500 Class 07 (Zoom)

https://thomaselove.github.io/500-2025/

2025-02-27

Agenda for our Zoom Call

- Presentations (2-3 minutes each) of the Project Proposals (Draft 2)
  - Each of you will give a 2-3 minute talk (no slides) in which you will briefly describe the title, population, outcome, treatment and covariates included in your second Project Proposal draft. Be prepared to specify where the data come from, and how you sampled it (or plan to sample it), as well as any collaborators you are working with.
- Settling the OSIA Plans (schedule + who will serve as second reader for each paper)
- (if time allows) Brief Discussion of D'Agostino Jr (1998)

Section 1

Project Proposal Draft 2 Presentations

Section 2

Settling the OSIA Plans

Section 3

D'Agostino Jr (1998) Tutorial

STATISTICS IN MEDICINE
Statist. Med. **17**, 2265–2281 (1998)

TUTORIAL IN BIOSTATISTICS

PROPENSITY SCORE METHODS FOR BIAS REDUCTION IN THE COMPARISON OF A TREATMENT TO A NON-RANDOMIZED CONTROL GROUP

RALPH B. D'AGOSTINO, Jr.*

Department of Public Health Sciences, Section on Biostatistics, Wake Forest University School of Medicine, Medical Center Boulevard, Winston-Salem, NC 27157-1063, U.S.A.

Summary

In observational studies, investigators have no control over the treatment assignment. The treated and non-treated (that is, control) groups may have large differences on their observed covariates, and these differences can lead to biased estimates of treatment effects. Even traditional covariance analysis adjustments may be inadequate to eliminate this bias.

The propensity score, defined as the conditional probability of being treated given the covariates, can be used to balance the covariates in the two groups, and therefore reduce this bias. In order to estimate the propensity score, one must model the distribution of the treatment indicator variable given the observed covariates.

Once estimated the propensity score can be used to reduce bias through matching, stratification (subclassification), regression adjustment, or some combination of all three. In this tutorial we discuss the uses of propensity score methods for bias reduction, give references to the literature and illustrate the uses through applied examples.

Matching

Discussion of three main techniques (building on Rosenbaum and Rubin)

- nearest available matching on the estimated propensity score
- Mahalanobis metric matching including the propensity score
- nearest available Mahalanobis metric matching within calipers defined by the propensity score, which, essentially, combines the first two methods into one.

Applied Example: March of Dimes Matching

Table I. Group comparisons prior to matching

Variable	Post-term		Term		Comparisons	
	Mean	SD	Mean	SD	Two-sample t-statistic	Standardized difference in %†
	$N = 749$		$N = 9241$			
Sex of child	0·527	0·500	0·500	0·500	1·42	5·4
Parity	0·697	1·12	0·790	1·01	− 2·40*	− 8·7
Mother's age (years)	28·2	5·20	28·8	5·1	− 3·38**	− 12·7
Deliverey mode	1·28	0·455	1·23	0·431	2·75**	10·2
Hobel prenatal score	8·20	7·09	9·05	7·50	− 2·99**	− 11·6
Hobel Intrapartum score	10·09	8·62	7·41	7·46	9·37**	33·3
Child's age (months)	23·01	11·58	22·19	13·34	1·62	6·5
Child's birthweight (log grams)	8·20	0·143	8·11	0·149	15·58**	60·3
Mother's race (white = 1, non-white = 2)	1·19	0·488	1·22	0·539	− 1·77	− 6·7
Class (high = 3, low = 1)	1·628	0·778	1·650	0·759	− 0·79	− 3·0
Antepartum complications (yes/no)	0·729	0·445	0·699	0·459	1·71	6·5
Vaginal bleeding (yes/no)	0·128	0·335	0·124	0·329	0·36	1·4
Abnormal labour (yes/no)	0·453	0·498	0·354	0·478	5·42**	20·6
Logit of the propensity score	2·15	0·798	2·83	0·797	− 22·34**	− 60·0

* $0{\cdot}05 > p > 0{\cdot}01$

** $p < 0{\cdot}01$

† The standardized difference in % is the mean difference as a percentage of the average standard deviation: $100(\bar{x}_p - \bar{x}_t)/\sqrt{\{(s_p^2 + s_t^2)/2\}}$, where for each covariate $\bar{x}_p$ and $\bar{x}_t$ are the sample means in the post-term and term groups, respectively, and s_p^2 and s_t^2 are the corresponding sample variances

After Mahalanobis matching

Table II. Group comparisons after matching for variables used in Mahalanobis metric matching

Variable	Post-term		Term		Comparisons	
	Mean	SD	Mean	SD	Two-sample *t*-statistic*	Standardized difference in %
	$N = 749$		$N = 749$			
Sex†	0·527	0·500	0·527	0·500	0·00	0·0
Parity	0·697	1·12	0·629	0·997	1·24	6·4
Mother's age (years)	28·2	5·20	28·1	4·68	0·40	2·1
Delivery mode	1·28	0·455	1·28	0·452	0·01	0·0
Hobel prenatal score	8·20	7·09	7·63	6·53	1·62	8·4
Hobel intrapartum score	10·09	8·62	9·72	8·13	0·87	4·5
Child's age (months)	23·01	11·58	23·0	11·25	0·01	0·07
Child's birthweight (log grams)	8·20	0·143	8·20	0·129	0·82	4·4
Mother's race (white = 1, non-white = 2)	1·19	0·488	1·19	0·460	− 0·03	0·2
Class (high = 3, low = 1)	1·628	0·778	1·676	− 0·738	− 1·23	− 6·3
Antepartum complications (yes/no)	0·729	0·445	0·716	0·451	0·57	2·9
Vaginal bleeding (yes/no)	0·128	0·335	0·097	0·295	1·94	10
Abnormal labour (yes/no)	0·453	0·498	0·428	0·495	0·97	5
Logit of the propensity score	2·15	0·798	2·18	0·773	− 0·68	− 2·5

* *p*-values for all *t*-tests larger than 0·05
† Sex was exactly matched by design

Other Methods in D'Agostino Jr (1998)

- Stratification
  - Example from the Active Management of Labor Trial
- Regression (Direct) Adjustment
  - refers to two published studies: Berk and Newton (1985) and to Muller et al. (1986)
- Additional research work largely focused (in 1998) on missing data

Class 8 topics

- Instrumental Variables
- Tanenbaum 2019
- Elbadawi 2021
- Discussion of Rosenbaum Chapter 7
- Lab 3 due to Canvas by 9 AM 2025-03-06.