More Probability Terminology

Simple Event:. An event that is associated with exactly one outcome.
Symbol $\mathbf{E_1}$, $\mathbf{E_2}$, …

Impossible Event: An event that is associated no outcomes.
Symbol: **Ø**

Certain Event: An event that is associated with all outcomes in the sample space.
Symbol: **S**

Intersection: A ∩ B = The event that A **and** B will occur (also written "A and B")

Union: A U B = The event that A **or** B will occur (also written "A or B")

Complement : A^c = The event that A will **not** occur (also written "not A")

Disjoint Events: Two or more events that cannot occur at the same time

Independent Events: One event occurring does not effect the likelihood of the other event(s) occurring

Basic Probability Rules

Rule 1: $0 \leq P(A) \leq 1$ for any event A

Rule 2: $P(S) = 1$

Rule 3: Iff A and B are disjoint then
$P(A \cup B) = P(A) + P(B)$

Rule 4: $P(A^c) = 1 - P(A)$

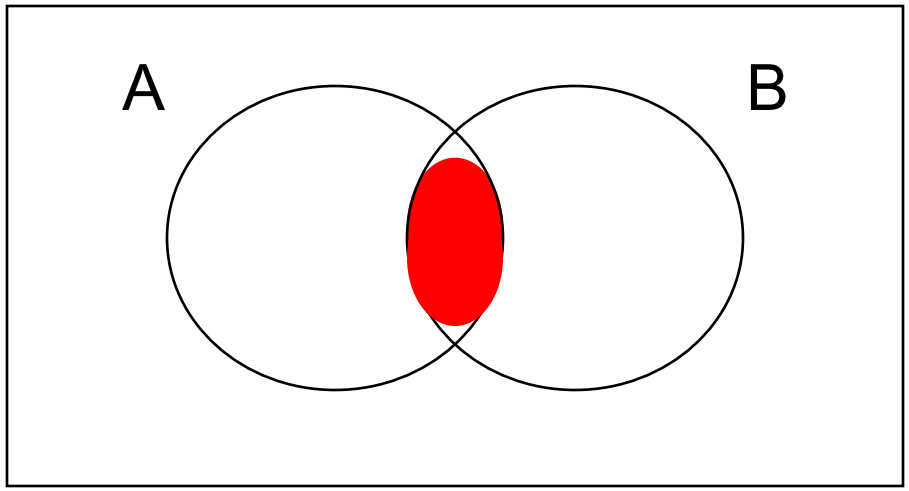
Rule 5: Iff A and B are independent then

