A Dual Frame Rdd/Registration-based Sample Design:
Lessons from Oregon's 2004 National Election Pool Survey

Warren Mitofsky[1], Joel Bloom[2], Joseph Lenski[3], Scott Dingman[1], and Jennifer Agiesta[3]
Mitofsky International[1]
University of Oregon[2]
Edison Media Research[3]

Abstract

Researchers conducting pre-election surveys by telephone have experimented with samples selected from voter registration lists (RBS). This frame includes past voting history and demographic information about voters, but it is missing telephone numbers. The success rate for matching the registration lists to commercial phone numbers ranges between 50% and 65%. The alternative design for telephone samples is random digit dialing (RDD). The problems with RDD samples are the screening necessary to identify residential phone numbers and registered voters. The more complete representation of phone numbers argues for RDD samples. Efficiency makes RBS a desirable alternative if the under representation bias can be eliminated. A dual frame sample was designed to achieve the advantages of RBS supplemented with an RDD sample to eliminate the undercoverage bias.

Keywords: RBS, dual frame, pre-election, telephone survey.

1. The Problem

In recent years researchers conducting pre-election surveys by telephone have experimented with samples selected from voter registration lists (RBS). These lists not only identify potential voters, they also may include past voting history and demographic information about each voter. These characteristics can be used as stratification variables, which can improve the design of the sample. They also can be used as a source of parameters for improving the estimates. Registered individuals are sampled and can be approached by name. The probabilities of selection for individuals can be equal or unequal, depending on the rates of selection in various strata.

There is, however, a major shortcoming when using registration lists as a sampling frame: telephone numbers usually are not part of the registration list. If the registration list has telephone numbers or phone numbers are appended contact information is usually incomplete. That is because phone numbers usually are not required when one registers, or the phone numbers may not be current, or phone numbers cannot be appended for the entire list. The success rate for matching the registration list of a state to commercial phone lists typically ranges between 50 and 65 percent,

The alternative design for pre-election telephone samples is random digit dialing (RDD). In this mode all residential telephones have an equal chance of selection. The probabilities of selecting an individual depend on the number of unique residential phone numbers in the household and the number of adults in the household. All individuals living in households with at least one phone line have a known non-zero chance of selection. The small number of individuals living in institutions may have no chance of selection in many RDD designs. The other problem with RDD samples is the work required to separate working residential phone numbers from business and nonworking numbers. Stratification for RDD sample selection is limited to geographic characteristics.

Another potentially larger problem with RDD sampling is that – in the absence of voter registration information and respondent vote history – we are forced to accept self-reported voter registration. Given the well-documented tendency of some non-registered respondents to falsely claim registration, this can be a significant problem, especially in low turnout states. We also have to rely exclusively on self-reported intention to vote, rather than the documented voter history available with RBS lists.

The interviewing cost of reaching a registered voter is less for RBS than for RDD samples. (See Green, 2003) However, the cost of acquiring an RBS list that can be used for an unbiased sample design may seriously affect the cost advantage of the interviewing. There is a much greater potential bias due to missing phone numbers for an RBS frame than there is for RDD samples missing individuals (although the over-report of voter registration and likelihood of voting prevalent in RDD-sample surveys may be just as bad, if harder to quantify). The more complete representation of phone numbers argues for RDD samples. However, the

increased efficiency due to the stratification possibilities and the past voting history make RBS a desirable choice if the under representation bias can be eliminated.

Proponents of RBS for pre-election surveys make their case by comparing results from simultaneous RBS and RDD surveys. (Green, 2003; Morin, 2003) This empirical approach, however, provides no assurance for future surveys – even substantively large differences between any two polls are often within their margins of error. There is no way to generalize from this type of argument. RBS may prove itself more reliable on any given occasion. However, there is no theoretical basis for believing the results will also be reliable for future surveys.

2. Dual Frame Sample Design

Rather than enter this polemic we chose another course. We constructed a dual frame design for our sample of Oregon voters in the 2004 general election. In Oregon, all voting is by mail. No one goes to the polls to vote on election day, making it impossible to conduct traditional exit polls at the polling place with voters after they cast their ballots. In all other states Edison Media Research and Mitofsky International conducted exit polls. In 12 of these other states RDD surveys of absentee voters or those casting early votes at special polling stations were conducted by telephone.

