

# Propensity Score Calibration

HUG, October 27, 2009

# We've Got Data – Observational Data

- Data collected to administer the health care system
- Not collected for research
- Generally concerned with payments
  - ▶ Payments to physicians
  - ▶ Payments to pharmacists
  - ▶ Hospital budgets based on patient load

Would like to use this data to answer research questions

# Advantages of Admin Data

- Low cost relative to collecting primary data
- (but definitely not low-cost)
- Encompasses (almost) the full range of recipients and providers
  - ▶ not just physicians and patients in academic centres, or subjects who meet strict enrollment criteria
- Can follow people across the continuum of care
- Can include people who do not receive care, as well as those who do

# Disadvantages of Admin Data

- People are not randomly assigned to their treatments
  - ▶ E.g. People receiving drug A were older and sicker than people receiving drug B.
  - ▶ Differences in outcome may be due to differences the patients, rather than differences due to their treatment
- Clinical information (severity of disease) lacking
  - ▶ May be supplemented by chart reviews
- Long delay in (some) data availability

# Propensity Score Analysis

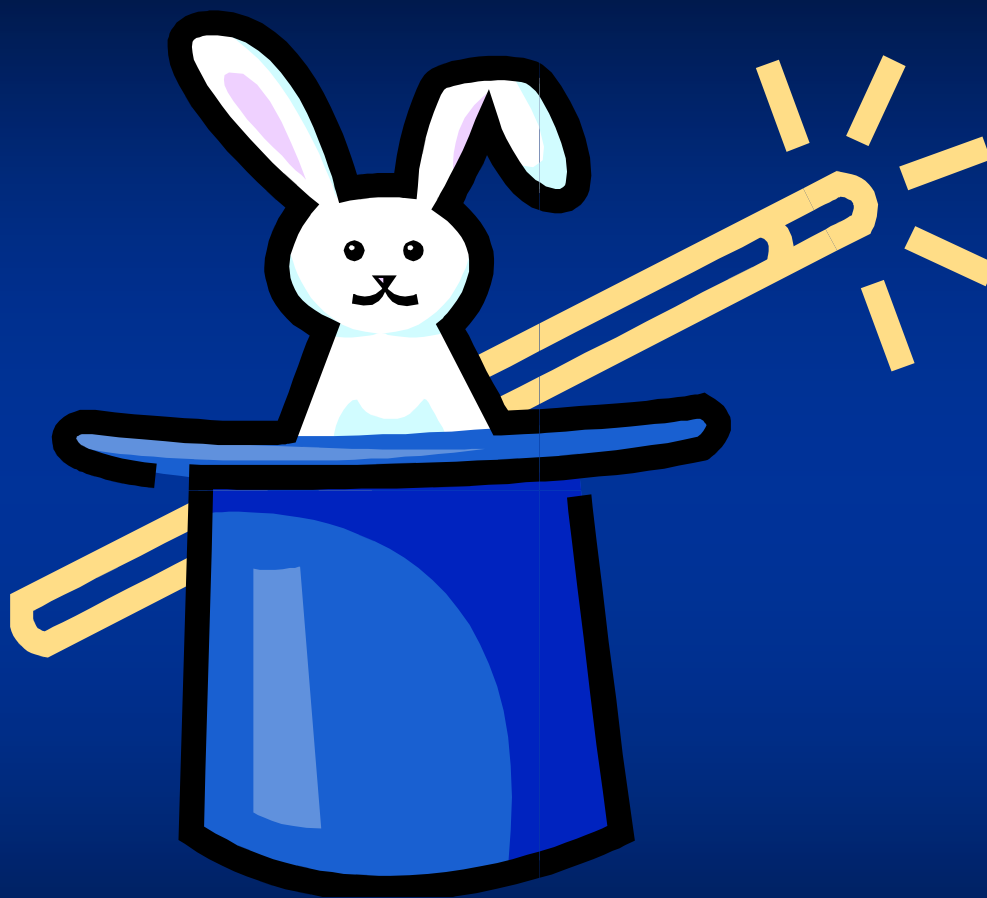
- One method for analyzing observational data
- Propensity score = probability of being in one of the two treatment groups
- Calculated using logistic regression  
proc logistic;  
model Drug\_A = age sex comorbidities ...;  
output out = results predicted = phat;

```
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  model Drug_A = age sex comorbidities ...;  
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```

Propensity score =  
 $\text{logit}(\text{probability}(\text{Drug\_A}))$

# Once the Propensity Score is Calculated...

- Match people from treatment A with people from treatment B
  - ▶ Match on the propensity score (+/- caliper)
  - ▶ Can additionally match on “important” variables (e.g. age, sex, specific comorbidities)
  - ▶ 1:1 or 1:many
- Use **paired** analysis to compare outcomes of matched sets (e.g. conditional logistic regression)



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**But ...**

# Missing Key Clinical Information

- Observational data are not collected in order to promote your research question
