A STUDY OF RING/NO ANSWER NUMBERS IN RANDOM DIGIT DIALING TELEPHONE SURVEYS

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Correct classification of ring/no answer (R/NA) numbers in random digit dialing (RDD) telephone surveys has been a problem since this sampling technique was instituted some 20 years ago. R/NA numbers are those which, when dialed, result in a continuous ringing with no answer. It has been shown that not all such numbers are associated with a working telephone. Instead, some R/NA numbers are unassigned by the telephone company and are not connected to a recorded operator message. Even after repeated dialings of such a number, one is still uncertain about whether or not the number is associated with an eligible reporting unit. Thus, the computation of the correct response rate, [(Number of completed interviews/number of eligible reporting units) x 100] is impossible.

Prior research indicates that these R/NA numbers comprise some 3 to 5 percent of the total sample [Groves and Kahn (1979), Lavrakas (1987), O'Neil (1979) and Steegh (1981)]. Glasser and Metzger (1972) point out that the status of R/NA numbers can be determined only by extensive follow-up, perhaps contacting the appropriate telephone company business office. They state that ignoring R/NA numbers risks biases of nonresponse. Efforts to make extensive (15-20) callbacks and calls to telephone company business offices to determine the status of some numbers provides a standard on the prospective yield of any RDD sample.

Thompson (1982), in a follow-up study of a U.S. Coast Guard Survey, reports that less than half of a sample of 1,500 no answer/busy numbers proved to be working numbers, that the proportion of households in the sample was not greatly different from that of the main survey, and the fractions of completed interviews were similar. Some telephone company representatives feel that the R/NA numbers are largely a rural phenomenon and concentrated in offices which cannot afford recordings to handle all unassigned numbers (Groves and Kahn, 1979).

White (1983) examined methods of response rate calculation used in five telephone health surveys with particular attention to the handling of no answer/busy outcomes and found that methods differed substantially in classifying and allocating such numbers to response categories. His recommendations were for survey researchers to adopt a uniform classification scheme for telephone survey outcomes and to develop a uniform response rate formula.

Frankel, et al. (1982) suggested that units of unknown status be allocated to eligible and ineligible categories in the same proportion as among the units of known status. The use of the CASRO[1] estimator of the response rate was recommended. This estimator is of the form

$$R = \frac{C}{E + \left(\frac{E}{K}\right)U} \ ,$$

where

R = the estimated response rate,

C = number of completed interviews with reporting units,

E = number of eligible reporting units among all reporting units with known status in the sample,

K = number of known status reporting units in the sample and,

U = number of unknown status reporting units.

Because Iowa is a largely rural state, with 154 independent telephone companies serving some 1,053,000 occupied housing units, 96 percent of which have telephones, one could expect a substantial number of R/NA numbers in any RDD survey.

The objectives of this study were to 1) determine the status of R/NA numbers, 2) estimate the degree to which the problem occurs in urban and rural areas, 3) evaluate the accuracy of operator information regarding R/NA numbers, and 4) compare different methods of computing response rates. A three-stage follow-up study of R/NA numbers was designed using samples from two RDD Surveys.

Procedure

The RDD sampling frame used at the Statistical Laboratory, Iowa State University, includes all working one-hundred number banks within central office codes used in Iowa. This frame has yielded an average of 46.5% working household numbers on statewide surveys over the past eight years and is updated on an annual basis. Thus, the frame yields a higher percentage of households than some RDD methods. Groves and Kahn reported about 22% of their RDD sample were households and Glasser and Metzger reported 20%.

The first study, conducted in 1985, used a stratified statewide random sample of 1,358 RDD numbers to interview 507 residents regarding public awareness of the mission of Iowa State University's Extension programs. The second study of 3,178 RDD numbers, stratified by urban-rural, was used in 1986 to locate and screen 1,483 residents to determine their eligibility to participate in a personal interview study of housing needs and preferences.

In both studies, a call rule of a minimum of eight attempts, two daytime, two weekend and four evening calls, rotated over a two-week period, was followed. The average number of attempts for all numbers was 9.9. All nonworking numbers were dialed twice to guard against misdialings. The average number of attempts for R/NA numbers was 10.8 in Study 1 and 11.9 in Study 2.

As the interviewing phase of each project was concluding, Stage 1 of the follow-up was initiated. An interviewer called telephone operators to determine whether the R/NA numbers were considered as working or non-working by the telephone companies. This is usually not done in RDD surveys since it is a somewhat costly procedure. Some telephone companies will not release this information in order to protect customer confidentiality.

During Stage 2 of the study, all R/NA numbers were called three to five months after the completion of the interviewing phase of the studies. If a number was reached, the interviewer verified the number and determined the time period during which the number had been assigned to the respondent. If the number had been assigned to the respondent during the interviewing phase, the interviewer attempted to ascertain why the number had not been reached earlier. By conducting Stage 2 during summer and early fall, it was hoped that residents absent from their household during winter and early spring months could be identified. Since the R/NA numbers had been classified as working or non-working by operators in Stage 1, most discrepancies in operator information could be identified.

