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1.1 8

What is the probability that a five-card poker hand contains the ace of hearts?

$$\begin{aligned}\mathbb{P}(A\heartsuit) &= \frac{|E|}{|S|} \\ &= \frac{C(51,4)}{C(52,5)} \\ &= \frac{51\cdot 50\cdot 49\cdot 48}{1\cdot 2\cdot 3\cdot 4}\cdot\frac{1\cdot 2\cdot 3\cdot 4\cdot 5}{52\cdot 51\cdot 50\cdot 49\cdot 48} \\ &= \frac{5}{52}\end{aligned}$$

1.2 Birthday Problem

Given a group of n people, what is the probability of at least two people having the same birthday?

2 7.2

$\mathbb{P}$: $S \to [0,1]$ is called probability if

1. $\forall s \in S, 0 \le \mathbb{P}(S) \le 1$
2. $\sum_{s\in S} \mathbb{P}(s) = 1$

Disjoint (mutually exclusive)

$$\mathbb{P}(E \cup F) = \mathbb{P}(E) + \mathbb{P}(F)$$

$$\begin{aligned}&\mathbb{P}(E \cup F) = \mathbb{P}(E) + \mathbb{P}(F) - \mathbb{P}(E \cap F) \\ &\mathbb{P}(E \cap F) = 0\end{aligned}$$

Independent

$$\mathbb{P}(E \cap F) = \mathbb{P}(E) \cdot \mathbb{P}(F)$$

2.1 Random Variable

$$\begin{aligned} X &: S \to \mathbb{R} \\ \mathbb{P}(X) &\to [0,1] \\ S &\to \mathbb{R} \to [0,1] \end{aligned}$$

2.2 Conditional Probability

$$\mathbb{P}(E \mid F) = \frac{\mathbb{P}(E \cap F)}{\mathbb{P}(F)}$$

Probably of E if F happened. (after F happened)

3 7.3

4 7.4