Generalizing Observational Study Results *Applying Propensity Score Methods to Complex Surveys*

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Objectives

- Provide a tutorial for using propensity score methods with complex survey data
- Present results from a simulation study investigating the performance of various propensity score methods with survey weights
- Original motivation: Effectiveness study of type of primary healthcare provider on healthcare spending in MEPS dataset

Background

- Nationally representative survey data represent important data sources for effectiveness studies
  - Challenge = potential confounding
- Lack of clear guidelines on how to use propensity score methods in this context
  - Wide variability in methods and inferences in current literature

Propensity Score Overview

- Propensity score = probability of receiving the treatment, conditional on covariates

$$p(x_i) = \Pr[T_i=1|X_i = x_i]$$

- Conditioning on propensity score will reduce confounding (Rosenbaum & Rubin, 1983)

Propensity Score Methods

- Multiple techniques to condition on propensity score:

1. Matching: match individuals on propensity score
2. Subclassification: create classes of individuals with similar propensity scores
3. Weighting: weight individuals using propensity scores

Causal Estimands

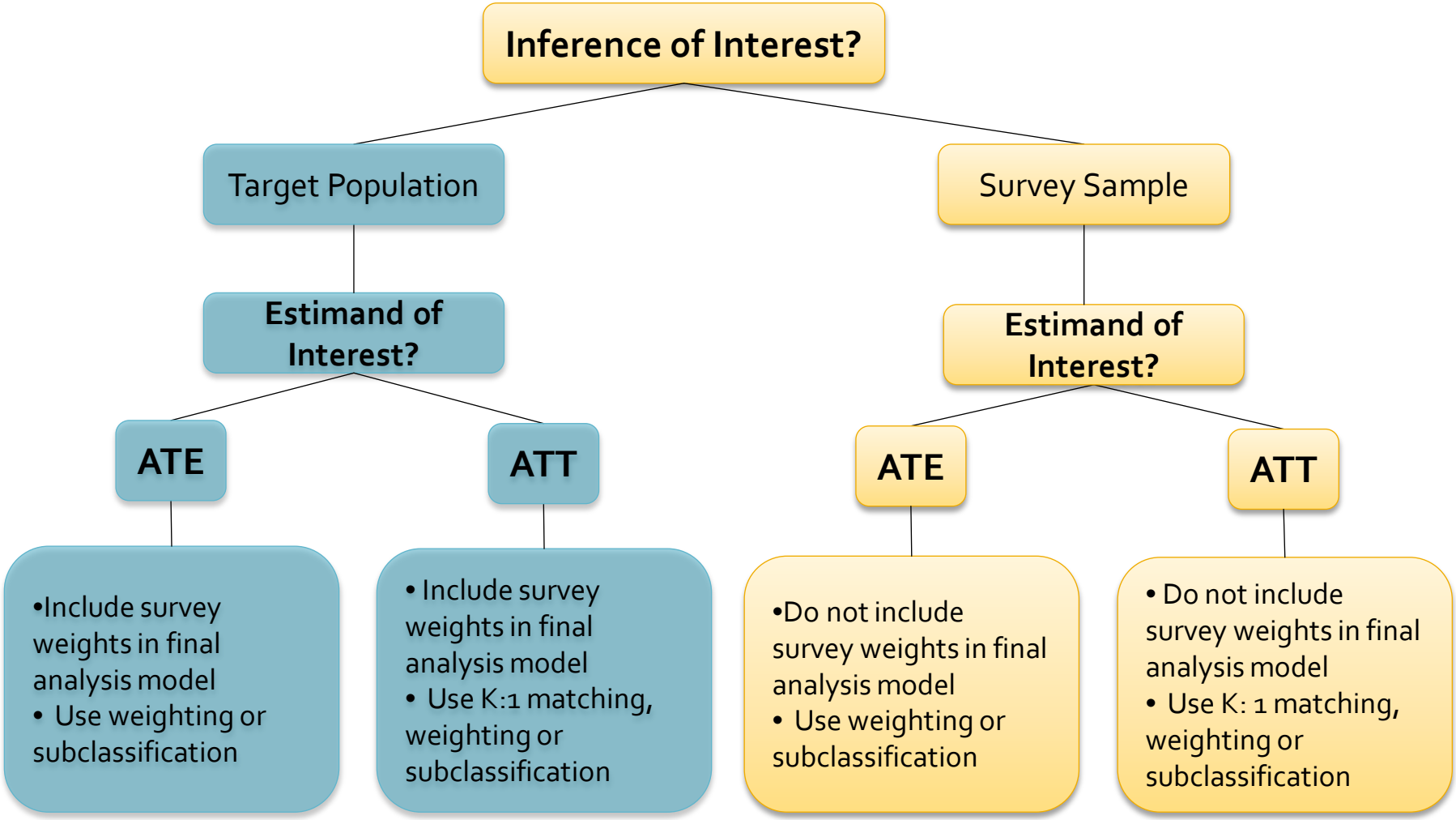
- **Average Treatment Effect (ATE)**

- ATE = compares mean outcome if *entire population* had received Treatment to mean outcome if *entire population* had received Control

Causal Estimands

- **Average Treatment Effect (ATE)**
- ATE = compares mean outcome if *entire population* had received Treatment to mean outcome if *entire population* had received Control
- **Average Treatment Effect on Treated (ATT)**
- ATT = compares mean outcomes for *individuals who in reality received Treatment* to the mean outcomes if *these same* individuals had instead received Control

Conceptual Flowchart



Simulation Study Overview

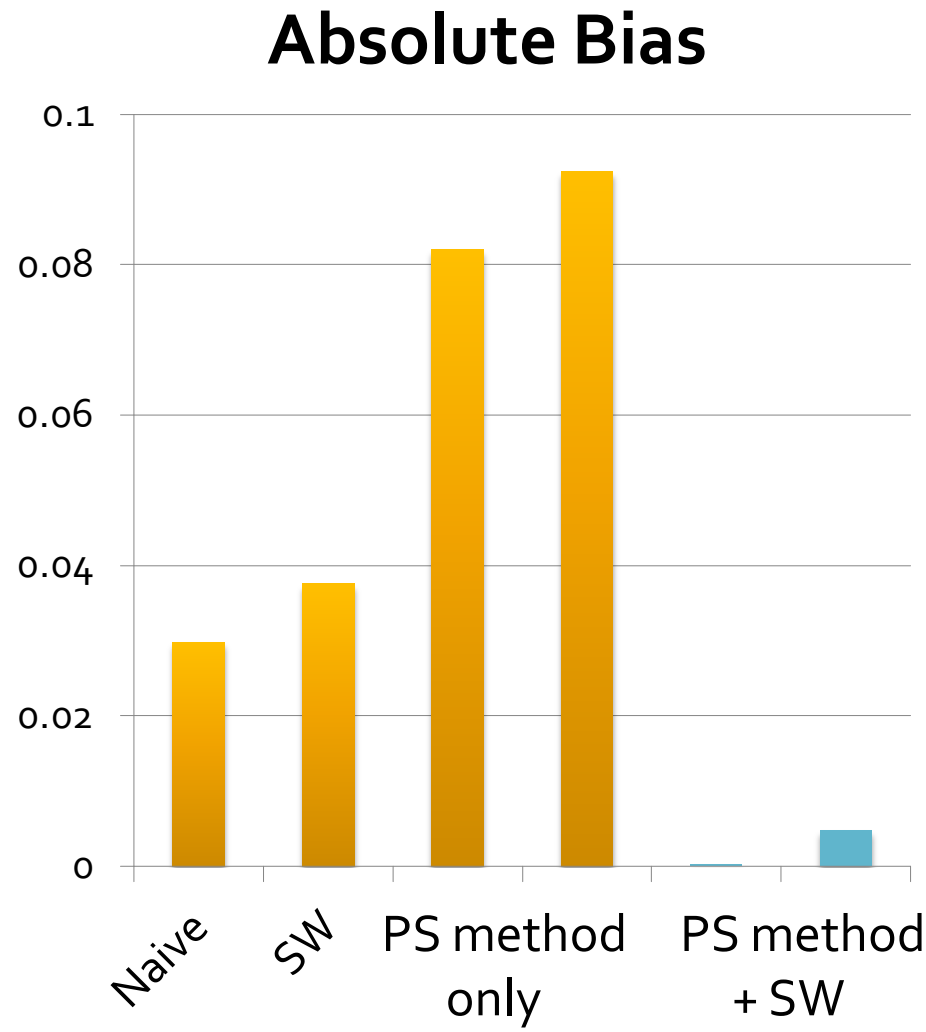
- Performed simulation study to compare propensity score methods when generalizing results to original study population

