§3.7 Sensitivity analysis.

Outline:
1. Understand the concept of sensitivity analysis.
2. Carrying out a sensitivity analysis in practice.

\subsection {Background}

Recall: The mean goal of matching is to achieve balance on observed covariates.

Overt bias: occur when balance on observed covariates is not achieved. We $\times$ fully control for these variables.

目标: 我们希望能够识别出 overt bias.

段: **Unobserved variables**: Matching 无法控制未观测到的变量.

Recall 2: Randomized trials — achieve balance on observed and unobserved variables. (因此 treatment 的分配完全是随机的) 与所有的 X 都无关.

hidden bias: 存在未观测到的变量, 并且这些变量都是 confounders.

述清 ignorability assumption $Y^0, Y^1 \perp A \mid X$.

\subsection {Sensitivity analysis}

Main idea: 如果存在 hidden bias, 考虑 hidden bias 多严重时会改变结论 (①改变 causal effect 的显著性; ②改变 effect 的方向)

符号说明:
{ π_j: 第 j 个 subject 接受 treatment 的概率.
{ π_k: 第 k 个 subject 接受 treatment 的概率.

• 如果第 j 个 subject 与第 k 个 subject perfectly matched, 那么 $X_j = X_k$

• 如果 $\pi_j = \pi_k$, no # hidden bias.

• Inequality (odds ratio;)

$$\frac{1}{\Gamma} \leq \frac{\frac{\pi_j}{1-\pi_j}}{\frac{\pi_k}{1-\pi_k}} \leq \Gamma \text{ (odds ratio)}$$

• Γ 的大小可以检验 Ignorability assumption 是否被 violated, 以及被 violated 的程度.

若 $\Gamma=1$, no overt bias.

若 $\Gamma>1$, implies hidden bias. ✓

操作: 不显著.

$\Gamma \uparrow$: 直到 treatment effect

• 若 Γ 稍微变动, 结果就变了, 那么结果对未观测变量非常敏感.

举例 (1) 若 Γ adds to $\Gamma=1.1$, treatment effect $\times$ significant

(2) Γ adds to $\Gamma=5$.