

## § 4.5 Assessing balance

任务: 检查 covariate balance 是否实现 (IPTW 之后)

目标: Weighted sample  $\Leftrightarrow$  randomized trial

思路: 与之前 Propensity score 之后的检查方法相同, 采用 standardized difference.

(Covariate balance can be checked on the Weighted sample using standardized difference)

注意: 是对 weighting 之后的样本做检验, 而不是

(1) 原样本。

Two surveys: Table 1: summary statistics plot

① Table 1: ① Weighted means mean (sd) of each covariate stratified on treated group and control group (using

② standardized difference after weighting: (recall smd)

is the difference in means between groups, divided by the pooled standard deviation.

② plot

$$smd = \frac{\bar{x}_t - \bar{x}_c}{\sqrt{\frac{s_t^2 + s_c^2}{2}}} \quad \text{绝对值}$$

② Standardized difference after weighting

o weighted means (variance) of each covariate stratified on treated group and control group.

o Take difference in weighted means and divide by an estimate of pooled weighted standardized deviation.

! smd 越小越好,  $\geq 0.02$  imbalance  $0.4 \mid 0.2 \mid 0.2 \mid 0.4$

	Raw data		smd	Weighted data		smd
	control	treated		control	treated	
$\bar{x}$						
$s^2$						
$n$						
$v_1$						
$v_2$						
$\vdots$						

(b) If imbalance after weighting

① refine propensity score ~~model~~ model

> summary(weight)  
> tail(sort(weight))  
> head(sort(weight))

A person who was likely to be treated (given covariates) but wasn't:

$$P(A_i=1|X_i) = \frac{1}{10} \quad \text{treated} \quad \frac{1}{10} \quad \text{control} \quad \text{but wasn't}$$

$$P(A_i=0|X_i) = \frac{1}{10} \Rightarrow \text{weight} = \frac{1}{\frac{1}{10}} = 10$$

## § 4.6 Distribution of weights

4.6.1 Intuition Weight  $\rightarrow$  large standard error

• 极端的一个例子

1 person  $\rightarrow$  weight 10000  $\rightarrow$  1 个人代表 10000

outcome: 1 (10000 个人的 outcome 都依赖于 1 个人, 个人有很大的噪声, 很大的误差)

相当于 10000 个人的 outcome 都是 1.

如果 1 个人的 outcome data 很显著地影响了参数估计, 那么 standard error 就会非常大.

Prefer person to have not too large weight.

## 4.6.2 Bootstrapping

Estimate standard error: bootstrapping

Step 1: Randomly sample from original data (有放回)

Step 2: Use sample data to estimate parameters

Step 3: Repeat the procedure for k times.

Step 4: Take the variance of k estimators as the estimate of standard error.

问题: 当一些 weight 非常大的 sample 被采样时, 该样本对估计量的作用非常显著.

当这些 weight 非常大的样本不被采样时, 作用对估计量的作用非常明显, 所以大 weight 的样本会使估计量 standard error 的波动很大, 越大.

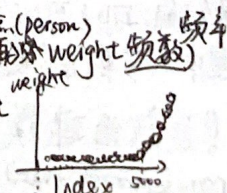
## 4.6.3 Relationship with positivity assumption.

weight =  $\frac{1}{P(A_i=1|X_i)}$  若 weight  $\uparrow$ ,  $P(A_i=1|X_i) \downarrow$

假设 weight 非常非常大, 那么  $P(A_i=1|X_i)$  就会非常趋向于 0. 这有可能违背 positivity assumption. (near violation)

## 4.6.4 Checking Weights

(1) plot density plot (所有样本的 weight 频率) weight-index plot



Summary Statistics (quantiles) min/max/mean/median