Set operations
and
Venn Diagrams
Set operations and Venn diagrams

\[ A \cap B = \{ x \mid x \in A \text{ and } x \in B \} \]
This is the intersection of A and B.

\[ A \cup B = \{ x \mid x \in A \text{ or } x \in B \} \]
This is the union of A and B.

An element of \( A \cap B \) belongs to both A and B,

an element of \( A \cup B \) is required to belong to at least one of the sets.
\[ A \cap B = \{ x \mid x \in A \text{ and } x \in B \} \]
\[ A \cup B = \{ x \mid x \in A \text{ or } x \in B \} \]
Sets and the Universal Set

A = \{1,2,3,4\}, B = \{1,3,5,7\}, and C = \{7,9,3\}, and the universal set U = \{1,2,3,4,5,6,7,8,9\}. Locate all this information appropriately in a Venn diagram.
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With each number, place it in the appropriate region.
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Check out the Venn diagram and make sure you agree with where all the elements have been placed.
Distributive Law for Unions

\[ A \cup (B \cap C) = (A \cup B) \cap (A \cup C) \]
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\[ A \cup (B \cap C) = (A \cup B) \cap (A \cup C) \]
DeMorgan’s Law

\[(A \cup B)^c = A^c \cap B^c\]
DeMorgan’s Law

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\((A \cup B)^c\) is the gray region in this picture.
DeMorgan’s Law

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\((A \cup B)^c\) is the gray region in this picture

At this stage \(A\) is painted green.
DeMorgan’s Law
\[(A \cup B)^c = A^c \cap B^c\]

\[(A \cup B)^c\] is the gray region in this picture

Now B is painted red, so what’s outside of A and outside of B hasn’t been painted.
DeMorgan’s Law

\[(A \cup B)^c = A^c \cap B^c\]

(A \cup B)^c \text{ is the gray region in this picture}

What hasn’t been painted is \(A^c \cap B^c\)
DeMorgan’s Other Law

$$(A \cap B)^c = A^c \cup B^c$$
DeMorgan’s Other Law

\[(A \cap B)^c = A^c \cup B^c\]
Grouping Students

Let’s denote by $M$ and $B$ the students in a particular university that are studying mathematics and business. Write down the set that describes each of the following groups of students:

(a) students studying math but not business
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\[ M \cap B^c \]
Grouping Students
Let’s denote by M and B the students in a particular university that are studying mathematics and business. Write down the set that describes each of the following groups of students:

(b) students studying both math and business
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(b) students studying both math and business

\[ M \cap B \]
Grouping Students

Let’s denote by M and B the students in a particular university that are studying mathematics and business. Write down the set that describes each of the following groups of students:

(c) students studying either math or business
Grouping Students

Let’s denote by M and B the students in a particular university that are studying mathematics and business. Write down the set that describes each of the following groups of students:

(c) students studying either math or business

\[ M \cup B \]
**Grouping Students**

Let’s denote by M and B the students in a particular university that are studying mathematics and business. Write down the set that describes each of the following groups of students:

(d) students who study neither math nor business
Grouping Students

Let’s denote by \( M \) and \( B \) the students in a particular university that are studying mathematics and business. Write down the set that describes each of the following groups of students:

(d) students who study neither math nor business

\[(M \cup B)^c \ \text{or} \ \ M^c \cap B^c\]
Grouping Students

Let’s denote by M and B the students in a particular university that are studying mathematics and business. Write down the set that describes each of the following groups of students:

(e) students who don’t study math and who don’t study business
Grouping Students

Let’s denote by M and B the students in a particular university that are studying mathematics and business. Write down the set that describes each of the following groups of students:

(e) students who don’t study math and who don’t study business

\[(M \cup B)^c \text{ or } M^c \cap B^c\]
Sketching regions representing sets:

Sketch the region corresponding to the set

\[(A \cup B^c) \cap C\]
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