

# Bayesian Inference

**Likelihood:** Probability of observing the data that has been observed assuming that the data came from a specific scenario.

ex II  $P(\text{test} = \text{positive} | \text{disease})$

**Prior:** Previous knowledge on the subject.

ex II Disease is very rare.

**Posterior Probability:** What is the probability of you having the disease given that the test is positive.

$$\text{Posterior} = \frac{\text{Likelihood} \times \text{Prior}}{\text{Evidence}}$$

$$P(\text{disease} | \text{test} = \text{positive}) = \frac{P(\text{test} = \text{positive} | \text{disease}) \times P(\text{disease})}{P(\text{test} = \text{positive})}$$

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

Likelihood  $\rightarrow$   $P(\text{test} = \text{positive} | \text{disease})$   
 Prior  $\rightarrow$   $P(\text{disease})$   
 Evidence  $\rightarrow$   $P(\text{test} = \text{positive})$

ex II  $P(\text{disease}) = 0.00148$

$$P(\text{test} = (+) | \text{disease}) = 0.93$$

$$P(\text{test} = (-) | \text{disease}) = 0.99$$

$$P(\text{disease} | \text{test} = (+)) = \frac{P(\text{Person has disease} \& \text{test} (+))}{P(\text{test} (+))}$$

$$P(\text{disease} \& \text{test} (+)) = \frac{P(\text{disease}) \times P(\text{test} = (+) | P(\text{disease}))}{0.00148 \times 0.93} = 0.0013$$

$$P(A \& B) = P(A|B)P(B) = \text{Likelihood} \times \text{Prior}$$

$$P(\text{disease} | \text{test} (+)) = \frac{0.0013}{0.011} \approx 0.12 \rightarrow \text{Posterior}$$

Evidence  $\rightarrow$   $P(\text{test} = \text{positive})$   
 $= P(\text{disease} | (+)) + P(\text{no disease} | (+))$