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 exposure-unmeasured counfounder 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: **observed exposure - outcome effect**

Quantifying Unmeasured Confounding

What you'll need:

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

Main function

tip_coef()

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

Quantifying Unmeasured Confounding

What you'll need:

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

Main function

tip_coef()

confounder_outcome_effect:
relationship between the unmeasured confounder and outcome

Quantifying Unmeasured Confounding

What you'll need:

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

Main function

tip_coef()

effect_observed

exposure_confounder_effect

confounder_outcome_effect

Main function

tip_coef()

specify one, it will estimate the other

effect

exposure_confounder_effect

confounder_outcome_effect

Example

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

```
library(tipr)
tip_coef(effect_observed = 2.4,
         exposure_confounder_effect = 0.3)
```

```
## # A tibble: 1 × 4
##   effect_observed exposure_confounder_effect confo…¹ n_unm…²
##             <dbl>                       <dbl>   <dbl>   <dbl>
## 1             2.4                         0.3       8       1
## # … with abbreviated variable names
## #   ¹confounder_outcome_effect, ²n_unmeasured_confounders
```

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.**

05:00