Simplifying Causal Inference

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Overview

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- Solution: Matching to preprocess data (review)

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- Problem: The most commonly used method can increase imbalance!
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- (Coarsened Exact Matching is simple, easy, and powerful)
- $\rightsquigarrow$ Lots of insights revealed in the process

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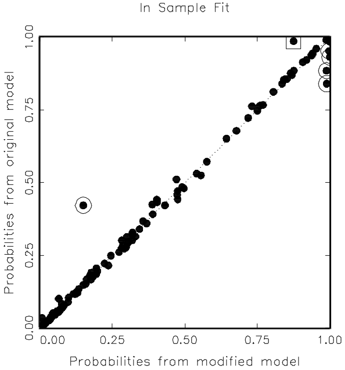
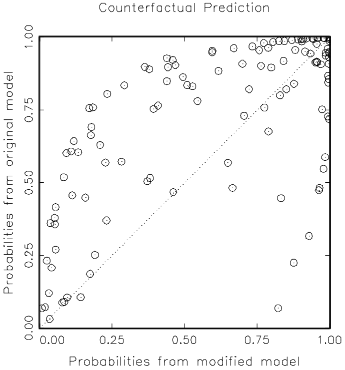
- Counterfactual question: UN intervention switched for each war
- Data analysis: Logit model
- The question: How *model dependent* are the results?

Two Logit Models, Apparently Similar Results

	Original "Interactive" Model			Modified Model		
Variables	Coeff	SE	P-val	Coeff	SE	P-val
Wartype	−1.742	.609	.004	−1.666	.606	.006
Logdead	−.445	.126	.000	−.437	.125	.000
Wardur	.006	.006	.258	.006	.006	.342
Factnum	−1.259	.703	.073	−1.045	.899	.245
Factnum2	.062	.065	.346	.032	.104	.756
Trnsfcap	.004	.002	.010	.004	.002	.017
Develop	.001	.000	.065	.001	.000	.068
Exp	−6.016	3.071	.050	−6.215	3.065	.043
Decade	−.299	.169	.077	−0.284	.169	.093
Treaty	2.124	.821	.010	2.126	.802	.008
UNOP4	3.135	1.091	.004	.262	1.392	.851
Wardur*UNOP4	—	—	—	.037	.011	.001
Constant	8.609	2.157	0.000	7.978	2.350	.000
N		122			122	
Log-likelihood		-45.649			-44.902	
Pseudo R^2		.423			.433	

Doyle and Sambanis: Model Dependence





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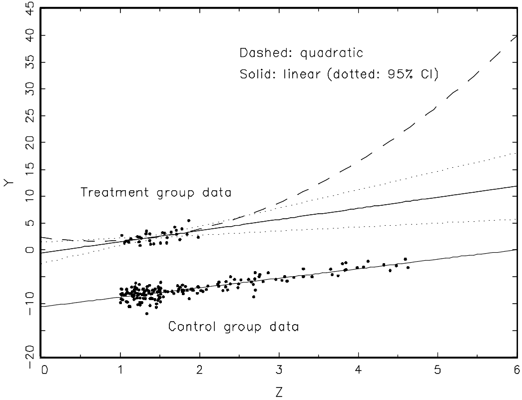

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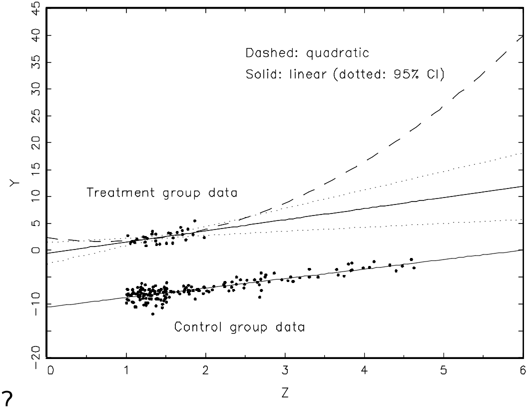

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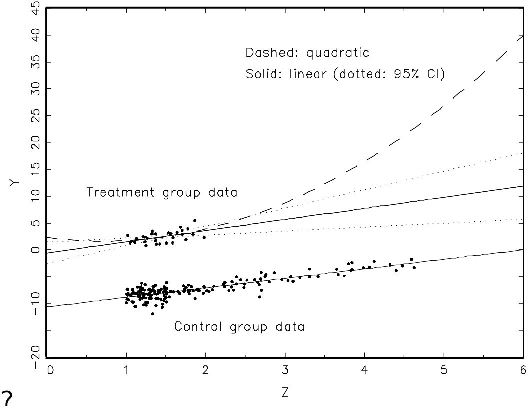

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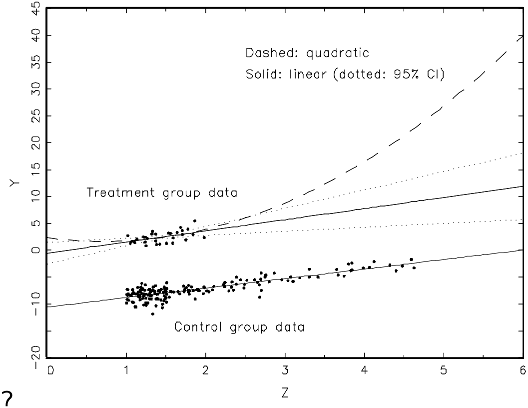

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- Preprocess II: Match (prune bad matches) within interpolation region

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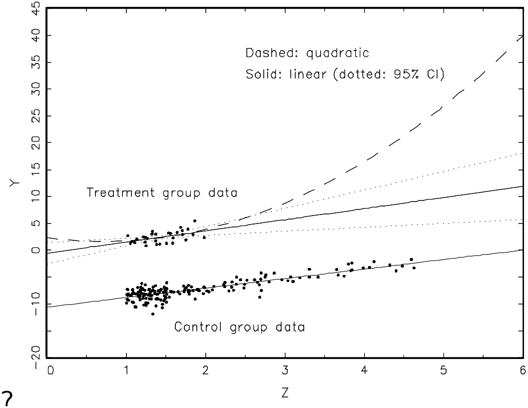

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- Preprocess I: Eliminate extrapolation region
- Preprocess II: Match (prune bad matches) within interpolation region
- Model remaining imbalance

Matching within the Interpolation Region

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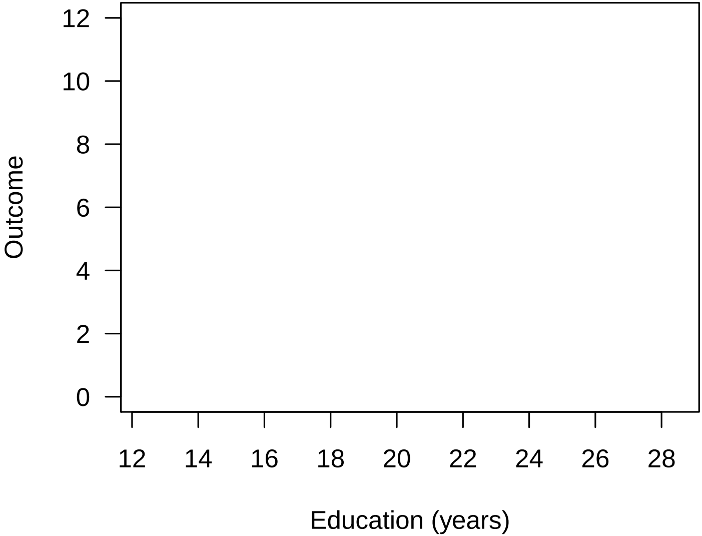

