this: experimental design

next time: probability

read:))) book ch. 7-8

LN pp. 95-118 ①

AMS7 16 Oct 18

today: LN pp. 69+

hwk 1 due by 11.59 pm tonight (wed 17 Oct 18) at canvas

hwk 2 due Sun 28 Oct (please start now)

outcome (Y): cortex weight (mg)

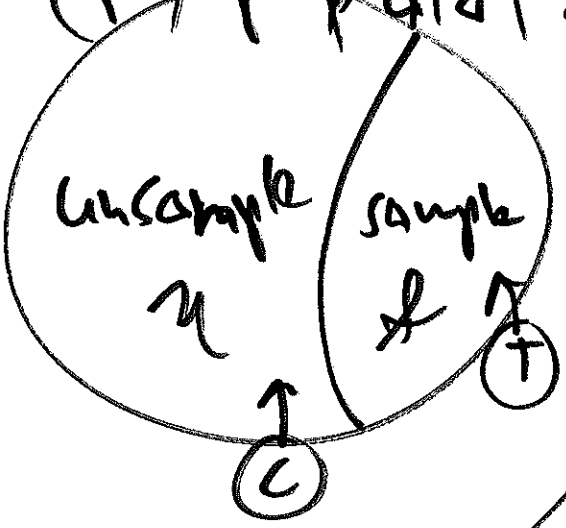
treatment (X): ⓣ enriched = ↖ treatment
ⓒ deprived = ↖ control

subjects: (male) rats ≈ 1920

goal (R.A. Fisher)

try to make ⓣ, ⓒ groups as similar as possible, in all relevant ways, except for ⓣ/ⓒ distinction

(P) population (Neyman) (≈1920) ②



simplest solution

assign rats to T, C at random

R (36) | Design 1 | Get 120 male rats from genetically pure strain, assign 60 at random to T & the other 60 to C (in a like-random fashion)

completely randomized design

valid? yes

experimental subjects

CRD

pop.

genetically pure strain

life at random

n=120 male rats

60 T

at random

60 C

unbiased

design 1 dataset

(T) cortex weight

$$\begin{bmatrix} 689 \\ 702 \\ \vdots \\ | \end{bmatrix} \quad (mg) \qquad n_1 = 60$$

mean $\bar{Y}_1 = 683$ mg

SD $s_1 = 32$ mg

(C) cortex weight

$$\begin{bmatrix} 655 \\ 693 \\ \vdots \\ | \end{bmatrix} \quad (mg) \qquad n_2 = 60$$

mean $\bar{Y}_2 = 647$ mg

SD $s_2 = 30$ mg

Q1 Is 683 mg different from 647 mg by an amount that's large in terms of practically significant (practsig) / practically significant (biological)?

yes → A1) First, 683 is $683 - 647 = 36$ mg heavier $(\bar{Y}_1 - \bar{Y}_2)$ (absolute comparison)

Second, (relative comparison) ④

$$\frac{683\text{ mg} - 647\text{ mg}}{647\text{ mg}} = \frac{+36}{647} \doteq 5.6\%$$

The mean cortex wt. in (T) was 5.6% larger than mean cortex wt. in (C)