- Setup
  - 100,000 individuals
  - single covariate
  - survey weight (no clustering)
  - 2,000 simulations

Estimating the ATE

- Reference methods
  - Naive (no propensity scores, no survey weights)
  - Survey weights only
- Appropriate propensity score methods
  - Weighting
  - Subclassification
- Evaluated each approach, with and without survey weights

ATE Results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Naive
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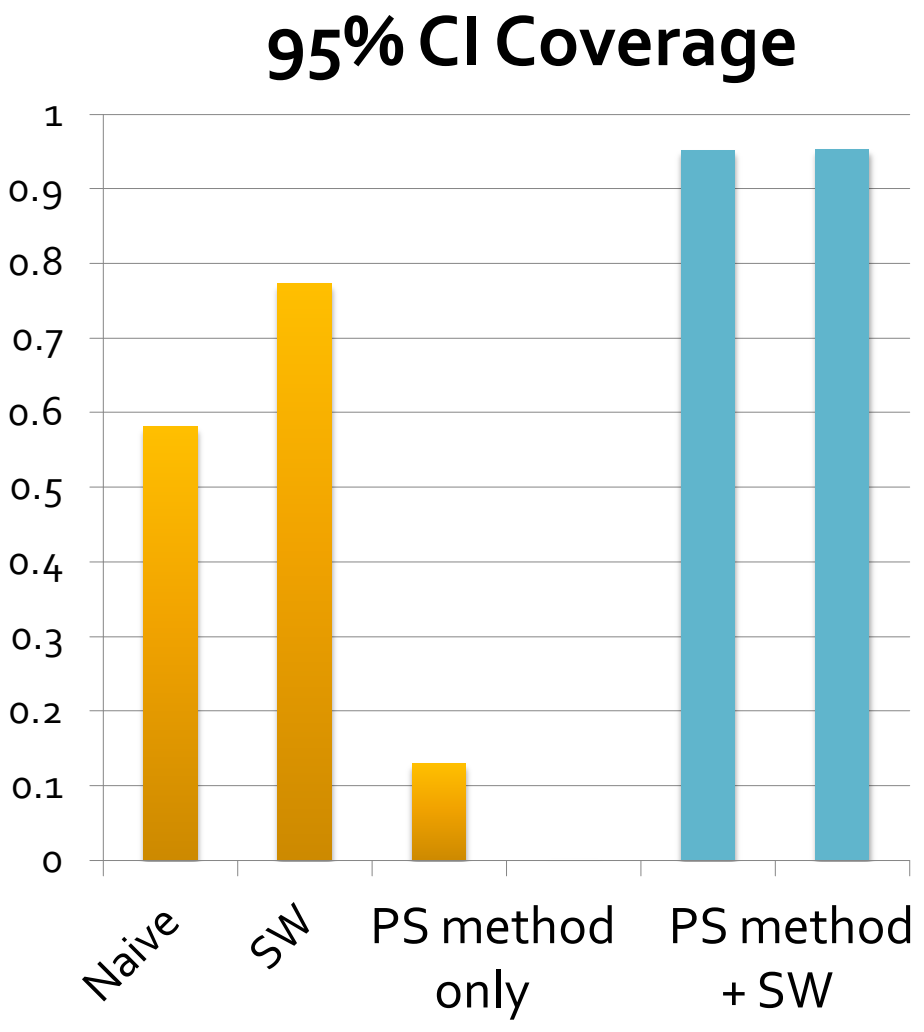