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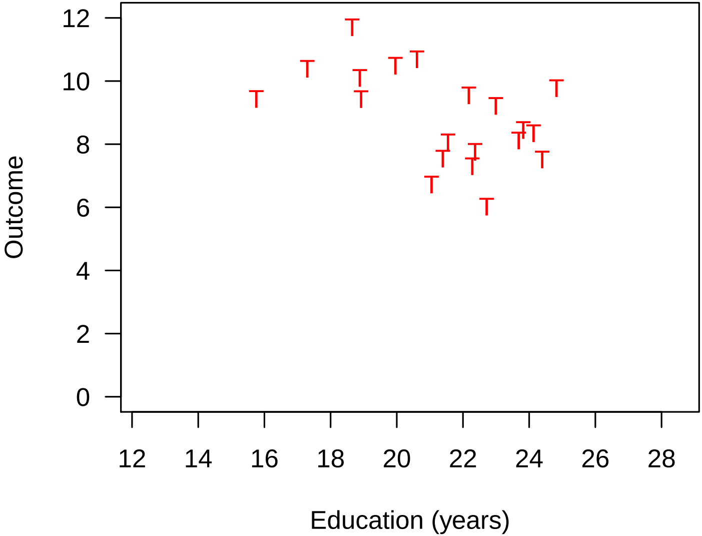

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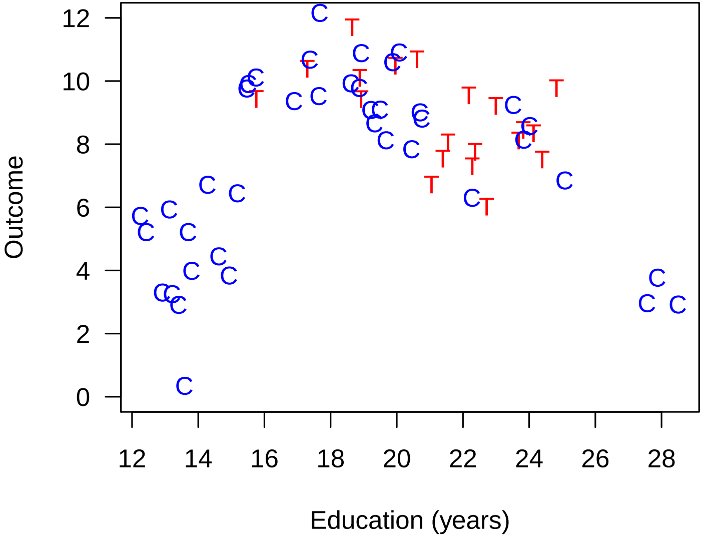

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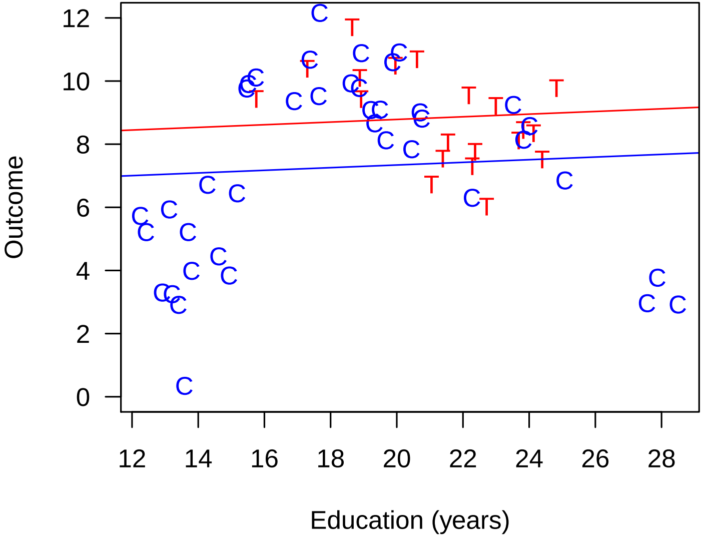

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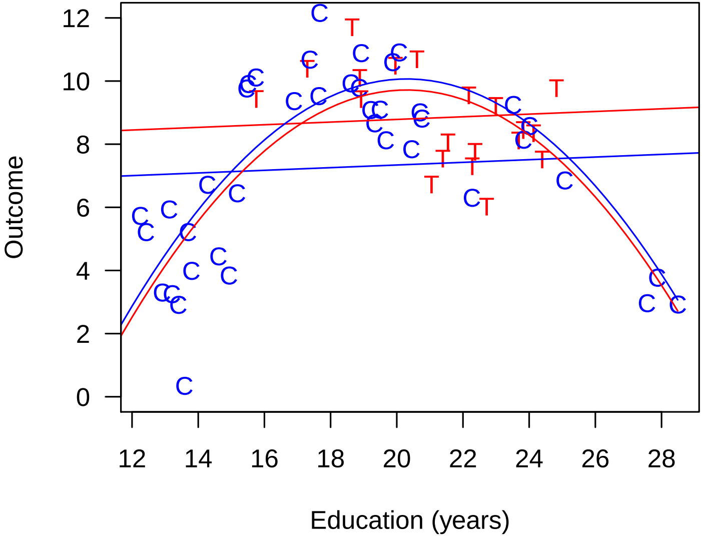

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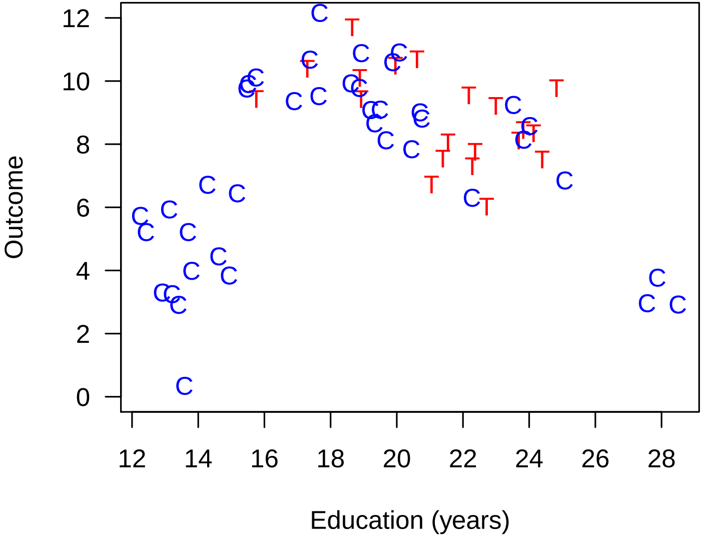

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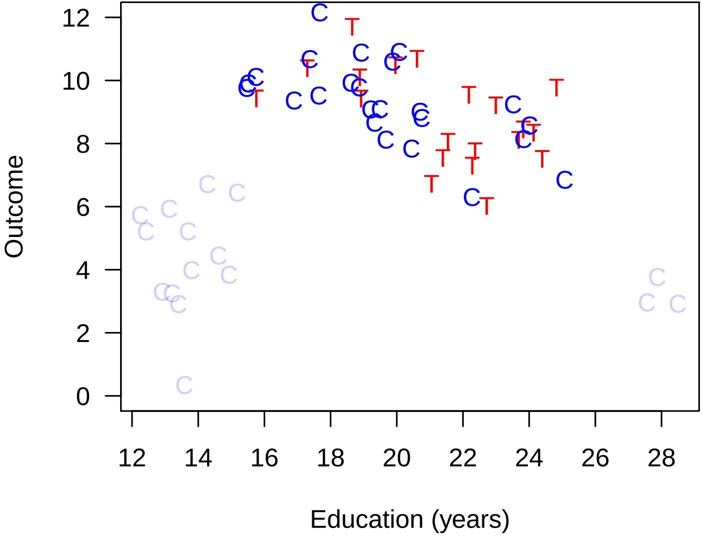

