The basic rules of probability govern how we calculate the likelihood of different outcomes or events.

## Rules of Probability

### Addition Rule (for "OR" events)

The Addition Rule is used to find the probability that **at least one** of two events, A or B, will occur.

* General Addition Rule (for any events A and B):  
    
  P(A or B)=P(A∪B)=P(A)+P(B)−P(A∩B)  
    
  We subtract P(A∩B) (the probability of both A and B occurring) to prevent the outcomes in the intersection from being double-counted.
* For Mutually Exclusive Events:  
  If events A and B cannot happen at the same time (i.e., they are disjoint, so P(A∩B)=0), the formula simplifies to:  
    
  P(A or B)=P(A)+P(B)

### Multiplication Rule (for "AND" events)

The Multiplication Rule is used to find the probability that **both** events, A and B, will occur.

* General Multiplication Rule (for any events A and B):  
    
  P(A and B)=P(A∩B)=P(A)⋅P(B∣A)  
    
  This formula is derived from the definition of conditional probability. P(B∣A) is the conditional probability of B given that A has already occurred.
* For Independent Events:  
  If events A and B are independent (meaning the occurrence of A does not affect the probability of B, so P(B∣A)=P(B)), the formula simplifies to:  
    
  P(A and B)=P(A)⋅P(B)

### Complement Rule

The Complement Rule relates the probability of an event to the probability of that event **not** occurring. The complement of event A is denoted as Ac or A′.

* Formula:  
    
  P(Ac)=1−P(A)  
    
  Since an event must either occur (A) or not occur (Ac), the sum of their probabilities must equal the total probability of 1. This rule is often used to calculate the probability of "at least one" event by finding the complement (the probability of "none") and subtracting it from 1.

## Conditional Probability

**Conditional Probability** is the probability of an event A occurring **given** that another event B has already occurred.

* **Notation:** It is written as P(A∣B), read as "the probability of A given B."
* Formula:  
    
  P(A∣B)=P(B)P(A∩B)​  
    
  This is essentially saying that out of all the outcomes where B has occurred (which becomes the new reduced sample space), we are only interested in the fraction of those outcomes where A also occurred (A∩B).
  + *Note: This formula requires P(B)>0.*