PS method only
PS method + SW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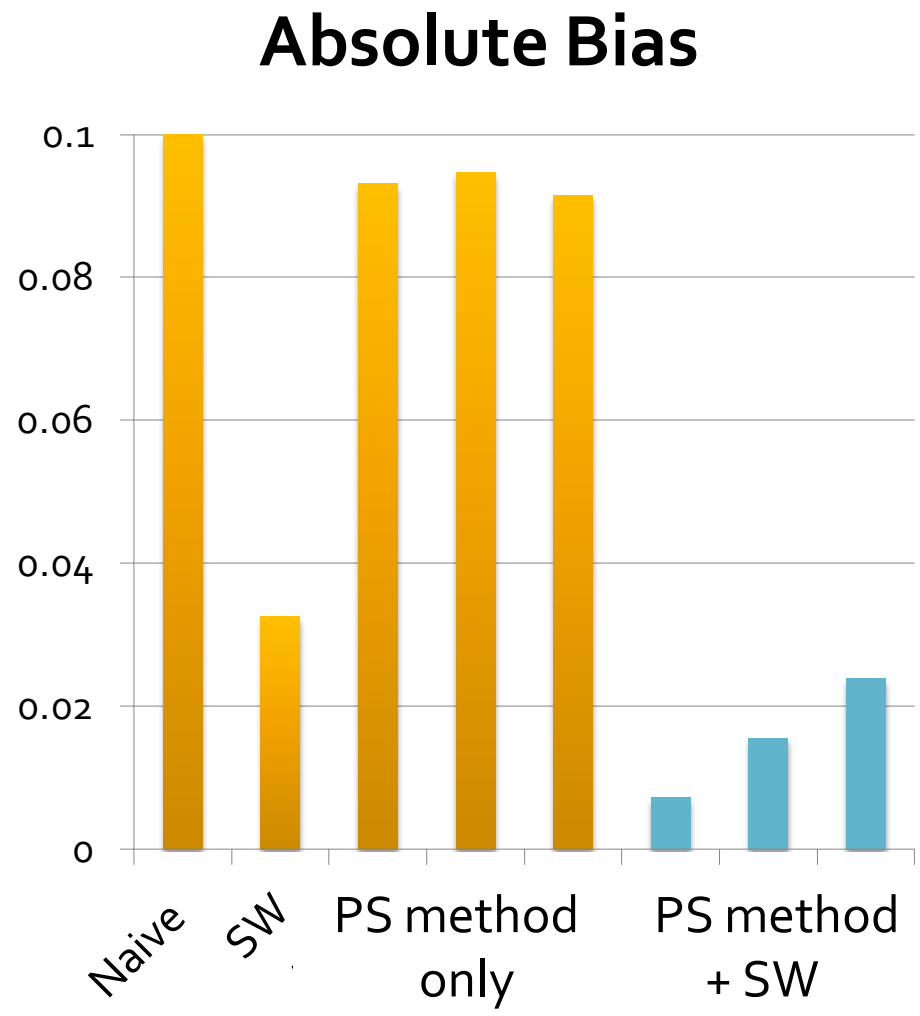
Naive
SW
PS method only
PS method + SW

Estimating the ATT

- Reference methods
  - Naive (no propensity scores, no survey weights)
  - Survey weights only
- Appropriate propensity score methods
  - Weighting
  - Subclassification
  - Nearest Neighbor matching (1:1)
- Evaluated each approach, with and without survey weights