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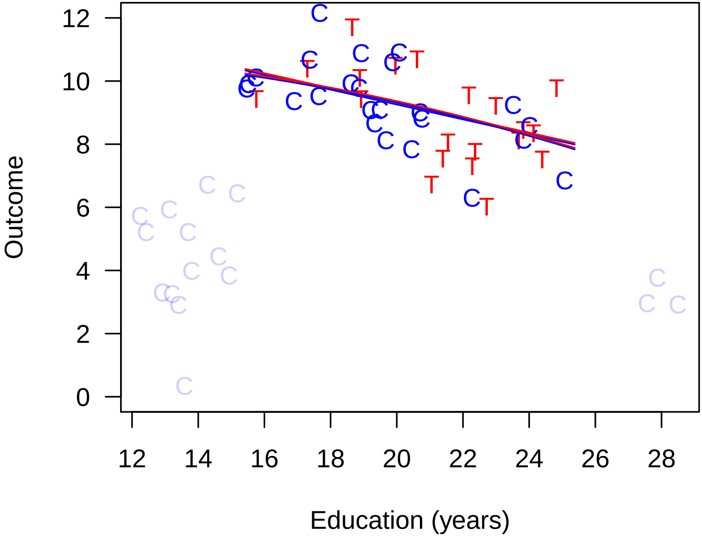

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Matching reduces model dependence, bias, and variance

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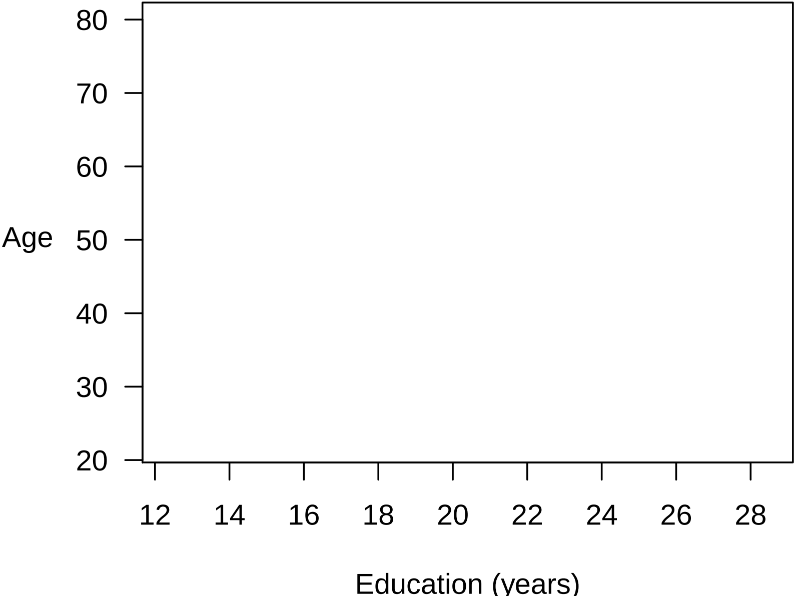

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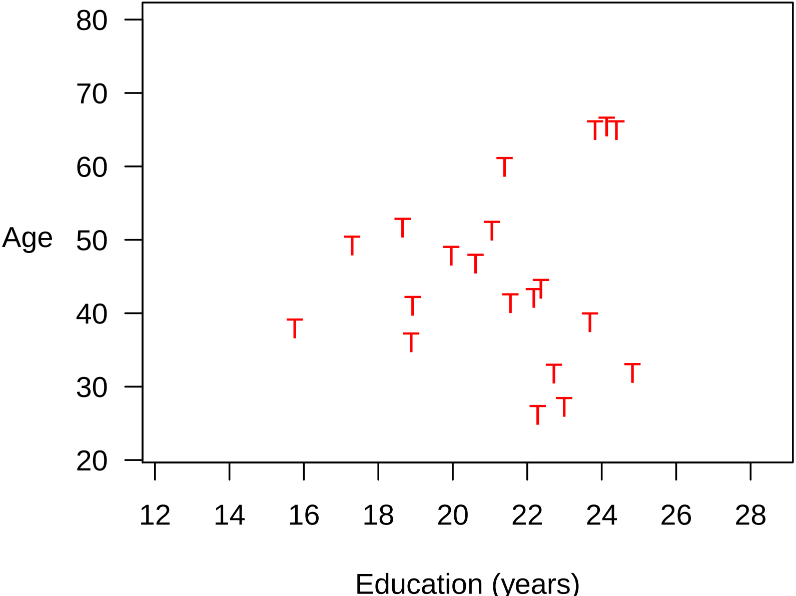

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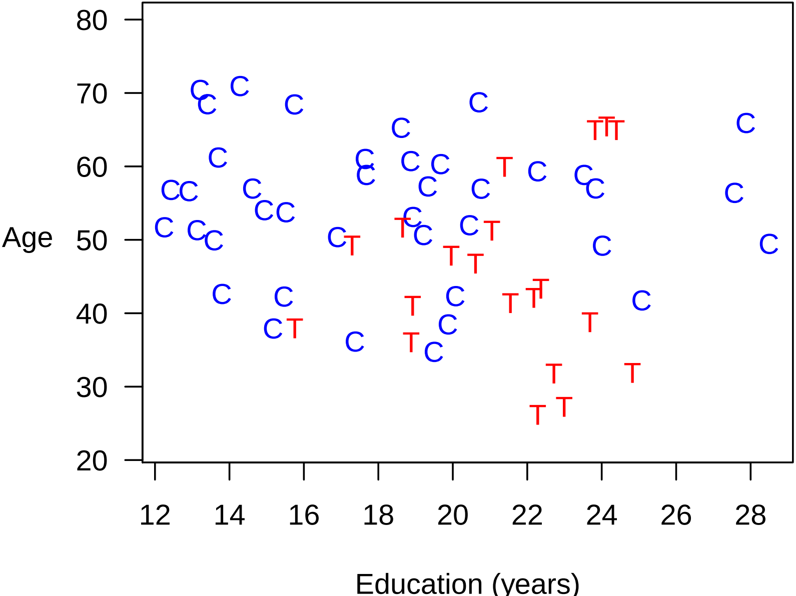

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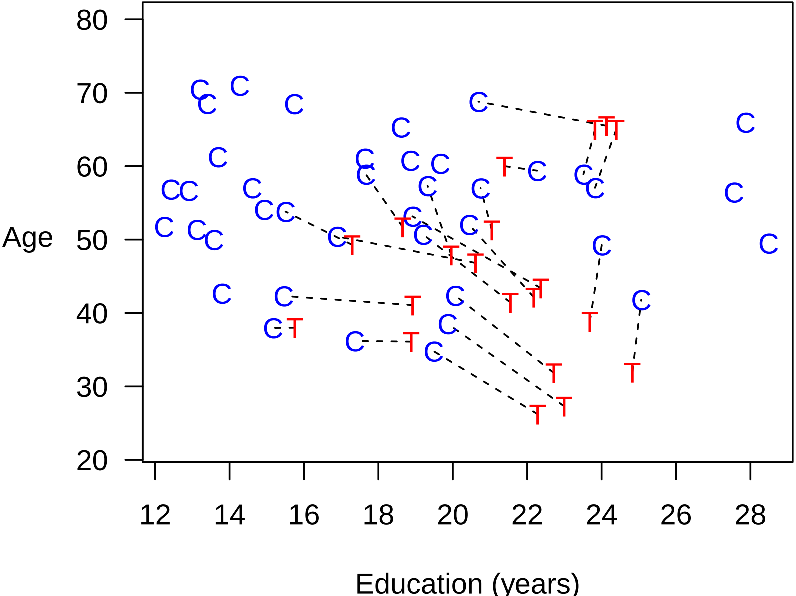

