exercise2

Xiang Li

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Exercise1

a

Randomized trial.

b

Eligibility criteria:

participants were recruited from 15 universities across the United States.

Exposure definition (Intervention and control):

X = 0, not receive access to Tess

X = 2, receive access to Tess for 2 weeks

X = 4, receive access to Tess for 4 weeks

Assignment procedures:

random assignment at start

Follow-up period:

4 weeks after randomization

Outcome definition:

3 types of survey scores: PHQ-9, GAD-7, PANAS

Causal contrast of interest:

E(Y(4)) - E(Y(2))

E(Y(4)) - E(Y(0))

E(Y(2)) - E(Y(0))

c

Yes, because the participants are randomly assigned, so everyone has opportunity to be exposed or not exposed.

d

Based on the original assignment result, the output should be marked as X = 4.

Exercise2

a

Target trial.

b

Eligibility criteria:

individuals are registered in Danish registry systems.

Exposure definition (Intervention and control):

X = 0, not confirmed infection of listed enteric pathogens

X = 1, confirmed infection of listed enteric pathogens

Assignment procedures:

based on case data, not randomization

Follow-up period:

1 year follow-up

Outcome definition:

Death or not within 1 year

Causal contrast of interest:

E(Y(1)) - E(Y(0))

c

Not exchangeable, because for individuals who have been confirmed infection, they have no opportunity to be not exposed.

Exercise3

a

```
set.seed(519)
n = 10000
confounder = rbinom(n = n, size = 1, prob = 0.5)
```

b

```r
exposure = rep(NA, n)
n0 = length(confounder[confounder == 0])
n1 = n - n0
exposure[confounder == 0] = rbinom(n = n0, size = 1, prob = 0.25)
exposure[confounder == 1] = rbinom(n = n1, size = 1, prob = 0.75)
```

c

```r
y0 = confounder + rnorm(n)
y1 = y0
```

d

```r
outcome = y0 * (1 - exposure) + y1 * exposure
```

e

```r
table(confounder, exposure)
```

```
##            exposure
## confounder    0    1
##           0 3691 1258
##           1 1217 3834
```

No exchangeability, because X is not randomly assigned in each confounder group.

f

```r
mean(outcome[exposure == 1]) - mean(outcome[exposure == 0])
```

```
## [1] 0.5072929
```

Not causal difference, because there is no exchangeability.

g

```
E_outcome1 = mean(outcome[(exposure == 1) & (confounder == 1)]) * mean(confounder ==
    1) + mean(outcome[(exposure == 1) & (confounder == 0)]) * mean(confounder ==
    0)
E_outcome0 = mean(outcome[(exposure == 0) & (confounder == 1)]) * mean(confounder ==
    1) + mean(outcome[(exposure == 0) & (confounder == 0)]) * mean(confounder ==
    0)
ATE = E_outcome1 - E_outcome0
ATE
```

```
## [1] 0.005487423
```

Exercise4

a

$E(Y(1)) = (10 * 1 + 90 * 0)/100 = 0.1$

$E(Y(0)) = (1000 * 1 + 9000 * 0)/10000 = 0.1$

$E(Y(1)) - E(Y(0)) = 0$

$E(Y(1))/E(Y(0)) = 1$

$(E(Y(1))/(1 - E(Y(1))))/(E(Y(0))/(1 - E(Y(0)))) = 1$

b

	Cancer (Y=1)	No cancer(Y=0)	Total
Diabetes (X=1)	$10 * 0.2 = 2$	$90 * 0.1 = 9$	11
No Diabetes (X=0)	$1000 * 0.1 = 100$	$9000 * 0.01 = 90$	190
Total	102	99	201

c

$E(Y(1)) = (2 * 1 + 9 * 0)/11 = 0.182$

$E(Y(0)) = (100 * 1 + 90 * 0)/190 = 0.526$

$E(Y(1)) - E(Y(0)) = -0.344$

$E(Y(1))/E(Y(0)) = 0.346$

$(E(Y(1))/(1 - E(Y(1))))/(E(Y(0))/(1 - E(Y(0)))) = 0.200$

The causal contrast is different among these two types of population, because selection bias.