$$P(A \cap B) = P(A) \cdot P(B)$$

Note: Iff = If and only if

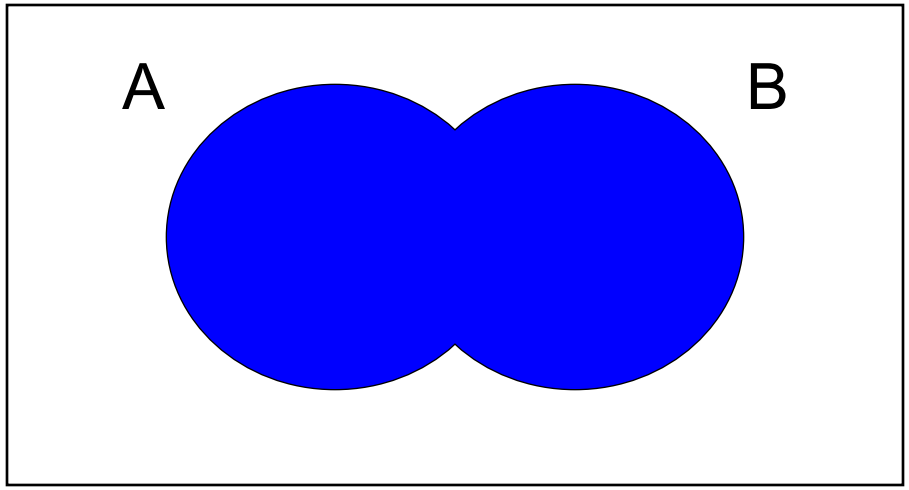
Intersections of Events

Intersection: $A \cap B$ = The event that A and B will occur



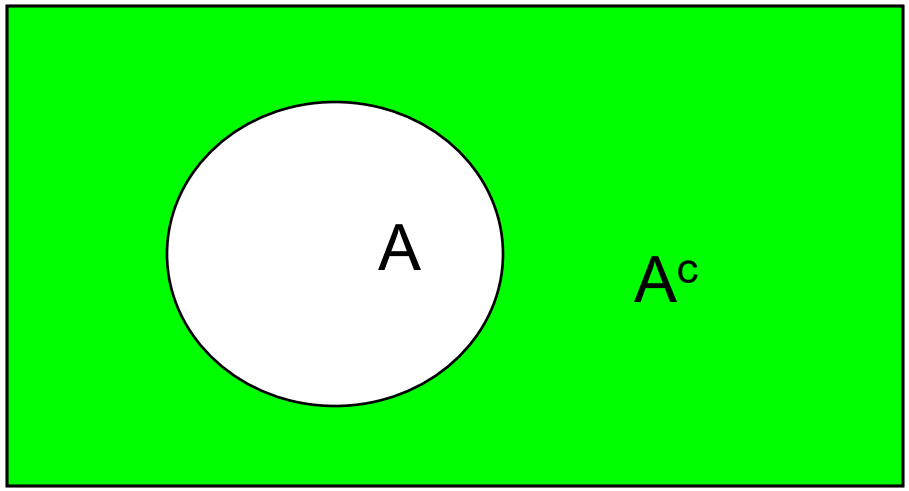
Unions of Events

Union: A U B = The event that A or B will occur (possibly both)



Complements of Events

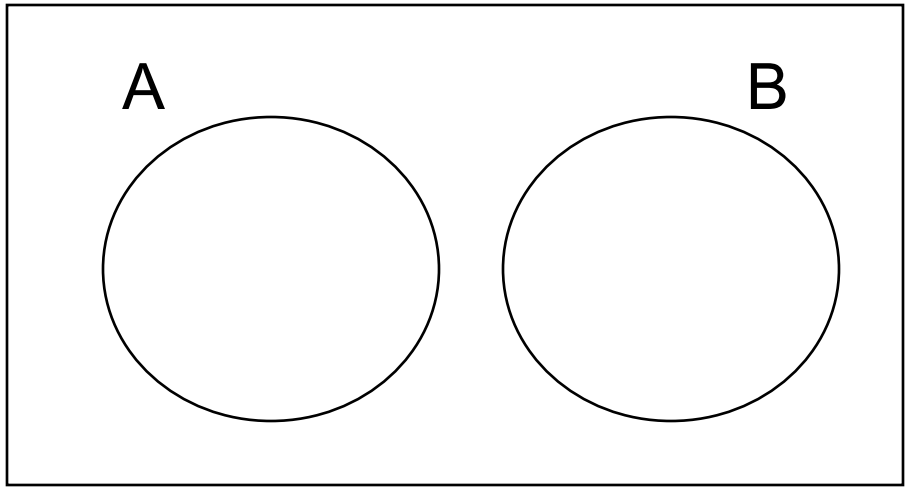
Complement: A^c = The event that A will not occur.



$P(A^c) = 1 - P(A)$ (Rule 4)

Disjoint Events

Two events A and B are said to be disjoint (or mutually exclusive) if they cannot both happen at the same time.



NOTE: $A \cap B = \varnothing$

A and *B* are disjoint if (and only if):

$P(A \cup B) = P(A) + P(B)$ (Rule 3)

Independent Events

Definition:

Two events *A* and *B* are said to be **independent**
if knowing that *A* will occur does not change the
probability that *B* will occur.