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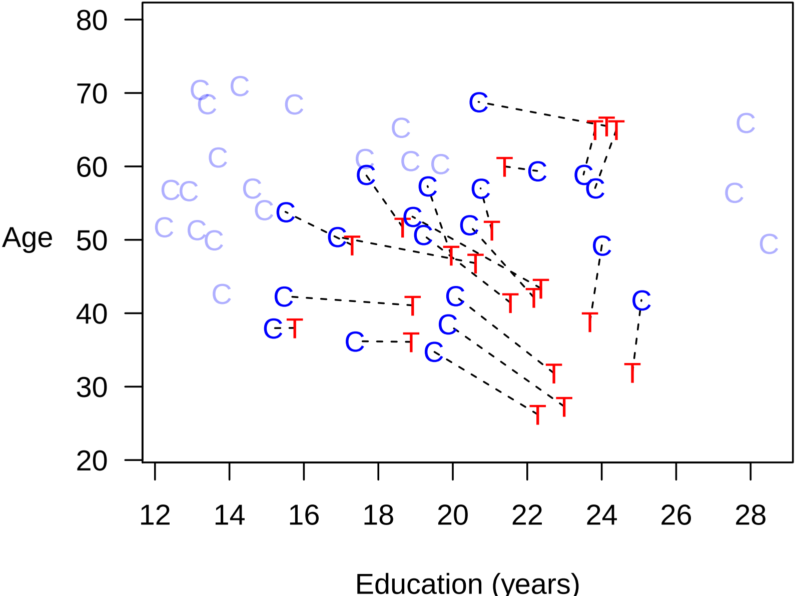

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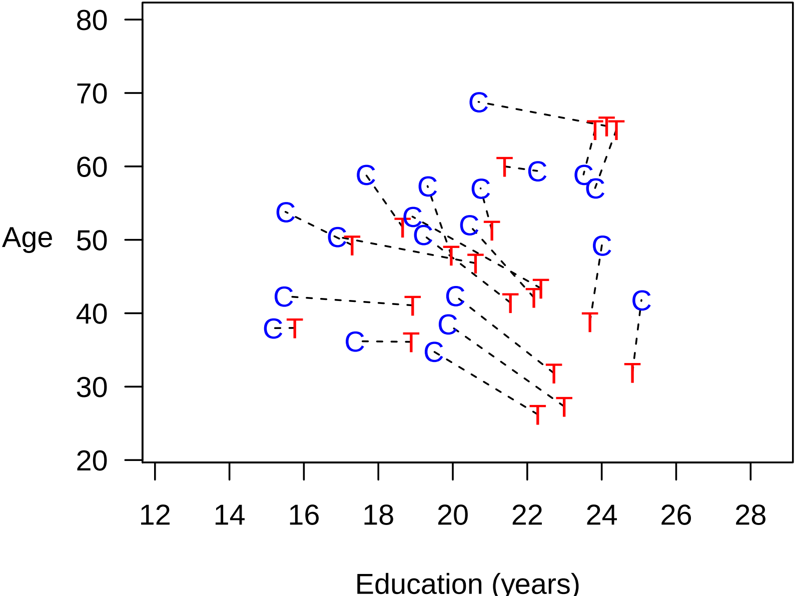

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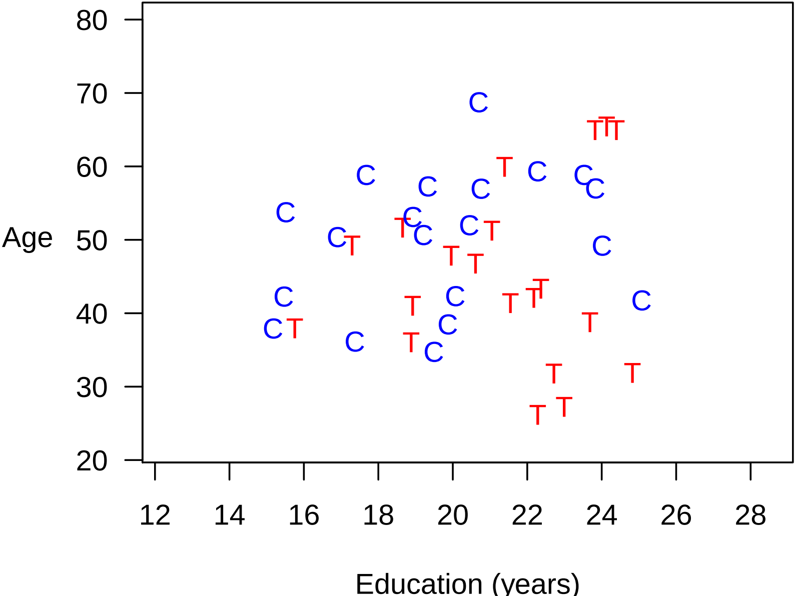

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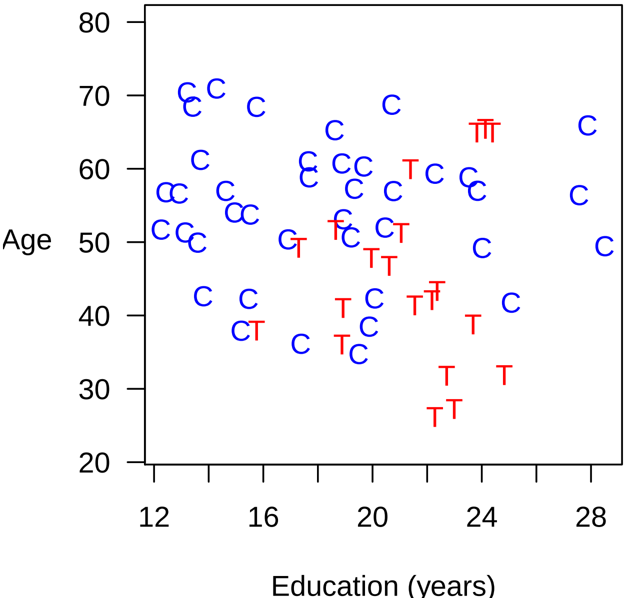

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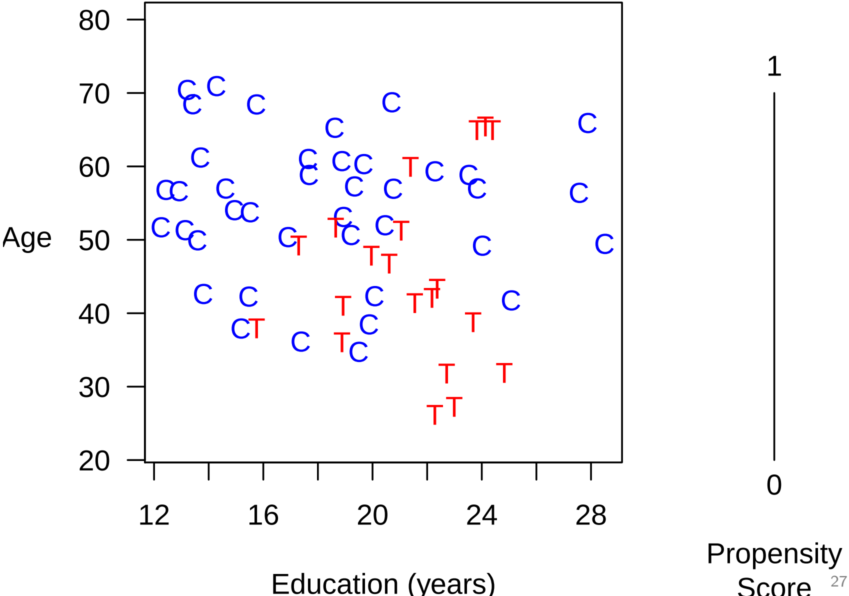

