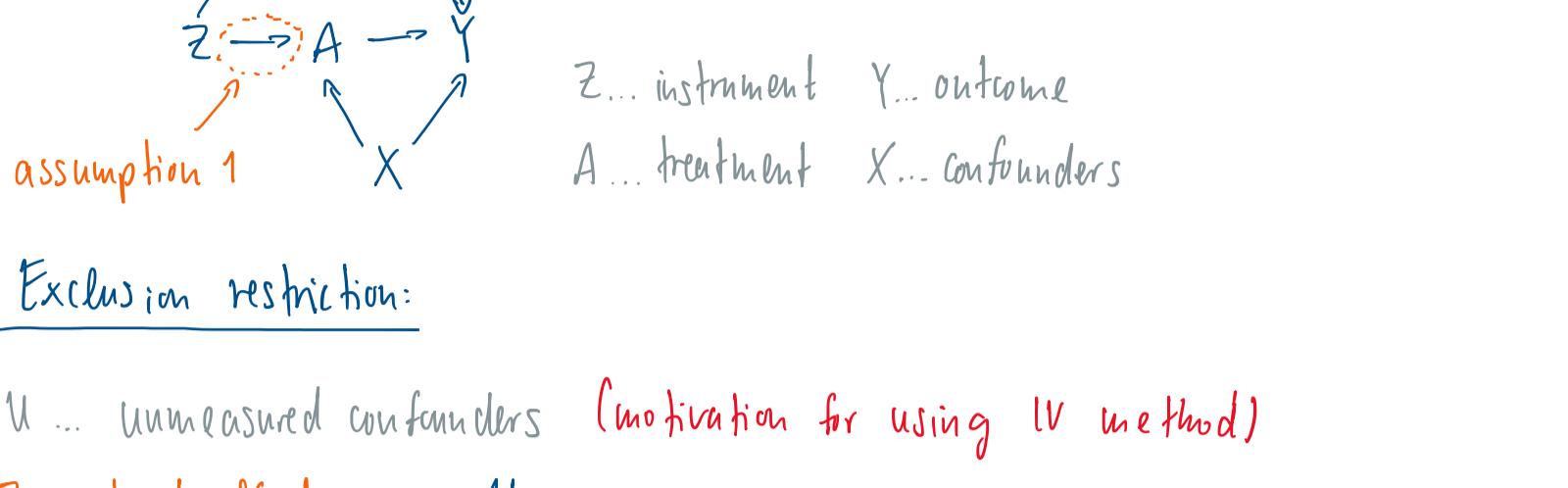


Assumptions about IVs

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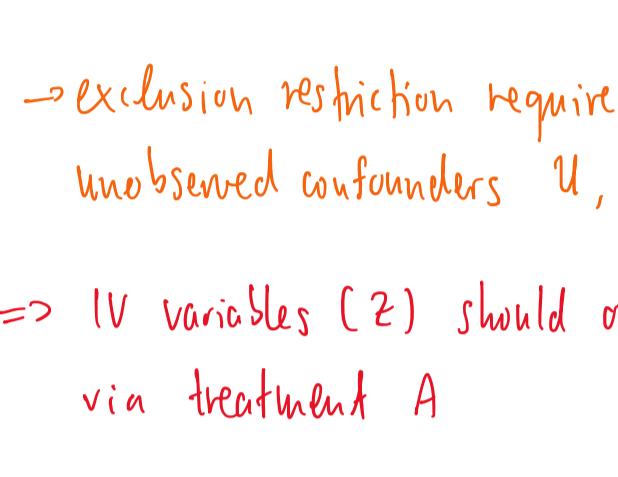
- a variable is an instrumental variable (IV) if:
 1. it is associated with the treatment (assumption 1)
 2. it affects the outcome through its effect on treatment;
↳ exclusion restriction (Assumption 2)

DAG with IV:



Exclusion restriction:

U ... Unmeasured confounders (motivation for using IV method)



→ exclusion restriction requires that Z cannot directly, or indirectly via unobserved confounders U, affect the outcome Y.

⇒ IV variables (Z) should only have one path to outcome Y, namely via treatment A

- 1) Not direct impact of Z on Y.
- 2) No indirect impact of Z on Y (other than via A). } Z is a valid instrument

Are these exclusion restrictions realistic / reasonable?

- if Z is a random treatment assignment then:

- (1) it should affect treatment received (we can check this)
- (2) it should not affect outcome Y or unmeasured confounders (U)
 - ↳ however, if subjects are not blinded, then they know what treatment they receive. In this case, this knowledge could affect their behaviour and as such eventually affect outcome Y.
 - ↳ likewise, if clinicians aren't blinded to assignment, then it could affect treatment administration

Causal Effect:

- assuming we use an IV, then we want to estimate the complier average causal effect (CACE) (a.h.a. "local treatment effect").

$$E[Y^{Z=1} - Y^{Z=0} | \text{compliers}] = E[Y^{A=1} - Y^{A=0} | \text{compliers}].$$

↳ the causal effect (CE) of treatment among subjects/subpopulation of compliers → who take whatever treatment they are assigned.

Identification challenge:

- Recall subpopulations:

	A ⁰	A ¹	Label
0	0	0	Never-takers
1	0	1	Compliers
1	1	0	Non-compliers
1	1	1	Always-takers

for IV method, this is the subpopulation we are interested in

↳ challenge: we cannot identify the compliers from the observational data.

↳ see:

Z	A	A ⁰	A ¹	Compliance Class / Label
0	0	0	?	Never-taker or complier
0	1	1	?	Always-taker or defier
1	0	?	0	Never-taker or defier
1	1	?	1	Always-taker or complier

} WID
monotonicity assumption

Motivates the need for additional assumption: Monotonicity

Monotonicity assumption:

→ monotonicity assumption = there are no defiers (non-compliers) in the study population

↳ no one consistently does the opposite of what they are told.

→ it is called monotonicity b/c the assumption is that :

the probability of treatment should increase with more encouragement

w/ monotonicity assumption → no defiers, thus the table of compliance labels looks as follows:

Z	A	A ⁰	A ¹	Compliance Class / Label
0	0	0	?	Never-taker or complier
0	1	1	?	Always-taker or defier
1	0	?	0	Never-taker or defier
1	1	?	1	Always-taker or complier

} With monotonicity we have

} no defiers in the study

⇒ the monotonicity assumption allows us to identify / estimate the complier average causal effect (CACE)