# Bayes' Theorem

## 1. Definition

Bayes' Theorem is a mathematical formula used to determine the conditional probability of events.  
It updates the probability of a hypothesis based on new evidence.

## 2. Formula

P(A|B) = [P(B|A) \* P(A)] / P(B)

## 3. Example

Suppose 1% of people have a disease (P(D) = 0.01), a test detects it correctly 99% of the time (P(Pos|D) = 0.99),  
but also shows a false positive 5% of the time (P(Pos|¬D) = 0.05).  
  
To find the probability that a person has the disease given that they tested positive (P(D|Pos)):  
  
Use the formula:  
P(D|Pos) = [P(Pos|D) \* P(D)] / [P(Pos|D)\*P(D) + P(Pos|¬D)\*P(¬D)]  
 = (0.99\*0.01) / (0.99\*0.01 + 0.05\*0.99)  
 = 0.0099 / (0.0099 + 0.0495) = 0.0099 / 0.0594 ≈ 0.1667

## 4. Python Code (with user input)

# Bayes' Theorem with input  
  
P\_A = float(input("Enter P(A) - prior probability of disease (e.g. 0.01): "))  
P\_B\_given\_A = float(input("Enter P(B|A) - true positive rate (e.g. 0.99): "))  
P\_B\_given\_notA = float(input("Enter P(B|¬A) - false positive rate (e.g. 0.05): "))  
  
P\_notA = 1 - P\_A  
P\_B = P\_B\_given\_A \* P\_A + P\_B\_given\_notA \* P\_notA  
P\_A\_given\_B = (P\_B\_given\_A \* P\_A) / P\_B  
  
print(f"Probability of having the disease given a positive test: {P\_A\_given\_B:.4f}")