$\left(\frac{\bar{Y}_1 - \bar{Y}_2}{\bar{Y}_2}\right)$

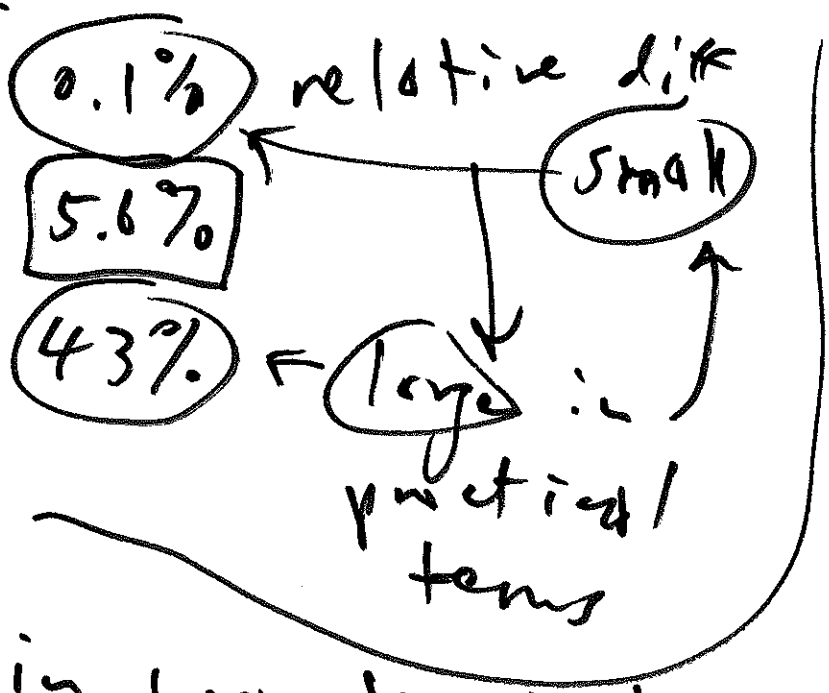
$$\frac{647\text{ mg} - 683\text{ mg}}{683\text{ mg}} = \frac{-36}{683} \doteq -5.3\%$$

The mean cortex wt. in (C) was 5.3% smaller than mean cortex wt. in (T)

$\frac{3-2}{2}$

3 is 50% bigger than 2, but 2 is only 33% smaller than 3 $\left(\frac{2-3}{3}\right)$

5.6% increase in cortex wt → $(5.6^2)\%$ increase in synapses $= 31\%$



heuristic (approximate) rule: ① relative differences of 5% or more are often large in practical terms ② smaller relative differences than 5% can also be practically significant, especially if they accumulate over time — a change of 1% per year sounds small, but over (say) a 10-year period it is!

Q: In design I, is it fair to conclude that the diff. (5.6%) was caused by ⊕ vs. ⊖ environment?

Q: Is design 1 unbiased?

Def A data-gathering method is unbiased if, when repeated hypothetically & the results averaged, you get the right answer

Def Bias: a systematic tendency to get the wrong answer, either on high or low side

Def: A design is valid for causal conclusions if it's unbiased

(completely randomized design (CRD)) = (randomized controlled trial (RCT) (medicine))

(12.41)

Y (outcome) (cortex weight)

X (treatment: supposedly causal factor (SCF))
- (T) enriched environment
- (C) deprived

the potential enemy ← bias

Z_1 (potential confounding : genetics
confusing factor
(PCF))

Def: Z_1 is a PCF if

- it's plausible that Z_1, Y are associated
& - ——— Z_1, X are assoc.

Def. two variables U & V are associated if, when one goes up, the other tends to go up (or down) on average