ATT Results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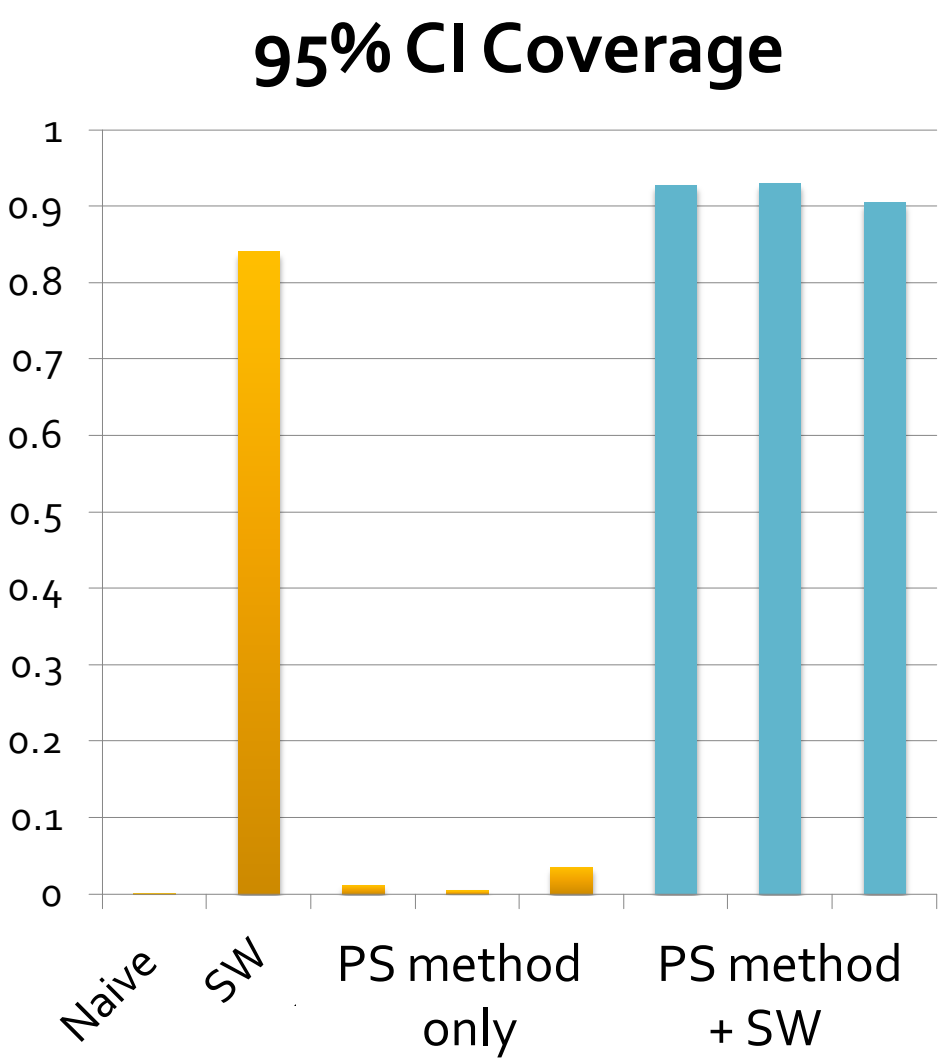
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Simulation Summary

- In general, combination of propensity score method and survey weighting is necessary to achieve unbiased treatment estimates
  - PS Weighting: multiply PS weights by SW
  - Subclassification: use SW to combine across subclasses
  - Nearest Neighbor Matching: SW regression within matched sample
- Propensity score methods perform similarly
  - ATE: weighting, subclassification
  - ATT: weighting, subclassification, nearest neighbor matching