Notes:

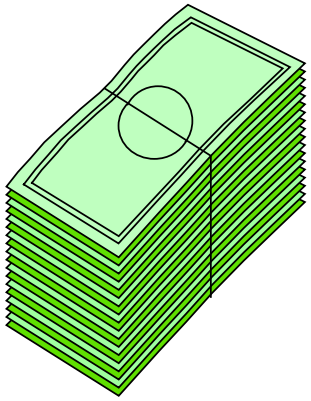
- If *A* is independent of *B* then also *B* is independent of *A*.
- *A* and *B* are independent if (and only if):

$$P(A \cap B) = P(A) \cdot P(B) \text{ (Rule 5)}$$

Independent Events?

A : I will win the lottery.

B : It will rain tomorrow.



A fair coin is tossed twice

A : The first coin toss is a head

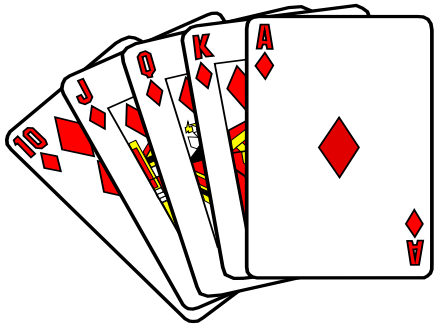
B : The second toss is a head

Independent Events?

5 cards are drawn from a deck of cards

A : The first card is a diamond

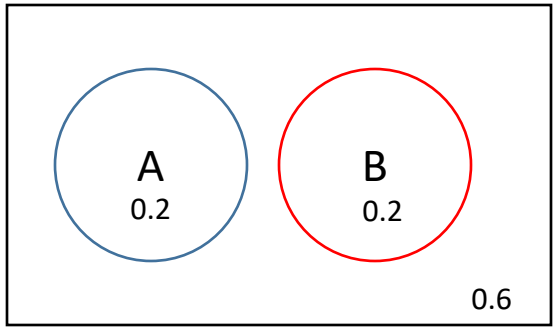
B : The second card is a diamond



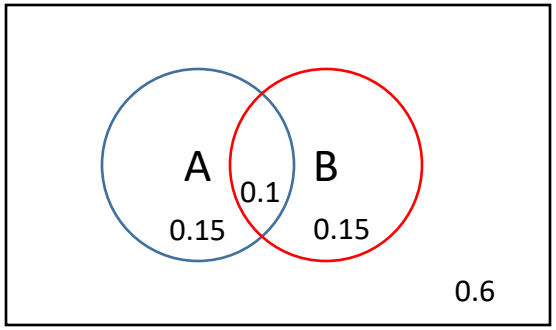
A : The Seattle Seahawks will go to playoffs this season.

B : The Seattle Seahawks will win the Super Bowl this season.

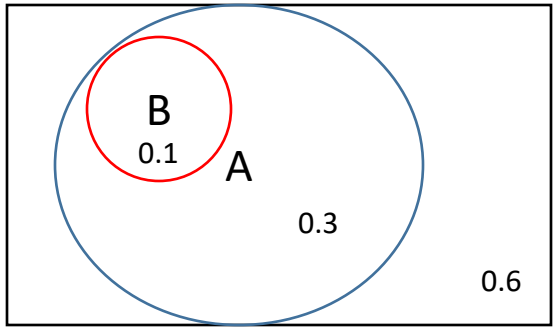
Independent vs Disjoint Events



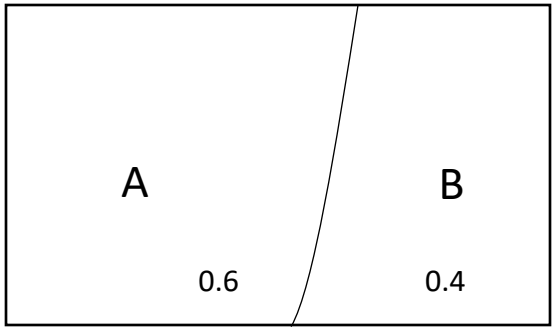
Independent?
Disjoint?



