Causal Estimators: Conceptual Overview

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Confounder = 1

Outcome under control	Outcome under treatment
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

Confounder = 2	2	?
	2	?
	?	3

Outcome Modeling

1) Model the conditional mean of the observed outcomes

2) Predict counterfactuals

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

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

	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

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

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

Weighting

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

Confounder = 2	2	?
	2	?
	?	3

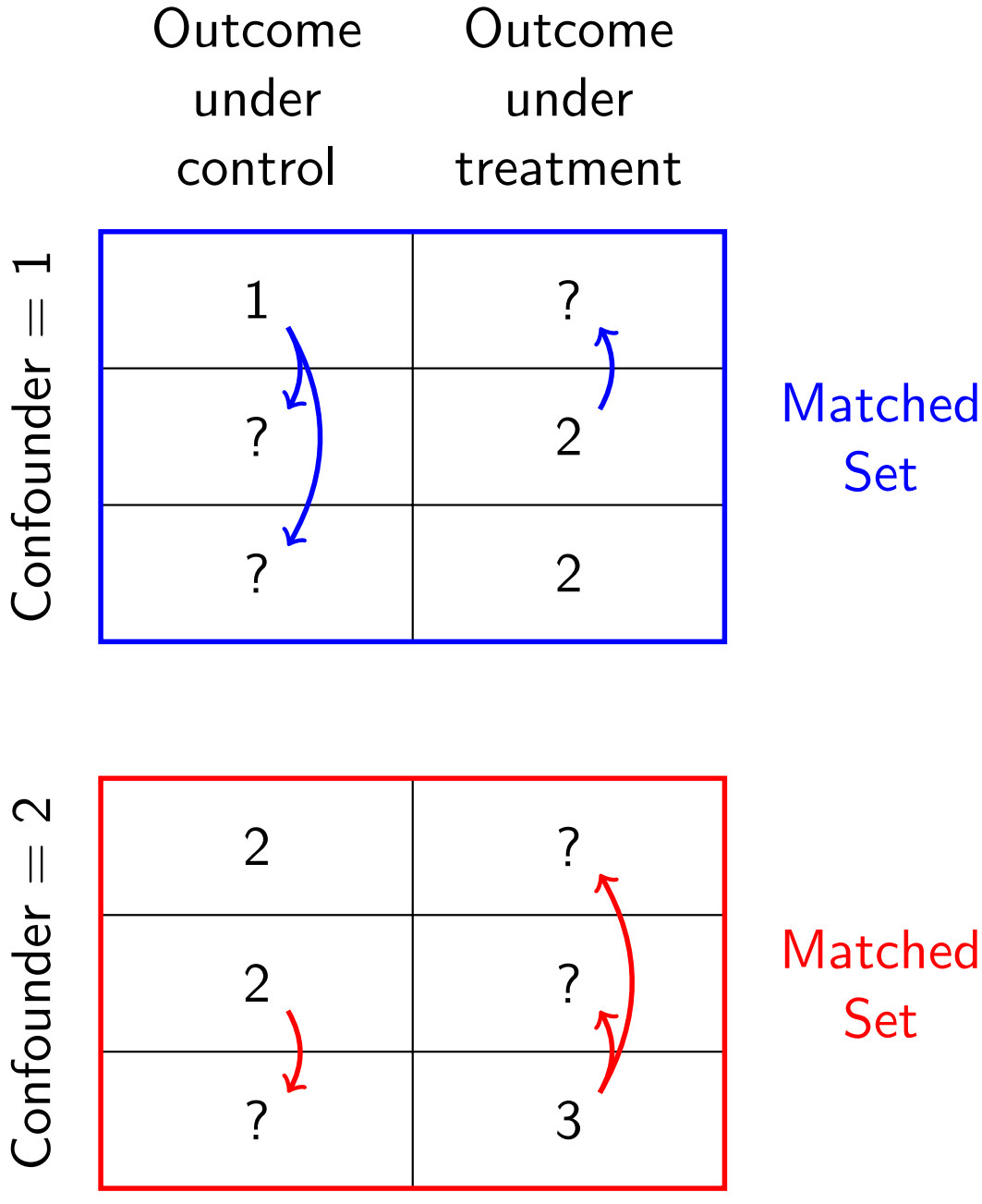
Weighting

	Outcome under control	Outcome under treatment	Probability of Observed Treatment
Confounder = 1	1	?	1 / 3
	?	2	2 / 3
	?	2	2 / 3
Confounder = 2	2	?	2 / 3
	2	?	2 / 3
	?	3	1 / 3