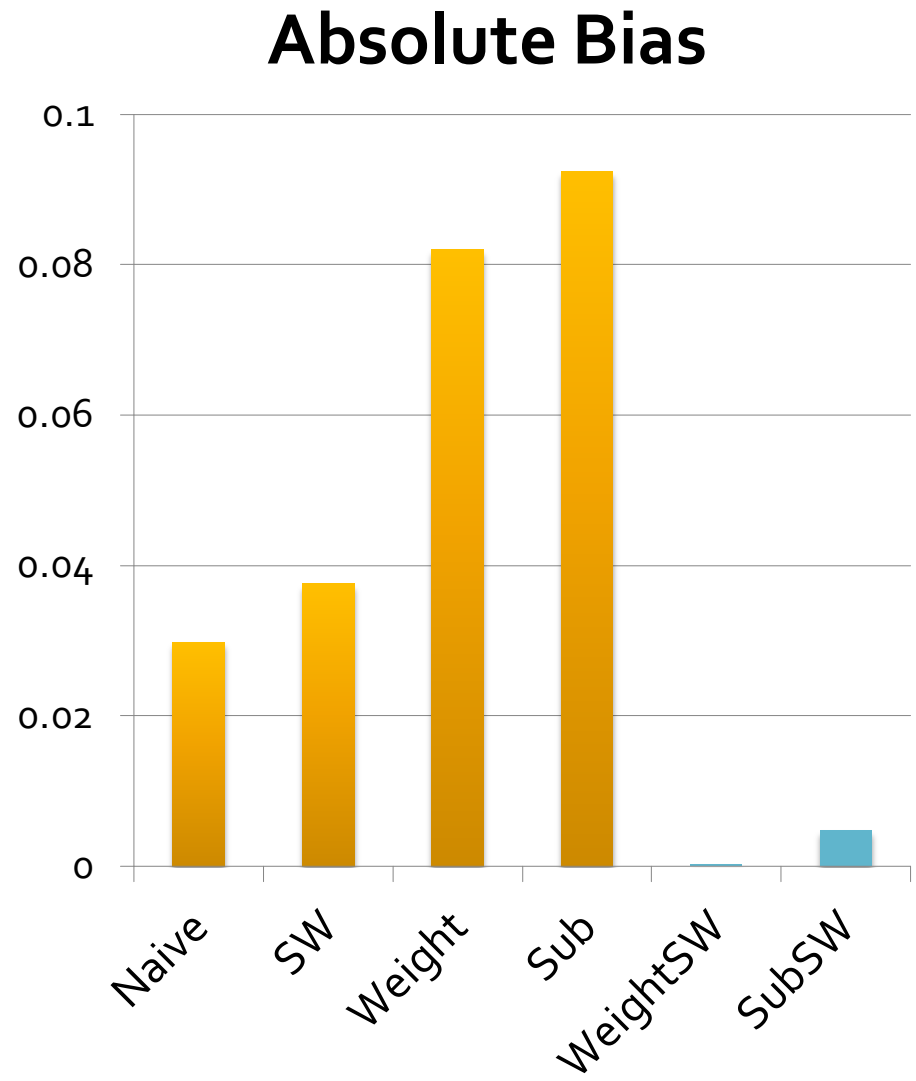
Discussion

- First quantitative investigation of methods for combining propensity score methods and survey weights

- Future work could explore:
  - Further differentiating between performance of various PS methods
  - More complex survey designs
  - Effects of PS model misspecification

Thanks!

