

# Tipping Point Sensitivity Analyses

Lucy D'Agostino McGowan

Wake Forest University

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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 confounder-exposure effect**
- 3 The unmeasured confounder-outcome effect**

**What will tip our confidence bound to  
cross zero?**

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# Tipping point

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

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

$\beta_{UO}$ : 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

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

$\delta$ : **standardized mean difference** of the unmeasured confounder between the exposed and unexposed groups

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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**

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# Main function

tip\_coef()

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

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# Main function

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**outcome\_association: association  
between the unmeasured  
confounder and outcome**

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# Main function

## tip\_coef()

effect

smd

outcome\_association

# Main function

tip\_coef()

**specify** one, it will **estimate** the other

effect

smd

outcome\_association



# Example

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

```
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