The purpose of the dual frame design was to achieve some of the advantages of RBS and supplement it with the coverage of an RDD sample. We selected one sample of individuals by name from the RBS frame. This was an equal probability selection from among registered voters with telephone numbers. We selected a second sample from an RDD frame of land-lines. *We then removed from this RDD sample any telephone number that was on the RBS frame.* This gave each potential voter only one means of selection.[1] We tried unsuccessfully to implement this approach during

the presidential primaries using commercially available registration lists. But the vendors of the registration lists would not screen our RDD sample against the entire statewide registration list frame.

There were several reasons for using a dual frame design. The papers by Green and Gerber (2003) seem to indicate lots of potential for a much more efficient survey design by using a registration sampling frame. It has several appealing properties:

1. There is the guarantee that names on the list are registered to vote. The traditional RDD samples used by seven national pre-election surveys in 2004 screened respondents to identify who was and was not registered to vote. Between 77% and 91% of those screened in late October claimed to be registered, with a median of 84%.[2] While this is only a first step in identifying likely voters for these surveys, the numbers are large overstatements of registration. Even if those misreporting registration are screened out of the likely voter pool the overstatement results in interviews with hundreds of unregistered people for each survey. Verified registration studies of the adult population, like those carried out by the National Election Study until 1988, are not regularly conducted these days. But the available information suggests that about two-thirds of the population age 18 and older is registered.

2. Registration lists that have the voting history of the individual provide an efficient means of stratification of the frame. For example, high turnout voters can be sampled at different rates than low turnout voters. Those with a past history of participation in party primaries can be sampled at different rates than those with lower or no history of such participation. Sampling at different rates can produce efficiencies, provided the rates of selection are not too different. (As this was a presidential election in a state with a traditionally high turnout, in a year expected to have a higher than average turnout, we did not sample from the list at differential rates based on past behavior.)

3. Registration lists also contain personal characteristics of the registered, such as age and gender and sometimes other characteristics. Geographic location of the registered individuals also is available, including zip code, county, and electoral jurisdiction. These characteristics can be

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[1] In retrospect we realized that an individual on the registration list with his or her telephone number who had a second telephone that was not on the registration list had an unrecognized second chance of selection. The registration list could have had either a land-line phone number or a cell phone. The RDD sample was land-lines only, to the best of our knowledge. Even though the number of individuals with multiple chances of selection is very small, this oversight can easily be corrected in future applications.

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[2] The seven surveys were conducted by ABC News/Washington Post, National Annenberg Election Study, CNN/USA Today/Gallup, Fox News, Marist Institute for Public Opinion, New York Times/CBS News, Pew Research Center.

tabulated for the frame and used as parameters for ratio estimates along with an area's vote in prior elections.

Unlike the RBS papers already published, we knew we did not want the inevitable under-coverage bias due to missing phone numbers of many people on the registration lists. Sampling two-thirds (or fewer) of the population of potential voters was not an acceptable option. It was essential for us to have a means of sampling those with unknown telephones. An RDD sample – matched to and purged of numbers appearing in the RBS list – provided the necessary almost complete coverage of the voting population. This RDD portion of the sample need not be selected at the same rate as the RBS portion. A somewhat lower probability of selection – weighted appropriately – will give the necessary unbiased coverage without noticeably increasing the sampling error.

The Oregon survey was conducted by the University of Oregon Survey Research Laboratory (OSRL) at the University of Oregon at our direction. Joel Bloom was the project manager responsible for the implementation of the survey. We obtained the registration list for the entire state as it was on September 15, 2004. Telephone numbers were successfully matched with the registration list for 61% of the individuals on the list, (1,318,227 out of 2,150,781 total registered individuals). Some telephone numbers were added to the list from directories by a vendor and others were already on the list.