ATE Results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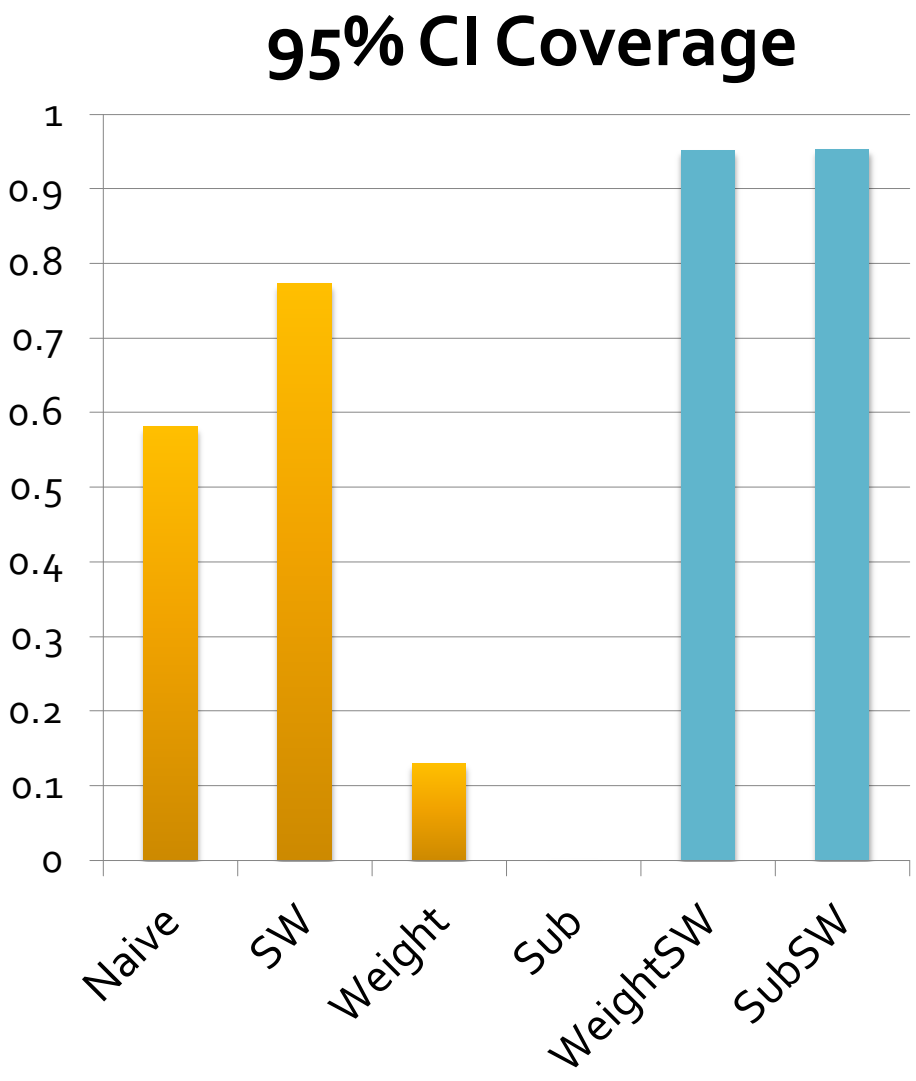
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