Bayes Theorem: Takeaways

Concepts

- Independence, dependence, and exclusivity describe the relationship between events (two or more events), and they have different mathematical meanings:

$$\begin{aligned} \text{Independence} \quad &\Longrightarrow \quad P(A \cap B) = P(A) \cdot P(B) \\ \text{Dependence} \quad &\Longrightarrow \quad P(A \cap B) = P(A) \cdot P(B|A) \\ \text{Exclusivity} \quad &\Longrightarrow \quad P(A \cap B) = 0 \end{aligned}$$

- If two events are **exhaustive**, it means they make up the whole sample space Ω.
- **The law of total probability** can be expressed mathematically as:

$$P(A) = P(B_1) \cdot P(A|B_1) + P(B_2) \cdot P(A|B_2) + \cdots + P(B_n) \cdot P$$

- The law of total probability is often written using the summation sign Σ:

$$P(A) = \sum_{i=1}^{n} P(B_i) \cdot P(A|B_i)$$

- For any events A and B, we can use **Bayes' theorem** to calculate P(A|B):

$$P(A|B) = \frac{P(A) \cdot P(B|A)}{\sum_{i=1}^{n} P(A_i) \cdot P(B|A_i)}$$

- P(A|B) is the **posterior probability** of A *after* B happens ("posterior" means "after"). P(A) is the **prior probability** of A *before* B happens ("prior" means "before").

Resources

- An intuitive approach to understanding Bayes' theorem
- False positives, false negatives, and Bayes' theorem