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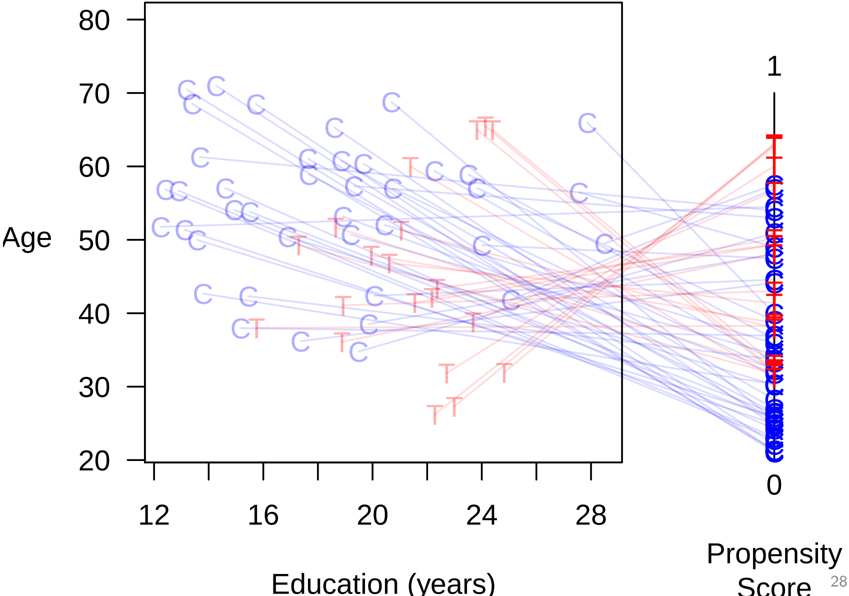

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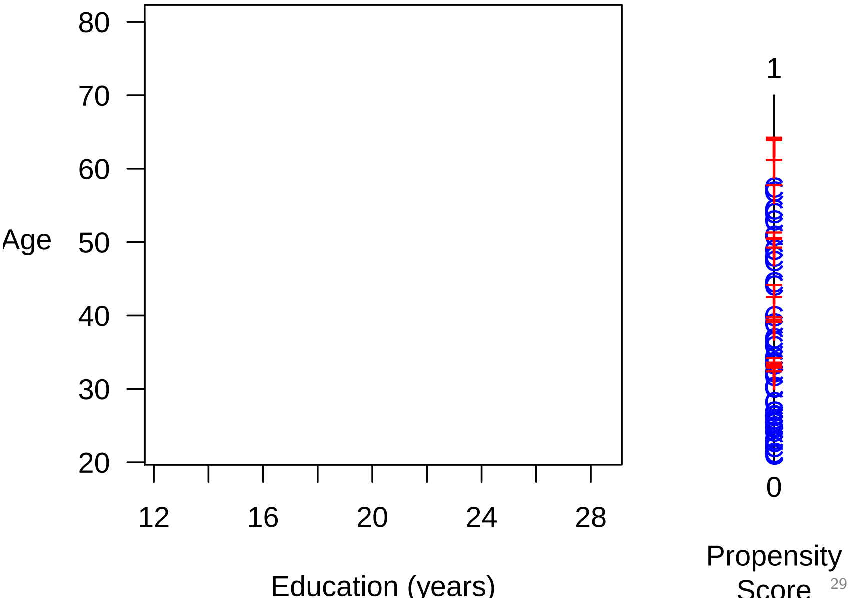

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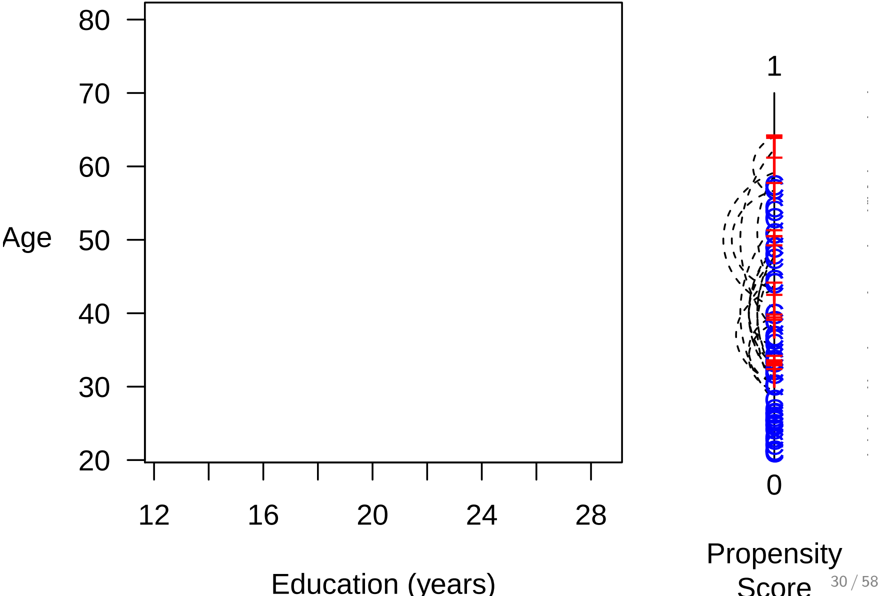

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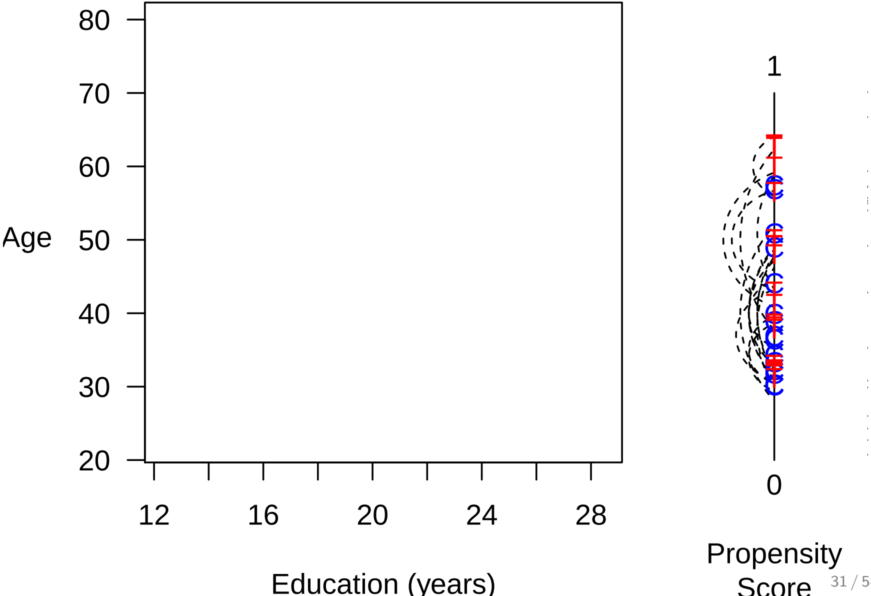

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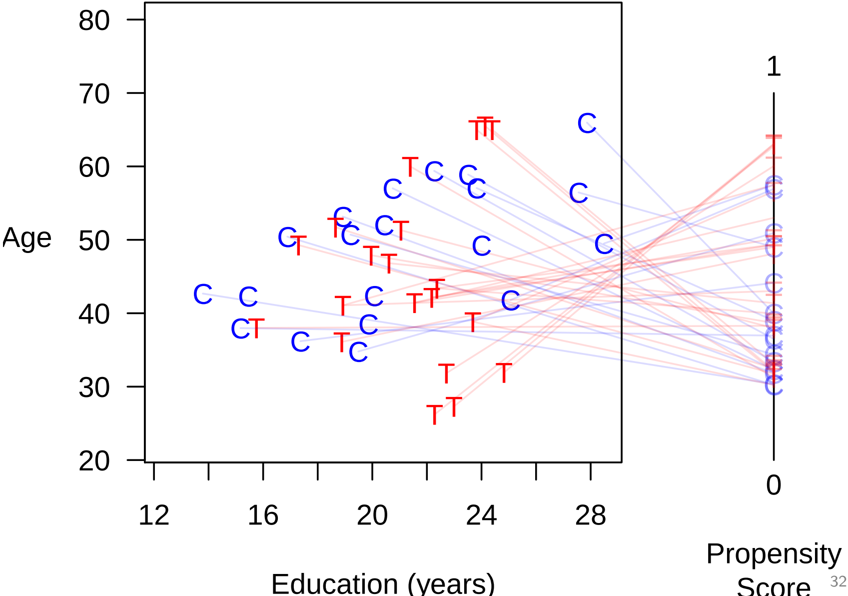

