Event Operations

STAT 330 - Iowa State University

Outline

In this lecture, students will learn event operations to combine events into new events. These will be used when finding probabilities for various events.

Set Theory

Set Notation

Review symbols $\in, \notin, \subset, \subseteq, \supset, \supseteq$.

- If x is an element of set B, this is denoted $x \in B$

- If y is not an element of set B, this is denoted $y \notin B$

- If every element of set A is also an element of set B, then A is a subset of B. $A \subseteq B$

Let A and B be two events $\cdots$

- *Union* ($\cup$): $A \cup B$ is the event consisting of all outcomes in A or in B or in <u>both</u>.

$$A \cup B = \{\omega \mid \omega \in A \text{ or } \omega \in B\}$$

Set Notation Cont.

- *Intersection* ($\cap$): $A \cap B$ is the event consisting of all outcomes simultaneously in A and in B.

$$A \cap B = \{\omega \mid \omega \in A \text{ and } \omega \in B\}$$

- *Complement* ($\bar{A}$): The complement of an event A ($\bar{A}$) is the event consisting of all outcomes not in A.

$$\bar{A} = \{\omega \mid \omega \notin A\}$$

Set Notation Cont.

- *De Morgan's laws*:

$$(\overline{A \cup B}) = \bar{A} \cap \bar{B} \qquad (\overline{A \cap B}) = \bar{A} \cup \bar{B}$$
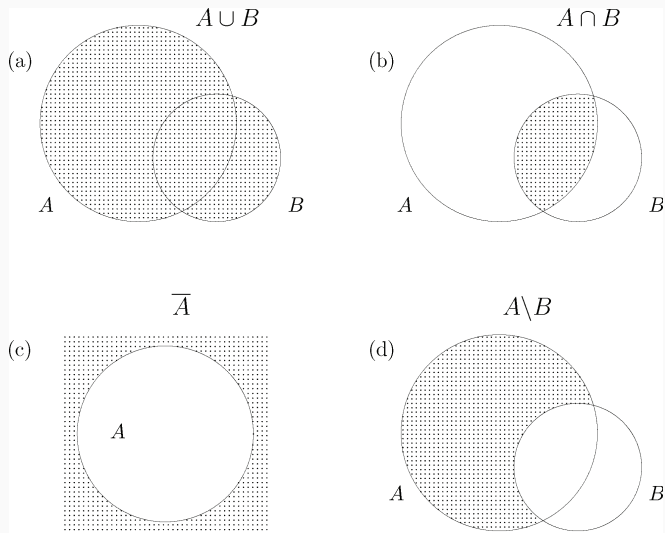
- *Empty set* ($\emptyset$): $\emptyset$ is a set containing no elements, usually denoted by $\{\}$. The empty set is a subset of every set:

$$\emptyset \subseteq A$$

- *Disjoint/mutually exclusive sets*: Sets A, B are disjoint if their intersection is empty:

$$A \cap B = \emptyset$$

- *Pairwise disjoint sets*: Sets $A_1, A_2, A_3, \cdots$ are pairwise disjoint if $A_i \cap A_j = \emptyset$ for any $i \neq j$

(a) $A \cup B$

(b) $A \cap B$

(c) $\overline{A}$

(d) $A \backslash B$

Set Notation Cont.

$\Omega = \{1, 2, 3, 4, 5\}$
$A = \{1, 2, 3\}$
$B = \{2, 3, 4\}$
$C = \{4, 5\}$

1. $\bar{A} =$
2. $A \cup B =$
3. $A \cap B =$
4. $A \cap C =$
5. Are A and B disjoint?
6. Are A and C disjoint?
7. Are A,B,C pairwise disjoint?

Recap

Students should now be familiar with event operations to form new events from given events. Student should be familiar with Venn Diagrams as a way to visualize event operations.