal set of all whole numbers from 1 to 9

$$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$$

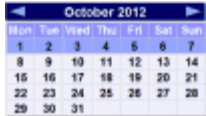
Term	Notation	Venn Diagram	Example
Set C is a subset of set B if every element of C is also an element of B .	$C \subset B$	 <p>A rectangular box labeled U in the top right corner contains two nested ovals. The outer oval is labeled B and is shaded gray. The inner oval is labeled C and is also shaded gray, representing that C is a subset of B.</p>	
The intersection of sets A and B is the set of all elements that are in both A and B .	$A \cap B$	 <p>A rectangular box labeled U in the top right corner contains two overlapping ovals labeled A and B. The overlapping region between the two ovals is shaded gray, representing the intersection of A and B.</p> <p>$A \cap B$ is the double-shaded region.</p>	
The union of sets A and B is the set of all elements that are in A or B .	$A \cup B$	 <p>A rectangular box labeled U in the top right corner contains two overlapping ovals labeled A and B. The entire area covered by both ovals, including their intersection, is shaded gray, representing the union of A and B.</p> <p>$A \cup B$ is the entire shaded region.</p>	
The complement of set A is the set of all elements in the universal set U that are <i>not</i> in A .	A^c or $\sim A$ or \bar{A}	 <p>A rectangular box labeled U in the top right corner contains a white oval labeled A. The area within the box that is outside the oval is shaded gray, representing the complement of A.</p> <p>A^c is the shaded region.</p>	

Term	Notation	Venn Diagram	Example
Set C is a subset of set B if every element of C is also an element of B .	$C \subset B$	 <p>A rectangular box labeled U contains a large oval labeled B. Inside B is a smaller oval labeled C. Both B and C are shaded gray.</p>	 <p>A rectangular box labeled U contains a large oval labeled B with elements $1,3,5,7,9$ above it. Inside B is a smaller oval labeled C with elements $4,8$ inside it. Another element $2,6$ is shown to the right of C but inside B.</p>
The intersection of sets A and B is the set of all elements that are in both A and B .	$A \cap B$	 <p>A rectangular box labeled U contains two overlapping ovals labeled A and B. The overlapping region is shaded gray.</p> <p>$A \cap B$ is the double-shaded region.</p>	 <p>A rectangular box labeled U contains two overlapping ovals labeled A and B. The overlapping region contains the element 2. Oval A also contains $3,5,7$ and oval B contains $4,6,8$. Elements $1,9$ are shown above the box.</p>
The union of sets A and B is the set of all elements that are in A or B .	$A \cup B$	 <p>A rectangular box labeled U contains two overlapping ovals labeled A and B. The entire area covered by both ovals is shaded gray.</p> <p>$A \cup B$ is the entire shaded region.</p>	 <p>A rectangular box labeled U contains two overlapping ovals labeled A and B. The overlapping region contains the element 2. Oval A also contains $3,5,7$ and oval B contains $4,6,8$. Elements $1,9$ are shown above the box.</p>
The complement of set A is the set of all elements in the universal set U that are <i>not</i> in A .	A^c or $\sim A$	 <p>A rectangular box labeled U contains a white oval labeled A. The area outside A but inside U is shaded gray.</p> <p>A^c is the shaded region.</p>	 <p>A rectangular box labeled U contains a white oval labeled A with elements $2,3,5,7$ inside it. The area outside A but inside U is shaded gray and contains elements $1,4,6,8,9$.</p>

Complement of an Event: All outcomes that are NOT the event.



When the event is **Heads**, the complement is **Tails**



When the event is {**Monday, Wednesday**} the complement is {**Tuesday, Thursday, Friday, Saturday, Sunday**}



When the event is {**Hearts**} the complement is {**Spades, Clubs, Diamonds, Jokers**}

So the Complement of an event is all the **other** outcomes (**not** the ones we want).

And together the Event and its Complement make all possible outcomes.

Example: You roll a die. Event A is rolling a prime. Event B is rolling an odd number.

Draw a Venn diagram. Find:

1. $A \cup B$
2. $P(A \cup B)$
3. $A \cap B$
4. $P(A \cap B)$
5. A^C
6. $P(A^C)$