Definition: Event

An **event** in probability theory is a Subset of the Sample Space Ω. It represents a collection of outcomes to which a probability can be assigned.

Formal Definition

Given a sample space Ω, an event A is any subset of Ω:

$$A \subseteq \Omega$$

The collection of all events forms a -algebra (sigma-algebra) $\mathcal{F}$ on Ω.

Types of Events

1. **Elementary Event**: Contains exactly one outcome
   - Example: $\{3\}$ when rolling a die
2. **Compound Event**: Contains multiple outcomes
   - Example: "Even number" $= \{2, 4, 6\}$ when rolling a die
3. **Certain Event**: The entire sample space Ω
   - Always occurs with probability 1
4. **Impossible Event**: The empty set $\emptyset$
   - Never occurs, has probability 0

Event Operations

Using set operations from Union and Intersection:

- **Union** $A \cup B$: "A or B occurs"
- **Intersection** $A \cap B$: "Both A and B occur"
- **Complement** A^c: "A does not occur"
- **Difference** $A \setminus B$: "A occurs but not B"

Examples

For a die roll with $\Omega = \{1, 2, 3, 4, 5, 6\}$: - Event "rolling an even number": $A = \{2, 4, 6\}$ - Event "rolling at least 4": $B = \{4, 5, 6\}$ - $A \cap B = \{4, 6\}$ (even and at least 4) - $A \cup B = \{2, 4, 5, 6\}$ (even or at least 4)

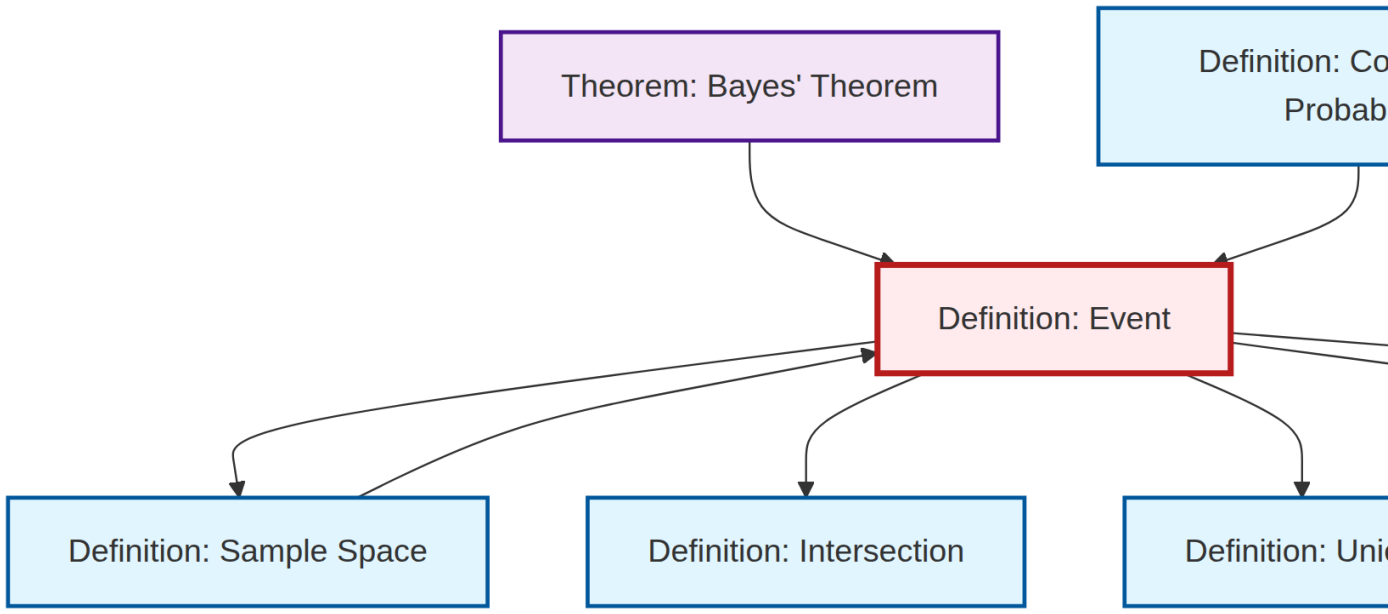
Probability of Events

In a Probability Space, each event A is assigned a probability $P(A)$ such that: - $0 \leq P(A) \leq 1$ - $P(\Omega) = 1$ - $P(\emptyset) = 0$

Special Relationships

- **Mutually Exclusive**: Events A and B where $A \cap B = \emptyset$
- **Exhaustive**: Events whose union equals Ω
- **Independent**: Events where $P(A \cap B) = P(A)P(B)$

Dependency Graph



Local dependency graph