통계분석

Statistical Analysis

Probability

Quantification (a measure) of likelihood that some event will occur

How can we assign a number to the likelihood that some event will occur?

Basics of Probability

Experiment : Repeatable process that give well defined outcomes

ex. tossing a dice

ex. tossing two coins

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Sample space : A set of all possible outcomes, S

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ex. all possible outcomes from tossing two coins, **{HH, HT, TH, TT}**

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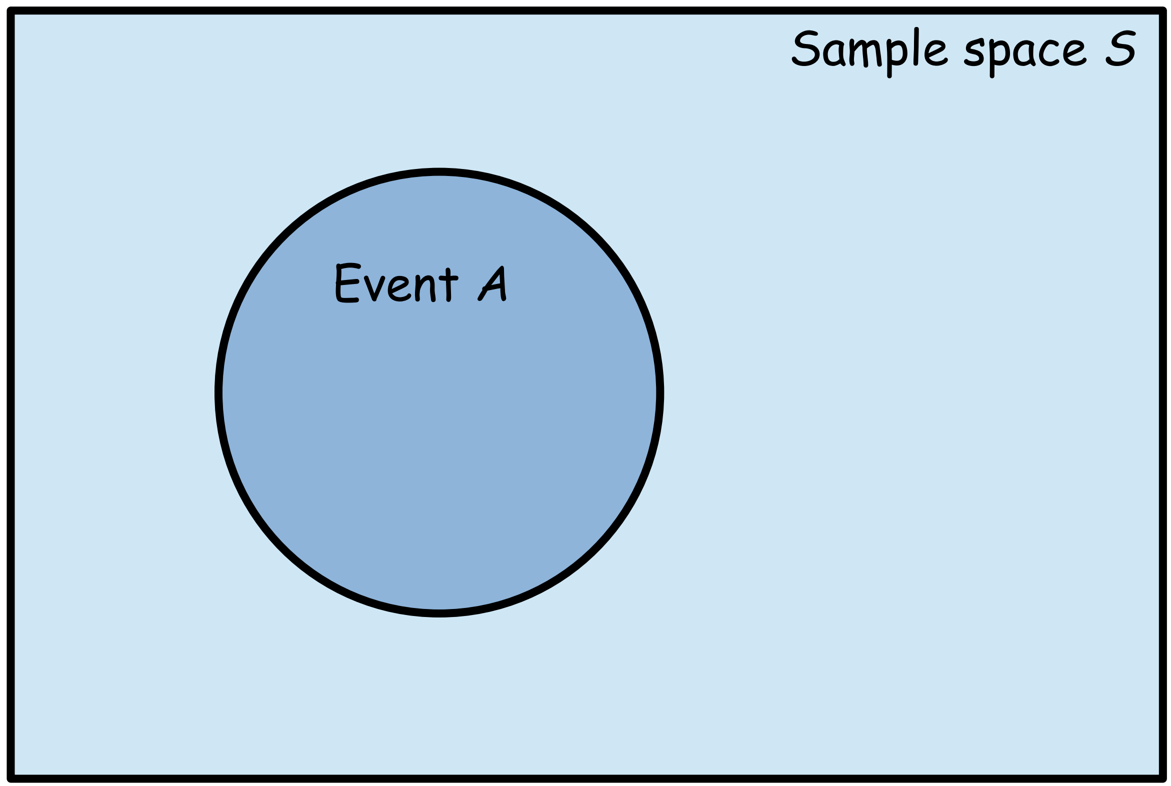
Event : A subset of the sample space