The last phase of the study was a second series of calls to all R/NA numbers, with the exception of households and businesses identified at Stage 2. Calls on the first study were made almost three years after completion of the interviewing phase, while those on the second study were made about two years later.

Results

The classification of the RDD sample telephone numbers from both studies is shown in Table 1. The four percent difference in working household numbers is probably due in part to using a newly updated sampling frame for Study 2, yielding a higher fraction of household numbers (50.7%). For the combined samples of both studies, 5.1 percent of the sample numbers were classified as R/NA. The higher percent of R/NA numbers on Study 1 probably resulted from a time frame of three weeks for completing the project, whereas the second study was conducted over a five-week period.

Results of the operator follow-up are shown in Table 2. Overall, telephone operators refused to provide information on 15.5 percent of the R/NA numbers. We note that operators were less cooperative in providing information in the second study. Of those numbers for which operator information was obtained, slightly over one-third were designated as working numbers.

Results of the first series of call-backs (Stage 2) are displayed in Table 3. Of the 232 R/NA numbers 23 (10%) were associated with eligible households and 10 (4%) were non-residential numbers during the interviewing phase of the projects. Twenty percent of the R/NA numbers were identified as non-working, and sixty-four percent were still R/NA.

Stage 3 results are summarized in Table 4. During the second series of call-backs, of the 148 R/NA numbers remaining at Stage 2, 10 (6.8%) were eligible households and 8 (5.4%) were non-residential numbers at the time of interviewing on the studies. Seventy-seven (52%) remained R/NA numbers.

Data in Table 5 combine the results of both Stages 2 and 3 of telephone call-backs to R/NA numbers and are shown according to the operator information obtained at Stage 1. Thirty-three of the numbers (14.2%) represented eligible households not enumerated at the time the studies were conducted. Another 18 numbers (7.8%) were identified as non-residential. Seventy-seven numbers (33.2%) remained R/NA. Thus, the status of 181 of the 232 R/NA numbers (78%) at the time of interview remained unknown. These results are somewhat disappointing since many questions remained unanswered. Since phone companies may assign or disconnect numbers as soon as 90 days after termination of the previous client, and many smaller companies do not connect all unassigned numbers to a recording, accurate forecasts based upon the two call-back stages of this study are not possible.

Results indicate that the operator information was fairly reliable. Fifteen of the 71 numbers (21.1%) which operators designated as "assigned" were subsequently identified as non-working; some of these numbers could have been disconnected during the interim between operator contact and call-backs during Stages 2 and 3. Twenty-three numbers (32.4%) still remained R/NA. Of the 125 numbers which the operator indicated to be non-working, three (2.4%) were, in fact, eligible households and three were non-residential when the studies were conducted.

The effects of using different methods to calculate response rates are shown in Table 6. If the rates are calculated considering all R/NA numbers first as working numbers and then as non-working numbers, these two values represent the bounds of the true response rate. If the CASRO estimator is modified to include results of 1) the operator information on R/NA numbers, and 2) the two call-back stages, these two response rates are within two percent of the CASRO estimator for both studies.

Another interesting result of the study was that of the urban/rural differentiation in regard to R/NA numbers. Sample numbers were designated as urban if the central office code was assigned to a city with a population of 20,000 or more; otherwise, they were classified as rural. As shown in Table 7, the proportion of R/NA's was much higher for the rural stratum i.e, 7.5 percent as contrasted to 2.2 percent. Of the 232 R/NA numbers, 186 (80.2%) were contained in the rural stratum. This seems to be a confirmation of the results of Groves and Kahn who found that sample numbers that yield constant ringing over many calls are three times as prevalent in the non-SMSA's.

Another related result was that all of the ring/wrong numbers in the follow-up study were rural numbers. This was suspected when discussing the problem with respondents as well as telephone company officials. If a number is unassigned, it frequently rolls over into the next available number, most often a number which is identical except for the last digit. Another indication that rural ring/no answer numbers are less likely to be assigned to a household is that only 13.9 percent of the ring/no answers which received a nonworking designation at the end of the study were urban numbers.

Conclusions

Results confirm the impression that R/NA numbers in RDD samples is a continuing problem without an efficient solution. If strict guidelines for a thorough call back procedure are used, one can still expect three to five percent

of the numbers to be assigned to this category. Use of the CASRO estimator to allocate R/NA numbers to appropriate categories is recommended when reporting response rates. Follow-up calls to the telephone company operator are relatively reliable and could be used to properly classify these numbers when reporting response rates. Based on these findings, it is felt that it is not worth the resources to follow R/NA numbers over time, as the results are inconclusive. If one is working with a largely rural sample, an awareness of the problem of R/NA numbers is especially important. When reporting results and response rates, researchers should report R/NA numbers and discuss how they were treated in the response rate calculation.

