

# Set Operations

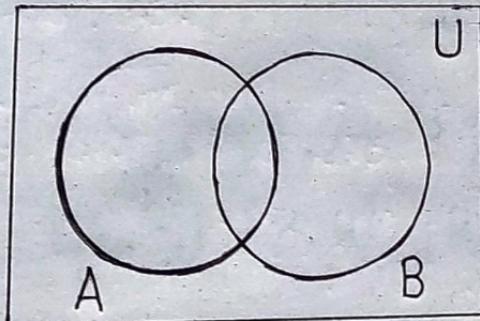
A set is a collection of items.

We denote a set using a capital letter and we define the items within the set using curly brackets. For example, suppose we have some set called "A" with elements 1, 2, 3. We would write this as:

$$A = \{1, 2, 3\}$$

This tutorial explains the most common set operations used in probability and statistics.

## Union



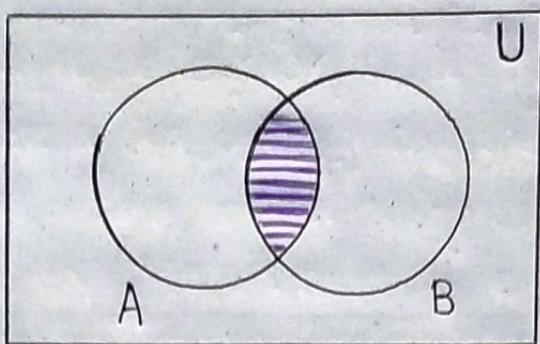
Definition: The union of sets A and B is the set of items that are in either A or B.

Notation :  $A \cup B$

Examples:

- $\{1, 2, 3\} \cup \{4, 5, 6\} = \{1, 2, 3, 4, 5, 6\}$
- $\{1, 2\} \cup \{1, 2\} = \{1, 2\}$
- $\{1, 2, 3\} \cup \{3, 4\} = \{1, 2, 3, 4\}$

## Intersection



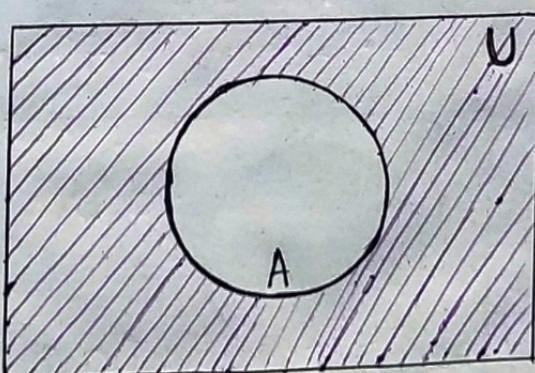
Definition: The intersection of sets A and B is the set of items that are in both A and B.

Notation:  $A \cap B$

Examples:

- $\{1, 2, 3\} \cap \{4, 5, 6\} = \{\emptyset\}$
- $\{1, 2\} \cap \{1, 2\} = \{1, 2\}$
- $\{1, 2, 3\} \cap \{3, 4\} = \{3\}$

## Complement



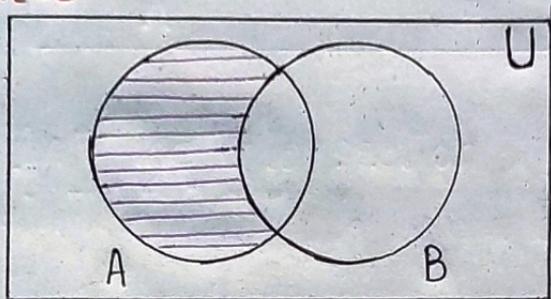
Definition: The complement of set A is the set of items that are in the universal set U but are not in A.

Notation:  $A'$  or  $A^c$

Examples:

- If  $U = \{1, 2, 3, 4, 5, 6\}$  and  $A = \{1, 2\}$ , then  $A^c = \{3, 4, 5, 6\}$
- If  $U = \{1, 2, 3\}$  and  $A = \{1, 2\}$ , then  $A^c = \{3\}$

## Difference



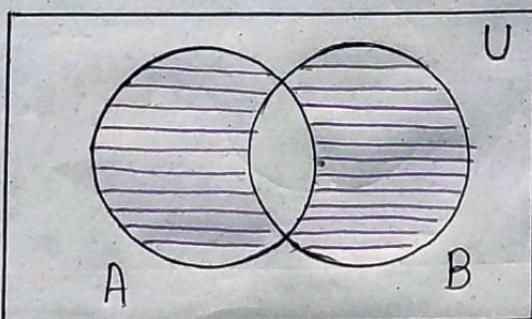
Definition: The difference of sets  $A$  and  $B$  is the set of items that are in  $A$  but not  $B$ .

Notation:  $A - B$

Examples:

- $\{1, 2, 3\} - \{2, 3, 4\} = \{1\}$
- $\{1, 2\} - \{1, 2\} = \{\emptyset\}$
- $\{1, 2, 3\} - \{4, 5\} = \{1, 2, 3\}$

## Symmetric Difference



Definition: The symmetric difference of sets  $A$  and  $B$  is the set of items that are in either  $A$  or  $B$ , but not in both.

Notation:  $A \Delta B$

Examples:

- $\{1, 2, 3\} \Delta \{2, 3, 4\} = \{1, 4\}$
- $\{1, 2\} \Delta \{1, 2\} = \{\emptyset\}$
- $\{1, 2, 3\} \Delta \{4, 5\} = \{1, 2, 3, 4, 5\}$

## Cartesian Product

		Set A	
		H	T
Set B	1	(H, 1)	(T, 1)
	2	(H, 2)	(T, 2)
	3	(H, 3)	(T, 3)

Definition: The cartesian product of sets A and B is the set of ordered pairs from A and B.

Notation:  $A \times B$

Examples:

- If  $A = \{H, T\}$  and  $B = \{1, 2, 3\}$ , then  $A \times B = \{(H, 1), (H, 2), (H, 3), (T, 1), (T, 2), (T, 3)\}$
- If  $A = \{T, H\}$  and  $B = \{1, 2, 3\}$ , then  $A \times B = \{(T, 1), (T, 2), (T, 3), (H, 1), (H, 2), (H, 3)\}$