ex. all cases where the number of heads is at least one

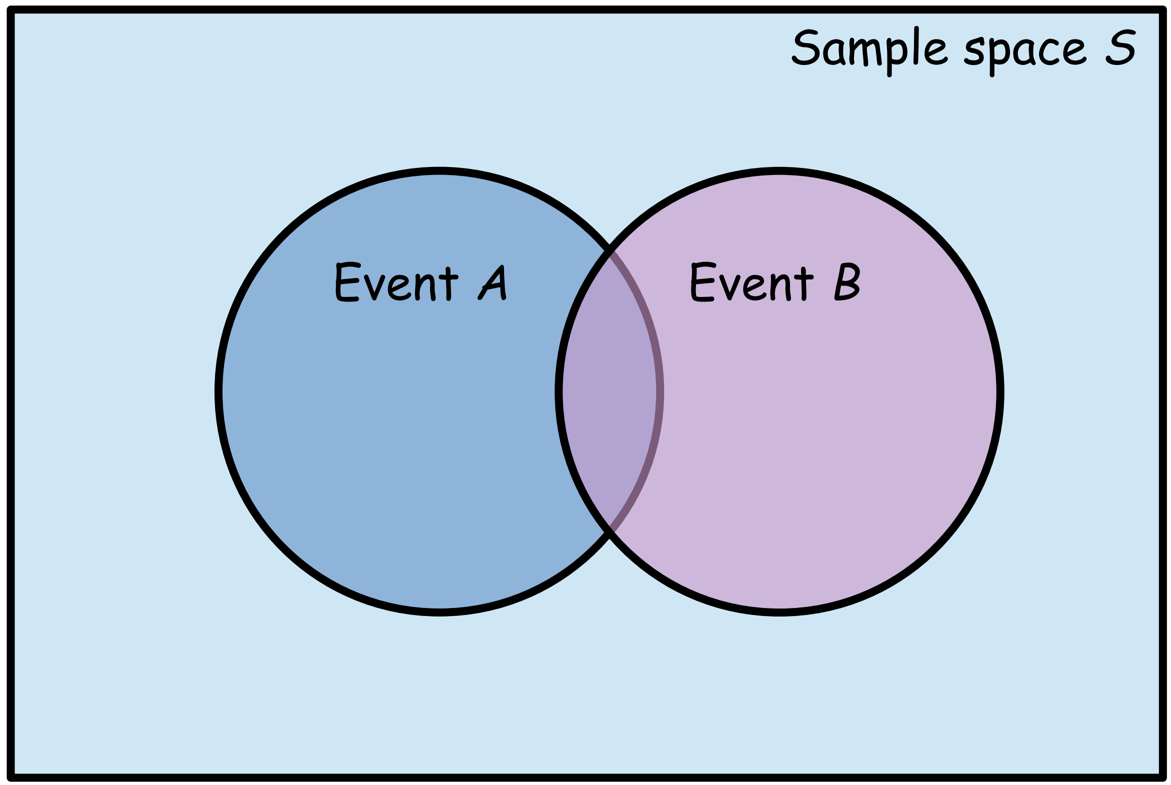
{HH, HT, TH, TT}

The event A has occurred when the outcome of the experiment is in a subset A.

Set Theory: Venn Diagram



Set Theory: Venn Diagram



Set Theory

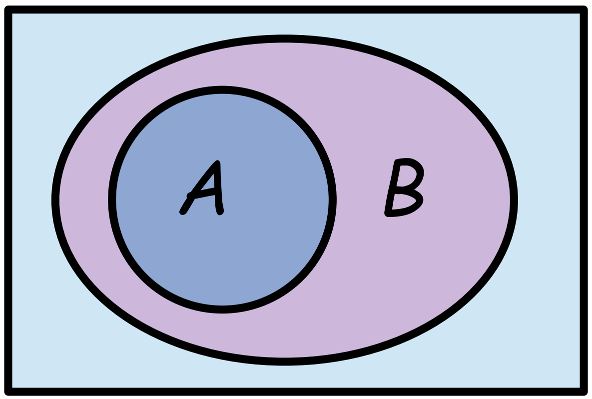
Relations between Events

For sets A and B, which are subsets of the sample space S,

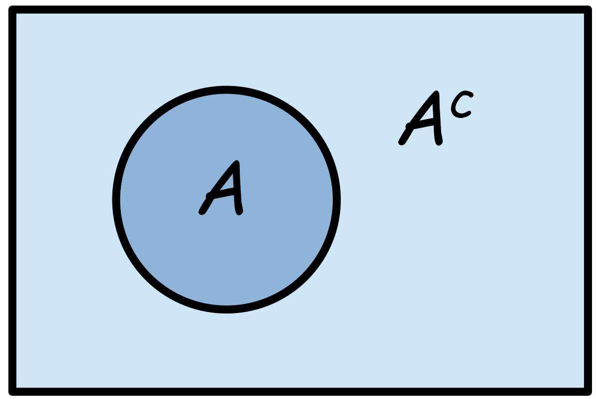
$A \subset B$	All elements of A are included in B
$A \cap B$	Intersection = a set of elements included in both A and B
$A \cup B$	Union = a set of elements included in A or B
A^c	Complement = a set of elements not included in A
$A - B$	Difference = a set of elements included in A, but not in B
$A = \phi$	Null (empty) set = a set of no elements

