RESOURCES VS. COVERAGE – HOW TO MINIMIZE ONE AND MAXIMIZE THE OTHER: A CASE STUDY FROM AN EDUCATION SURVEY

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1. Purpose of Paper

This paper describes the methodology and criteria for targeting specific state sources to maintain or improve the frame coverage for the Private School Survey (PSS). These criteria take into consideration the quality and timing of the state information as well as the net coverage improvement to the overall PSS at the national and sub-national levels.

As part of its universe development, the PSS collects data from Early Childhood Centers (ECCs). However, due to budget, scheduling, or other work competing for time or money it is not always feasible to update the frame from every state source. When this occurs, the challenge is to prioritize the processing of the state sources taking into consideration costs, schedule, and coverage requirements. This initiative is essential to ensuring that the quality of the estimates and total variance meets both the U.S. Census Bureau and customer expectations.

2. Background

2.1 The Private School Survey

The PSS is a census of private schools collecting data from all 50 states plus the District of Columbia and is conducted for every other school year (e.g. 2001-2002, 2003-2004, etc.). The next cycle of the PSS is for the 2005-2006 school year. Every two years the U.S. Census Bureau, under the sponsorship of the National Center for Education Statistics (NCES), updates the universe of private schools and then collects data on the private schools with grades first through twelfth (or grades kindergarten through twelfth). We refer to these as traditional private schools. Lists for updating the universe with these traditional schools come from state departments of education and 28 of the main private school associations. A separate coverage improvement operation updates the PSS universe with additional in-scope schools (called "births) from county-level area frame sources. In this operation, field representatives do an independent search in a nationally representative sample of counties and locate private schools still missing from the universe after the list frame updating.

2.2. The Early Childhood Care Frame

The component of the PSS of interest in this paper is the Early Childhood Care (ECC) frame. In 1995, NCES added to its PSS scope private schools where kindergarten was the highest grade, or K-terminal schools. After some investigation, PSS analysts discovered that the lists of traditional schools had poor coverage of schools with a kindergarten, both K-terminals and schools with a kindergarten and at least one higher grade (Johnson, Edwards, Daniels, Parmer, 1999). To remedy this problem, NCES and the Census Bureau created the ECC frame.

The ECC frame collects both K-terminal schools and traditional private schools containing a kindergarten. Lists for updating the universe with these ECCs come primarily from state daycare licensing agencies or occasionally from childcare referral agencies. Subsequent evaluations of the ECC frame revealed that these lists improved the coverage of private schools containing a kindergarten (Johnson *et al*, 1999).

Operationally, the ECC lists are difficult to collect from our sources, are much larger than traditional lists; are difficult to process because of missing data, varied electronic or paper formats, and non-standard reporting nomenclature or other characteristics; and contain a large number of facilities that are out-of-scope for the PSS. Examples of out-of-scopes include babysitters, daycare facilities without kindergarten programs, infant care, and even adult care facilities. Processing a list from every state can more than double the survey's total cost and extend the survey's schedule beyond the agreed to deadlines. While everyone would like to believe we have full budget and unlimited time and resources to achieve the greatest quality

[1] *This report is released to inform interested parties of ongoing research and to encourage discussion of work in progress. The views expressed on statistical, methodological, technical, or operational issues are those of the authors and not necessarily those of the U.S. Census Bureau.*

possible, that is simply not true in reality. How could survey managers balance concerns about the survey's cost and schedule against the need for high quality/coverage? Our answer: Targeting.

3. Targeting Goals and Objectives

3.1. Goals

The NCES and the Census Bureau decided the ECC targeting had two main goals:

- Attain the best coverage (quality) possible:

  Ideally, any strategy would obtain the highest possible birth yield (that is, legitimate in-scope private schools to add to the universe) without discriminating against any state. The better the coverage, the more accurate the PSS results can be. We admit that, at this time, we do not have accurate coverage measurement in place at the state level and, subsequently, could set no absolute target goal for coverage. For the initial attempts at targeting, we went with the goal that "more is better."

- Maintain an even and predictable workload to stabilize costs:

  We wanted to manage the constraints of time/resources, budget, and scope by meeting schedule deadlines, keeping costs consistent from cycle to cycle, and maintaining an even and predictable workload. Since adjusting the time schedule every cycle was not an option, this goal really boiled down to managing workloads to manage costs.

