19 Apr 18
AMS 7

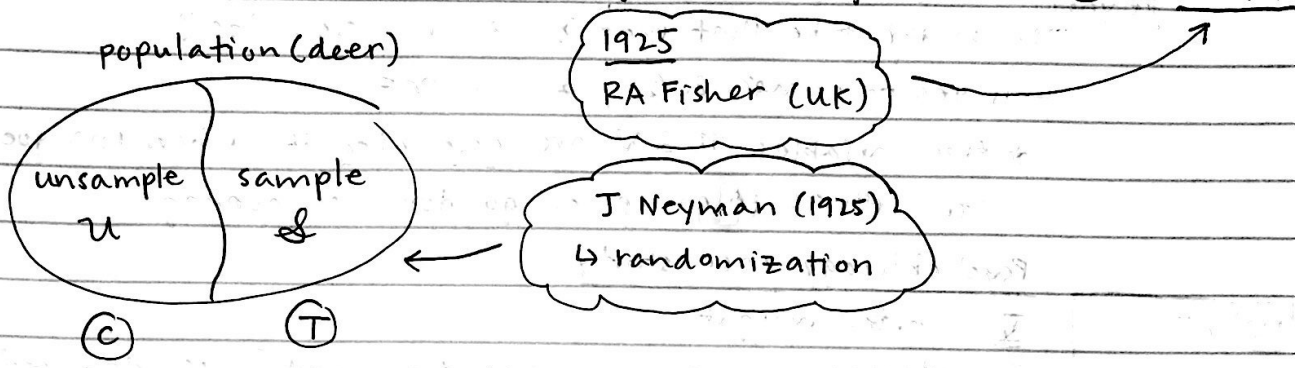
this time: experimental design

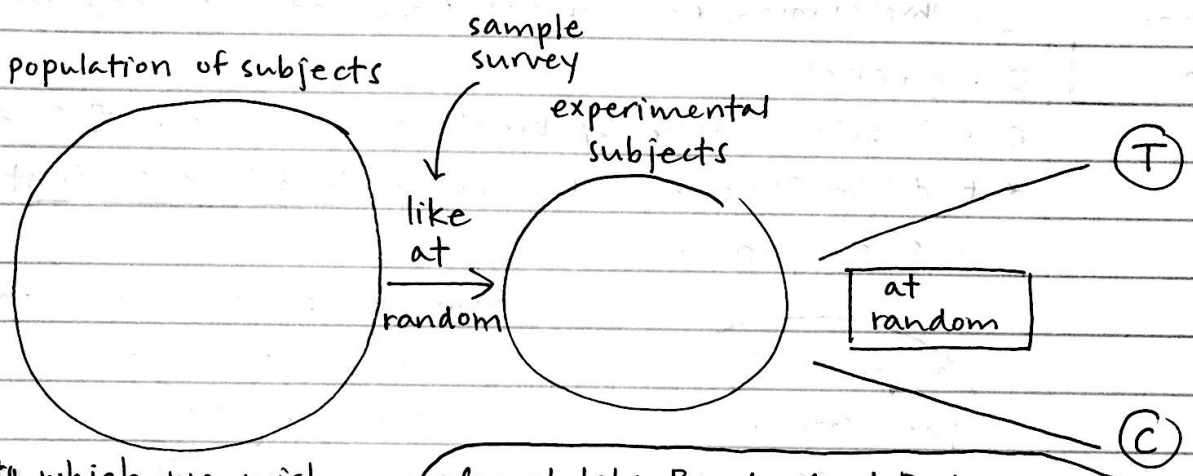
next time: probability

Q: Goal of assignment of experimental subjects to Ⓣ or Ⓒ

A: Ⓣ & Ⓒ groups should be as similar as possible, in all relevant ways — except for Ⓣ/Ⓒ distinction

— simplest method to achieve this goal → assign to Ⓣ or Ⓒ at random





to which we wish to |generalize|

Q_1: Is the CRD valid? (for drawing cause & effect conclusions)

A_1: yes, no bias anywhere

Q_2: Might there be other designs that are also valid but more accurate than CRD?

A_2: Yes

Completely Randomized Design

|def:| a design is valid if it's unbiased.

|def:| a design is unbiased if

a) no bias has crept in when (eg.) assigning subjects to T/c & choosing subjects in the first place

b) if many people replicated our design on average across these replications, you would be able to identify the truth.

|def:| bias = a systematic tendency to get wrong answer on high or low side.

