STAT 131
7 May 20
(lecture)

this time: conditional densities

next time: multivariate distributions, transformations

please finish reading all of DS ch. 3 except section 3.10 (later)

1

UCLA case study: gender and marijuana legalization preference

X (G) $= \begin{cases} 1 & \text{if female} \\ 0 & \text{not} \end{cases}$

Y (MLP) $= \begin{cases} 1 & \text{if favor legalization} \\ 0 & \text{not} \end{cases}$

Y (MLP)	X (gender)
0	1
0	0
1	1
⋮	⋮

$n = 106$

↓ sort

Y	X	
1 ⋮ 1	1 ⋮ 1	29
1 ⋮ 1	0 ⋮ 0	52
0 ⋮ 0	1 ⋮ 1	20
0 ⋮ 0	0 ⋮ 0	5
		106

joint PMF

2x2 contingency table: bivariate discrete PMF

	Y (MLP) 1	0	marginal for X
X (G) 1	29	20	49
0	52	5	57
marginal for Y	81	25	106

$$P(Y = y \mid X = x) = ?$$

$P(\underline{Y = 1}) = P(\text{yes to MLP}) = \frac{81}{106} \doteq \underline{79\%}$

$P(Y = 1 \mid X = 1) = P\left(\begin{smallmatrix}\text{yes}\\\text{to}\\\text{MLP}\end{smallmatrix} \,\middle|\, \text{female}\right) = \frac{29}{49} \doteq 60\%$

$P(Y = 1 \mid X = 0) = P\left(\begin{smallmatrix}\text{yes}\\\text{to}\\\text{MLP}\end{smallmatrix} \,\middle|\, \text{male}\right) = \frac{52}{52} \doteq 90\%$

Are X and Y independent in this joint PMF?

no

$P(Y = 1 \text{ and } X = 1) = \frac{29}{106}$

they are strongly dependent

$\neq \cancel{P}\ P(Y = 1) \cdot P(X = 1)$

$\left(\frac{81}{106}\right) \cdot \frac{49}{106}$

dependent = strongly associated

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

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

population → stationarity → sample

all possible (m, d) pairs — the observed (m, d) pairs

defective?

1 = Y
0 = N defective?

1s
&
0s

like ~~IID~~

D_1 $d_1 = 0$ 0%
D_2 $d_2 = 0$ 0%
$d_3 = 1$ 33%
D_n $d_4 = 0$ 25%

(m)

mean $\theta = ?$
(unknown)

defectives
$= N = \sum_{i=1}^{m} D_i$

$\hat{\theta}$ = proportion of defectives

$= \frac{N}{m} = \frac{1}{m} \sum_{i=1}^{m} D_i$

using $\hat{\theta}$ to estimate θ is an example of statistical inference

case I

pop.
known
whole general

deduction → sample unknown (don't have it yet)

part particular

like ~~IID~~

?

this is probability

easier

STAT 131 before

Stat 132/206

Case II pop. induction sample

unknown known

whole general part particular

?

n

~~like IID~~

this is statistics:

harder

induction = statistical inference

A.C.D. ~~said deduction~~

Sherlock Holmes: induction

Bayesian

info content = 0

posterior information about nuclear accidents before 3 mile island in 1979 = prior info (external) about the possibility of such accidents + data (internal) info about all previous accidents