The registration list was the source of 622 completed interviews. Individuals were selected by name from the registration list. Another 280 interviews were completed from the RDD portion. Each RDD residential number represented a household; one individual was selected at random within each household. The relative size of the RBS and RDD share of the registered population were estimated from the registration list and weighted in proportion to their share of the population.

3. Sample Implementation

For the Oregon National Election Pool voter survey we were able to obtain a complete statewide list of registered voters rather than a sample of 20,000-30,000 records typically selected for other RBS surveys. This enabled our information technology team to first draw an RDD sample and then screen every number in the RDD sample against the entire statewide voter registration list. Any phone number in the original RDD sample that appeared in the statewide voter registration list was purged from the RDD list. This resulted in a modified RDD sample.

This method found quite a large number of matches. From our original RDD sample of telephone numbers 22% were purged because they matched numbers already found on the statewide voter registration list. If the original RDD sample had nothing but residential numbers the percentage would have been a lot higher, perhaps approaching close to half the original RDD sample. (See table 1)

The unique and relevant property of this RDD sample was that it precisely complemented the RBS. Voters missed by the RBS were covered in the RDD sample and vice versa. There was no overlap except when there was a multiple land-line telephone household and only one line appeared on the registration list.[3] For the population of voters on the statewide registration list with readable telephone numbers on their case record we were able to use the RBS methodology to represent them in our sample. Our RDD sample represented all other voters, including those who registered after the registration list was compiled (a very large number in 2004), those who moved without updating their new phone number on their voter registration record, or who for any other reason were not represented on the registration list.

Looking at coverage, again, our statewide voter list had 1,318,227 registration records with phone numbers. In calling respondents drawn from this list, we found that 21% of the numbers were ineligible for a variety of reasons (see table 1, below for details). Applying the inverse figure of 79% to the statewide database yields an estimate of 1,050,000 records with useable phone numbers. Dividing this figure by the 2,150,781 registered voters reported by the secretary of state's office gives us an estimate for list sample coverage of 48.7%. Thus, each part of the sample – RBS and RDD – should each represent roughly half of Oregon's voters.

Sample of both types was called daily or almost daily to ensure the survey's strict deadlines would be met. This is unlike most surveys, as there is no flexibility about the delivery date. At the same time OSRL maintained its standard of making up to 20 dial attempts for each phone number and calling at all times of day, 9:00 AM through 9:00 PM local time, except for Sundays when calling began at noon. Because of the need to add sample right up to the last day of the survey some numbers were not called as frequently as we would have normally liked.

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[3] This dual chance of selection can be accounted for in subsequent surveys.

4. Sample Report

As expected, the biggest difference between the two samples was the prevalence of ineligible telephone numbers in the RDD sample, due to the fact that so many known residential numbers had been purged from the list before we started. As shown in Table 1, below, we used a total of 5,241 numbers of which over two-thirds were ineligible. By far the largest category was disconnected numbers (2,486 or 46%) followed by nonresidential (620/11%), fax/modem (367/7%), and non-working numbers (142/3%).

For the RBS sample we used a much smaller number of total telephone numbers – 2,613 to achieve a larger number of completed interviews. This was due to the fact that this list had a much smaller percentage of ineligible numbers. Again, as shown in table 1, the RBS sample included only 539 ineligibles or 21% of all numbers. Here the largest category was wrong numbers (210, or 8% or the sample), followed by disconnected numbers (196/8%). Other categories represented 2% or less of the overall RBS sample.

Looking at response rates and refusal rates, the overall survey response rate was 35%, with a 33% refusal rate.[4] Response rate was actually slightly higher in the RDD sample than the RBS sample – 38% compared to 35%. Refusal rates were also comparable – 33% overall, with 35% for RDD and 31% for RBS.

The difference in call efficiency, however, was very large. Because so many of the numbers in the RDD sample were ineligible, the large majority of numbers were only dialed one time, producing a misleadingly low figure of 2.5 average dial attempts per number, compared to 3.5 for RBS and 2.8 overall. The numbers even out when we look at the average attempts necessary to complete an interview among the subsample of numbers that generated a completed interview. In this group of numbers the RDD completes averaged 2.6 attempts compared to 2.9 for RBS and 2.8 overall.

