Section 2.2
Sets and Venn Diagrams

A set is a collection of objects. Two sets are equal if they contain the same elements.

The Universal set is the set of interest in a particular discussion.

Set \( A \) is a subset of set \( B \) if every element that is in set \( A \) is also in set \( B \). The notation for this is \( A \subseteq B \).

Set \( A \) is a proper subset of set \( B \) if every element that is in set \( A \) is also in set \( B \) and there is at least one element in set \( B \) that is not in set \( A \). The notation for this is \( A \subset B \).

Example: In this class, raise your hand if you’re a Kinesiology major.

The complement of set \( A \), which is written as \( A^c \), is the set of all elements that are in the universal set but are not in set \( A \). Key word in word problems will be: “not”

Example: Everyone in this class that is not a Kinesiology major.

The union of \( A \) and \( B \), which is written as \( A \cup B \), is the set of all elements that belong either to set \( A \) or to set \( B \) or to both \( A \) and \( B \). Key words in word problems will be: “or” or “either and or both”

Example: The group of all athletes at UH that play Baseball or Soccer or both sports.

The intersection of \( A \) and \( B \), which is written as \( A \cap B \), is the set of all elements that belong to both set \( A \) and set \( B \). Key words in word problems will be: “and”, “both”, “but”, “nor”

Example: The group of all athletes at UH that play Baseball AND Soccer.

If the intersection of two sets is empty (the empty set is denoted by \( \emptyset \)), then the sets are disjoint or mutually exclusive and we write \( A \cap B = \emptyset \).

Example: Rolling a six-sided dice once and the result is an even and an odd number.
Some Useful Properties

\[ U^c = \emptyset \quad \emptyset^c = U \quad (A^c)^c = A \]

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

Example 1: Let \( A = \{2, 4, 6\} \), \( B = \{0, 2, 6, 9\} \), \( C = \{3, 4, 7\} \), and \( U = A \cup B \cup C \)

a. Find \( U \).

b. Is \( C \subset U \) ?

c. Find \( A^c \).

d. Find \( A \cap C \).

e. Find \( C \cap (B \cup A^c) \).
A **Venn diagram** is a visual representation of sets.

Some look like:

![Venn Diagram](image)

Example 2: Use shading to state the region(s) that represent(s) the given set.

a. \((A \cap B^c)\)

![Diagram for A \cap B^c](image)

b. \((A^c \cup (B \cap C))\)

![Diagram for A^c \cup (B \cap C)](image)

c. \((A \cap (B \cup C))\)

![Diagram for A \cap (B \cup C)](image)
Example 3: In a survey of 374 coffee drinkers it was found that 227 take sugar, 245 take cream, and 163 take sugar and cream with their coffee. How many take neither sugar nor cream with their coffee?

Example 4: The following Venn diagram represents the number of students enrolled in the courses listed. Use the Venn diagram to answer the following questions.

![Venn Diagram]

a. How many students are enrolled in at least 2 of the three subjects mentioned here?

b. How many students are enrolled in at most 1 of the three subjects mentioned here?

c. How many students are enrolled in Statistics or English but not Business Calculus?