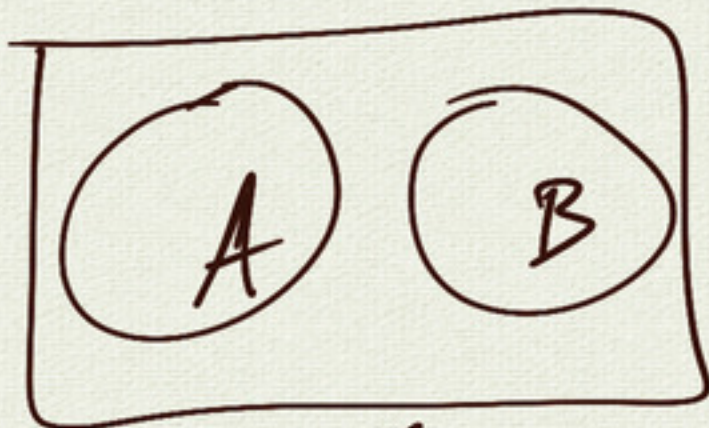


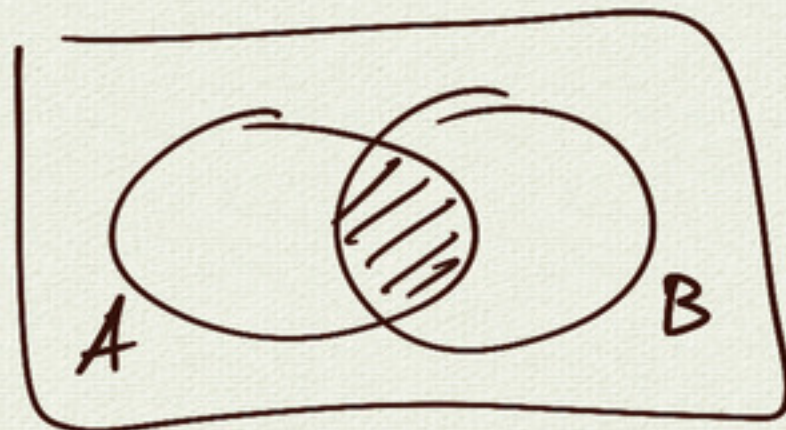
2 events: A, B

$$P(A \cup B) \stackrel{?}{=} P(A) + P(B)$$



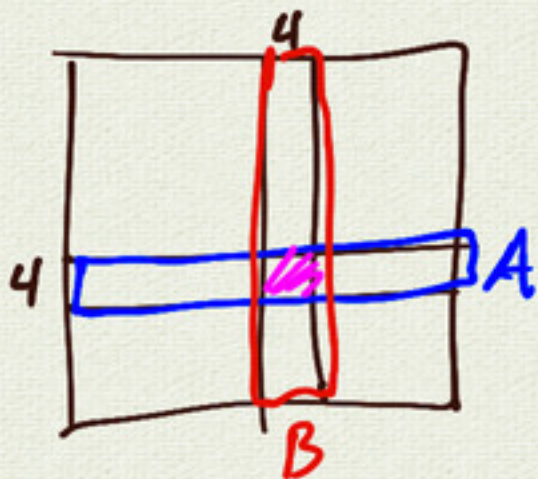
$$A \cap B = \emptyset$$

$$\Rightarrow P(A \cup B) = P(A) + P(B)$$



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

OK



P(at least 1 four)

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

$$= 6 + 6 - 1$$

$$= 11$$

Examples

Soccer example:

Tessa .9 success rate for penalty kicks

Take 10 shots.

$$P(\text{exactly 8 successes}) = ?$$

$$\frac{1}{(.9)(.9) \dots} \frac{1}{(.9)(.1)(.1)} = (.9)^8 (.1)^2$$

$$0 \ 0 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ \leftarrow \text{same probability}$$

$$P(\text{exactly 8 successes}) = \binom{10}{2} (.9)^8 (.1)^2$$

$$P(\text{exactly 7 successes}) = \binom{10}{3} (.9)^7 (.1)^3$$

"binomial distribution"

$$P(\text{at least 8 successes}) = P(8) + P(9) + P(10)$$

$$P(\geq 1 \text{ success}) = P(1) + P(2) + \dots + P(10)$$
$$\binom{10}{1} (.9)^9 (.1)^1 + \dots + P(10)$$

$$P(0 \text{ success}) + P(\geq 1 \text{ success}) = 1$$

$$P(\geq 1 \text{ success}) = 1 - P(0 \text{ success})$$

$$(.1)^{10} = \underbrace{\binom{10}{10}}_1 \underbrace{(.9)^0}_1 (.1)^{10}$$

example

bag M&M's : 20 red
10 green

pick 8 M&M's

$$P(\text{exactly 6 red}) = ?$$

2 green

$$= \frac{\binom{20}{6} \binom{10}{2}}{\binom{30}{8}}$$

ways to choose 6 red out of 20 red

ways to choose 2 green from 10 green

ways to choose 8 items out of 30

$$P(\text{exactly 5 red}) = \frac{\binom{20}{5} \binom{10}{3}}{\binom{30}{8}}$$

3 green

"hypergeometric"