

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 σ -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)

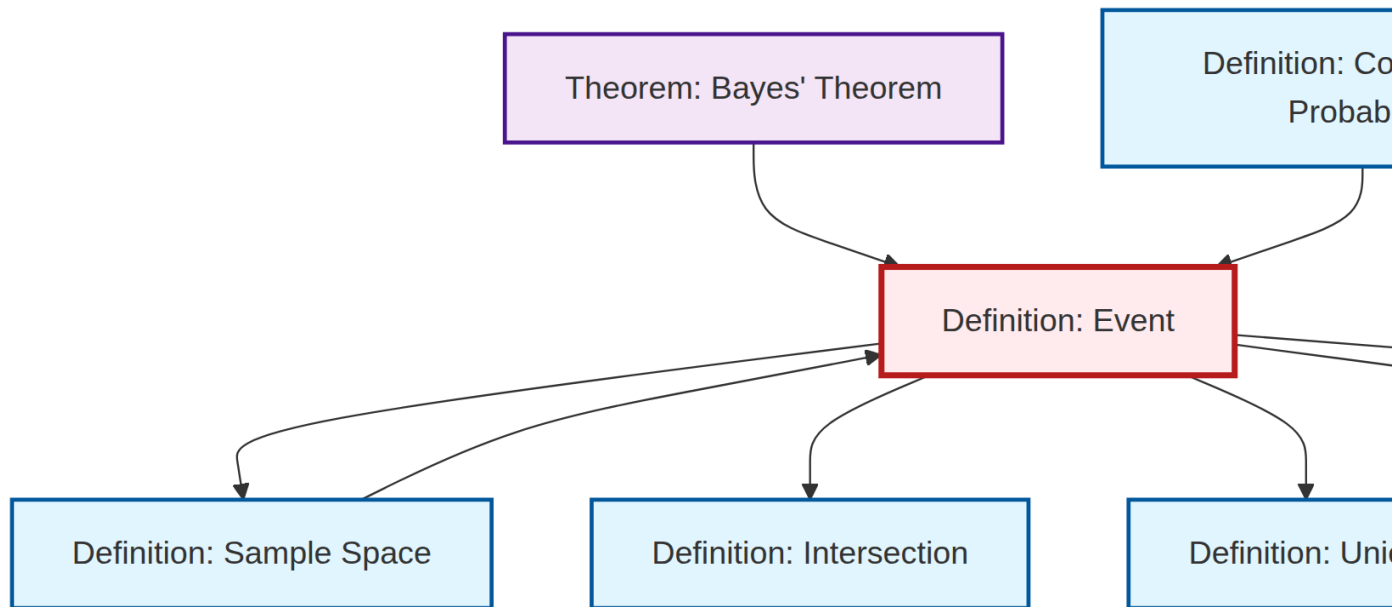
Probability of Events

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