← positive association

negative association →

how defeat bias from PCFs

2 ways

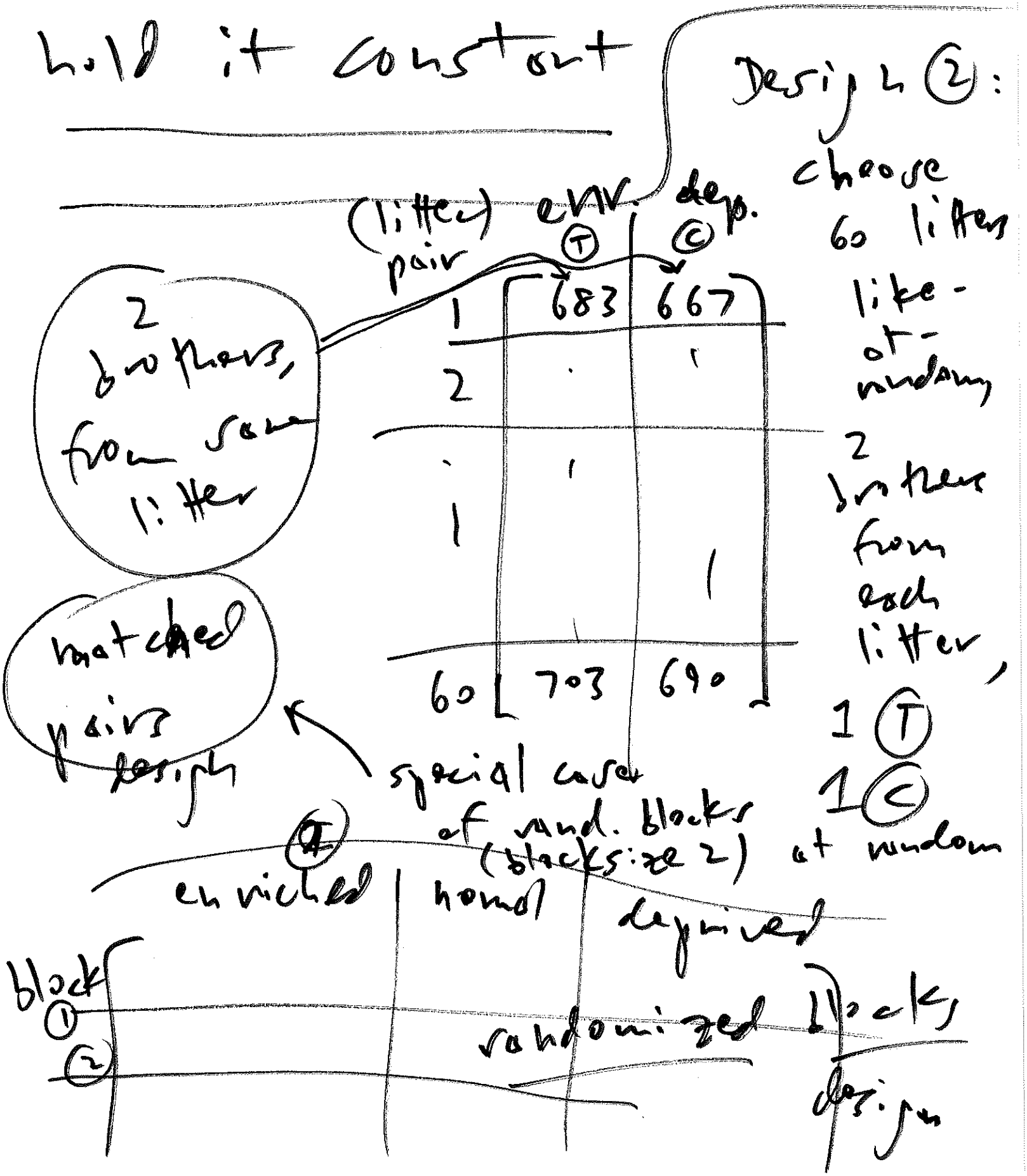
1. at design time
   - (A) (simple but less accurate) randomize to T, C
   - (B) (more complicated but more valid accurate) matched pairs

2. at analysis time

strong way to defeat a PCF:

hold it constant

Design ②:



insomnia (L - 58)

Y (outcome): # hrs. sleep

X (treatment) < (T) drug blue pill w/ active ing.
(C) not drug blue pill, no active ing.

(T) blue pill
(C) nothing

⇐ all subj. know which group they're in

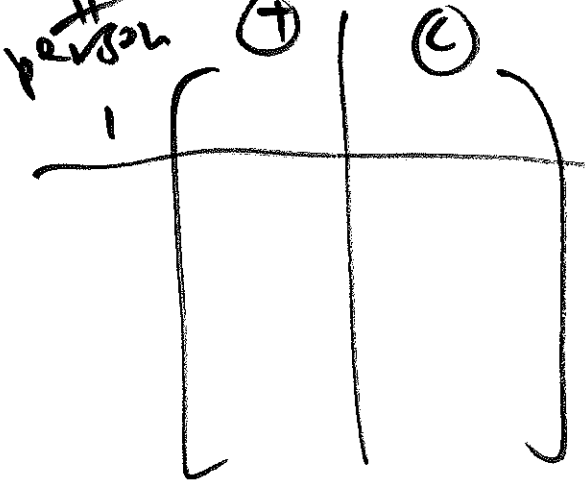
placebo effect: people sometimes respond to the idea of treatment rather than treatment itself

placebo: inert substance, looks just like treatment intervention

subjects don't know if they're in Ⓣ, Ⓒ

blinding: subjects to Ⓣ/Ⓒ status (good precaution)

also possible (& good) to blind experimenters to Ⓣ/Ⓒ status: double-blind if I'm



← some person in my study holds all RVs constant

Repeated - measures (longitudinal) design