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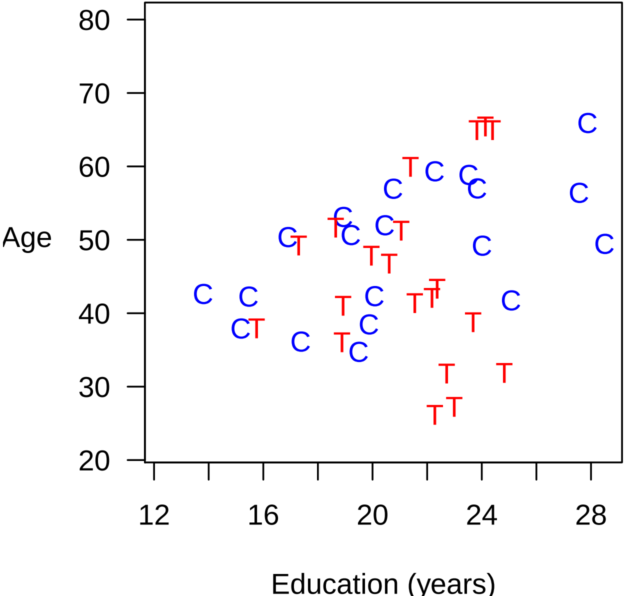

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    - <u>Temporarily coarsen</u> X as much as you're willing
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   - Apply exact matching to the coarsened X, $C(X)$

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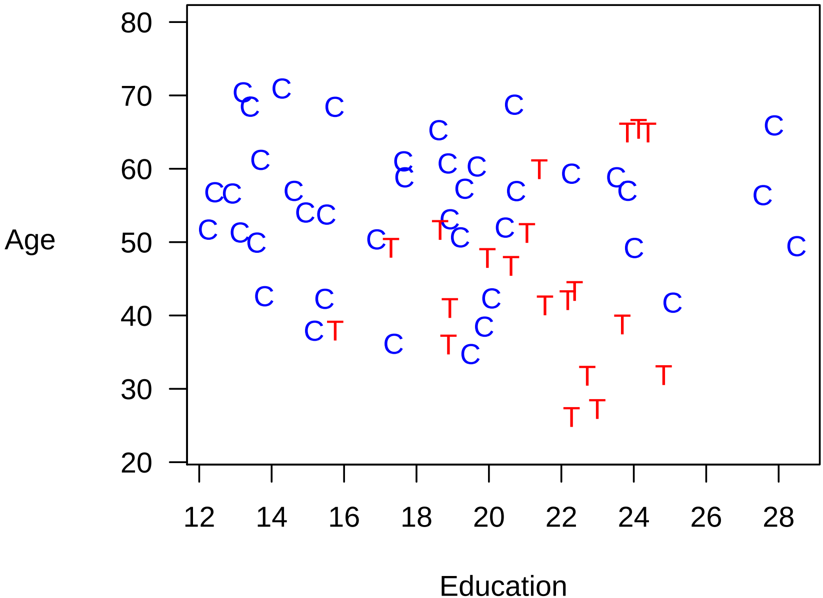

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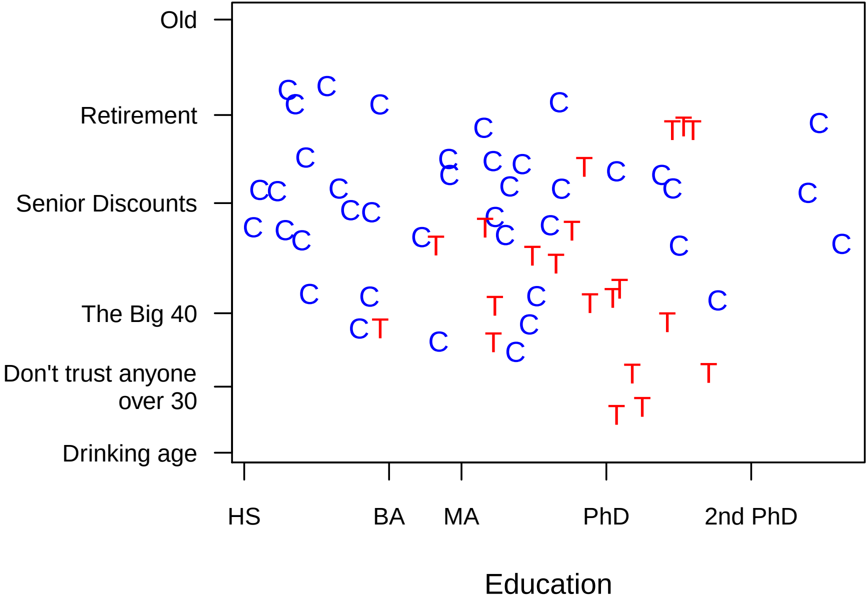

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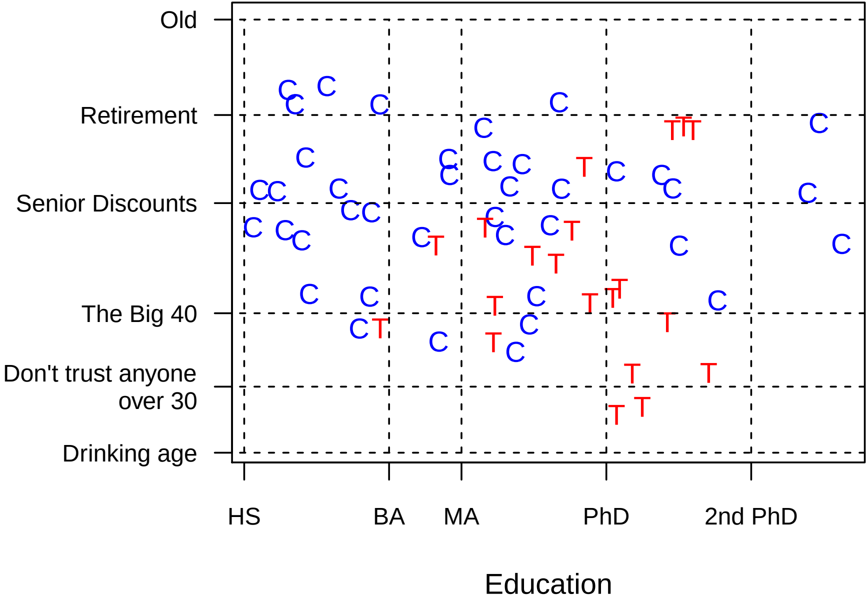

