Early Experience of Adaptive Design Work in the NSCG

Ben Reist

Federal Economic Statistics Advisory Committee Meeting
June 2014
National Survey of College Graduates

- Sponsored by National Center for Science and Engineering Statistics (NCSES) at the National Science Foundation (NSF)

- Part of the Science & Engineering Statistical Data System (SESTAT)

- Person-level survey sampled from American Community Survey (ACS)

- Target population is college graduates

- Occurs every 2-3 Years

2013 Data Collection

- February 21 – August 25

- Sample Size ~143,000 cases
  - 83,000 in New Cohort (2011 ACS)
  - 60,000 in Old Cohort (2009 ACS + 2010 NSRCG)

- Data collection modes include: internet, mail, phone
  - Different costs and effort
Methodology Studies

- What Strategies Work?
  - Incentive Timing
  - Priority Mail vs. First Class Mail
  - Mode Switching
  - Incentive Conditioning
Motivation for Adaptive Design

- NSCG Priority:
  - Reduce the time from start of data collection to delivery of finished product.

<table>
<thead>
<tr>
<th>Processing Step</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Collection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Editing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imputation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weighting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variance Estimation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Needs to be done **without** sacrificing data quality!
Motivation for Adaptive Design

- Additional Goals
  - Allocate data collection resources efficiently
  - Avoid exhausting money and time
  - Move beyond response rate as the major metric of survey quality
Challenges to Implementation

- **System:**
  - Independent data collection systems

- **Processing:**
  - Move processing
  - Make assumptions

- **Data Quality:**
  - What measures do you use?
  - How do you use them in the decision-making process?
Adaptive Design Components
Targeted for 2013 NSCG

Challenges Served as a Roadmap for 2013

- Integrate Disparate Data Collection Systems
  - Integrated Systems
  - Integrated Reporting
- Institute Flow Processing
- Data Monitoring Methods
  - Increase Access to Paradata
  - Implement Methods
- Determine Possible Interventions
Integration of Systems
Integration of Systems

Baseline (2010)

- Input files must be delivered to several different locations
- Many unrelated handoffs
- Separate intermediaries for mail and telephone
- Response files located in several different locations
- No mode-level interventions or communication without data flow to/from NSCG
- Different contact paths by mode
Integration of Systems

New Version (2013)

- Input files now delivered to one location
- Response files are now all in one location
- Single intermediary
  - Aware of all modes
  - Can pass info between modes
  - No need to wait for NSCG to affect action/interventions
- Single contact path for all modes
Integration of Systems

New System Functionalities

- CATI Holds from Internet
  - Every 2 Hours
- Mail Processing Holds
  - Daily
- Data Monitoring Holds
  - Weekly
- Integrated Reporting
  - Daily
Integrated Reporting

- Universal Tracking System (UTS)
  - Census Bureau enterprise-wide reporting system
  - Combines data streams from various systems
  - Met two major NSCG needs for adaptive design
    - Full Contact Path Report
      - Chronological report of all contacts for a sample person
      - Allowed us to respond to a specific sample person request
    - Contact Aggregation Report
      - Total contacts by category for a sample person
      - Include in data monitoring
Flow Processing
Flow Processing

- Complete most/all parts of processing
- NSCG has a goal of daily processing
- Make some assumptions
  - Less editing or less manual review
- Need coding, editing, imputation, weighting, and variance estimation
Flow Processing

- Section in red is processing
- Normally completed after data collection
- Completed on a daily basis
- Allows daily production of estimates of interest and quality measures
Flow Processing Benefits

- Operational Benefits
  - Processing programs completed earlier
  - Real-world testing opportunities

- Data Benefits
  - See effects of changes in editing or imputation rules immediately in the data
  - Daily views of “final” data and data quality
  - This information is important for data monitoring
Data Monitoring
Data Monitoring & Intervention

• Data-driven view of “what’s going on?”
• Make data-driven data collection interventions
• Propensity models
  • Uses frame, 2010, and 2013 NSCG data
  • Determine propensity to be in the respondent population
• R-indicators\(^1\),\(^2\) (initial monitoring metric):
  • Great sampling frame (ACS)
  • What “type” of cases are responding?
  • Identify under-/over- represented groups
Data Monitoring & Intervention