  Doing the ECC operation for all states is not inexpensive or efficient. As mentioned above, the ECC lists are difficult to process. The processing operations are complex and time consuming. The list processing typically adds a high percentage of out-of-scope cases. Since the mode of data collection is mail, followed by phone attempts for mail non-responders, followed by personal visits to phone non-responders, a high number of these out-of-scope cases are discovered only during costly personal visits, thus adding to the data collection costs.

  For example, in 1999-2000, staff processed 17 ECC lists and gained 1,056 potential ECC births. In the data collection phase, 765 (72%) were identified as out-of-scope. Of the 765 out-of-scopes, 416 cases (54%) required telephone follow-up after the questionnaire mail-out phase, and 62 cases (8%) required additional field follow-up.

  The entire ECC operation, from list collection to data collection, can cost up to 50% more than the traditional PSS list frame operation. As a coverage improvement frame, this makes the ECC operation expensive. High out-of-scope rates and resulting high data collection costs make it essential to try to stabilize costs at an acceptable level to the survey sponsor. Spreading the full ECC operational costs over more than one PSS cycle and maintaining a consistent workload each cycle would help manage annual costs and budgets as well as allowing for better planning of human resource requirements.

3.2. Objectives

To fulfill the goals above, NCES and the Census Bureau developed the following objectives:

- Spread the total "full" ECC operational cost (the cost of processing every state) over two or more survey cycles. A 'cycle' is defined as the two year period up to and including the PSS enumeration.
- Process every state at least once every three cycles.
- Process the historically high yielding states as often as possible. For our purposes, "yield" is the total number of additional in-scope schools added to the universe.
- Maintain a workload of 16-20 states (750-1100 births) each cycle.
- Allow maximum system flexibility to swap states between cycles when necessary to meet desired cost and workload levels.

4. Targeting Options

4.1. Non-rotation Options

The three easiest options were less than adequate because they did not meet both goals. We list them here for completeness.

- Status Quo

  With the 'Status Quo' option there would be no real plan. Staff would process some state lists one cycle and some state lists another cycle. With this option, staff would collect and process whatever lists they can, given the schedule and budget. One advantage of this option is that it is easy. Borrowing the "First In First Out" concept from other fields, the first lists received are processed until time and budget expire. 'Status Quo' could meet the goal of stabilizing costs because the budget could be fixed at a flat rate for every cycle. On the other hand, it could not achieve the goal of attaining the best coverage. With no set plan, the number of births may fluctuate from cycle to cycle. Some states may never get processed because they are not received at all or are not received in time.

- Full ECC

  In the 'Full ECC' option staff would try to collect and process all the state lists each cycle. By processing all the state lists, survey managers would certainly meet the first goal of obtaining the best coverage possible. However, since this is a costly option, it would not meet the goal of stabilizing costs at an acceptable level within the required time schedule. Since the number and quality of lists received would vary greatly from cycle to cycle, variable expenses such as overtime and additional processing staff or equipment could destabilize costs.

- Stop ECC

  In the 'Stop ECC' option staff would not collect or process any state lists. This option clearly meets the goal of stabilizing costs by eliminating the ECC operation. However, since we know the ECC frame does improve coverage, the other goal would not be met at all.

  Table 1, based on historical results, shows the approximate coverage lost if ECC updating had not taken place. The results varied greatly from cycle to cycle based on the number and quality of the lists we processed.

Table 1: Coverage Loss Without ECC Operation

Cycle	% Loss of Traditional Schools	% Loss of K-terminal Schools
1997-1998	1.3	29.3
1999-2000	0.2	5.2
2001-2002	0.9	15.1

Based on the results from the 2001-2002 PSS, according to Table 1, we would have lost approximately 0.9% of traditional schools and 15.1% of the K-terminal schools if no ECC updating was done.

4.2. Simple Rotation Options

Each of the above options has negative cost or coverage implications. Rotating states over two or more cycles may be a better way of achieving the ECC list frame goals and objectives. Rotation strategies considered included:

Figure 1: Possible Simple Rotation Strategies

Strategy:	All States Rotate Over:	Each Cycle Process:
2-cycle rotation	4 years	1/2 of states
3-cycle rotation	6 years	1/3 of states
4-cycle rotation	8 years	1/4 of states

Any of these options would meet the goal of maintaining an even workload and stabilizing costs over a specified number of cycles provided the states were divided evenly into their groups based on difficulty to process and expected yield (expected adds/births). These options still do not address how to maximize coverage since not all states in the processing group will submit a list in any given year (some states are more problematic and rarely submit a list) and the high yield states would be processed at the same frequency as the low yield states.