However, to determine the overall productivity of the two lists we need to look at the total number of dial attempts compared to the numbers of completed interviews those attempts generated. Here, of course, the RDD list is far less efficient than the RBS list. As shown in the final rows of table 1, it took 12,547 dial attempts to complete the 280 interviews in the RDD sample, a ratio of 48

dial attempts per completed interview.[5] In contrast, it took only 9,254 dial attempts to complete the 622 interviews in the RBS sample, a ratio of 15 dial attempts per completed interview. Clearly, the gains in coverage from the dual-framework method come at a price.

5. Weighting

For the exit polls the subsample of the interviews used for cross-tabulations are forced to the larger estimation sample or to the election results, depending on the time on election night when the weighting takes place. The weighting used for the data presented here are those used for the telephone interviews only, before the survey results were weighted to match the vote estimates. These estimates were *not* forced to the election outcome. The sum of the weights was normalized at the end of the weighting process to equal the total sample size. RBS frame respondents started with a weight of one. RDD respondents were weighted to account for the probability of selection within the household and the number of land-line telephone numbers in the household. Parameters for age by gender from the registration list were used for an additional step in the weighting. The RDD interviews were weighted to represent the 39% of the registration list that did not have telephone numbers. The RBS portion represented the other 61%. The extremely large and small weights were truncated. The weights were iterated five (5) times to minimize departure from parameters.

6. Comparison of Result

It should be noted that neither the RDD nor the RBS portions of this sample represent the state of Oregon. The results from the RBS portion of the sample were what could be expected from a sample of the portion of this frame linked to telephone numbers. The results from the RDD interviews are

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[4] OSRL calculates CASRO-type response and refusal rates; AAPOR response and refusal rates would generally both be somewhat lower.

[5] The reader should keep in mind that the efficiency for a typical RDD sample would be far higher – the matching and purging process we used removed fully half of the registered voters from the original RDD list!

Table 1: Sample Report by Type of Sample

	RDD	RBS	Total
Last Call Disposition			
No answer	398	70	468
Busy	81	24	105
Answering machine	260	365	625
Wrong number	9	210	219
Disconnected number	2486	196	2682
Non-working number	142	57	199
Non-residential number	620	20	640
Fax/Modem	367	26	393
Language barrier	45	8	53
Not home/CB	24	114	138
Too busy/CB	34	56	90
R too ill now	1	5	6
R too ill ever	6	12	18
R deceased	0	8	8
Unable to interview ever	1	9	10
R gone survey dates	21	66	87
Ineligible	12	6	18
Screening Device/CD	0	1	1
Screening Device/Refusal	3	1	4
Hangup	241	138	379
Refusal	336	587	923
Partial interview/CB	2	7	9
Completed interview[6]	281	609	890
Non-Voter Complete	81	18	99
Total Sample Used	5451	2613	8064
Total Ineligible	3683	539	4222
Ineligible as % of Total	68%	21%	52%
Response Rate (CASRO)[7]	38%	33%	35%
Refusal Rate (CASRO)	35%	31%	33%
Maximum Dial Attempts	20	14	20
Average Dial Attempts/Number	2.5	3.5	2.8
Average Attempts/Completed Surveys Only	2.6	2.9	2.8
Total Dial Attempts	13,547	9,254	22,801
Total Dial Attempts Per Completed IW	48	15	25

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[6] For purposes of this table, a completed interview means that the respondent completed the entire survey interview. For purposes of inclusion in the survey data, a small number of additional interviews were included of respondents who answered one or more of the vote questions but did not complete the last part of the interview.

[7] For calculation of response rates, non-voter completes were counted as completed interviews.