- Benchmarking to frame and sample totals
  - Evaluate non-response propensity model
- Stability of estimates\(^3\)
  - Help develop stopping rules\(^4\)[\(^5\]: Are new respondents moving the estimates/variance? Is it “worth it” to continue?
- Fraction of missing information\(^6\)
  - Help develop stopping rules: Measures uncertainty surrounding imputed values (Requires multiple imputation)
Interventions

- Data Monitoring provides information
  - Watch it or act on it?
  - 2013 NSCG includes mode-switching test
  - Monitoring methods help identify target cases
    - Move case to mode with the highest response propensity
    - Hold a case in web if it is a “low impact” case
    - Put a CATI case on hold (no contacts) if R-indicator indicates the group is over-represented
  - Need to identify more possibilities
- Interventions are part of cost/quality tradeoff in adaptive design
Interventions

- Other types of interventions
  - Investigate and react to issues in data collection
    - Web server was extremely slow during first week of data collection
    - Used web paradata to identify time frame of slow service
    - Identified respondents affected by slow service
    - Mailed apology letter
R-Indicators Overview

- Sample R-Indicators
  - Evaluate representativeness of respondent population as compared to the sample population, given a set of balancing variables

- Unconditional Partial R-Indicators
  - Variable-Level
    - Evaluate which variables are driving the variation in propensities
  - Category-Level
    - Evaluate which subgroups of a variable or a cross of variables are over- or under-represented
R-Indicators Overview

Sample R-Indicators (Balancing Model) for Incentives Study Groups vs. Weighted Response Rate

\[ R(\hat{\rho}) = 1 - 2 \left( \frac{1}{N-1} \sum_{i=1}^{N} \frac{s_i}{\pi_i} (\hat{\rho}_i - \hat{\rho})^2 \right) \]

\[ 0 \leq R(\hat{\rho}) \leq 1 \]

- \( R(\rho) = 1 \) means that the respondent population is fully representative of the sample population (all cases have the same propensity to respond)
- A decreasing R-Indicator means an increase in the variation in propensities.
- Can compare different samples (as here) provided the same variables are used in the balancing propensity model.
Data Monitoring Example

Unconditional R-Indicators for Variables in the Balancing Propensity Model (with Data Through 8/17) - MOSW

\[ R_u(\text{var}, \hat{\rho}) = \sum_{k=1}^{K} \frac{N_k}{N} (\hat{\rho}_{x,k} - \hat{\rho}_x)^2 \]

0.00 \leq R_u \leq 0.50

Variable –Level Unconditional Partial R-Indicators:
- **Identify variables** that drive variation in propensity.
- \( R_u = 0 \) means the variable does not drive variation in propensities
Data Monitoring Example

Partial Unconditional R-Indicators for Race/Ethnicity
(Data Through 8/17) - MOSW

\[ R_u (\text{var}, k, \rho) = \sqrt{\frac{N_k}{N}} (\bar{\rho}_{x,k} - \bar{\rho}_x) \]

-0.50 ≤ \( R_u (\text{var}, k, \rho) \) ≤ 0.50

Category – Level Unconditional Partial R-Indicators:
- **Identify subgroups** that are over- or under-represented.
- This information can be used for targeting cases
Cases in the over-represented group & in CATI were put on hold to reduce contact attempts/shift resources to other cases. (Total of 40 cases)

For this intervention, cases in the over-represented group were identified. 50% of cases will only receive a web invite instead of a full questionnaire packet. Results in cheaper mailings, and reduction in future resources needed for keying. (Total of 498 cases)

Cases in over-represented group were not sent week 18 questionnaire or week 23 final mailing. (Total of 508 cases)

Cases in over-represented group & not in CATI were held out of CATI to reduce contact attempts. (Total 495 cases)

Cases in under-represented groups moved to CATI to pursue those cases more aggressively. (Total of 85 cases)
- All interventions improved representativeness vs. a control where no mode switching occurred.

- Sending a web-invite only to over-represented cases resulted in fewer responses and reduced over-representation. (Tradeoff between Response/Representativeness)

- Moving cases to CATI in the under-represented groups resulted in increased response rates and representativeness as compared to the control.

- Until the end of data collection, the black bachelor population behaves nearly identically in both the mode switching and control group.
Questions

- What information needs to be provided to data users about interventions taken?

- How should we balance the quality of key estimates and quality of the microdata?

- How much adaptation is too much adaptation and how will we know?
References