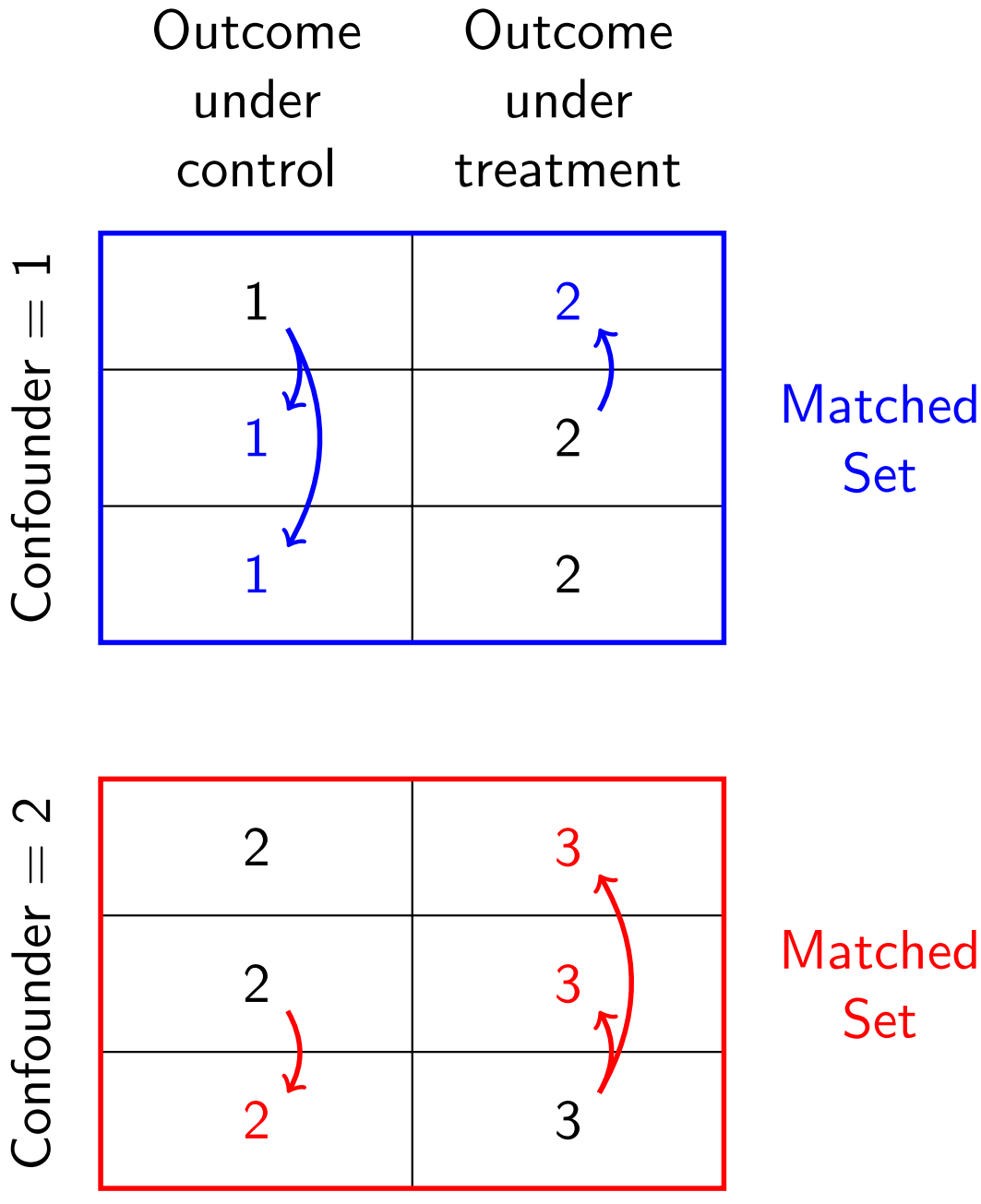
Weighting

	Outcome under control	Outcome under treatment	Probability of Observed Treatment	Inverse 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