Set Theory

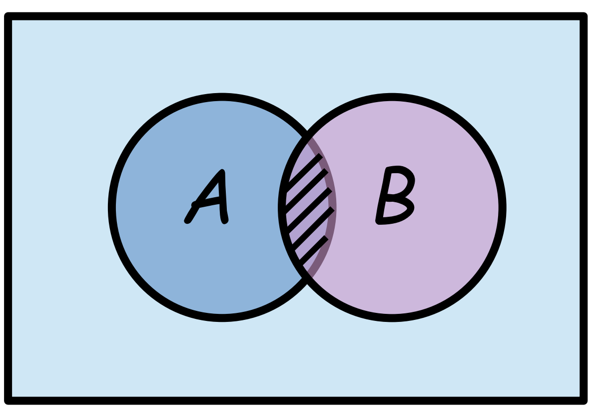
Relations between Events



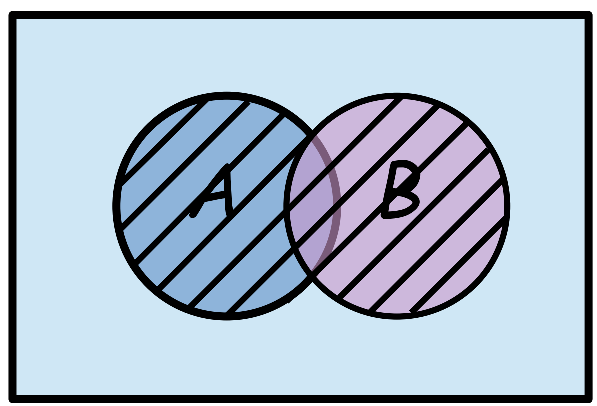
$A \subset B$



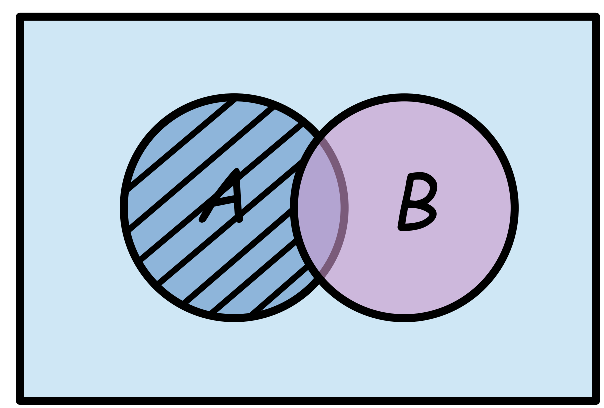
A^c



$A \cap B$



$A \cup B$



$A - B = A \cap B^c$

Set Theory

Relations between Events

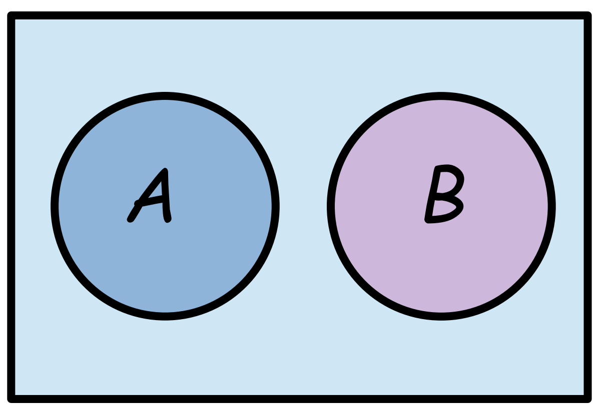
- de Morgan's Law

$$(A \cap B)^c = A^c \cup B^c$$

$$(A \cup B)^c = A^c \cap B^c$$

- Mutually exclusive (or disjoint) events

$$A \cap B = \phi$$



Probability as a function

$\xrightarrow{\text{tossing}}$ {HH, HT, TH, TT}

A = {cases when two coins are heads} = {HH} P(A) = 0.25

B = {cases when the number of tails is only one} = {HT, TH}

P(B) = 0.50

C = {cases when at least one coin shows head} = {HH, HT, TH}

P(C) = 0.75

Probability as a function

Events	P (Probability)
$A \longrightarrow$	$P(A) = 0.25$
$B \longrightarrow$	$P(B) = 0.50$
$C \longrightarrow$	$P(C) = 0.75$
(sub)sets	numbers

Probability: Basic Rules

1. $P(A) \geq 0$ for $A \subset S$

2. $P(S) = 1$

3. For mutually exclusive subsets $A_i, i = 1, \cdots, n$

$$P(\cup_{i=1}^{n} A_i) = \sum_{i=1}^{n} P(A_i)$$

$$\cup_{i=1}^{n} A_i = A_1 \cup A_2 \cup \cdots \cup A_n$$

$A_i \cap A_j = \phi$ for any $i \neq j$

Probability: Basic Rules

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In fact, other properties of probability can be derived from these three rules.