

Calculation of Nonresponse for Telephone Panel Surveys

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Over several years, I have been working with issues related to RDD (Random Digit Dialed) generated telephone survey panels and attrition rate calculations. This is not an area of study that gets much attention since this is not a very common sample design for panel studies. For this study, I examine how nonworking numbers and noncontacts impact the number of completed interviews across time and also the amount of effort involved to contact the telephone numbers based on the number of call attempts. This is a work in progress and so this is an informal report on the findings thus far. It is only descriptive, no statistical tests are used. I will note here that I have changed a variable of interest. I have broken out the noncontacts to include a separate variable, *never reached*. This should hopefully clarify some of the questions asked during the workshop. Opinions and errors are the sole responsibility of the author and do not represent opinions of the Bureau of Labor Statistics.

The Study

The data come from the Telephone Point of Purchase Survey (TPOPS). The Bureau of Labor Statistics (BLS) conducts the TPOPS to collect the establishment sample frame used in pricing goods and services for the Consumer Price Index. The TPOPS identifies the name and address of the outlets (e.g., grocery stores, theatres, physicians, and mail-order catalogs) where households purchase various types of goods and services. The sample for each panel is selected via RDD. Each quarter one-fourth of the sample is new RDD sample and the rest are returning sample ($n \cong 42,000$ cases per quarter). Once a household is selected it may be reinterviewed up to three more times over the next nine to 12 month period. The number of targeted completed cases each quarter is approximately 17,000 urban households. The sample used for this study includes the RDD sample drawn in the second quarter of 2001 to its retirement in the first quarter of 2002 ($n=14,461$). Response rates for the four quarters were 57%, 57%, 53%, and 52% respectively; response rates are based on the AAPOR standard definitions and calculation rate (RR4), using an estimate for .27% of the unknowns.

Final Outcome Codes

Interviews include completed interviews and partially completed interviews. *Refusals* include verbal refusals and break-offs (hang-ups) at the household and respondent level. *Noncontacts* include cases where the telephone number is confirmed as eligible but a respondent is *never reached* or never available (e.g.,

uncompleted callbacks, answering machine message that indicates that it is a eligible case) and other eligible cases that cannot be completed (e.g., hard of hearing, language barrier, absence, and hospitalized). *Unknowns* are situations where the number is always busy, ring no answer, and call-blocking and call-screening systems. For this study the ring-no-answers (never reached) will be removed from the unknown category and presented as a separate variable. This is done because the *never reached* are sub-sampled in the first quarter and one-half are returned to sample for the subsequent quarters.

Not eligible are cases so designated by the requirements of the study (e.g. telephone numbers outside the sampled geographic area, military and farm households, and non-residential households). *Nonworking numbers* are also ineligible but are kept separate for the purpose of this study. Nonworking numbers are removed in the first quarter, but those numbers that become nonworking after the first quarter are not removed from the sample because they are considered eligible sample units. Other cases that become ineligible in subsequent quarters also remain in sample.

Calling Rules

Calling rules impact the final call outcome distribution for the sample panel used for the study.¹ The first calling rule deals with the ring-no-answer problem (i.e., the cases that are *never reached*). After 12 consecutive ring-no-answers, one half of these cases are removed from sample and the other half of the cases receives no more calls until the next quarter. Also included in the 12 call rule are answering machines (AM). After 12 consecutive calls to AMs, calling stops until the next quarter. AMs can be coded out as a noncontact if the message indicates it is a household (e.g., *hi this is Bill and Sue please leave a message*) or as an unknown if the message is vague (e.g., *you have reached 202-999-9999, please leave a message*). After 30 call attempts, the second rule requires that calling stops on all other noncontact cases (mostly composed of callbacks and answering machines). Appendix A shows the entire list of variables used within the call counter.

There are also calling rules for refusals. Calls stop after two refusals in one quarter. Refusals are removed from

¹ The final call outcome code is the last outcome code associated with the case; unfortunately this does not allow us to know much about what goes on with the case during the calling period, except number of call attempts.

sample after two refusals in two consecutive quarters; hard refusals are removed immediately. It is important to note here that the tables presented will not include the refusals deleted from the sample based on the calling rules. This is because the interest in this study is the viable sample for each quarter.

