

Expected Value

unbiasedness of
OLS estimators

$$E(\hat{\beta}) = \beta$$

under certain assⁿs

linear in
parameter

random
sample

variation
in each x

No linear relⁿ
among x 's

$$\text{wage} = \beta_0 + \beta_1 \text{educ} + \beta_2 \text{exper} + \beta_3 \text{age} + u$$

$$\text{age} = 6 + \text{educ.} + \text{exper}$$

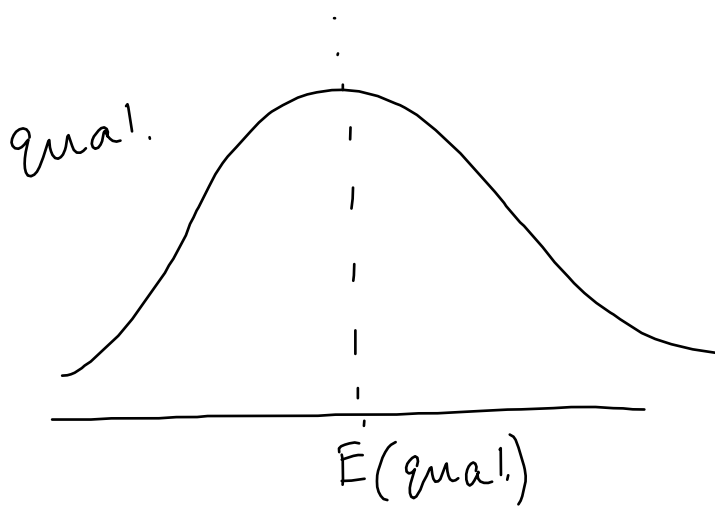
$$n \geq k+1$$

u unrelated
to each x

$$E(u | x_1, \dots, x_k)$$

$$= E(u) = 0$$

$$\begin{aligned} \text{property} &= \beta_0 + \beta_1 \text{sq.ft.} + \beta_2 \# \text{BRs} \\ \text{value} &+ \beta_3 \text{lot size} + u \end{aligned}$$

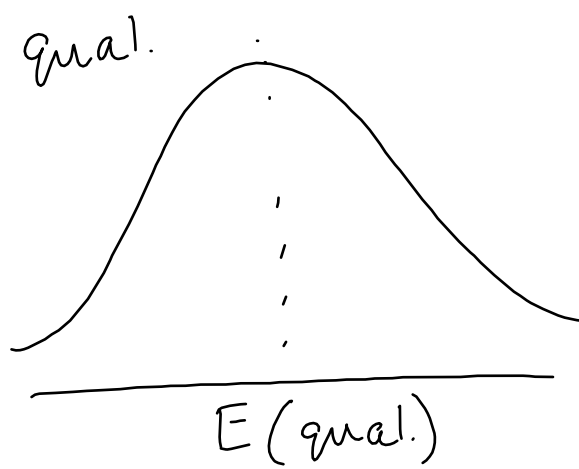


size = 1500 sq.ft.

#BRs = 2

lot size = 2000 sq.ft.