Oregon Random Digit Dialing (RDD) and Registration Based Sampling (RBS) Comparison: 2004 General Election

Table 2 – Marginals

How Voted Question:	Candidate:	RDD Sample	RBS	Total (RDD+RBS)	Election Result
		(280)	(622)	(902)	
President	Kerry	51	53	52	51
	Bush	47	45	46	47
	Other	3	2	2	1
Senate	Wyden	66	68	67	63
	King	31	31	31	32
	Other	3	1	2	5
Measure 33	Yes	49	42	45	43
(Expand Medical Marij)	No	51	58	55	57
Measure 36	Yes	57	53	54	57
(Define Marriage)	No	43	47	46	43

Demographic Question:	Response:	RDD Sample	RBS	Total (RDD+RBS)
Age:	18-24	7	10	8
	25-29	7	3	5
	30-39	22	13	16
	40-44	10	12	11
	45-49	13	11	12
	50-59	21	23	23
	60-64	8	8	8
	65-74	6	10	9
	75 or over	6	11	9
Gender:	Male	45	50	48
	Female	55	50	52
Race:	White	92	93	93
	Black	1	1	1
	Hispanic/Latino	4	1	2
	Asian	1	1	1
	Other	3	4	3

Sampling error: RDD = 3%, RBS = 2%, DIFF (RDD-RBS) = 4%

Table 3 -- Differences: (Kerry% – Bush%)

Question:	Response:	RDD	RBS	Total RDD+RBS
Are you:	Male	-16	0	-6
	Female	21	17	19
Are you: Age:	White	-1	6	3
	18-24	29	36	34
	25-29	41	17	31
	30-39	-4	1	-2
	40-44	-1	2	1
	45-49	-5	12	4
	50-59	-7	18	9
	60-64	14	-2	4
	65-74	16	-19	-9
	75 or over	16	12	13

Sampling error on the difference for entire sample: RDD (Kerry – Bush) = 6%, RBS (Kerry-Bush) = 4%, DIFF (RDD-RBS) = 7% For any subgroup increase the sampling error by a factor equal to SQR RT (1/characteristic percentage of column total).

only a sample of those without telephone numbers matched to the registration list. The RDD portion does not represent all voters as a typical RDD sample would.

Overall the total estimates turned out to be fairly precise (table 2). The telephone survey estimated the correct winner in all four races. The error on the difference between the candidates for the survey and the actual election result was 2% for the presidential race and 5% for the senate race. (For an explanation of this error measurement see Mitofsky, 1998.) The per candidate errors are half as large. The errors on the two propositions were similar. The inclusion of the RDD portion of the sample improved the estimates from the RBS-only sample in three of the four races. We did not compare the RDD portion alone, as such a sample has never been used to represent all voters.

There are slight demographic differences between the two portions of the sample. The RBS sample slightly over-represents men and respondents 65 years and older. It under-represents those younger than age 50 and women. This is likely due to higher mobility rates among the young causing fewer of their phone numbers to be on the current registration list, and greater tenure among the older voters. The gender difference is likely a reflection of the higher portion of telephone numbers listed in the name of the male of the household. As the RDD sample only included phone numbers that were not assigned to anyone in the RBS list it seems to make

sense that the interviews from the RDD sample are slightly younger than the interviews from the RBS list. The small numbers of minorities in Oregon are under-represented from the RBS.

The vote for the presidential candidates from the RDD and RBS portions (table 3) has more differences than just the marginals. However, the sampling errors are much larger than any of the differences.

7. Conclusion

This RBS-RDD dual-frame sample design worked well in this situation. In states that can provide an up-to-date registration list in which a majority of those on the list have a valid phone number, this sample design provides an efficient way to include all potential voters in the sample frame. We did not take full advantage of the information available on the registration list for stratification. We made only slight use of the parameters for estimation. There is clearly more that can be done with these data in the way of sample design for stratification and for disproportionate selection.

We believe that eliminating the non-coverage bias of RBS, while retaining many of its stratification, selection and cost benefits recommends this design over either RBS or RDD used in a single frame design. The design also meets the requirement of having a sound theoretical sample design strategy. The same cannot be said for RBS alone.

Any optimization of the cost must include the cost of obtaining the registration list as well as the cost associated with the interviewing and data processing. It is not clear from our Oregon experience that RBS is as cost effective as earlier articles suggest.

We believe the dual frame approach is worth pursuing for other states, where registration lists are readily available.

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