The intent of this study is to assess the impact of nonworking numbers and noncontacts on the number of completed interviews across time and also the amount of effort involved to contact the telephone numbers based on the number of call attempts. It will also examine the viability of subsampling never reached numbers to determine if this provides a way to reduce coverage bias.

Results

The first set of tables examines the final call outcome code's frequency distributions across time in sample. Of interest in Table 1 is the high loss of sample due to nonworking numbers. The loss of nearly 30% of the sample is costly when you also consider that another 17.6% of the sample is lost due to ineligibility (47.6% or 6723 cases removed).

Noncontact is relatively low at 3.8% of the sample (mainly callbacks and answering machines, and the rest consist of things such as absence, ill, hard of hearing, and language barriers). The *never reached* are about 10% of the sample (n=1461). The *never reached* were subsampled in quarter one (n=708) and retuned to sample for subsequent calling. Only 26.2% of the sample ends up being a completed interview, illustrating the challenges of dealing with an RDD generated sample frame.

Table 1: Quarter One Final Call Distributions

Final Call Outcome	Percent	Frequency
Interview	26.2	3789
Refusal	13.3	1930
Noncontact	3.8	543
Nonworking	28.9	4179
Never Reached	10.1	1461
Not Eligible	17.6	2544
Unknown	0.1	15
Total	100%	14461

Table 2 illustrates how efficiency is improved by the removal of the ineligible cases (including nonworking numbers), the never reached, and a handful of refusals from the sample; about 54% percent of the RDD sample is removed after the first quarter of calling (n= 7809 missing cases). Completed interviews are now about 50% of the sample and continue around 50% for the next two quarters. Nonworking numbers (7.3%) and not eligible cases (2.8%) represent a very small part of the sample. The *never reached* category again represents about 10% of the sample.

Table 3 shows where the calling rule for refusals reduces the sample size by 845 cases in quarter three. Refusals now represent about 12% of the sample in quarter three and quarter four. The number of nonworking numbers increases to about 12% of the sample and remains about the same in quarter four (See Table 4). Noncontacts stay about the same as well. However, it is not safe to assume that the case outcomes are stable.

Table 2: Quarter Two Final Call Distributions

Final Call Outcome	Percent	Frequency
Interview	49.9	3319
Refusal	19.5	1298
Noncontact	10.2	676
Nonworking	7.3	487
Never Reached	9.7	643
Not Eligible	2.8	189
Unknown	0.6	40
Total	100%	6652

Table 3: Quarter Three Final Call Distributions

Final Call Outcome	Percent	Freq.
Interview	51.7	3004
Refusal	12.5	724
Noncontact	9.7	564
Nonworking	11.8	687
Never Reached	9.1	526
Not Eligible	3.2	187
Unknown	2.0	114
Total	100%	5806

Table 4: Quarter Four Final Call Distributions

Final Call Outcome	Percent	Freq.
Interview	51.4	2870
Refusal	11.5	641
Noncontact	9.3	519
Nonworking	12.9	721
Never Reached	10.7	597
Not Eligible	4.2	236
Unknown	0.1	4
Total	100%	5588

Quarter Two Nonworking Numbers and Noncontacts

Since all of the nonworking numbers are removed in the first quarter, the comparison will use quarter two data to compare nonworking numbers to noncontacts across time in sample.

Of the 487 cases of nonworking numbers in quarter two, a little more than half of this number will remain nonworking for the subsequent two quarters (69.2% and 53%). Similarly, 53.9% and 56.7% of noncontacts in quarter two remain noncontacts in quarters three and four

respectively (See Table 5 and Table 6). The rise in noncontact in quarter four appears to be due to miscoding in quarter three, the unknowns are 6.82% in quarter three and 0.15% in quarter four.

