Tipping Point Sensitivity Analyses

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Recall: Propensity scores

Rosenbaum and Rubin showed in observational studies, conditioning on propensity scores can lead to unbiased estimates of the exposure effect

1. **There are no unmeasured confounders**
2. **Every subject has a nonzero probability of receiving either exposure**

Quantifying Unmeasured Confounding

What you'll need:

1. **The exposure-outcome effect**
2. **The unmeasured counfounder-exposure effect**
3. **The unmeasured confounder-outcome effect**

What will tip our confidence bound to cross zero?

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Tipping point

$$\beta_{UO}(LB_{obs}, \delta)$$

Tipping point

$$\beta_{UO}(LB_{obs}, \delta)$$

β_{UO}: the **unmeasured confounder-outcome effect**

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Tipping point

$$\beta_{UO}(LB_{obs}, \delta)$$

LB_{obs}: **limiting bound** - the bound closest to the null

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Tipping point

$$\beta_{UO}(LB_{obs}, \delta)$$

δ: **standardized mean difference** of the unmeasured confounder between the exposed and unexposed groups

Quantifying Unmeasured Confounding

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Tipping Point

$$\beta_{UO}(LB_{obs}, \delta) = \frac{LB_{obs}}{\delta}$$

Tipping Point

$$\delta(LB_{obs}, \beta_{UO}) = \frac{LB_{obs}}{\beta_{UO}}$$

tipr

Main function

tip_coef()

- effect: **observed exposure - outcome effect**

Quantifying Unmeasured Confounding

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Main function

tip_coef()

smd: **scaled mean difference between the unmeasured confounder in the exposed and unexposed population**

Quantifying Unmeasured Confounding

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3. The unmeasured confounder-outcome effect

Main function

tip_coef()

outcome_association: **association between the unmeasured confounder and outcome**

Quantifying Unmeasured Confounding

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Main function

tip_coef()

- effect
- smd
- outcome_association

Main function

tip_coef()

specify one, it will estimate the other

- d
- smd
- outcome_association

Example

Our causal effect estimate: 3.5 lbs (95% CI 2.4 lbs, 4.4 lbs)

```
library(tipr)
tip_coef(effect = 2.4,
         smd = 0.3)
```

```
## # A tibble: 1 × 4
##   observed_effect   smd outcome_association n_unmeasured_co…
##             <dbl> <dbl>               <dbl>            <dbl>
## 1             2.4   0.3                   8                1
```

The observed effect (2.4, 4.4) WOULD be tipped by 1 unmeasured confounder with the following specifications:

estimated standardized mean difference between the unmeasured confounder in the exposed population and unexposed population: 0.3

estimated association between the unmeasured confounder and the outcome: 8

Your turn

1. **Use the** `tip_coef()` **function to conduct a sensitivity analysis for the estimate from your previous exercises.**

10:00