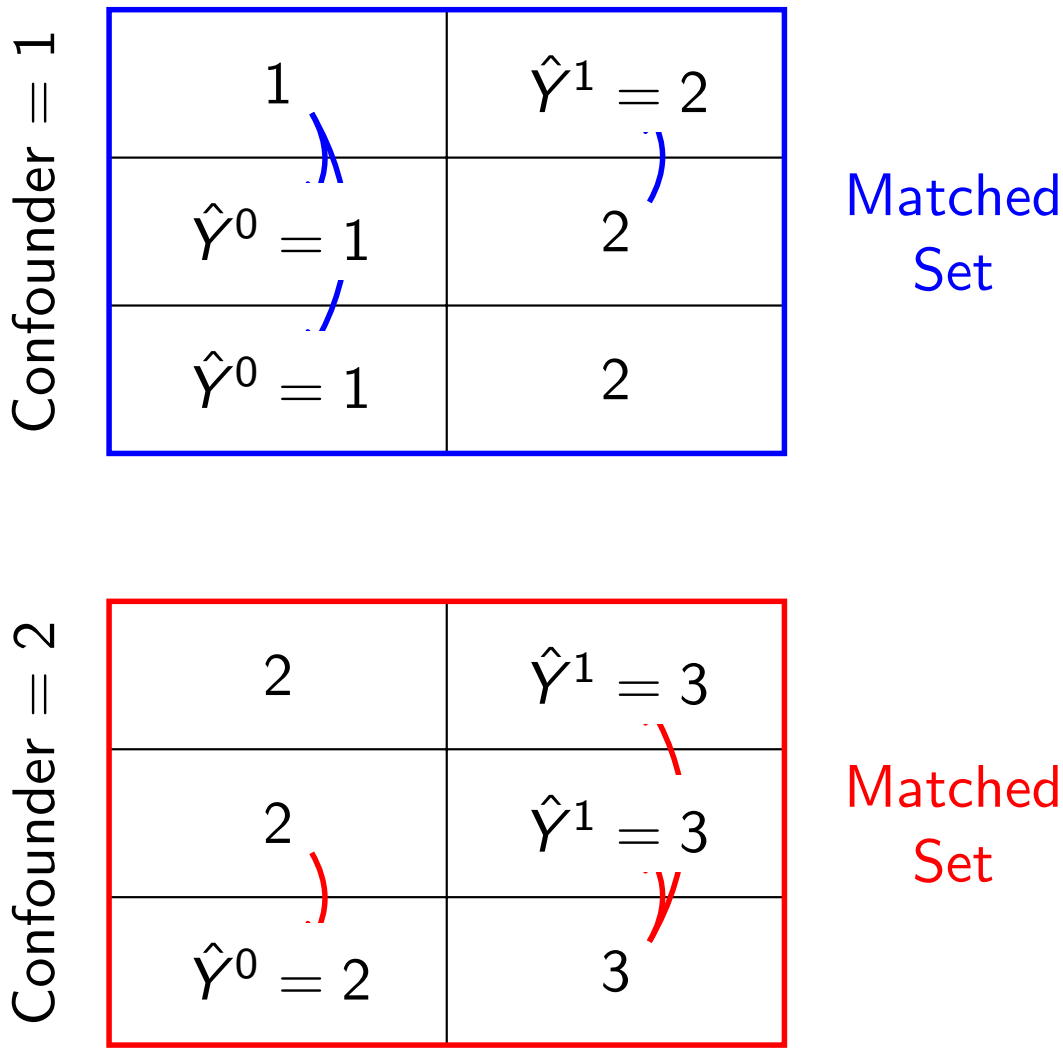
Matching


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

Matching


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