Completed interviews for nonworking numbers and noncontact are about equal in quarter three, 12.9% nonworking and 14.0% noncontact in quarter two are completed interviews in quarter three. This improves in quarter four for the nonworking numbers, with 18.7% being completed interviews. Table 6 shows that for noncontacts the chances remain about the same with 14.0% in quarter three and 13.1% completed interviews for quarter four. So what is the effort involved with implementing the calling rules?

Table 5: Quarter Two Nonworking Numbers by Quarter 3 and Quarter 4 Final Outcome Codes

Quarter 2 Nonworking	Quarter 3 Percent	Quarter 3 Freq.	Quarter 4 Percent	Quarter 4 Freq.
Interview	12.9	63	18.7	91
Refusal	6.2	30	10.3	50
Noncontact	4.7	23	6.6	32
Nonworking	69.2	337	53.0	258
Never Reach	3.3	16	5.0	25
Not Eligible	2.9	14	6.4	31
Unknown	0.8	4	0.0	0
Total	100%	487	100%	487

Table 6: Quarter Two Noncontact by Quarter 3 and Quarter 4 Final Outcome Codes

Quarter 2 Noncontact	Quarter 3 Percent	Quarter 3 Freq.	Quarter 4 Percent	Quarter 4 Freq.
Interview	14.0	184	13.1	173
Refusal	13.1	173	13.3	175
Noncontact	18.8	248	17.6	232
Nonworking	8.1	107	11.4	151
Never Reach	35.1	463	39.1	516
Not Eligible	4.1	54	5.3	70
Unknown	6.8	90	0.2	2
Total	100%	1319	100%	1319

The next set of figures show the number of call attempts broken into groupings that account for the calling rules (12-14 calls represent the 12 call attempt rule; 30 or more represents the 30 call rule).

Figure one shows the frequencies of nonworking numbers for quarter's two and four. The vast majority of calls are completed by the first call attempt. This is due to the use of recorded messages in America to indicate nonworking numbers. The trailing off after two calls

probably indicates that the first few attempts might have been busy during the first few calls, or ring-no-answer until the telephone company assigned a recorded nonworking number message to the telephone number. This can occur, for example, if the person moves but does not disconnect the telephone right away.

A comparison of the two figures shows how effort increases across time in sample for noncontacts, but not for nonworking numbers. The quarter four noncontacts (n=519) are double the number of quarter two (n=676) for the 30 or more call attempts, even though the number of noncontacts is fewer then in quarter two (157 fewer cases).

Figure One: Quarter Two and Quarter Four Call Attempts by Nonworking Numbers

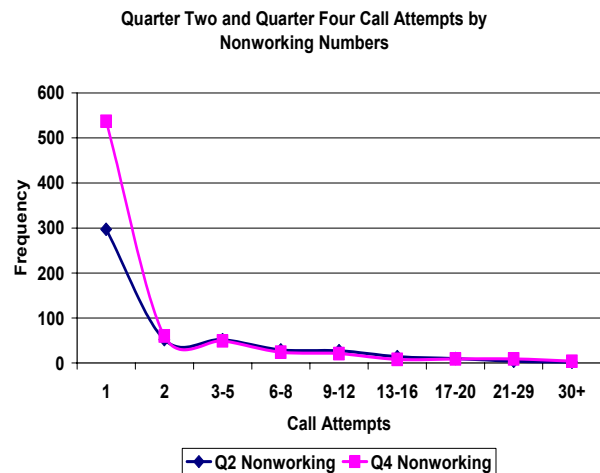
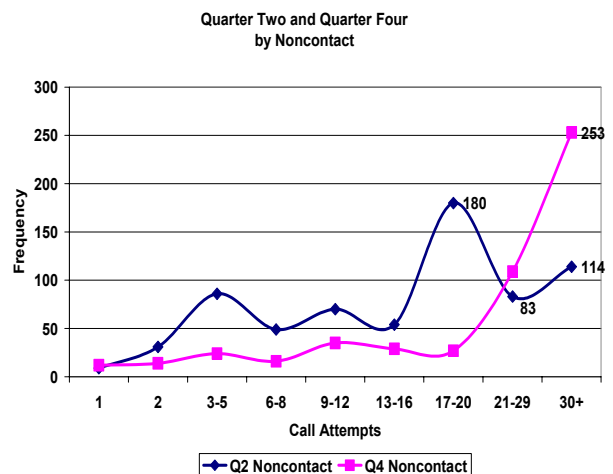


