Disc. Sec. 3

case study: death penalty

AMS 131
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①

outcome variable (effect) (Y): $\begin{cases} 1 & \text{if death penalty (DP)} \\ 0 & \text{not} \end{cases}$

predictor variable (cause) (X): $\begin{cases} 1 & \text{if } \cancel{\text{defendant white}} \text{ (DW)} \\ 0 & \text{not (DB)} \end{cases}$ defendant black

basic design: observational study

threat to validity: bias from potential confounding factors (PCFs) $Z_1, \dots, Z_k$

one possible PCF (Z): $\begin{cases} 1 & \text{if victim white (VW)} \\ 0 & \text{not (VB)} \end{cases}$ ← victim black

as Z changes from VB to VW, quite possible that $P(DP) \uparrow$

as Z changes from VB to VW, quite possible that $P(DW) \uparrow$

so Z (ethnicity of victim) <u>is</u> a PCF; control for it by <u>holding it constant</u>.

study relationship between DP imposition (2)
and ethnicity of defendant separately for
VB and VW

(bottom table) (middle table)

naive analysis based only on top (aggregate) table:

if a murder is chosen at random

$P(DP) = \frac{36}{326} \doteq 11.0\%$

$P(DP \mid DW) = \frac{19}{160} \doteq 11.9\%$

$P(DP \mid DB) = \frac{17}{166} \doteq 10.2\%$

it appears that white defendants receive the death penalty more often than black defendants, which is a surprise

analysis of middle table (VW)

$P(DP \mid VW) = \frac{30}{214} \doteq 14.0\%$

$P(DP \mid VW, DW) = \frac{19}{151} \doteq 12.6\%$

$P(DP \mid VW, DB) = \frac{11}{63} \doteq 17.5\%$

holding ethnicity of victim constant at White, the rate of imposition of the death penalty rises (!), from 11.0% (top table) to 14.0%, and now Black defendants get the DP more often than white defendants analysis of bottom table (VB) ③

$P(DP \mid VB) = \frac{6}{112} \doteq 5.4\%$	holding ethnicity of victim constant at Black, the rate of imposition of the death penalty
$P(DP \mid VB, DW) = \frac{0}{9} = 0\%$	
$P(DP \mid VB, DB) = \frac{6}{103} \doteq 5.8\%$	

falls (!), from 11.0% (top table) to 5.4%, and (again) now Black defendants get the DP more often than White defendants.

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so: overall, in the aggregate (top table), as ethnicity of defendant moves from Black to White, $P(DP)$ goes up, but separately for each of VW (middle table) and VB (bottom table), as ethnicity of defendant moves from Black to white, $P(DP)$ goes down (i.e., the relationship reverses direction): this is a called Simpson's Paradox, and ~~[illegible]~~ there's nothing paradoxical going on.

Why did this happen?

① Murder victims typically know their murderer. ④

② In the U.S., white people tend to hang out with white people, and Black with Black.

③ Therefore white defendants are mostly murdering white victims.

④ Judges & juries in the U.S. impose the death penalty more often when the victim is White than when the victim is Black.

Homework for you, not to turn in:

show that ethnicity is indeed a PCF here, by computing and comparing

P(DP)	P(DW)
P(DP | VB)	P(DW | VB)
P(DP | VW)	P(DW | VW)

ex. T-S case study: Y = # of T-S babies (5)

T-S not

Y follows the Binomial distribution

with parameters n = # children

and p = P(T-S baby on any 1 child)

$$P(Y = y) = \begin{cases} \binom{n}{y} p^y (1-p)^{n-y} & \text{for } y = 0, 1, \dots, n \\ 0 & \text{else} \end{cases}$$

dbinom computes these

$y \in \{0, 1, 2, 3, 4, 5\}$ is called the support of the r.v. Y

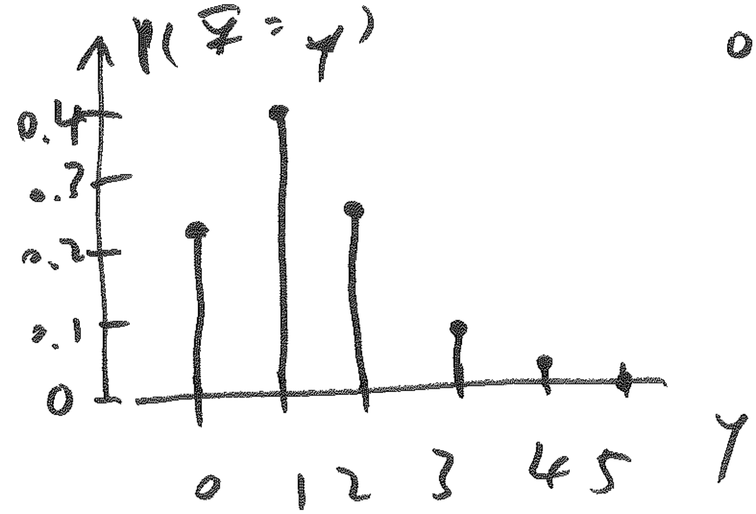
ex. $(n = 5, \ p = \frac{1}{4})$

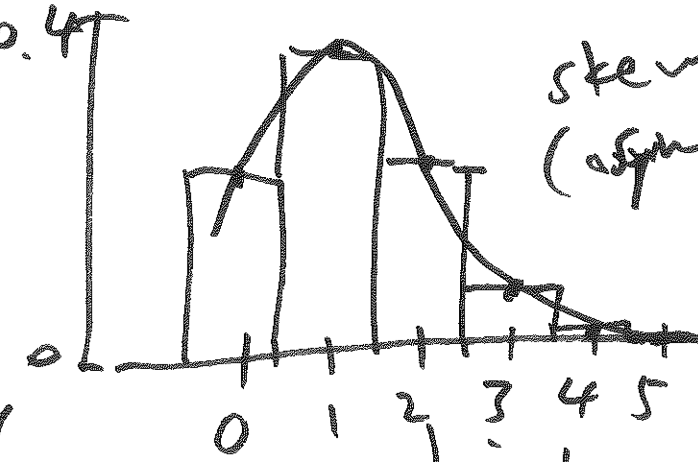
rbinom generates pseudo-random samples from Binomial(n, p)

↑ random sample

(Y follows the Binomial dist. with parameters n, p) ⟺ $(Y \mid n, p) \sim$ Binomial(n, p)

~ is distributed as





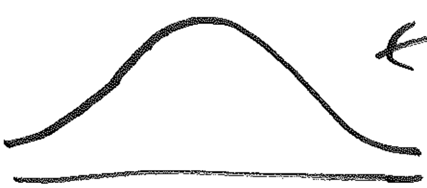
skewed (asymmetric)

histogram

\# of simulation replications = 1,000,000

the entire family

Binomial (n, p) : $\left\{ \begin{array}{l} n = 1, 2, \ldots \\ 0 \leq p \leq 1 \end{array} \right\}$



← symmetric