- Missing key clinical information
  - ▶ Smoking status
  - ▶ Immigration status
  - ▶ BMI
  - ▶ Self-reported health status

# Calibrated Propensity Score

- You must have a source of additional data for a subset of your sample
  - ▶ Survey data (e.g. CCHS)
  - ▶ Chart review

## For each person in the calibrated data set

- Original propensity score

$$PS\_original = \alpha_0 + \alpha_1(\text{sex}) + \alpha_1(\text{age})$$

- Calibrated propensity score

$$PS\_calibrated = \beta_0 + \beta_1(\text{age}) + \beta_2(\text{sex}) + \beta_3(\text{smoking status})$$

- Relationship between original and calibrated PS

$$PS\_calibrated = \delta_0 + \delta_1(\text{treatment}) + \delta_2(PS\_original)$$

- $PS_{\text{calibrated}} = \delta_0 + \delta_2(PS_{\text{original}})$ 
  - ▶ No need to re-run the matching
  
- $PS_{\text{calibrated}} = \delta_0 + \delta_1(\text{treatment}) + \delta_2(PS_{\text{original}})$ 
  - ▶ Use this relationship to calculate the (estimated)  $PS_{\text{calibrated}}$  for everyone
  - ▶ Re-create the matched pairs

# Stürmer's paper

- Original analysis used the PS as a covariate rather than matching on the PS
- Logistic regression used to estimate the effect of treatment on a binary outcome  
proc logistic;  
model outcome = treatment propensity\_score;

## Original analysis

$$PS\_original = \text{logit}(\alpha_0 + \alpha_1(\text{sex}) + \alpha_1(\text{age}))$$

$$P(\text{outcome}) =$$

$$\text{logit}(\beta_0 + \beta_1(\text{treatment}) + \beta_2(PS\_orig))$$

## What is wanted

$$PS\_calibrated =$$

$$\text{logit}(\gamma_0 + \gamma_1(\text{age}) + \gamma_2(\text{sex}) + \gamma_3(\text{smoking status}))$$

$$P(\text{outcome}) =$$

$$\text{logit}(\eta_0 + \eta_1(\text{treatment}) + \eta_2(PS\_calibrated))$$

## How to get there

$$PS\_calibrated = \delta_0 + \delta_1(\text{treatment}) + \delta_2(PS\_original)$$

$$\eta_1 = \beta_1 - \delta_1 \beta_2 / \delta_2$$

# References

## PS Calibration:

Stürmer et al. Performance of Propensity Score Calibration:  
A simulation study. *Am J Epidemiol.* 2007; 165(10):  
1110-1118

## Propensity score methods:

*Biom J.* 2009; 51(1): 171-84

*J Clin Epidemiol.* 2008; 61(6): 537-45

*Stat Med.* 2008; 27(12): 2037-49

*Stat Med.* 2007; 26(16): 3078-94

*Stat Med.* 2005; 24(10): 1563-78