# Probability Multiplication Rule

## 1. Definition

In **probability theory**, the **multiplication rule** (also called the **multiplication theorem**) helps you find the probability of two events **both** occurring — that is, the **joint probability** of two events.

## 2. Formula

* **For independent events A and B**:  
  The probability that both A and B occur is given by:

P(A∩B)=P(A)×P(B)P(A \cap B) = P(A) \times P(B)P(A∩B)=P(A)×P(B)

* **For dependent events A and B**:  
  The probability that both A and B occur is given by:

P(A∩B)=P(A)×P(B∣A)P(A \cap B) = P(A) \times P(B \mid A)P(A∩B)=P(A)×P(B∣A)

## 3. Example

Example 1 (Independent): Tossing a coin and rolling a die:  
P(H ∩ 4) = P(H) \* P(4) = 1/2 \* 1/6 = 1/12  
  
Example 2 (Dependent): Drawing 2 cards without replacement:  
P(Ace1 ∩ Ace2) = (4/52) \* (3/51) = 1/221

## 4. Python Code (with user input)

P\_disease = 0.01

P\_no\_disease = 1 - P\_disease

P\_pos\_given\_disease = 0.99

P\_pos\_given\_no\_disease = 0.05

joint\_pos\_and\_disease = P\_pos\_given\_disease \* P\_disease

joint\_pos\_and\_no\_disease = P\_pos\_given\_no\_disease \* P\_no\_disease

print("🔹 Multiplication Step")

print(f"P(Positive ∩ Disease): {joint\_pos\_and\_disease:.5f}")

print(f"P(Positive ∩ No Disease): {joint\_pos\_and\_no\_disease:.5f}")