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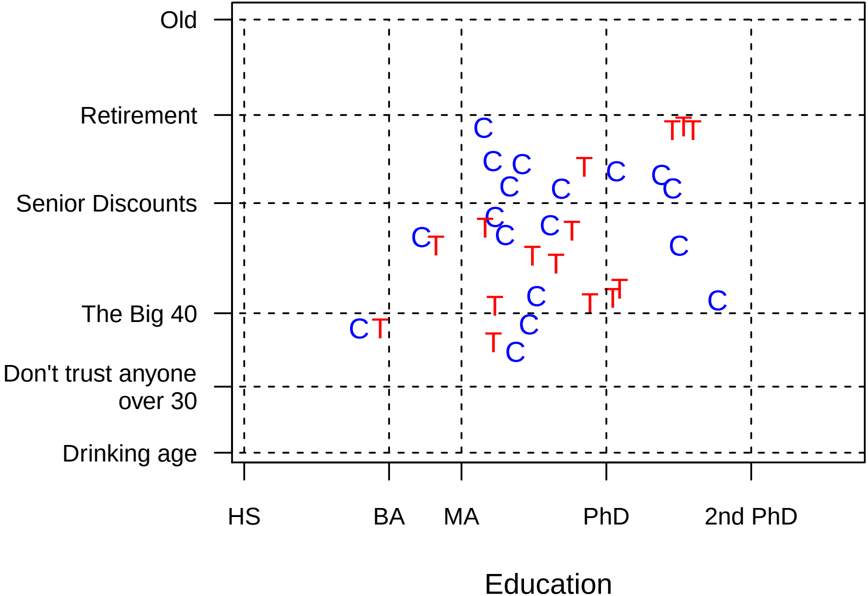

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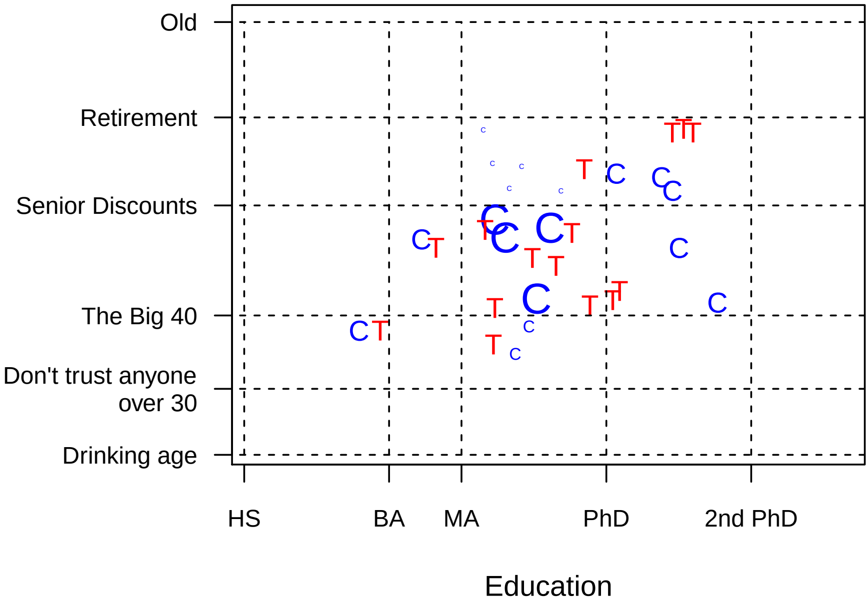

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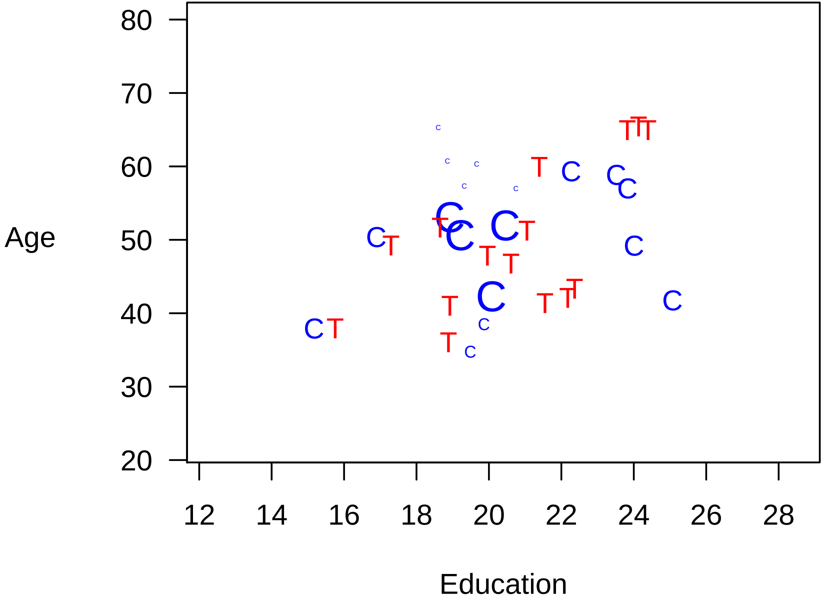

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  - Difference of multivariate histograms (L1):

$$\mathcal{L}_1(f,g;H) = \frac{1}{2} \sum_{\ell_1 \cdots \ell_k \in H(\mathbf{X})} |f_{\ell_1 \cdots \ell_k} - g_{\ell_1 \cdots \ell_k}|$$

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- CEM: Choose imbalance, match, check matched n
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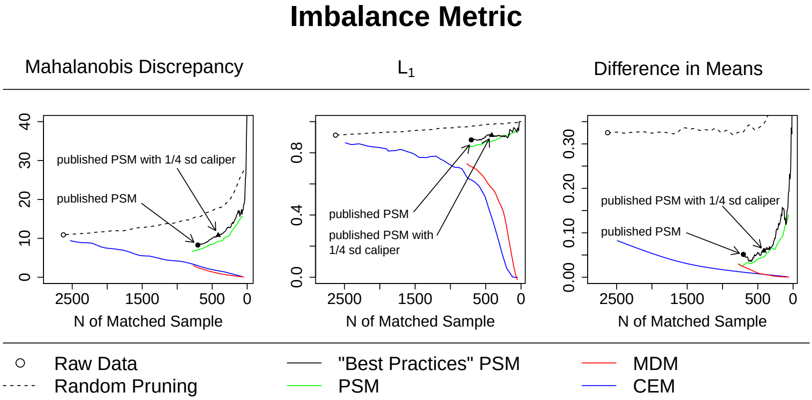
- Given matched solution $\rightsquigarrow$ matching method is irrelevant
- Our idea: Identify the *frontier*: lowest imbalance for each n; then choose a matching solution

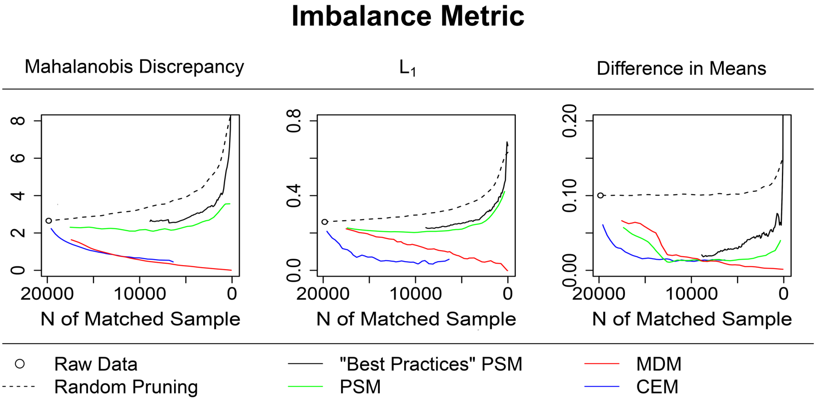
A Space Graph: Foreign Aid Shocks & Conflict

King, Nielsen, Coberley, Pope, and Wells (2012)



