

Causal Estimators: Conceptual Overview

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Outcome
under
control

Outcome
under
treatment

Confounder = 1

1	?
?	2
?	2

Confounder = 2

2	?
2	?
?	3

Outcome
under
control

Outcome
under
treatment

Confounder = 1

1	?
?	2
?	2

Confounder = 2

2	?
2	?
?	3

Outcome Modeling

- 1) Model the conditional mean of the observed outcomes
- 2) Predict counterfactuals

	Outcome under control	Outcome under treatment
Confounder = 1	1	?
	?	2
	?	2

	Outcome under control	Outcome under treatment
Confounder = 2	2	?
	2	?
	?	3

Outcome Modeling

- 1) Model the conditional mean of the observed outcomes
- 2) Predict counterfactuals

$$E(Y \mid A, X) = \alpha + \beta X + \gamma A$$

$$\hat{\alpha} = 0, \hat{\beta} = 1, \hat{\gamma} = 1$$

	Outcome under control	Outcome under treatment
Confounder = 1	1	$\hat{Y}^1 = 2$
	$\hat{Y}^0 = 1$	2
	$\hat{Y}^0 = 1$	2

Confounder = 2	2	$\hat{Y}^1 = 3$
	2	$\hat{Y}^1 = 3$
	$\hat{Y}^0 = 2$	3

Outcome Modeling

- 1) Model the conditional mean of the observed outcomes
- 2) Predict counterfactuals

$$E(Y | A, X) = \alpha + \beta X + \gamma A$$

$$\hat{\alpha} = 0, \hat{\beta} = 1, \hat{\gamma} = 1$$

Outcome
under
control

Outcome
under
treatment

Confounder = 1

1	?
?	2
?	2

Confounder = 2

2	?
2	?
?	3

Outcome under control	Outcome under treatment	Probability of Observed Treatment
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Confounder = 1

1	?	1 / 3
?	2	2 / 3
?	2	2 / 3

Confounder = 2

2	?	2 / 3
2	?	2 / 3
?	3	1 / 3

WeightingOutcome
under
controlOutcome
under
treatmentProbability
of Observed
TreatmentInverse
Probability
Weight

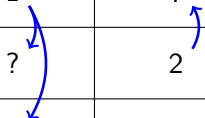
Confounder = 1

1	?	1 / 3	3
?	2	2 / 3	3 / 2
?	2	2 / 3	3 / 2

Confounder = 2

2	?	2 / 3	3 / 2
2	?	2 / 3	3 / 2
?	3	1 / 3	3

Matching

	Outcome under control	Outcome under treatment		
Confounder = 1	1	?		
	?	2		Matched Set
	?	2		

Confounder = 2	2	?
	2	?
	?	3

Matched Set

Matching

Outcome
under
control

Outcome
under
treatment

Confounder = 1

1	2
1	2
1	2

Matched
Set

Confounder = 2

2	3
2	3
2	3

Matched
Set

Outcome
under
control

Outcome
under
treatment

Confounder = 1

1	$\hat{Y}^1 = 2$
$\hat{Y}^0 = 1$	2
$\hat{Y}^0 = 1$	2

Matched
Set

Confounder = 2

2	$\hat{Y}^1 = 3$
2	$\hat{Y}^1 = 3$
$\hat{Y}^0 = 2$	3

Matched
Set