Last lecture

Conditional Probability (Ch 2.3)

- Examples
- Solver
- 3 doors problem revisited

$$P(E_i|A) =$$

$$P(B|A) = \begin{cases} P(A) & \text{if } P(A) \\ P(A) & \text{odd} \end{cases}$$

$$\text{undefined } P(A) = 0$$

$$\underline{P(A)} = \sum_{i} P(A E_{i})$$

$$= \sum_{\lambda} P(A|E_{\lambda})P(E_{\lambda})$$

Agenda

Bayes formula (Ch 2.10)

Examples

Independent Events/RVs (Ch 2.4)

- Definition
- Motivation
- Examples and Facts
- Distributions (Ch 2.4)
 - Bernoulli
 - Binomial

Disease problems

Assume there is a disease A, and the corresponding test T

What do the followings mean?

$$P(T|A) = 0.9$$

$$P(T|A^c) = 0.05$$
Test in lab/test company

$$P(A) = 0.01$$
 => CDC job.

•
$$P(A|T) = P(AT)$$

Really partient cares.

0,9 × 0.0) P(T/A)P(A) P (AT) 0,9x0,0 + 0.05 x 0.99 P(T(A)P(A)+P(T(A')PCA') PLT 0,009 = 0.009+~0.05 0,009

Disease problems

According to CDC survey on smoker

- 18% of adults are smokers
- 15% of women are smokers
- Population = 50% men + 50% women $P(\omega) = 50\%$
- What fraction of adult smokers are women

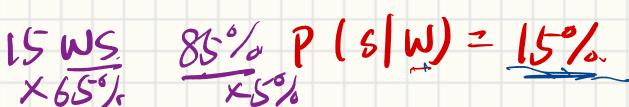
$$P(W|S) = \frac{P(S|W)P(W)}{P(S)}$$

$$= \frac{15\% \times 50\%}{18\%} = \frac{5}{12}$$

P(S) = 18%

P(S|W)=15%

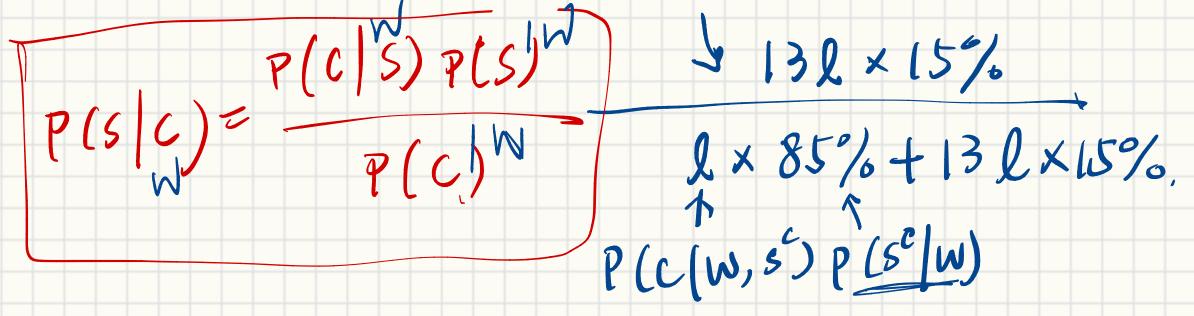
Disease problems



According to CDC survey on smoker vs. lung cancer

- Compared to nonsmokers, women who smoke are 13 times likely to get lung cancer
- If I pick a female lung cancer patient, how likely she is a smoker?

 Smoker?



Independent Events/ RVs

Definition

A and B are events, they are mutually indepent if P(B|A) = P(B) or P(AB) = P(A)P(B) P(B|A) = P(AB) P(B|A) = P(AB) P(B|A) = P(AB)

- P(B|A) = P(B) implies P(A|B) = P(A)
- If P(A) = 0, B is independent of A

Definition

A and B are events, they are mutually independent.

- P(B|A) = P(B) or P(AB) = P(A)P(B)

RVs X and Y are independent if A and B are independent for any $X \in A$ and $Y \in B$

Motivation

noll a die

Independent is a common but strong property P(AB) = P(A)P(B)Factorize. the pmf

- - Compute the pmf easily
 - Will skip Ch 2.3 affect only my HW2 and Midterm 1?
 - If I join this club, will it affect my GPA?
- Decide the model complexity
 - What really affects the results?
 - What do I need to ask when reviewing a loan request?
 - What input data do I need to predict the defect?

Examples

Physically independence – Toss a coin and roll a die (N, X)

•
$$A \triangleq \{N = H\}$$

• $B \triangleq \{X = 6\}$ $P(B|A) = \frac{1}{6} = P(B)$

Probabilistic independence

$$A \triangleq X \text{ is even}$$

$$B \triangleq \{X \equiv 0 \pmod{3}\}$$

$$B = \{2, 4, 6\}$$

$$B = \{3, 4, 6\}$$

$$B = \{3, 4, 6\}$$

$$A = \{2, 4, 6\}$$

$$B = \{3, 4, 6\}$$

$$A = \{3, 4, 6\}$$

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$$A = \{3, 4, 6\}$$

$$A = \{$$

Slido

Choose "independent" RVs/ Events
Pick X from 52 playing card,
{X is RED} vs. {X is prime}



B. $\{X \text{ is even}\} \text{ vs. } \{X \text{ is prime}\}$

357 11 13

/#4285709

C. Pick Y from 365 days, $\{Y \text{ is rainy at Champaign}\}\$ vs. $\{Y \text{ is holiday}\}\$



D. {Any midterms on Y} vs. {Y is holiday}