$\overline{Y}$ (outcome)

$\overline{X}$ (treatment) (supposedly causal factor [SCF])

$\overline{z}$ (potential confounding factor [PCF])

* in experimental design, PCFs are the enemy, because without controlling

— how to test whether a $\overline{z}$ (is) a PCF

if yes | ① might it be true that $\overline{Y}$, $\overline{z}$ are associated? (either positively or negatively)

② might it be true that $\overline{X}$, $\overline{z}$ are associates?

— if yes to both ① & ②, $\overline{z}$ is a PCF

* two variables $\overline{u}$ & $\overline{v}$ are <u>associated</u> if, when one goes up, the other tends to go up or go down on average

<u>Psychobiology case study</u>

(NB) all rats were male

$\overline{Y}$: cortex weight

$\overline{X}$: psychological environment (enriched (T) vs. deprived (C))

$\overline{z}_1$: genetics

* CRD defeats PCFs by breaking link between $\overline{X}$ & $\overline{z}_1$

* to defeat PCFs more thoroughly, <u>hold them constant</u> in the T/C comparison

a genetically pure strain of rats

chose litters at <u>random</u>

from any chosen litter with 22 males, chose 2 males at random (T, C)

- assignment inside each pair was at random

pop → (like at random) → experimental subject → (T) / (C) at random

mean SD cortex weight

$n_T = 60$ $n_C = 60$

difference D = T − C

(CRD) T > C

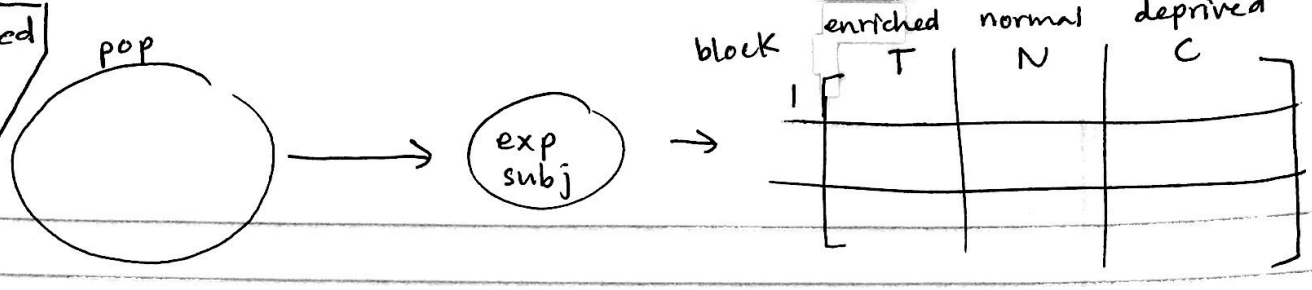
analyze T & C independently

pairs matched on $\overline{z}$ = genetics

matched pairs design → 1 row for each pair, n = 60

pair	T	C	
1	708	679	+29
2	695	697	−2
⋮	⋮	⋮	

randomized blocks design



CRD: valid, not as accurate as possible

randomized blocks design: valid, likely to be more accurate than CRD

↳ special case: matched pairs design (randomized blocks w/ block size 2)

repeated measures design

ex. T = drug to help with insomnia

outcome $\underline{Y}$: hours of sleep

treatment $\underline{X}$: take new drug vs. ~~don't take it~~ take current best drug

- make Ⓣ & Ⓒ pills look identical
- if Ⓒ pill has no active ingredient, it's called a placebo

placebo effect: people tend to respond to the idea of treatment, in addition to or instead of the Ⓣ itself

hawthorne effect: people tend to change behavior when they know they're being watched

- Ⓣ, Ⓒ pill look identical: blinding subjects to T/C states
- also good idea to blind experimenters to T/C states
- ★ both blinds: double-blind experiment
- often not ethically possible to randomize people to Ⓣ smoking vs. Ⓒ not smoking

Observational Studies

$\underline{Y}$: health status (lung cancer? heart disease?)

$\underline{X}$: Ⓣ smokers
Ⓒ non-smokers

$Z_1, Z_2 \ldots$ lots of PCFs