Independent?
Disjoint?



Independent?
Disjoint?



Independent?
Disjoint?

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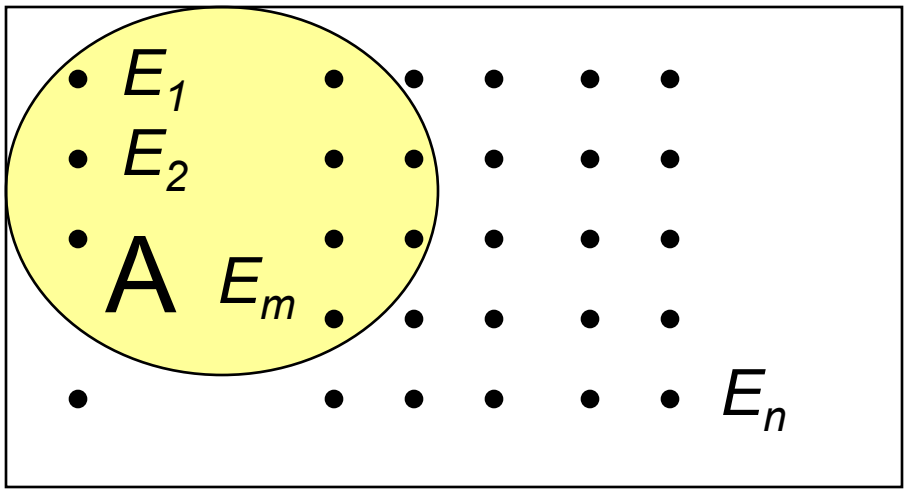
Note: Iff = If and only if

Calculating the Probability of an Event

Probabilities in a Finite Sample Space:

1. Assign probabilities to all simple events $E_1, E_2, \ldots E_n$
2. Suppose the event *A* consists of (is the union of) the simple events $E_1, E_2, \ldots E_m$, *then*

$$P(A) = \sum_{i=1}^{m} P(E_i)$$



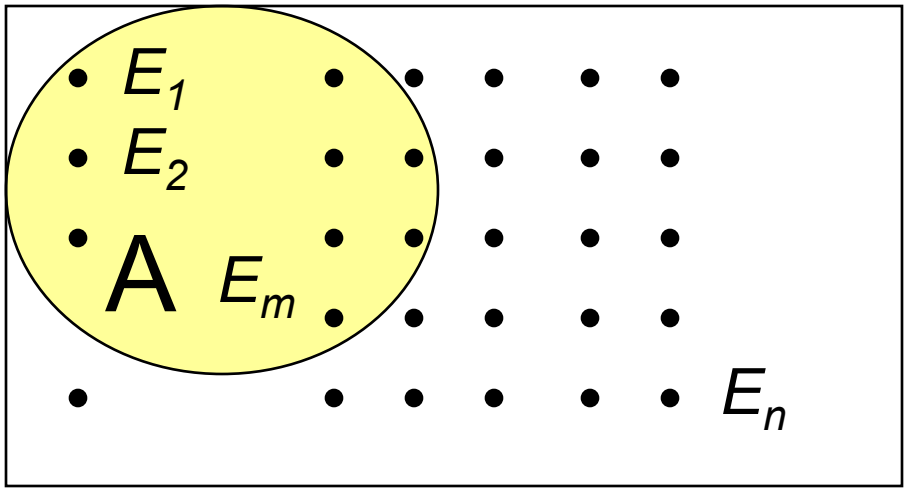
Calculating the Probability of an Event

Special Case: Sample Space with Equally Likely Simple Events

1. $P(E_i) = \frac{1}{n}$

2. Suppose the event *A* consists of *m* simple events $E_1, E_2, \ldots E_m$, then

$$P(A) = \frac{m}{n}$$



CASE: Coin Tosses

- Toss a coin four times
- Define the event:
  A = Two heads are observed

$P(A)$ =