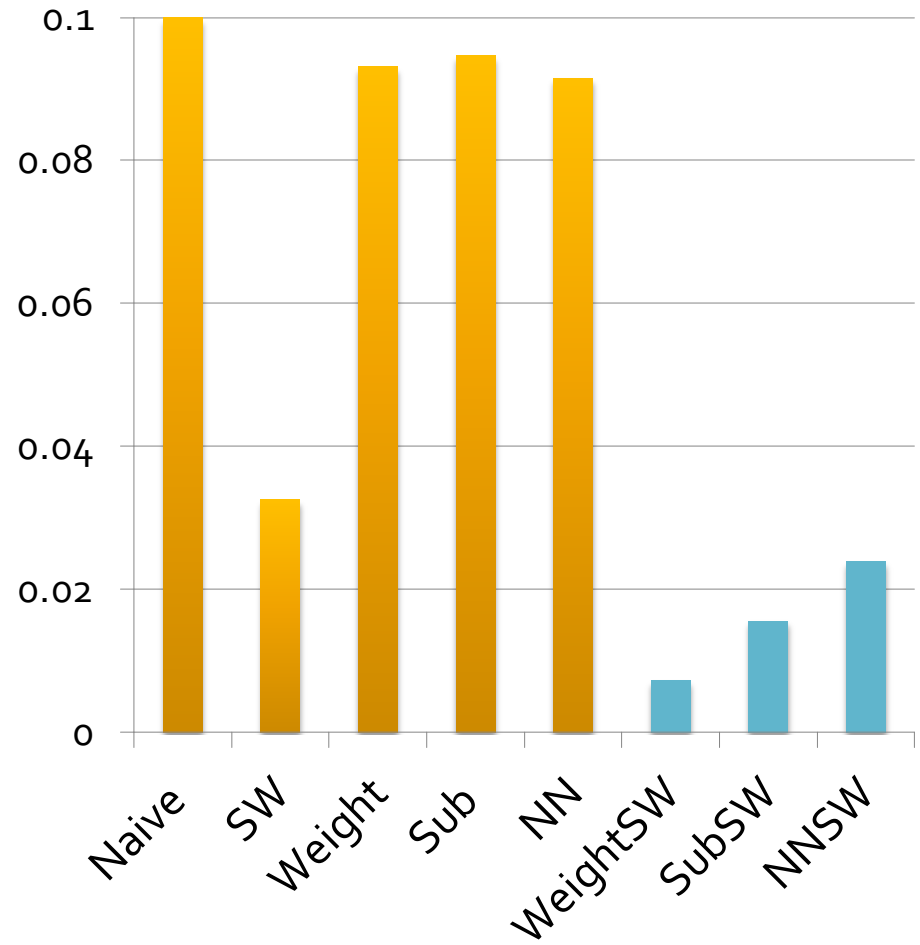
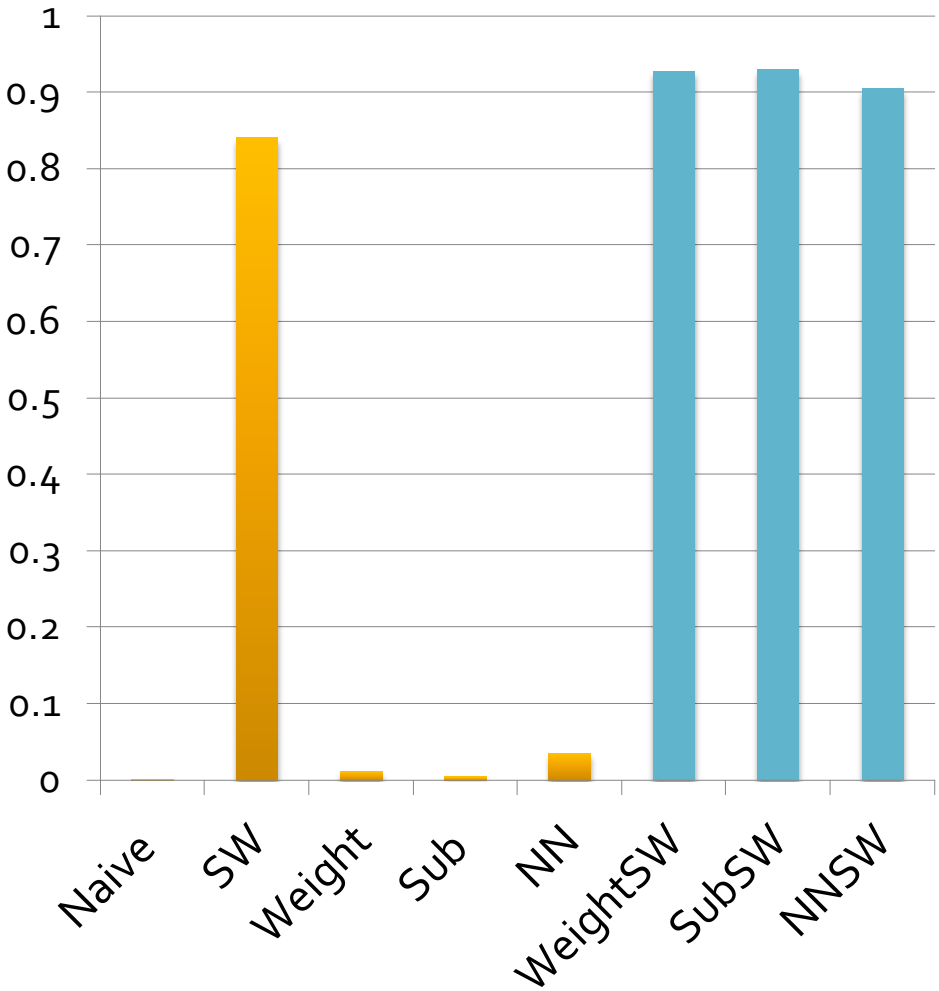
ATT Results

Absolute Bias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