# Basic Probability Cheat Sheet

## 1. Probability Fundamentals

- **Probability Range:**

$$0 \leq P(A) \leq 1$$

- **Sample Space:**

$$P(S) = 1$$

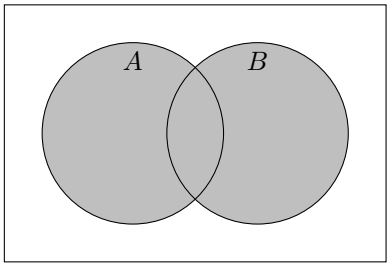
- **Complement Rule:**

$$P(A') = 1 - P(A)$$

## 2. Set Operations and Relationships

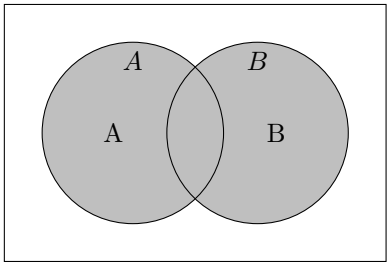
- **Addition Rule (General):**

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$




- **Disjoint Events (Mutually Exclusive):**

$$P(A \cap B) = 0$$



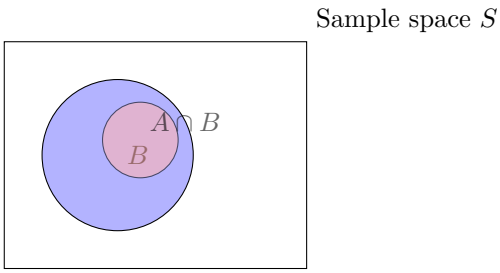

- **Inclusion-Exclusion (3 Sets):**

$$\begin{aligned} P(A \cup B \cup C) = {} & P(A) + P(B) + P(C) \\ & - P(A \cap B) - P(A \cap C) - P(B \cap C) \\ & + P(A \cap B \cap C) \end{aligned}$$

## 3. Conditional Probability and Independence

- **Conditional Probability:**

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




- **Multiplication Rule (General):**

$$P(A \cap B) = P(A \mid B) \cdot P(B)$$

- **Independent Events:**

$$P(A \cap B) = P(A) \cdot P(B)$$

- **Mutual Independence (3+ Events):**

$$P(A \cap B \cap C) = P(A) \cdot P(B) \cdot P(C)$$

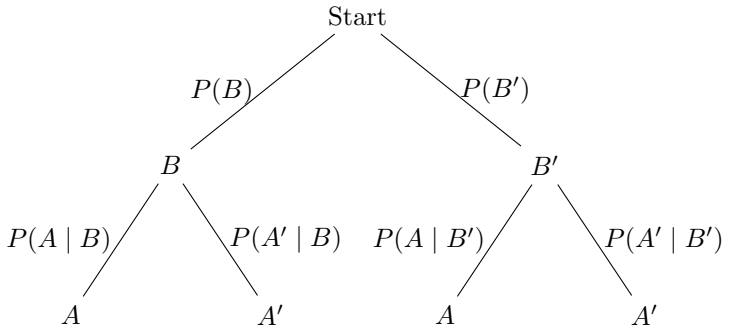
- **Conditional Independence:**

$$P(A \cap B \mid C) = P(A \mid C) \cdot P(B \mid C)$$

## 4. Law of Total Probability and Bayes

- **Law of Total Probability:**

$$P(A) = P(A \mid B)P(B) + P(A \mid B')P(B')$$




- **Bayes' Theorem:**

$$P(A \mid B) = \frac{P(B \mid A) \cdot P(A)}{P(B)}$$

## 5. Set Identities and Logic Rules

- **De Morgan's Laws:**
$$(A \cup B)' = A' \cap B', \quad (A \cap B)' = A' \cup B'$$
- **Complement Identities:**
$$A \cup A' = S, \quad A \cap A' = \emptyset$$
- **Double Complement:**
$$(A')' = A$$
- **Subset Rule:**
$$A \subseteq B \Rightarrow P(A) \leq P(B)$$
- **Partition of the Sample Space:**
$$B_1 \cup B_2 \cup \cdots \cup B_n = S, \quad B_i \cap B_j = \emptyset$$