Statistical Small Area Estimation: Some examples and current projects at NCHS

Donald Malec, National Center for Health Statistics, CDC

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The findings and conclusions in this presentation are those of the author and do not necessarily represent the official positions of the National Center for Health Statistics, Centers for Disease Control and Prevention.
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   - Required: the small area sample is part of a larger sample that does provide precise (direct) estimates for the larger area
   - Optional: related covariates are available for all small areas
Examples Of The Definition:

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   - **Context**: The World Fertility Survey - contraceptive use
   - **Small Area Method**: Wong and Mason, JASA, (1985)
     - Within Country Covariates: Education Level, Rural Status
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   - **Small Area Method**: None needed for 5-year estimates - block group sample large enough

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   ▶ Context: Diabetes prevalence measured in the National Health Interview Survey
   ▶ Small Area definition requirements: NHIS diabetes prevalence can be precisely estimated for the U.S.

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What Are Small Area Estimates?

**Typical form:** $\hat{w} \cdot \hat{y}(direct) + (1 - \hat{w})\hat{y}(model)$

- $\hat{y}(direct)$: Estimate using only data within the small area
- $\hat{y}(model)$: Estimate for small area using a model of the relationship across small areas
- $0 \leq \hat{w} \leq 1$: weight - estimated from data. Gets larger as the small area sample increases
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**Example:** County per capita income, Fay & Herriot, *JASA*, (1979)

- $\hat{y}(direct)$: log of county PCI using county data from the Current Population Survey
- $\hat{y}(model)$: $\hat{a} + \hat{b} \times \log(\text{CensusPCI})$
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   - Typical estimates which use only data from each area may be suppressed due to small sample size
   - Small Area Estimates could fill this gap
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2. More demand for statistics on small areas or domains than are affordable through increased sample size
   ▶ Small Area Estimates do not require additional sample - are labor (model based) intensive
   ▶ Can provide a "first look" at data - use small area data to prioritize resources for additional sample
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3. Uniform quality - uniformity of definitions across Small Area Estimates
   - Input data from same survey
   - Covariates typically (can be required) to be from the same source (e.g. IRS)
   - Estimates and model constructed at one time - share the same assumptions
Assumptions Needed

- Although data-based, the model may still not fit well for some small areas.
- $\hat{y}(direct)$ usually needs further model assumptions to be implementable... e.g., Normality.
- Estimates of $Var(\hat{y}(direct))$ are often imprecise but needed.
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More like....

- a way to fill in missing data
- combine direct data with a model ... gets better with more direct data
Some current projects at NCHS - in order of maturity

1. County estimates of smoking and cancer screening rates
2. State and sub-state estimates of people who use only wireless phones
3. Fast screening for outcomes that vary by small area
4. Small Area Estimates from the NHIS utilizing block-linked American Community Survey data
5. Some preliminary work on model-based estimates using Health care data
Combine NHIS county estimates by telephone status with BRFSS estimates

Strengthen county estimate using associations with socio-demographic variables

Estimates for 2000-2003 and 1997-1999 available online from the National Cancer Institute

http://sae.cancer.gov

Current estimates under development - modifying method to account for cell-phone only population
State and sub-state estimates of people who use only wireless phones

- Combine NHIS estimates of wireless rates with rates measured at other times
- Strengthen this component with state and substate estimate obtained form the American Community Survey
- Current method estimates:
  - used to benchmark mixed-frame telephone surveys
- Relatively new - possible improvement being investigated
Fast screening for outcomes that vary by small area

- Small Area Estimation requires resources: analyst time, evaluation and review time
- Project based on premise that it is easier to estimate the small area variability than it is to estimate each individual small area
- Method uses simple model with no covariates
- Evaluation so far - discern among NHIS health insurance outcomes at the state level
- Method will break down if little data is available ANYWHERE - currently investigating when this happens
Small Area Estimates from the NHIS utilizing block-linked American Community Survey data

- Working with the U.S. Census Bureau to create a NHIS/ACS file at the block-level and develop Small Area Estimates
- ACS: detailed estimates of health insurance, overall health, socio-economic variables
- Aim: use ACS estimates as covariates to create “NHIS like” estimates for small areas
- Targets: health insurance and access to care outcomes for states and the border counties of Mexico
Other Uses of Small Area Methodology

▸ Provide modeling ideas that can be used to analyze health outcomes and their interactions over geography

▸ The “synthetic data” approach to disclosure avoidance is often based on small area modelling. Small Area Estimates, themselves, will provide more disclosure avoidance than the original estimates.

▸ Some of the small area methodology research involves finding more accurate methods for incorporating the sample design into modelling

▸ Local Communities: Have options of using available small area estimates as an additional component to their local data
Thank you.
dmalec@cdc.gov