Matching

$$D_i = \begin{cases} 1 & \text{treated} \\ 0 & \text{untreated / control} \end{cases}$$

e g college educ $(D=1)$, no college educ $(D=0)$

$Y_i(1)$ potential outcome of i with treatment

$Y_i(0)$ " " " without "

$\Delta_i = Y_i(1) - Y_i(0)$ = treatment effect for obs i

Δ_i never observed

$\Delta^{ATE} = E[Y(1) - Y(0)]$ average treatment effect (ATE)

Observed for i $\quad y_i, D_i, x_i$

$$y_i = D_i Y_i(1) + (1 - D_i) Y_i(0) = \text{observed outcome for } i$$

Assumptions to estimate Δ^{ATE}

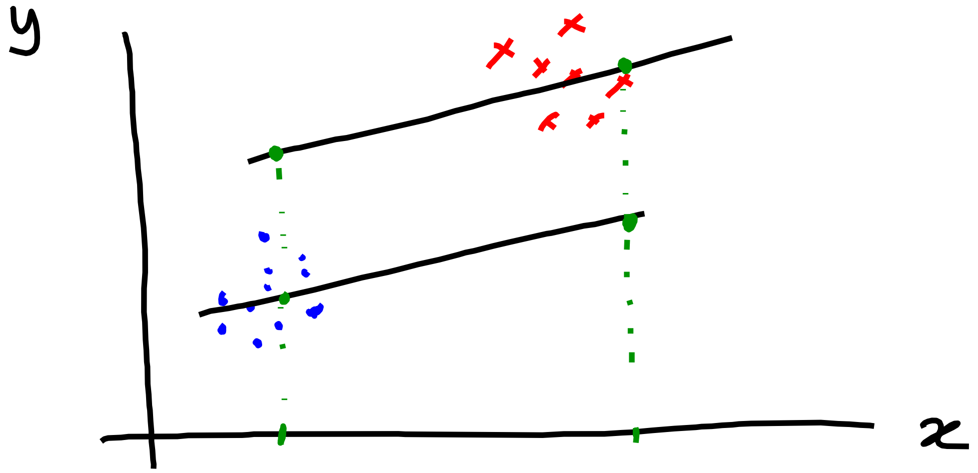
$$Y(0), Y(1) \perp D \mid x$$

$$0 < P(D=1 \mid x) < 1$$

Random sample $\{y, D, x\}$

Matching → when comparing treated and control obs, more weight given to similar obs

No functional form ass^{n}s (such as linear regression)



$$\hat{\Delta}^{ATE} = \frac{1}{N}\sum_i \left[Y_i(1) - Y_i(0) \right]$$

↳ infeasible → missing data/counterfactual

$Y_i(0)$ $D_i = 0$ $Y_i(1)$ $D_i = 0$

$Y_i(1)$ observed if $D_i = 1$; $Y_i(0)$ unobserved if $D_i = 1$

$Y_i(1)$

Replace $Y_i(0)$ with a close match to i

but with $D = 0$ (e.g $Y_j(0)$ where $D_j = 0$)

$D = 1$ $Y_j(1)$ $D_j = 1$

Various matching approaches to determine what weight to attach to obs from the <u>opposite</u> group

One approach relies on the propensity score, $p(x)$

$$p(x) = Pr(D=1 \mid x)$$

↳ typically estimated using logit/probit

$$Y(0), Y(1) \perp D \mid x \Rightarrow Y(0), Y(1) \perp D \mid p(x)$$

Single nearest neighbor matching $Y_j(1)$

If $D_i = 1$ & $Y_i(0)$ is unobserved use $Y_j(0) = y_j$

$D_i = 0$ & $Y_i(1)$ where $D_j = 0$ & p_j is $D_j = 1$

closest to p_i