

NONRESPONSE BIAS FROM "NO ANSWER/BUSY" CALLS IN A TELEPHONE SURVEY

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SUMMARY

In a telephone interview survey conducted by the U. S. Coast Guard early in 1977, a total of 15,234 calls either were not answered or encountered busy signals. These uncompleted calls were investigated further by making repeated calls to a sample of 1,500 of the 15,234. The population of interest was boating households. The results from this additional sampling show that failure to use "No Answer/Busy" data in deriving population estimates would have biased the population estimates upward. Estimates on the main body of data plus the sample of 1,500 "No Answer/Busy" calls gave 1.0% fewer boats, 2.5% fewer boat operators, and 2.0% fewer operator households than did estimates from the main body of data alone. Assuming that the sample of 1,500 was representative of all 15,234 "No Answer/Busy" calls, the resulting estimates showed 19.4% fewer boats, 25.0% fewer boat operators, and 20.3% fewer operator households.

In a previous telephone interview survey conducted by the U. S. Coast Guard early in 1974, a rather large number of "No Answer/Busy" (NA/B) calls were encountered. Since the failure to complete such calls might conceal sample information which differed from that gotten in the completed calls, a special study was made of the NA/B calls encountered in the Coast Guard's 1977 survey. A sample of 1,500 of the 15,234 NA/B numbers was called further until all but a few had been resolved (Table 1).

As shown in Table 1, less than half of the NA/B sample of 1,500 proved to be working numbers. Further the proportion of households in the sample was not greatly different from that of the main survey, and the fractions of completed interviews to total numbers were similar. Thus far, we would anticipate no problem from existence of the substantial count of NA/B numbers among those called. However, let us look at the effect on population estimates. In so doing, we must consider the survey design and the procedure for calculation of population estimates.

The survey design consisted of 400 strata with two probability sampling units (PSU's) in each stratum. Each PSU consisted of all the households served by a single telephone exchange. Calculation of the population estimates required:

1. Expansion of sample values to values in each PSU.
2. Weighted combination of the two PSU values in each stratum to give single stratum population values.
3. Simple addition of stratum values to give grand totals.

The first task of Step 1 was to estimate the population of all households in each PSU. This was done by applying the sample information on proportion of households to non-households in a PSU to the count of total working numbers in that PSU. Calculations were done under two conditions, (1) that the NA/B numbers be ignored and (2) that the household fraction of the NA/B numbers be considered. The resulting two sets of estimates of households in PSU's symbolized as M_{ih} and M'_{ih} , thus provided the choices of either ignoring or using information on NA/B calls.

The second task combined the remainder of Step 1 and all of Step 2. Inputs included data on disposition of the telephone calls, either the M_{ih} or the M'_{ih} , and sample values for each PSU. The outputs were summed over all strata (Step 3) to get grand totals or national estimates.

The population estimates actually were calculated in three ways (Table 2). In the first way, no use whatever was made of the NA/B information. In the second, limited use was made, i.e., the M'_{ih} were used in all strata but disposition data was used only in the strata which contained the additional 112 completed interviews (Table 1). In the third, full use was made of all available information on dispositions in all strata, as well as all the M'_{ih} and the sample data of the 112 completed interviews.

The results (Table 2) attest to the need, in conducting a telephone survey of this kind, both for sampling the NA/B numbers for appropriate use of results from such sampling in calculating the population estimates. The "Limited" use, which involved data from only a 10% sample of the NA/B numbers and only partial use of the disposition data, gave decreases in population estimates of only 0.1-0-3%. The "Full" use, still involving only a 10% sample of the NA/B data but using all the disposition data afforded by the sample, gave decreases in population estimates of 1.9-2.5%. The "Projected" use, assuming that the 10% sample of NA/B numbers was representative of the entire NA/B population of 15,234, gave decreases of 19.4-25%. These latter reductions would be significantly greater than the sampling errors. Thus population estimates that were calculated without regard to NA/B data could have been seriously biased upward.

The results presented above concern population totals only. A limited investigation on the effects of use vs. non-use of NA/B data on estimates of sub-groups of boats showed no significant difference ($P < 0.99$) between "Limited" use and "Full" use on sizes of sub-groups (Table 3).

Table 1

Disposition of "No Answer/Busy" (NA/B) Calls

Item	Numbers of calls	
	Main survey	NA/B sample
Total numbers dialed	83,732	1,500
Operator refusals	---	37
Working numbers	51,109	688
NA/B numbers	15,234 ^a	91 ^b
Non-households	6,274	135
Households	28,261	553
Boating households	6,018	
Completed interviews	5,507	112

^aAfter 3 calls.^bAfter 5 calls.

Table 3

Population estimates of types of primary boats under full and limited use of NA/B data. (000 omitted)

Boat type (or item)	Full use	Limited use
No answer or refused	19	14
Don't know	33	45
Rowboat	1212	1282
Skiff	271	266
Dinghy	93	95
Jonboat	910	963
Other open lightweight boat	959	1043
Sailboat	682	763
Canoe	644	698
Kayak	47	46
Bowrider runabout	1548	1689
Non-bowrider runabout	1367	1541
Cabin cruiser	465	504
Houseboat	37	42
Inflatable boat	32	30
Inflatable raft	50	48
Non-inflatable raft	10	11
Pontoon boat	105	112
Thrillcraft	137	166
Other types	968	1095
Total	9589	10453

Table 2

Effects of No Answer/Busy (NA/B) Data on Population Estimates (000 omitted)

Use of NA/B	Boats	Operators	Households
No use	12,782	30,227	14,859
Limited Decrease ^a	12,765 0.1%	30,124 0.3%	14,843 0.1%
Full Decrease ^a	12,537 1.9%	29,484 2.5%	14,562 2.0%
Projected Decrease ^a	10,296 19.4%	22,679 25.0%	11,847 20.3%

^aDecrease from value for "No use".^bAssuming that the sample of 1,500 NA/B numbers is representative of all 15,234

REFERENCES

- (1) U. S. Coast Guard. (1978). Recreational Boating in the Continental United States in 1973 and 1976: The Nationwide Boating Survey. Accession Number ADA 052907. National Technical Information Service, Springfield, VA. 22161. Also available from U. S. Government Printing Office (call U. S. Coast Guard, phone 202-426-1052, for ordering information).