Table 1. Classification of sample telephone numbers subsequent to the interviewing phase of the studies.

Classification of number	Study 1		Study 2		Total	
	N	%	N	%	N	%
Working number						
Household	636	46.8	1,612	50.7	2,248	49.6
Business	120	8.9	302	9.5	422	9.3
Other	15	1.1	18	0.6	33	0.7
Subtotal	771	56.8	1,932	60.8	2,703	59.6
Non-working number						
Recording	403	29.7	914	28.7	1,317	29.0
Ring/wrong no.	63	4.6	137	4.3	200	4.4
Fast busy, etc.	25	1.8	59	1.9	84	1.9
Subtotal	491	36.1	1,110	34.9	1,601	35.3
Ring/no answer	96	7.1	136	4.3	232	5.1
Total	1,358	100.0	3,178	100.0	4,536	100.0

Table 2. Stage 1 follow-up: classification of ring/no answer numbers based on operator information.

Operator classification	Study 1		Study 2		Total	
	N	%	N	%	N	%
Working	36	37.5	35	25.7	71	30.6
Non-working	56	58.3	69	50.8	125	53.9
Undetermined*	4	4.2	32	23.5	36	15.5
Total	96	100.0	136	100.0	232	100.0

*Operator refused to provide information.

Table 3. Outcomes of Stage 2 follow-up classified by operator information obtained at Stage 1.

| | Operator classification (Stage 1) | | | |
Stage 2 outcome	Working	Non-working	Undetermined*	Total
Working number				
Eligible household	16	1	6	23
New household	2	2	-	4
Non-residential	4	3	3	10
Subtotal	22	6	9	37
Non-working number				
Recording	5	24	6	35
Ring/wrong number	-	12	-	12
Subtotal	5	36	6	47
Ring/no answer	44	83	21	148
Total	71	125	36	232

*Operator refused to provide information

Table 4. Outcomes of Stage 3 follow-up classified by operator information obtained in Stage 1.

| | Operator classification (Stage 1) | | | |
Stage 3 outcome	Working	Non-working	Undetermined*	Total
Working number				
Eligible household	6	2	2	10
New household	0	4	3	7
Non-residential	5	0	3	8
Subtotal	11	6	8	25
Non-working number				
Recording	10	25	3	38
Ring/wrong number	0	7	1	8
Subtotal	10	32	4	46
Ring/no answer	23	45	9	77
Total	44	83	21	148

*Operator refused to provide information

Table 5. Combined outcomes of Stages 2 and 3 follow-ups classified by operator information obtained at Stage 1.

| Combined outcome (2 & 3) | Operator classification (Stage 1) | | | |
	Working	Non-working	Undetermined*	Total
Working number				
Eligible household	22	3	8	33
New household	2	6	3	11
Non-residential	9	3	6	18
Subtotal	33	12	17	62
Non-working number				
Recording	15	49	9	73
Ring/wrong number	0	19	1	20
Subtotal	15	68	10	93
Ring/no answer	23	45	9	77
Total	71	125	36	232

*Operator refused to provide information

Table 6. Adjusted response rates using different methods of calculation.

| Method of calculation | Response rate (percent) | |
	Study 1	Study 2
Consider R/NA as nonworking	69.3	84.8
Consider R/NA as working	79.7	92.0
CASRO estimator, no follow-up	74.1	88.1
Modified CASRO estimator using Stage 1 follow-up (operator) information	75.9	89.4
Modified CASRO estimator using Stages 2 and 3 follow-up information	73.4	88.1

Table 7. Classification of sample telephone numbers by urban-rural strata

Classification of number	Urban N	Urban %	Rural N	Rural %
Working number				
Household	1,224	59.4	1,024	41.4
Nonhousehold	255	12.3	200	8.1
Subtotal	1,479	71.7	1,224	49.5
Non-working number	537	26.1	1,064	43.0
Ring/no answer	46	2.2	186	7.5
Total	2,062	100.0	2,474	100.0

Table 8. Classification of ring/no answer numbers based on operator information, by urban-rural strata.*

Operator classification	Urban	Rural	Total
Working	21 (45.7)	50 (26.9)	71 (30.6)
Non-working	10 (21.7)	115 (61.8)	125 (53.9)
Undetermined	15 (32.6)	21 (11.3)	36 (15.5)
Total	46 (100.0)	186 (100.0)	232 (100.0)

*Percents are shown in parenthesis.

FOOTNOTE

[1]White (1983) referred to this estimator as the CASRO estimator, since it was presented in a special report for the Council of American Survey Research Organizations (Frankel, 1982).

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