4.3. Hybrid Option

In the hybrid approach, analysts would improve upon the simple rotating options by adding a

component that uses targeting to maximize the coverage. For this, analysts would keep the rotating design, but alter it slightly to include different rotation cycles for different strata of states. While it seems the best option for maximizing coverage, maintaining an even workload, and stabilizing costs, the hybrid would not be a simple, straightforward method.

5. Recommended Design Strategy

We decided on the hybrid option. The overall design has two strata based on expected yield. Within each stratum are panels of states based on their difficulty to process. The high yield panels will rotate every two cycles while the low yield panels will be on a 3-cycle rotation.

5.1. Rotating Panel Design With Targeting

The steps in Figure 2 illustrate the design of the rotating panel strategy. First, we created two groups or strata based on the states' historical yield and placed each state in a stratum. Stratum 1 was High Yield (HY) States and Stratum 2 was Low Yield (LY) States. Then, we divided HY states into two flexible panels with relatively even workloads and yields. Each HY panel is targeted every other cycle. Finally, we divided the LY states into three flexible panels with relatively even workloads and yields. Each LY panel is targeted every third cycle.

Thus, for each PSS cycle, there is one panel of high yield states processed and one panel of low yield states processed. Figure 3 shows the strategy in place over the next six PSS cycles. For example, for the 2005-2006 PSS, we would target HY panel A and LY panel C for priority processing.

5.2. Targeting Selection Criteria

To determine how many states and which ones to put into a particular stratum and panel, analysts used the following criteria:

- Historical Yield to Determine Strata -- Only one factor determined strata formation: each state's historical yield. In the future we would like to add each state's projected growth of kindergarten age children in private schools. Using data from past cycles of ECC operations, analysts determined the number of added schools or births for each state. Then they ranked the states based on the mean number of births for each cycle processed. States with an average of 50 births or more per cycle went into the HY stratum. States with an average of less than 50 births per cycle went into the LY stratum. These parameters will be revisited each cycle to improve methods of defining each stratum. After this analysis, there were 12 states in the HY stratum and 39 states in the LY stratum.
- Estimated Workload to Determine Panels -- Going back to one of the objectives, we wanted to process about 16-20 states with an estimated workload of approximately 26,000 – 32,000 facilities every cycle. We tried to divide each stratum into equal size panels. Analysts again reviewed historical data and qualitatively evaluated the difficulty of processing each state's list. They were able to divide the 12 HY states into two panels of six states each and the LY states into three panels of 13 states each.

6. Execution - Recommended Collection Tactics

Based on past experience, collecting ECC lists from the states can be problematic. For the traditional PSS operation, NCES has developed a strong partnership with the state departments of education and the private school associations. These traditional sources have generally been quick to cooperate with the request for lists of private schools. This partnership does not exist with the ECC sources. Despite staff efforts, nonresponse can be high. As a result, staff may not receive a list from a targeted state. The execution of the targeting design needed to take this into account, so analysts devised state list collection tactics.

The collection tactics have three components as follows:

- First, staff will send a request letter to all states every cycle regardless of the target plan for the cycle. By doing this, the state agencies should get in the habit of expecting a request every two years.
- Second, staff will conduct follow-up as needed for the current cycle's targeted states. Rather than direct time and resources into collecting lists from every state, they will concentrate follow-up activities on just the targeted states.

- Third, if follow-up is unable to collect lists from all the targeted states, the targeting strategy is flexible and allows swapping a state from one panel (or cycle) to another. Staff can swap or substitute a similar yielding and workload state that already came in, or could be obtained, for a target state they cannot get. In this third tactic, staff will focus their follow-up effort on the state or states swapped into the panel, rather than on the original target state(s) in that panel.

7. Execution - Recommended Processing Priority

As soon as staff receives a targeted state list, processing will begin. The main processing goal is to process all of the targeted lists. However, some lists are hard to process due to their difficult format, unexpectedly large workload, or missing critical data (e.g., telephone numbers). This can jeopardize scheduled deadlines and increase the cost of the operation beyond the best-laid strategic plan. To accommodate situations like this, execution of the targeting strategy includes guidelines for the processing priority of lists.

The processing priority is as follows:

- First, staff will process states in the HY stratum before states in the LY stratum.
- Second, staff will process the late lists and swapped out states from the previous cycle before the targeted lists from the current cycle. For example, suppose staff were unable to obtain a list before the deadline from New Jersey for Cycle 1. To replace the New Jersey list, analysts decide to swap New Jersey for Cycle 2's New Hampshire because they are both in the same stratum and both have an equivalent estimated workload. New Hampshire is now a target state for Cycle 1 and New Jersey becomes a target state for Cycle 2 until such time as it may need to be swapped in or out again. When processing lists during Cycle 2, New Jersey has a higher priority over lists that are in the original Cycle 2 targeting plan. This will decrease the chances that any one state goes too long between its processing cycles.

