## TEOREMA DE BAYES

$$P(A|B) = \frac{P(B|A) \cdot P(A)}{P(B)}$$ BAYES RULE
INVERSE PROBABILITY

**CONDITIONAL PROBABILITY:**

WHAT IS THE PROBABILITY O OBSERVING A GIVEN I'VE OBSERVED B?

**EXAMPLE I - UNFAIR COIN**

I HAVE TWO COINS ON THE TABLE, ONE FAIR THE OTHER UNFAIR. I PICK ONE A RANDOM, THROW IT AND GET TAILS WHAT IS THE PROBILITY THAT I THREW THE FAIR COIN?

**EXAMPLE II - URNS**

ON A TABLE, THERE ARE TWO URNS: THE FIRST(I) HAS 70 BLACK & 30 RED BALLS WHILE THE SECOND(II) HAS 50 BLACK & 50 RED.

YOU PICK AN URN @ RANDOM & DRAW 3 BALLS: 2 BLACK & 1 RED. WHAT IS THE PROBABILITY YOU DREW FROM URN A?

SUCCESS = BLACK

$$P(I|x=2) = \frac{P(x=2|I) \cdot P(I)}{P(B)}$$

$$P(B) = P(x=2) = P(I) \cdot P(x=2|I) + P(II) \cdot P(x=2|II)$$

$$= 0.5 \cdot P(x=2|I) + 0.5 \cdot P(x=2|II)$$

**BAYESIAN VS. FREQUENTIST**

INVERSE PROBABILITY - WHAT DOES IT MEAN? FREQUENCY OR BELIEF?

**BAYESIAN DATA ANALYSIS**

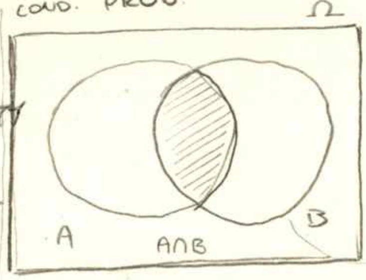
PARAMETERS ⟶ PRIORS

PRIORS + DATA ⟶ POSTERIORS

PRIOR DISTRIBUTION: OUR KNOWLEDGE ABOUT PARAMETERS PRIOR TO ANY OBSERVATION

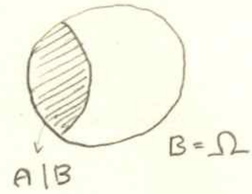
POSTERIOR DISTRIBUTION: OUR KNOWLEDGE ABOUT PARAMETERS AFTER DATA HAS BEEN OBSERVED.

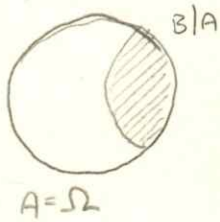
COND. PROB.




I.

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$




II:

$$P(B|A) = \frac{P(A \cap B)}{P(A)}$$

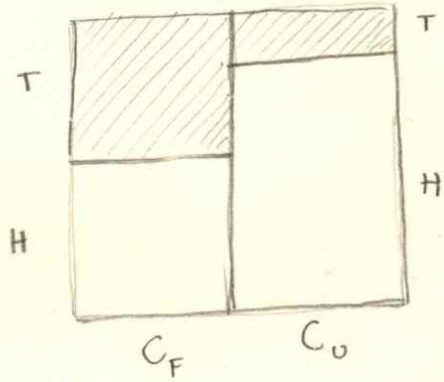
⇓ ISOLATE $P(A \cap B)$

$$P(A \cap B) = P(B|A)\, P(A)$$

⇓ SUBS. II IN I

$$P(A|B) = \frac{P(B|A)\, P(A)}{P(B)}$$

EXAMPLE I




$$P(C_F) = P(C_U) = 0.5$$

$$P(H|C_F) = P(T|C_F) = 0.5$$

$$P(H|C_U) = 0.7,\ P(T|C_U) = 0.3$$

$$P(C_F|H) = \frac{P(H|C_F) \cdot P(C_F)}{P(H)}$$

$$P(H) = P(C_F) \cdot P(H|C_F) + P(C_U) \cdot P(H|C_U)$$

$$= 0.5 \cdot 0.5 + 0.5 \cdot 0.7$$

$$= 0.25 + 0.35 = 0.6$$

$$\frac{0.5 \cdot 0.5}{0.6} = 0.4166$$

$$P(\theta|data) = \frac{P(data|\theta) \cdot P(\theta)}{P(data)}$$