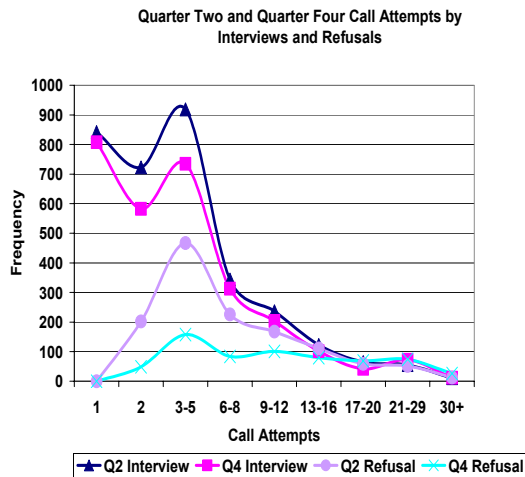
Figure Two: Quarter Two and Quarter Four Call Attempts by Noncontact



Note to Figure Two: Quarter three has a similar distribution to quarter two, falling below its curve and bimodal rather than tri-modal, the center smoothes out.

For comparison, figure three shows the outcomes for interviews and refusals by call attempts. This distribution shows a diminishing rate of return for effort. Most interviews and refusals are resolved by the first 3 to 5 call attempts, the curve drops off significantly after this with a great deal of effort going into resolving a few hundred cases. The refusal distribution is more elongated compared to interviews, especially by the last quarter.

Figure Three: Quarter Two and Quarter Four Call Attempts by Interviews and Refusals



Since the cases that become ineligible after the first quarter stay in sample, it is worth noting that the final outcome distributions are very similar to figure three for the interviews. Most of the ineligible cases are resolved with 3 to 5 calls, except the distribution is more bimodal for the 9 to 12 call attempts in comparison to the interview distribution. The shifting back and forth between eligible to ineligible status can probably be attributed to “soft refusals” or misunderstanding the screening question(s).

Never Reached Sub-sample

Finally, what about the decision to sub-sample the *never reached* number during the first quarter (n=708)? Did this decision help to reduce potential bias? As shown in the next three tables, the majority of the cases *never reached* result in a subsequent code of *never reached* (78.2%, 62.3%, and 69.3% respectively).

The lower percent in quarter three is largely accounted for by the large increase in the number of unknowns (12.1%). The rest of the cases are represented by nonworking numbers and other not eligible cases. Interviews and refusals combined only account for about 3.5% of the final outcome code each quarter. This resulted in a total net of 35 more completed interviews out of 9193 completed interviews for the final three quarters.

Fifty-five percent of the sub-sampled noncontacts remain noncontact across all four quarters. Five percent become nonworking across the next three quarters. Of the completed interviews, only two cases are completed interviews all three quarters, the majority of the rest of cases tend to bounce between noncontact, nonworking, and the not eligible outcomes.

Table 7: Quarter One Sub-sampled Noncontacts By Quarter Two Final Outcome Codes

Final Call Outcome	Percent	Frequency
Interview	1.6	11
Refusal	2.1	15
Noncontact	2.5	18
Nonworking	7.8	55
Never Reach	78.2	554
Not Eligible	7.8	55
Unknown	0.0	0
Total	100%	708

Table 8: Quarter One Sub-sampled Noncontacts By Quarter Three Final Outcome Codes

Final Call Outcome	Percent	Frequency
Interview	1.6	11
Refusal	1.7	12
Noncontact	2.4	17
Nonworking	12.7	90
Never Reach	62.3	441
Not Eligible	7.2	51
Unknown	12.1	86
Total	100%	708