Note that these are only guidelines. Managers monitoring the schedule and budget will remain flexible to address operational needs.

8. Conclusion

Now that there is an initial plan for collecting and processing the ECC lists, what's next? The next step is to implement this strategy for the 2005-2006 PSS. The list collection and universe updating activities begin in the fall of 2004. Managers and analysts will be monitoring how the strategy works and collecting results for evaluation. To aid in the evaluation, staff will analyze data from previous PSS cycles and compare to the current cycle. Based on these findings, survey staff will then refine the targeting strategy.

Plans for the future include continuing research as listed below.

- Update results from previous cycles for comparison. Analysts want to collect and analyze data on costs, births, out-of-scopes, coverage rates, and other survey data for use in evaluating and refining the ECC targeting strategy. This, for example, may include the cost of the ECC frame by data collection mode (i.e., mail-out, telephone follow-up, and personal visit follow-up) and possibly the ECC frame coverage rates by state.
- Investigate how individual state ECC lists affect the coverage of the traditional PSS. Questions analysts wish to answer include the following: How much do the ECC state lists increase coverage of the traditional PSS universe? Do any specific ECC state lists contribute more to the traditional PSS coverage than other lists? Are any state lists perpetually unproductive?
- Study kindergarten enrollment projections for each state. The NCES currently has data on kindergarten enrollment projections for public schools but does not make comparable projections for private schools. Analysts need to find or develop ways to get this data. Then, with these projections, analysts want to determine the states expected to grow and add private schools. As a result, they can amend the targeting criteria to include high growth states. (High growth states will be added to the high yield stratum.)
- Develop a model to predict or improve cost estimation. To ensure costs are stabilized, analysts want to better estimate the cost of any given workload. Doing so will require tracking costs at a lower level than currently done by survey managers. This includes tracking clerical processing and automated

frame development costs as well as tracking data collection costs by mode.

- Investigate ways to reduce the number of out-of-scopes generated during list processing. As a result, this should reduce data collection costs, especially follow-up costs. Reducing these out-of-scopes will involve improving process quality both in clerical and automated operations. Such system enhancements may lead to improvements or refinements in the targeting strategy.
- Investigate how (or if) targeting criteria should change for states with high growth but low yield. Most of these states will likely have a small number of private schools to start with. A growth rate of, say 10% for North Dakota would add about five schools while a 10% growth rate for California would add roughly 100 schools. Analysts will need to decide whether to target North Dakota.

9. References

Johnson, Nancy R. Edwards, Charles, H., Daniels, Courtney L., and Parmer, Randall, "Coverage Improvement of Terminal Kindergarten Program from Alternative Sources in the Private School Survey", *ASA Proceedings of the Section on Survey Research Methods, 1999.*

Figure 2: Illustration of Hybrid Rotating Panel Strategy

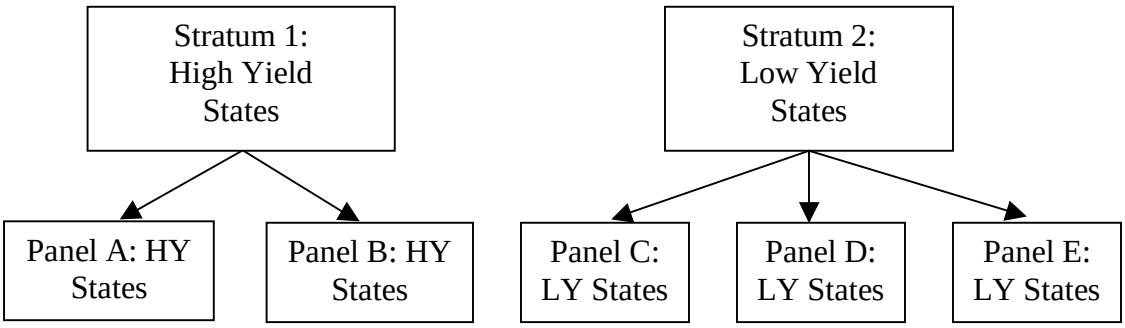

Figure 3: Summary of Future Rotating Panel Targeting Strategy

Cycle Year	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015-2016
High Yield Stratum Panel	A	B	A	B	A	B
Low Yield Stratum Panel	C	D	E	C	D	E