=

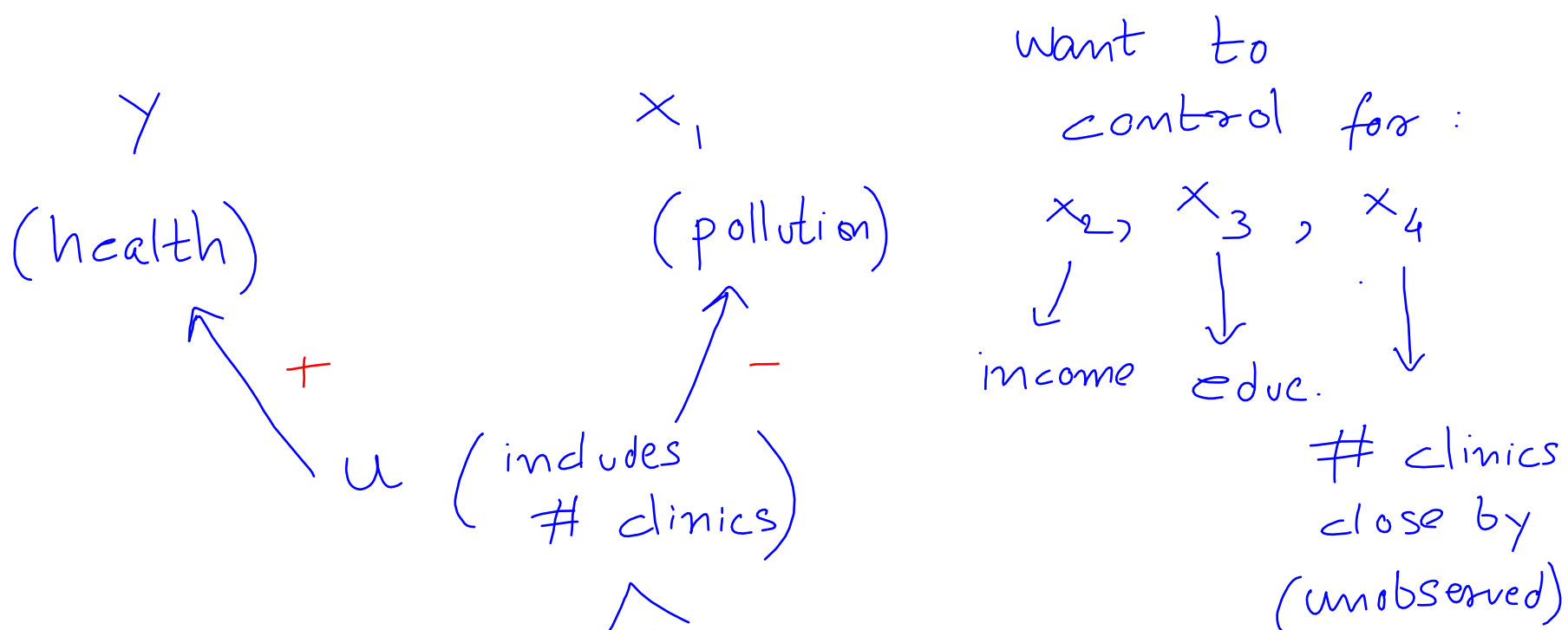


size = 2500 sq.ft.

#BRs = 3

lot size = 3000 sq.ft.

quality



OLS estimator for $\hat{\beta}_1 \rightarrow$ biased
 Omitted Variable Bias (OVB)

Depends on how # clinics related to
 X_1 and Y

e. g. environmental regulations $\rightarrow$ maybe only affect X_1

genetic factors $\rightarrow$ maybe only affect Y

Omitted Variable Bias

True model satisfying condⁿs for unbiasedness:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + u$$

wage
bwght

educ
smoking

IQ
alcohol

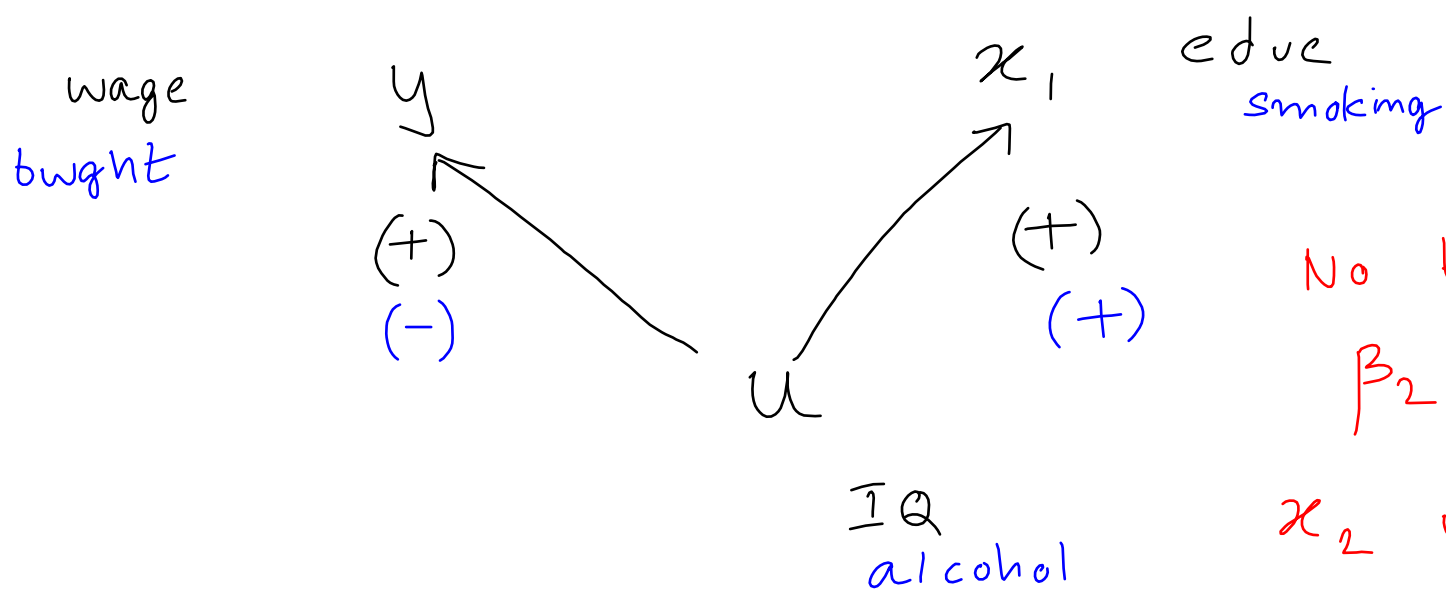
x_2 : omitted; estimate:

$$y = \beta_0 + \beta_1 x_1 + u$$

obtain $\tilde{\beta}_0$ and $\tilde{\beta}_1 \rightarrow$ biased

$$E(\tilde{\beta}) \neq \beta$$

Bias depends on β_2 and corr. b/w x_2 (omitted)
and x_1 (included)



No bias if
 $\beta_2 = 0$ or

x_2 uncorr. w/ x_1