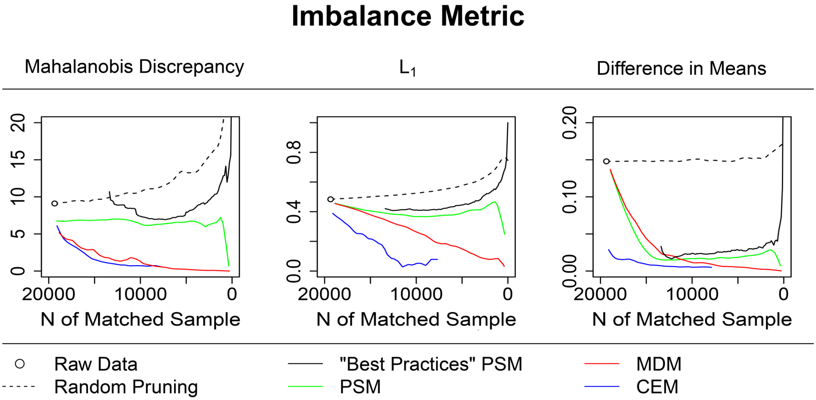
A Space Graph: Healthways Data

King, Nielsen, Coberley, Pope, and Wells (2012)



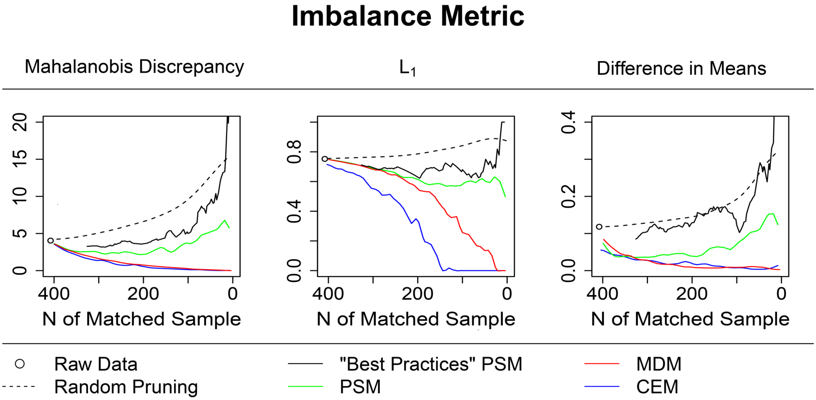
A Space Graph: Called/Not Called Data

King, Nielsen, Coberley, Pope, and Wells (2012)



A Space Graph: FDA Drug Approval Times

King, Nielsen, Coberley, Pope, and Wells (2012)



A Space Graph: Job Training (Lelonde Data)

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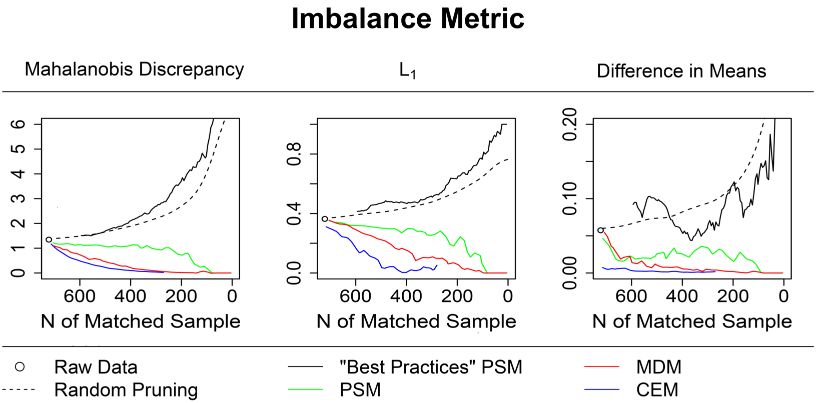
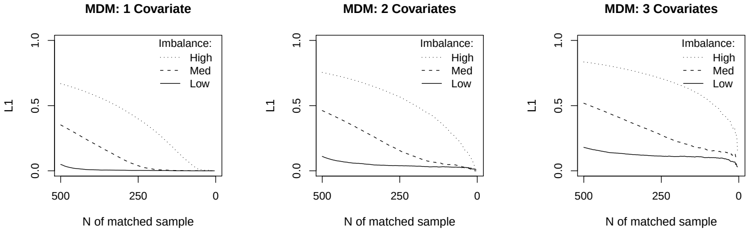
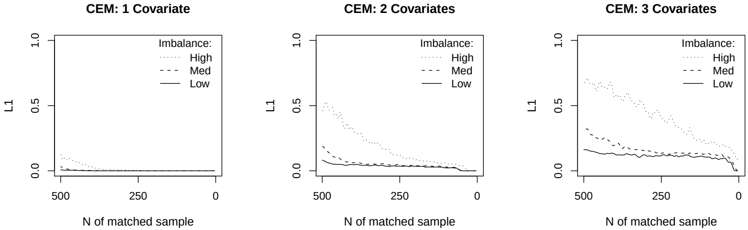


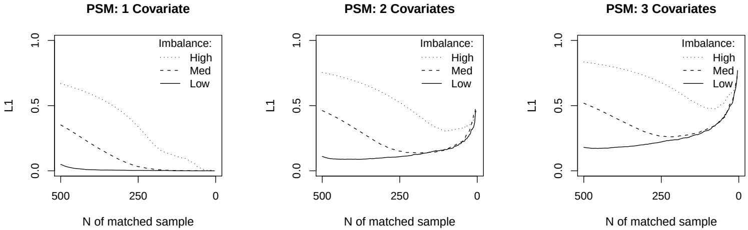
A Space Graph: Simulated Data — Mahalanobis



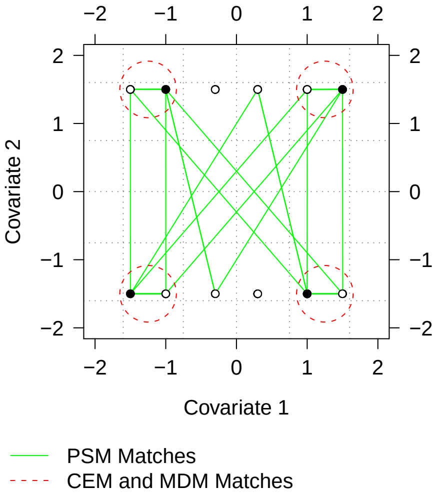
A Space Graph: Simulated Data — CEM



A Space Graph: Simulated Data — Propensity Score



PSM Approximates Random Matching in Balanced Data



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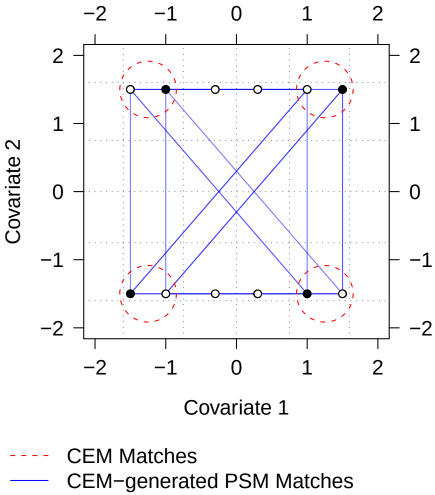
Destroying CEM with PSM's Two Step Approach



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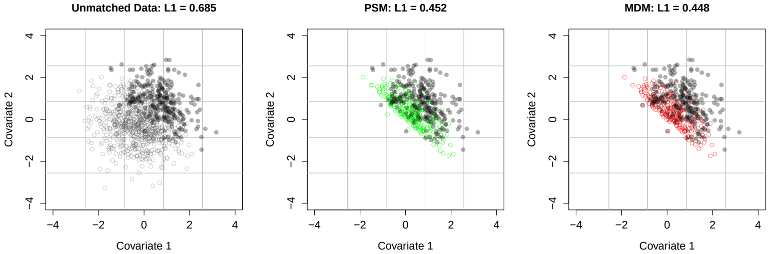
For papers, software (for R, Stata, & SPSS), tutorials, etc.

GaryKing.org/cem

Data where PSM Works Reasonably Well — PSM & MDM



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