Office hour: Tue & Wed. 2-3 pm BA 8119

What is this course about?

- The focus is to provide you with understanding of probability
- Probability theory is a mathematical tool
- Probability theory can be seen in almost every human and natural system

Course structure

Assignment 10%

Quizzes 20%

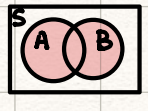
Midterm 25%

Final 45%

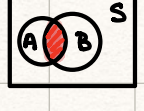
Review of set theory

- $x \in A$ means "x is an element of the set A"
- $x \notin A$ means "x is not an element of the set A"

- We can specify a set in two ways:
  - ↳ List all the elements, e.g.: $A = \{1, 2, 3, \cdots, 10\}$
  - ↳ Give a property that describes the elements, e.g., the interval $[0, 1]$ can be written as $A = \{x : 0 \le x \le 1\}$ $\quad A = \{x \mid 0 \le x \le 1\}$
- Empty set $A = \phi$, i.e. A has no elements.
- $A \subset S$, means "A is a subset of S"
- By definition, $A = S$ means $A \subset S$ and $S \subset A$
- Three basic set operation
  1. Union: Set of outcomes that are in A or B



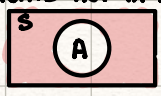
  - ↳ $A \cup B = B \cup A$
  - ↳ $\bigcup_{k=1}^{n} A_k = A_1 \cup A_2 \cup \cdots \cup A_n$
  2. Intersection: Set of outcomes that are in A and B



  - ↳ $A \cap B = B \cap A$

↳ $\bigcap_{k=1}^{n} A_k = A_1 \cap A_2 \cap \cdots \cap A_n$

3. Complement: The set of all elements not in A.

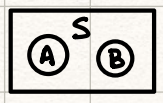


↳ $A^c = \{x : x \notin A\}$

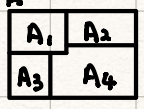
↳ Relative complement: The difference of sets A and B.

$A - B = \{x : x \in A \text{ and } x \notin B\}$

- Disjoint sets: A and B are mutually exclusive if $A \cap B = \phi$



- Partition: $A_1, A_2 \cdots$ are partition of set A if $A_1, A_2 \cdots$ are disjoint and $\bigcup_{k=1}^{n} A_k = A$



- Associative properties:

↳ $A \cup (B \cup C) = (A \cup B) \cup C$

↳ $A \cap (B \cap C) = (A \cap B) \cap C$

- Distributive properties:

↳ $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

↳ $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

- DeMorgan's rule:

↳ $(A \cup B)^c = A^c \cap B^c$

↳ $(A \cap B)^c = A^c \cup B^c$

Specifying Random Experiments:

Random experiment: An experiment in which the outcome varies in an unpredictable fashion when the experiment is repeated under the same conditions.

- Denoted by E
- Examples:

E_1: Toss a coin

E_2: Roll a dice

E_3: Record the price fluctuations of a stock