Table 9: Quarter One Sub-sampled Noncontacts By Quarter Four Final Outcome Codes

Final Call Outcome	Percent	Frequency
Interview	1.8	13
Refusal	1.5	15
Noncontact	2.6	18
Nonworking	15.5	109
Never Reach	69.3	488
Not Eligible	8.95	63
Unknown	0.28	2
Total	100%	708

Conclusions

Overall, the findings indicate that it is probably not worth the cost to sub-sample the *never reached* numbers in quarter one. The chances of reducing bias considering the effort involved is not warranted. In contrast, it might be worthwhile trying a sub-sampling of the nonworking numbers in quarter one as a test. Since all of the cases were removed in the first quarter it is difficult to draw any firm conclusions, but based on the small sample in quarter two (n=487 nonworking numbers) it indicates that maybe 13 to 15% could result in completed interviews. Nonworking numbers also represent nearly 30% of the sample loss in the first quarter, in comparison to only 14% noncontact. Since the majority of nonworking numbers take one call to determine if the number is still nonworking, compared to 12 calls for the *never reached* group, taking a sub-sample of this group might be more economical and have a greater likelihood of reducing bias.

Making 30 call attempts adds a good deal of cost to the study with only a small portion of the effort adding to the usable data (averaging less than 0.004% of the total completed interviews for the last three quarters). It would be worthwhile to consider other ways to optimize the calling rules. For example, if the second calling rule was limited to 20 call attempts for this panel it would mean 54659 fewer call attempts (Q1=17686, Q2=8864, Q3=11796, Q4=16313 call attempts). On the other hand, making fewer call attempts on cases less likely to yield a completed interview might be a better use of interviewer time and probably reduce cost. Finally, currently the call history is not available for analysis by the BLS. The findings indicate that it would be worthwhile to add the necessary variables to collect the call history for each case to better determine call efficiency. This would greatly aid in determining how to optimize calling rules.

Appendix A: Call Counter

Call Counter	Maximum Limit on Call Attempts	Rule which adds "1" to counter
Refusal Counter (RC)	2	outcome = 30, 31, 33, or 34
Ring No Answer (NCC) Counter	12	outcome = 80, 81, 82, 83, 84, 86 and NO previous outcome = 30, 31, 33, 34, 40-45, 47, 48, 49, 79, or 89
Total Contact Counter (TCC)	30	outcome = 30 - 89 and a previous outcome = 30, 31, 33, 34, 40-45, 47, 48, 49, 79, or 89

30-34 Hostile Breakoffs and Refusals

- 30 Hostile breakoff by respondent following interview progress* on this call.
- 31 Refusal by respondent at or after >Intro_1st< without interview progress* on this call
- 33 Refusal prior to >Intro_1st<
- 34 Immediate hang-up

* Interview progress is defined as getting past the front and into the middle.

40-41 Callback Needed and Acceptable

- 40 Partial interview obtained: callback needed and acceptable after interview progress on this call.
- 41 Callback needed and acceptable without interview progress on this call.

42-44 Delays in Reaching Household Respondent; No Interview Progress

- 42 All respondents temporarily absent or away
- 43 All respondents temporarily absent or in hospital

45-49 Special Situations

- 45 Residential/special place undetermined, contact information obtained
- 47 Language barrier or problem: refer to supervisor or language specialist
- 48 Respondent is deaf
- 49 Reached answering service or answering machine identified for the telephone number

70-79 Unresolved and Interim RDD Contacts

- 75 Unconfirmed non-working number (unconfirmed because information obtained from a recording)
- 79 Confirmed residential from other source (i.e., answering machine leads you to believe it's residential)

80-89 Calls Without Contacts to Sample Telephone Number

- 80 Ring no answer
- 81 Normal busy or circuits busy/FAX
- 82 Fast or WATS busy
- 83 Number could not be completed as dialed
- 84 No signal, funny signal
- 85 Bad connection
- 86 Number temporarily not in service
- 87 Wrong number dialed or reached
- 88 Possible wrong number. Person answering would not confirm sample number
- 89 Answering machine--unknown if reached sample number