Identifying Direct Causal Effects Under Unmeasured Confounding

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Introduction

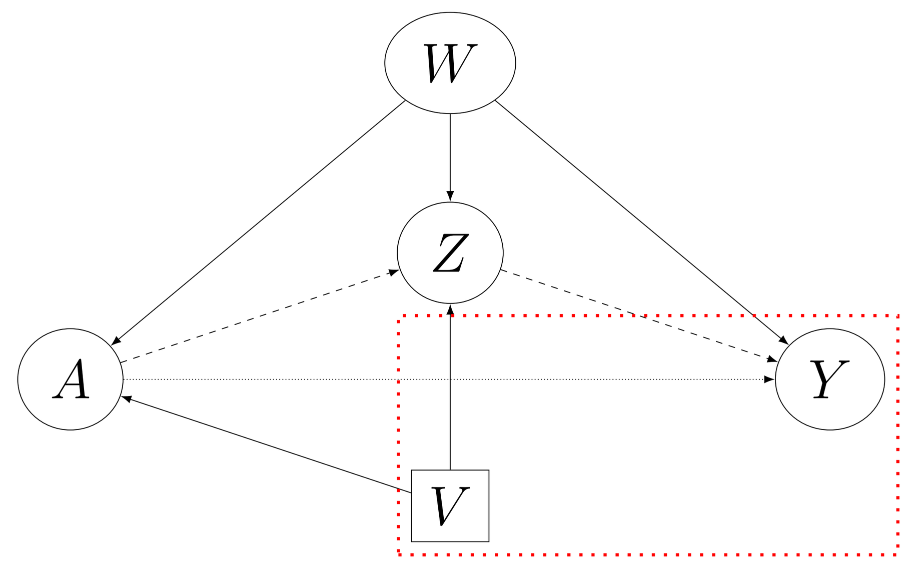
This is the background.

Statistical Problem

State the causal and statistical models, and estimand.
The causal target parameter is

$$\Psi^F(P_{U,X,0}) = \int_{w,z} \mathbb{E}[Y(1,z) - Y(0,z) \mid W = w] \\ p_Z(z \mid A = 0, w) p_W(w)\, dz\, dw \ .$$

Identification



(A1) No unmeasured endogenous pathways:
$f_Y(Z, A, W, V, U_Y) \equiv f_Y(Z, A, W, U_Y)$.

(A2) Conditional expectation equivalence:
$\mathbb{E}(Y \mid Z, A = 1, W, V) \equiv \mathbb{E}(Y \mid Z, A = 1, W)$

Theorem

Under assumptions A1 and A2, $\Psi^F(P_{U,X,0})$ is identified by

$$\Psi(P_0) = \mathbb{E}_{P_0}\mathbb{E}_{P_0}\{\mathbb{E}_{P_0}(Y \mid W, A = 1, Z) \\ - \mathbb{E}_{P_0}(Y \mid W, A = 0, Z) \mid A = 0, W\} \ .$$

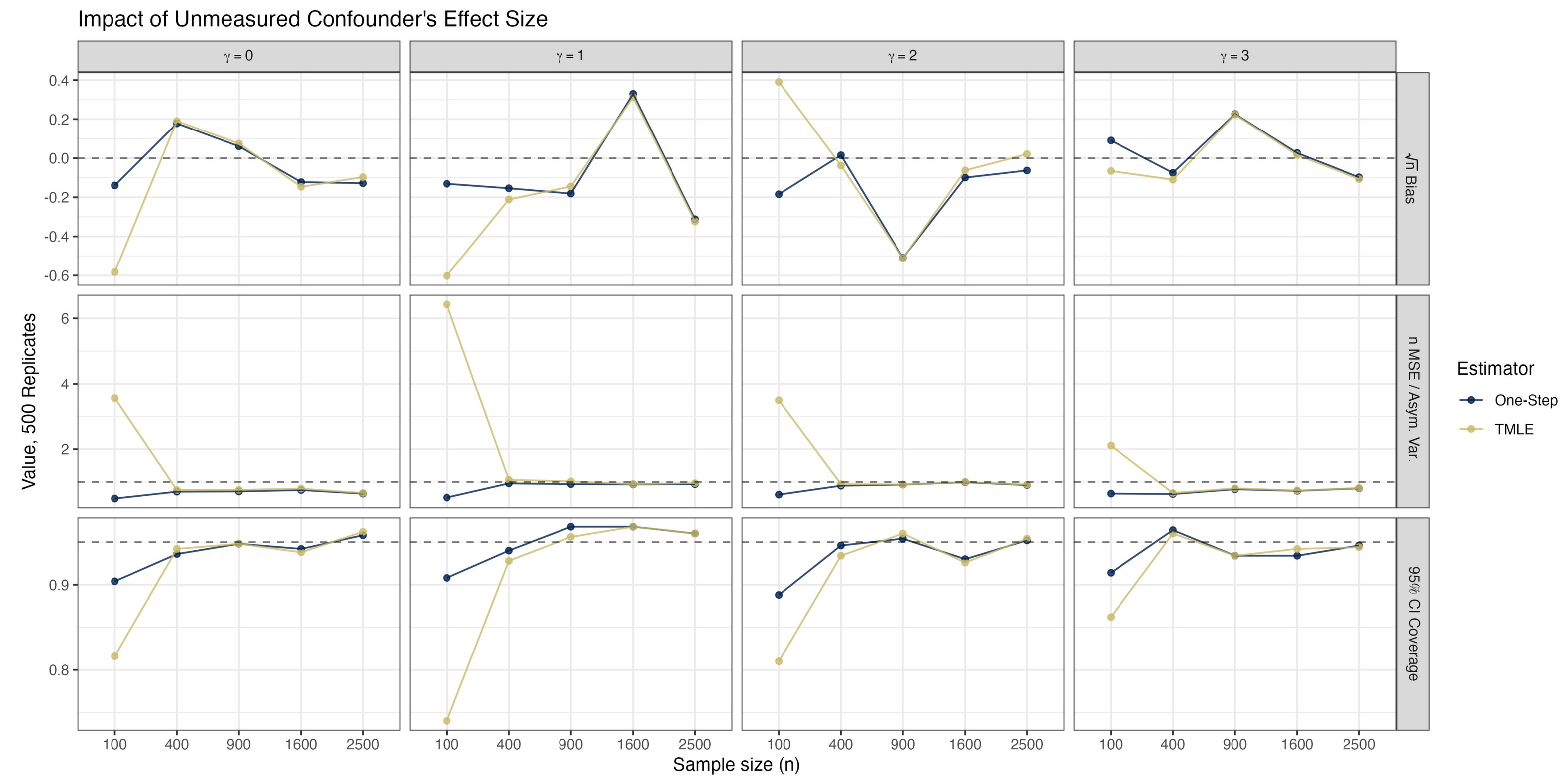
Inference

Statistical inference is possible using standard methods.

Simulation Study

We consider the following data-generating distribution:

$$\begin{aligned} W_1 &\sim \text{Unif}(-1, 1) \\ W_2 &\sim N(0, 1) \\ V &\sim N(0, 1) \\ A|W, V &\sim \text{Bern}\left((1 + \exp\{-W_1 - W_2 - V\})^{-1}\right) \\ Z|A, W, V &\sim \text{Bern}\left((1 + \exp\{-W_1 - W_2 - \gamma V - 3A\})^{-1}\right) \\ Y|Z, A, W, V &\sim N(3A + W_1 + W_2 + Z, 1) \ . \end{aligned}$$



Conclusions

Here are the important takeaways.

References

List of references.

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Thank you for paying my bills.

* *indicates shared first-authorship*

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