

# **SPPS 255: Principles of Pharmacoeconomics**

Propensity score matching

Monday, 05 May 2025

# OBJECTIVES

Brief introduction on the potential outcomes causal framework

Propensity score matching methods:

- Nearest neighbor approach
- Inverse probability weight (IPW) for average treatment effect (ATE)
- Inverse probability weight (IPW) for average treatment effect of the treated (ATT)

# ANOTHER METHOD TO ADDRESS CONFOUNDING

## Propensity score matching

### ([R Tutorial on propensity score matching methods](#))

#### Propensity Score Matching in R

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##### Introduction

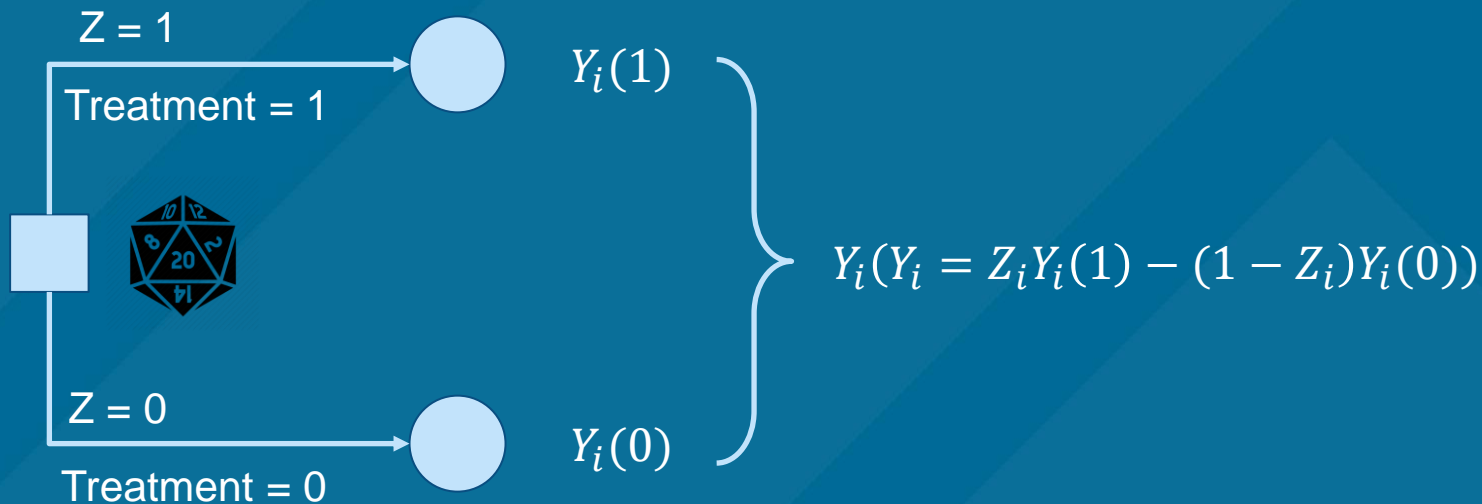
This is a tutorial on how to perform propensity score matching in R.

Propensity score matching is a statistical approach to balancing the observed covariates between groups.<sup>[1]</sup> In essence, the propensity score is the probability that an individual will be given the exposure conditional on their observable characteristics. A propensity score is estimated using regression model methods (e.g., logistic or probit) conditioned on the observed baseline covariates.

In randomized controlled trials, the subject is randomized into the treatment or control arms of a clinical trial. After randomization, the observed characteristics of the treatment and control groups are assessed for balance. If randomized is done correctly, then not only are the observed covariates balanced, but the unobserved covariates are equally balanced between the groups. In observational studies, this balanced is often not observed introducing potential bias or confounding.

# POTENTIAL OUTCOMES CAUSAL MODEL

Placeholder



## ATE VERSUS ATT

$$Y_i(Y_i = Z_i Y_i(1) - (1 - Z_i) Y_i(0))$$

Average treatment effect (ATE): At the population-level, this is the difference between moving from one group to another (untreated to treated)

$$E[Y_i(1) - Y_i(0)]$$

Average treatment effect of the treated (ATT): Among those who receive the treatment, this is the difference between moving from one group to another (treated to untreated)

$$E[Y_i(1) - Y_i(0) | Z = 1]$$

# RCT VERSUS OBSERVATIONAL STUDIES

In an RCT the  $ATT = ATE$  due to randomization.

In an observational study, individuals who received treatment may be different than individual who are untreated.

$$\begin{aligned} E[Y(1)|Z = 1] &\neq E[Y(1)] \\ E[Y(0)|Z = 0] &\neq E[Y(0)] \end{aligned}$$

# PROPENSITY SCORE

Propensity score is the probability that an individual will receive treatment (e.g., balancing score)

First condition: Treatment assignment is independent of the potential outcomes conditional on the observed covariates

$$(Y(1), Y(0)) \perp\!\!\!\perp Z \mid X$$

Second condition: Each individual has a non-zero probability of receiving the treatment condition on the observed covariates

$$0 < P(Z = 1|X) < 1$$

# NEAREST NEIGHBOR

You can get a n:1 match between the untreated and treated groups using a nearest neighbor matching strategy

Individuals have a propensity score that is used for matching

Caliper size determines the precision of the match (e.g., 0.01 size)

Lose a lot of data that are not matched



# INVERSE PROBABILITY WEIGHTS

Inverse probability weights maximize the sample size by assigning each individual a weight based on the propensity score

IPW of the ATE: 
$$ipw_{ATE} = \frac{Z_i}{ps_i} + \frac{(1 - Z_i)}{(1 - ps_i)}$$

IPW of the ATT: 
$$ipw_{ATT} = \frac{ps_i Z_i}{ps_i} + \frac{ps_i (1 - Z_i)}{(1 - ps_i)}$$

## ADDITIONAL RESOURCES

[Propensity score matching in R tutorial](#)

